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Editors

Margaret Crawford

Media Specialist

Mason City Public Schools

Mason City, IA

And

Michael Simonson

Professor

Instructional Technology and Distance Education

Nova Southeastern University

Fischler Graduate School of Education and Human Services

North Miami Beach, FL

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## Preface

For the twenty-third year, the Research and Theory Division of the Association for Educational Communications and Technology (AECT) is sponsoring the publication of the Proceedings. Papers published in this volume were presented at the National AECT Convention in Denver, CO. A limited quantity of these Proceedings were printed and sold in both hardcopy and electronic versions. It is also available on microfiche through the Educational Resources Clearinghouse (ERIC) system.

For the first time, the Proceedings of the AECT's Convention are published in two volumes. Volume #1 contains papers dealing primarily with research and development topics. Papers dealing with instruction and training issues are contained in volume #2, which also contains over 60 papers.

REFEREING PROCESS: Papers selected for presentation at the AECT Convention and included in these Proceedings were subjected to a reviewing process. All references to authorship were removed from proposals before they were submitted to referees for review. Approximately fifty percent of the manuscripts submitted for consideration were selected for presentation at the convention and for publication in these Proceedings. The papers contained in this document represent some of the most current thinking in educational communications and technology.

M. R. Simonson  
Editor

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# Exploring Qualitative Methodologies in Online Learning Environments

Mary Beth Bianco  
Alison A. Carr-Chellman  
Penn State University

## Abstract

*Qualitative inquiry is rich in personal interaction between participant and researcher. The researcher is an instrument (Creswell, 1998) and the participant an active sharer in the process and in some cases the final interpretation of the inferences, as well. The qualitative methodological processes, particularly those considered the three legs of triangulation – interview, observation and document analysis - vary in the degree and type of communicative aspects in specific contexts. The various methods used in collecting and interpreting qualitative data are best used together - multiple methods. (Denzin and Lincoln, 1998; Creswell, 1998) Using more than one gives the researcher an avenue to corroborate findings and add a deeper dimension to the study. For example, the probing of the interview combined with the interpretation of reports and the interaction of an observation form a more complete picture from which themes and issues emerge, allowing the researcher to tell the story of the participants more accurately and completely. (Denzin and Lincoln, 1998) Will the story be affected with the advent of new technological methods of not only collecting the data, but the data itself?*

*This discussion seeks to consider the issues related to conducting qualitative inquiries in online settings and the implications for using electronic means in interview and observation. Consideration needs to be given to the ramifications of online interview techniques. “Face-to-face” may not be “face-to-face” in online environments but may be only available other synchronous forms, such as, telephone or online discussion. The implications for electronic discussion formats for conducting interviews will also be discussed.*

*Triangulation, in the most accepted definition, then, may be implausible due to the fact that the interview or observational techniques are not logistically feasible or probable. Observation in natural settings is foundational to the integrity of the observation but should be investigated for workability as well as rectitude. (Creswell, 1998). Exploration into the implications for observation by electronic means should be conducted to determine the trustworthiness of this new form of data collection.*

*The methodology issues discussed here are those that relate to the interview and observational legs of triangulation in conjunction with possible avenues for document analysis. Various strategies for testing online qualitative inquiries will be considered and discussed related to their potential value to the inquiry process. The inquiry in this case centers on methodological implications for data collection and their impact on the qualitative process in online situations or by electronic means.*

## Introduction

There are a growing number of research studies being conducted on distance education, in particular, online learning environments (Schlough & Bhuripanyo, 1998; Hengni, 1998; Thompson and Nay, 1999; French, 1999; Moon, 1998; McIssac, et. al., 1999; Truman-Davis and Hartman, 1998; Gunawardena, et. al., 1998; Levin and Ben-Jacob, 1998; Hiltz, 1998; Chen & Mashhadi, 1998; Jannasch-Pennell, et. al., 1999; McFerrin, 1999; Donaldson and Tomson, 1999; Yong, 1998). Online or web-based course delivery is becoming more and more prevalent as an integral part of today's college curriculum. Instructors and university professors are providing more web support and universities are soliciting students to participate in online coursework in the “anytime, anywhere” model of instructional delivery. (Gladieux and Swail, 1999, Dunn, 2000).

As a result of the increased interest in research in the area of online learning, there has been a subsequent increase in the interest in the use of qualitative methods to gain a deeper understanding of online learning environments. In particular, there have been a large number of studies which examined, qualitatively, the student perceptions of online learning experiences (e.g., McNeil & Robin, 2000; McIsaac, et.al., 2000). However, there has not yet been adequate exploration of the use of qualitative methods in online learning environment inquiry.

In an effort to understand student's perceptions of their learning in this emerging environment, much research is being conducted in connection to online learning. Among the current topics of interest are studies which compare online to traditional delivery of the same course material; effectiveness of learning; student perceptions; fostering collaboration; and various course delivery models, (e.g., Diaz and Cartnal, 2000; Ryan, 2000).



Online learning has both its advocates and its detractors. These new technologies in instructional delivery carry both support for and definite opinions against online learning environments and their potential effect(s) on learning. If learning is at the heart of our choices regarding instructional delivery options, researchers and educators are obligated to fully understand student experiences in many types of learning situations. Student perceptions and experiences should be priorities in the design process and should be strongly considered prior to media selection decisions. It is difficult not to design for the "delivery method d'jour", however no matter how glitzy or well-funded online education options may be, their impact on learners' experiences as understood through qualitative inquiry should be carefully considered by all practicing instructional designers.

In an attempt to understand the culture of online-learning, qualitative methodology is a natural choice with regard to research design. The tenets of phenomenology (Denzin and Lincoln, 1998) lead us to deeper understandings of the experiences of the participants and the interpretation that informs our understandings. Phenomenological research assumptions carry with them the importance of the voice of the participant, their descriptions of their experiences, their reflections on their lived experiences. (Creswell, 1998; Moustakas, 1994). In considering online learning environments, these experiences are critical in an attempt to gain deeper understandings. This paper is an attempt to discuss some of the potential implications of doing qualitative research with online populations.

### **Distance Education – Attitudes and Perceptions**

David Noble's (2000) outcry against online learning and technology is largely aimed at the politics of technology. He argues that the technology itself is indeed value-laden and the demand for online education is non-existent, created by university administrators. (Young, 2000) He suggests that the motivations for online learning are nothing more than greed on the part of university administrators and should be resisted by faculty in the same ways that Luddites resisted the new technologies that they believed would put their own children out of future work. Others (Bowers, 1999; Woody, 1999) also argue that while the Internet is an excellent dispenser of information, education is not merely the acquisition of information. By making learning primarily about the acquisition of information, there is the potential to commodify higher education--learning becomes a product for sale rather than the experience of learning and growth. Like Noble, many are concerned for the financial emphasis placed on online learning environments with a lack of focus on "learning". (Noble, 1998; Woody, 1998).

Many supporters of online education (Dunn, 2000; Dede, 1997). envision a future where students will come to universities only for the social aspects of higher education, such as sports or other non-academic activities. In a report prepared by the College Board, predictions about the future of online learning environments included the demise of the university, as we know it, within 30 years. (Gladieux and Swail, 1999; Dunn, 2000). Gladieux and Swail go on to cite examples of complete degree programs offered by "traditional" universities online and refers to them as leaders in the electronic market. While considerations need to be made about the access to these new technologies and the target populations who benefit from technological advancement, other issues should be considered as well. The need exists for a qualitative examination of online instruction. Collaboration, social interaction and relationship building activities that exist in face-to-face instruction have been addressed somewhat in design literature

Qualitative methodologies are social at the core (Creswell, 1998; Denzin and Lincoln, 1998). There has always been an understanding that part of the qualitative inquiry experience is "being in the field." (Wolcott, 1995). Doing fieldwork, in which the inquirer worked in a natural setting to collect stories by observing, examining documents, and interviewing indigenous populations, has always been a cornerstone of the qualitative research experience. (Lincoln and Guba, 1985). What is the implication of doing qualitative research in online settings? Where is the field? Where is it located? Is it electronic? Collecting data at a distance begs the question - can qualitative research occur in the exploration of online learning and if so, how will that experience be defined? Will qualitative research lose a certain social quality when we translate these methods from naturalistic inquiry (Lincoln & Guba) into e-inquiry? Will the researchers enjoy the experience of doing qualitative research in an e-field as much as they enjoy being in a physical field? Will there be some important essence of the stories that are lost by doing qualitative research electronically? Is there any way to do qualitative research among online populations in a face-to-face mode and what is gained or lost in this choice? And what of the qualitative methods themselves? Will the traditionally separate methods of interview, observation and document analysis become blurred in online settings? If an interview is conducted in a chat mode, is it a document to be analyzed or an interview? Clearly we cannot answer all of these questions in any complete way here, we raise them as serious considerations for those engaged in qualitative research among online populations as well as for those who supervise students who wish to pursue qualitative inquiry projects in online education.

## Qualitative Research Epistemological Viewpoints

Qualitative research is conducted in an effort to understand the experiences and attitudes of people in contextually bound settings. Purposes of qualitative research include inquiry in natural rather than contrived settings and the understanding the ontological viewpoints of the participants. Perspective, perception and experience are epistemological notions that are sought in the interpretation and understanding of specific contexts or situations. Because we wish to understand perceptions, experiences, and perspectives of learners in online environments, there is a viable match between qualitative inquiry and online learning environments. However, online qualitative inquiry methodology has not been clearly delineated or explicated nor is it definitively prescribed in the qualitative inquiry literature. In some ways we have gotten ahead of ourselves. We are using qualitative inquiry because it appears to be an epistemological match with our goals for understanding online learning environments prior to truly exploring the impacts of this application on the field of qualitative inquiry and the underlying epistemological foundations on which that discipline is built.

The discussion that follows is an overview of the three most common qualitative data collection methods (interviewing, observations, and document analysis) and their relevance to the understanding of online learning environments. We explore some of the implications of using qualitative *methods* and base these implications on our own experiences conducting qualitative studies in online environments.

## Qualitative Methodology

### Interviewing

Interviews and observations are used as key methods of recording people's experiences, perceptions and attitudes in qualitative inquiry. (Creswell, 1998). Interviews range in type and length and are used for different purposes but are present in virtually all qualitative traditions. Interviewees are often selected utilizing purposeful sampling processes and are contacted in many different ways. Telephone interviews are conducted when access to participants in a face-to-face environment are hindered in some way. (Bruce, 1979; de Leeuw, 1992). Telephone interviews carry the advantage that the participant can be interviewed at a remote location saving travel time and money, but the researcher loses the opportunity to observe nonverbal communicative actions. Focus group interviews are used in situations where the interaction among participants is determined to be beneficial for the inquiry. Ideal interview situations are personal, face-to-face contexts where the interviewer and the interviewee have the opportunity to interact in an open atmosphere and establish rapport (Fontana & Frey, 1994). Typically, qualitative interviews are recorded either by audio or video and are transcribed for the analysis of data. There are a number of ways of approaching interviews from open-ended to highly structured interview protocols.

Computer-mediated interviewing (CMI) techniques add quite another dimension. Media utilized to conduct CMI's include synchronous chat, email and discussion forums. As with telephone interviews, in CMI, face-to-face contact is lost. Voice tone and inflection, hesitation or eagerness, and other audible indications that lead to deeper understandings that are not possible through CMI are lost. While not without benefit, interviews conducted via chat may arouse questions regarding the conveyance of meaning since voice and body language are absent. On the other hand, little is left unquestioned in terms of specific data because it is necessary to ask for continual clarification from the participant throughout the CMI.

Face-to-Face	Telephone	Computer-mediated
Visibility of facial expressions	Absence of facial expressions and body language	Absence of facial expressions and body language
Personal qualities of establishing rapport with the participant	Voice tone assistance in establishing rapport	Absence of personal contact to aid in establishing relationship with participant(s).
Communication is more natural to most people in conversation form	Conversational tones are possible	
Travel time required	Travel time saved	Travel time saved
Transcription costs incurred	Transcription costs incurred	Transcription costs saved
Travel costs incurred	Telephone costs may be	Typically no or low cost

	incurred depending on type of long distance utilized	via internet hookup
Opportunities for on-site experiences are preserved	Opportunities for on-site experiences lost	Opportunities for on-site experiences lost
Ability to interview a limited number of respondents	Ability to interview more respondents	Ability to interview many respondents including those abroad, disabled, elderly, housebound

Table 1: Comparison of interview data collection modalities

It is possible to see from Table 1 a comparison of the advantages and disadvantages of the three possible media for conducting qualitative interviews. Obviously the primary advantage of using the telephone or the CMI options are resource related, e.g., time and money to travel to remote sites. However, there is no clear indication of precisely how much is lost in terms of the deep understanding of the stories being told by the respondents by losing their affective, interpersonal, voice and body reactions to questions. It is not clear how much data may be lost by the very different type of rapport that is established online or by telephone and it is almost impossible to quantify or qualify this loss because qualitative data is so individualized that there is no easy comparison study that can be conducted to establish what is truly lost and/or gained in these three environments. We believe that these decisions are likely to be made too often because of cost considerations. Rather than seeking additional resources to allow the researcher to be in the natural setting, the breadth of respondents will be valued and the choices will be made to utilize cheaper methods than traveling to the site. It is the same principle as we use in the assignment of media in instruction. We ought not use a media merely because it is available, new, or glitzy--or well funded, but rather because it is what is called for in the instructional design based on the assessment, strategy selection, goals and objectives for the learner. In this same way, we should select telephone or CMI options for collecting qualitative data *because it is supported by the research question*. Methodological choices should not be made for financial reasons alone any more than they should be made for convenience reasons alone--thus the negative perception of samples of convenience studies. Instead we should allow our research question to drive our interview method choices among face-to-face, telephone, and CMI.

## Observations

Qualitative observations (Adler & Adler, 1994) elicit some of the same issues as interviews, but the concerns here are even more pronounced. How is it possible to "observe" an online class? We know what it means to observe a face-to-face classroom, and we know how to design an observation instrument to assist us in focusing on the proper interactions, experiences, cultures, and environmental cues. However, we don't know what any of this means in the online environment. Do we observe individuals at their machines in their home space? Do we observe the class as it interacts online? Is the electronic space the actual classroom? What sorts of things are we looking for, what type of instrument will help us to focus on those things? Participant observations where the researcher is part of the culture in which the observation is being conducted, as is the case with ethnographic studies, leave the role of the researcher even more undefined in online environments. It is important to consider the practical as well as the theoretical and philosophical aspects of participant observations in online class settings.

In our experiences this is perhaps one of the most difficult things to handle in online learning environment inquiry. Because we do have certain "scripts" (mental or physical) which guide our interview protocols, the interview procedures are still somewhat familiar to us in electronic media. Although the social nature of the interview is significantly altered, the pragmatics of how to go about it are still relatively similar--that is to set out as series of questions (structured, unstructured, semi-structured) and begin conversing with respondents. But how do we go about really observing the online learning environment? Is it even possible? Here is an even more evident exposure of the social nature of qualitative inquiry (Wolcott, 1995). Here we have a real rub, what sort of observational techniques should we use, can we rely on the old checklists for observations that we had used traditionally? Do we have to shift foci in the same ways that we do in traditional settings? Unfortunately, our experience raised more questions than answers in this regard. We attempted to "observe" online settings by reading through the ongoing synchronous exchanges such as chats and asynchronous discussion forum communication. In

the end, our experience was so limited in this regard, that there is little we can really say by way of overall impressions or guidance. Rather we can merely raise these questions for careful --even cautious-- consideration by those embarking in online learning environment inquiry.

## **Document Analysis**

Document analysis (Hodder, 1994) is perhaps the least difficult qualitative data issue to be resolved. Since there are fewer abstractions that are important (e.g., voice tone, culture of a classroom, etc.) in document analysis, the issues are a little less complicated. Clearly online course materials as with face-to-face course materials are prime candidates for document analysis in such studies. In the same way, student materials are also documents. But in the online environment, there are typically many more "printed" resources than there may be in the face-to-face environment. What is to be considered a document? Is the chat that the students conduct on regular Monday meeting times, for example, to be considered documentary, observation, or interview data? Documents typically included in qualitative research for data analysis appear in the form of written text. Written text assumes a purpose depending on the author and the intended use of the document. Creswell (1998) distinguishes between texts written as records of information, i.e., public documents, reports, contracts and others such as diaries or journals, written for personal use. Journals, logs and diaries are sometimes requested by the researcher as a way for participants to keep track of and reflect on their activities in a particular situation or context.

In online learning environments, information is presented in the form of written text in several aspects including (but not limited to) synchronous chat, discussion forum, project submissions, email communication and written reports or summaries. As these class activities are utilized in ways that intend to mirror activities typically integral to face-to-face learning environments, in which case they would not be considered in document analysis, but rather as observation or interview data. In what ways does this change the nature of data collected. In the case of document analysis, wherever this cautious distinction is drawn and there is care to maintain authenticity in the documents themselves, it is likely that, in this one area, there is the least impact of the switch from face-to-face to online inquiry subject. This is primarily because there is inherently less "socialness" to the procedures within most document analyses even within the qualitative tradition. It is more anthropological in nature, uncovering the cultures and understandings of authors as a result of careful dissection of documented data.

## **Conclusion and a Note of Caution**

With the growing interest in online education and the vast difference in teaching and learning between online and face-to-face learning environments, it is becoming more and more necessary to gain a better understanding of the experiences students face in new distance education endeavors of many institutions of higher education. While there is little research available in this area, we believe qualitative methods in seeking this information, are not only appropriate but necessary in developing a greater understanding of student experiences. However, the employ of qualitative methods founded on assumptions of the social nature of inquiry can only be used with great caution. It is essential that as we continue to examine online learning environments in qualitative ways that we carefully reflect on the experience of doing online interviews, online observations and electronic document analysis and try to capture how we see these experiences as differing from previous experiences in qualitative research.

It is essential that all good qualitative research have certain hallmarks of quality, and in one final note, we wish to emphasize the importance of disclosing one's researcher identity. Even more so than in many other areas, the online revolution has recently turned into an online opinion war with many folks lining up on both sides, pro (Dede, 1997 ) and con (Noble, 1998). Because the online learning craze is likely to affect our own lives and livelihoods, it is essential that we are clear with all readers of precisely our own feelings and biases with regard to this new innovation in honest, up front ways.

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# A Model for the Efficacious Use of Sound in Multimedia Instruction

Mary Jean Bishop  
Ward Mitchell Cates  
Lehigh University

## Abstract

*Recent technological advances now make possible full integration of sound in instructional software. This paper explores the systematic use of sound to enhance learning. It illustrates a model of the “instructional communication system” based on a combination of information-processing and communication theories. The model identifies and characterizes the way sound might be used to optimize learning from multimedia instruction.*

Technological and cost barriers to full integration of sound in instructional software have recently disappeared. Conceptual and preconceptual barriers, however, still appear to prevent software designers from using sound more effectively in their instructional products. Interface books seldom discuss the use of sound, and when they do, the use most often discussed is simple verbatim narration of on-screen text (see Bickford, 1997; Cooper, 1995; Galitz, 1997; Mandel, 1997). Because most “classics” of instructional interface design were written before sound was a viable design component, sound is seldom well discussed (see Alessi & Trolip, 1985, 1991; Hannafin & Peck, 1988; Jonassen, 1988; Keller, 1987). In general, interface design guidelines identify three main uses of sound in instructional software: to alert learners to errors, to provide stand-alone examples (like musical passages or digitized versions of speeches), or to narrate text on the screen (for redundant presentation, for non-readers, or for those with auditory limitations). Review of research on sound in instructional software reveals a focus on the third use cited above, digitized or computer-generated synthetic speech narration (see Barron & Atkins, 1994; Mann, 1995; Shih & Alessi, 1996). While some outside education have considered non-speech interface sounds (Blattner, Sumikawa, & Greenberg, 1989; Gaver, 1986), many promising uses remain unexplored.

Before one can determine sound’s potential contribution to instructional software, however, one must have a clear picture of the component processes involved in learning. Therefore, this paper begins by exploring the operations and limiting factors of information-processing.

## Information-processing Operations and Limiting Factors

According to information-processing theory, learning emerges from processing interactions among information from the environment and the learner’s knowledge and previous experiences. Most theorists have adopted at least the basic structure of the three-stage memory model first proposed by Atkinson and Shiffrin in 1968.

### The Atkinson-Shiffrin Information-processing Model

In the Atkinson-Shiffrin model, environmental stimuli in their primitive form are first handled by a sensory information store, or *sensory register*. Signals held here are readily displaced by subsequent signals in the same sensory channel. The sensory register filters and then routes incoming signals to a second, *short-term store* where information is held temporarily until it can be encoded for storage. *Encoding* is the process of building relationships and connections within new material or between new material and existing knowledge structures. Once encoded, the information is moved into *long-term store* in the form of *images* (the autobiographical knowledge or *episodic memories* one has for things that have been personally experienced) or *schemas* (the organized, propositional knowledge one has for the meanings, rules, and algorithms used to manipulate and understand the many symbol systems encountered in life) (Tulving, 1972). Long-term store is both the place where we hold newly encoded information and the place from which we retrieve well-established memories. Recovering information from long-term store requires *cues* that may be supplied externally by the situation or internally by one’s existing memories. These cues are used to search long-term store in order to identify and retrieve matches. *Control processes* “oversee” the cognitive system by regulating the exchange of information between the sensory register and long-term store, determining which search-and-retrieval strategies to use to access information from long-term store, and deciding when sufficient information has been retrieved.

Information-processing theorists maintain that learning occurs when information that has been transferred to and stored in long-term memory can be retrieved when needed. Transforming incoming environmental stimuli into learned images and schema involves three main operations: acquisition, processing, and retrieval. It appears, however, that limitations in each of these operations may restrict the amount of data one can store long-term.

## Limiting Factors in Information Processing

In order to acquire or make sense of the constant barrage of sensory information, an individual must decide, often unconsciously, which information to attend to and which to ignore. To explain this phenomenon, Broadbent (1958) posited that all information reaching the sensory register is subjected simultaneously, or in parallel, to a preliminary analysis based on prior knowledge. From this pre-perceptual analysis of the entire sensory scene, one chooses a smaller subset of stimuli to process successively, or in serial, through the rest of the cognitive system. The “bottleneck” created between parallel pre-perceptual and serial perceptual stages restricts the amount of information entering the cognitive system. Individuals remain essentially unaware of information not selected for attention.

Like many later researchers, Wundt (1896/1897) found short-term store is also of limited capacity: There is a limit to the amount of information, or maximal *cognitive load*, an individual can process in short-term store at any given time. Although it may be that cognitive load varies somewhat, depending upon the nature of input stimuli, our capacity for processing incoming data is certainly limited to some finite quantity. Information that exceeds cognitive processing capacity is dropped from short-term store without being processed. Further, unless information that enters the store is rehearsed, it decays within approximately five to twenty seconds. Short-term store limitations dictate that data not encoded and moved into long-term store must be overwritten to make room for new incoming stimuli (as when we forget a new phone number after hearing another series of numbers) or consciously rehearsed and then discarded immediately after use (as when we repeat a telephone number aloud until we have dialed it).

Memories often seem to fade with the passage of time. Forgetting is a failure to retrieve information from long-term store. There are three general hypotheses about the factors that cause forgetting, each of which probably contributes to overall retrieval problems. The decay hypothesis asserts that the strength of a memory simply weakens over time and therefore is harder to retrieve (Wickelgren, 1976). The interference hypothesis claims that competition among memories blocks the retrieval of a target memory (Postman, 1961). The retrieval-cue hypothesis asserts that at the time of retrieval we lose access to the internal “indices” that point to the memory’s location in long-term store (Norman, 1982). There is some evidence to suggest that once information has been moved to long-term store, it remains there forever (Nelson, 1971). While this means memories may never actually leave long-term store, individuals certainly can lose access to them.

Berlo (1960) suggested that the study of learning processes and the study of communication processes differ only in their point of view. While learning models generally begin with and focus on how messages are received and processed by learners, communication models most often begin with and focus on how messages are sent. Learning from instructional software, therefore, might be viewed as an *instructional communication system* with a set of interrelated parts working together to produce learning (Banathy, 1996).

## Communication Operations and Limitations

Communication is the transmission, reception, and decoding of signals. As was the case with information-processing theory, one model—Shannon and Weaver’s *The Mathematical Theory of Communication* (1949/1969)—appears to have been particularly influential in shaping communication theory.

### The Shannon-Weaver Communication Model

The Shannon-Weaver model proposes that all communication processes begin when a *source*, desiring to produce some outcome, chooses a message to be communicated. The message is encoded to produce a signal appropriate for transmission over the *channel* that will be used. After the message has been transmitted, a *receiver* then decodes the message from the signal transmitted. All channels have limited capacity. In humans, *channel capacity* generally refers to the physiological and psychological limitations on the number of symbols or stimuli that individuals can process. When more symbols are transmitted than a channel can handle, some information is lost.

According to Shannon and Weaver, communication is “perfect” when the information contained in a message affects the receiver in exactly the way intended by the source. Communication is rarely perfect, however; at any point things can get added to the signal that were not originally intended by the source. This spurious information, or *noise*, introduces errors that increase the uncertainty in the situation and make the signal harder for the receiver to reconstruct accurately.

### Limiting Factors in Communication

Shannon and Weaver divided the analysis of communication problems into three levels. “Level A” deals with how accurately the signal is received. When competing external or internal stimuli exist in a communication channel, the resulting noise introduces technical errors that can overpower all or part of a signal transmission. This disruption prevents the receiver from being able to select the communicated signal for decoding. No matter how accurately a message is transmitted, however, if it cannot be decoded by the receiver it is not likely to convey the



intended message. “Level B,” therefore, concerns how precisely the received signal conveys the intended message. Decoding requires the receiver to analyze an incoming signal based on his or her existing schemas. When no interpretive framework exists and none is supplied by the source, the resulting noise introduces semantic errors that prevent the signal from conveying the intended message. Even when a message is interpreted correctly, it still may not accomplish the source’s goal. Thus, “Level C” involves whether the received message ultimately produces the outcome desired by the source. To effect an outcome, the elements and structure of the message that assign connotative meaning —such as aesthetic appeal, style, execution, and other psychological and emotional factors— must mesh with the receiver’s own relevant beliefs, cultural values, and experiences. If this synthesis leads the receiver to make inferences about the message that are not intended by its source, the resulting noise introduces conceptual errors that can prevent the communication from producing the desired result.

Although Shannon and Weaver confined their work primarily to the study of Level A problems of mechanistic communication systems, they contended that improving the effectiveness and efficiency of the communication process overall requires applying concepts from their model to all three levels of communication problems. Their work suggested that there may be ways to anticipate communication difficulties and “front load” messages with the cues necessary to “squench” noise even before it occurs.

### **Using Sound to Squelch Noise in Instructional Communication Systems**

Sounds can support learning in a variety of ways. They can gain and focus learners’ attention, reducing the distraction of competing stimuli, engaging interest over time, and making environments more tangible and emotionally arousing (Kohfeld, 1971; Bernstein, Clark, & Edelstein, 1969; Thomas & Johnston, 1984). They can help learners condense, elaborate upon, and organize details about their surroundings, helping them to see interconnections among new pieces of information (McAdams, 1993; Winn, 1993; Yost, 1993). They can provide a familiar setting that may help learners relate incoming information to existing knowledge (Deutsch, 1980, 1986; Gaver, 1993). Thus, McAdams and Bigand (1993) argued that sound is uniquely suited to assist in the acquisition, processing, and retrieval of new information for those who are not hearing-impaired. If this is true, there may be systematic ways to design *multi-cue* instructional messages that overcome information-processing noise and optimize learning.

### **The Role of Multi-cue Messages in Instructional Communication Systems**

For some time it has been thought that simply adding cues to messages might improve the effectiveness of instructional communication. The idea behind *cue summation* is that the more cues used, whether within or across sensory channels, the greater the amount of information communicated and the more learning gained. While the results of cue summation studies appear contradictory on the surface, Severin (1967) maintained the differences might be explained by the degree of redundancy among cues used in the treatments. Severin noted that studies that found no difference between multiple-cue and single-cue communication used cues that were almost totally redundant, such as text coupled with word-for-word narration. In these studies the wedded cues apparently neither competed with each other nor supplied new information. In contrast, studies that found multiple-cue communications less effective than single-cue communications used cues with no redundancy between them, such as text coupled with unrelated speech. In these studies, the dueling cues probably exceeded channel capacity, producing noise that decreased communication efficiency. Severin concluded that studies that found multi-cue communications to be more effective than single-cue communications used cues that were partially redundant, like pictures coupled with related narration. In these studies, primary and secondary cues appear offset just enough for the secondary cue to supply the right balance of redundancy and new information. Severin contended that multi-cue messages can be designed to help improve instructional communication. The question is not just whether the message contains multiple cues, but whether those secondary cues supply the optimal amount of redundancy.

### **The Role of Redundancy in Instructional Communication Systems**

*Redundancy* is the information message cues share: the parts that “overlap.” For example, a source might attempt to correct technical problems in the system (Level A) by retransmitting or amplifying the signal. This content redundancy often can help overcome transmission errors by completing obstructed signals or by preventing the interference in the first place. A source anticipating semantic problems in the system (Level B) might attempt to correct them by supplying the relevant connections between and among related message signals. This context redundancy often can help overcome misinterpretations by furnishing denotative meanings for signals. A source might attempt to correct conceptual problems in the system (Level C) by carefully choosing signals that make appropriate links to receivers’ preexisting concepts in memory. This construct redundancy clarifies the connotative meanings behind message signals and reduces misunderstandings.

When a source anticipates noise at the various levels of communication, the trick may be in knowing how much and which sort of between-cue message redundancy to include in order to counteract noise. Striking this optimal balance may also be the key to successful instructional communication. Further, it appears that multi-cue

instructional messages incorporating sound might both deliver sufficient amounts of new information and supply the noise-defeating content, context, and construct redundancy necessary to enhance learning. Theories of system optimization, such as that presented by Wilde and Beightler (1967), recommend creating a model of the system in order to understand precisely what the system must do to accomplish its goal. This model might then serve as a frame of reference for subsequent evaluation of the system.

## Modeling the Instructional Communication System

Understanding the underlying component processes of instructional communication might begin by adding the receiver's information-processing transactions to the Shannon-Weaver model. Figure 1 depicts the receiver's component processes in more detail, illustrating an idealized representation of the three levels of communication as three learning phases (select, analyze, and synthesize) and depicting instructional communication limitations — channel capacity and noise— as constraints on the system.

If we were trying to discover only what output the system produces for a given mixture and amount of input, this “black box” model might be adequate. However, our concern here is to determine what amounts and mixtures of input at each phase of learning will bring about the kinds of system activity necessary to produce optimal learning output (Churchman, 1968). In order for us to understand how input might affect instructional communication, the model must approximate more closely the complex circles of influence that exist among the proposed learning phases, the system's component information-processing operations, and the human-communication system constraints. Figure 1 neither depicts the role that acquisition, processing, and retrieval operations play in each learning phase nor suggests how the system might utilize the content, context, and construct redundancy in an instructional message to help the receiver overcome system constraints.

In order to explore the area inside the boxes, it might be useful to move from the traditional flow-chart type of diagram toward a structural illustration that approximates more closely the more dynamic nature of the instructional communication system. The model illustrated in Figure 2 and in subsequent figures in this chapter

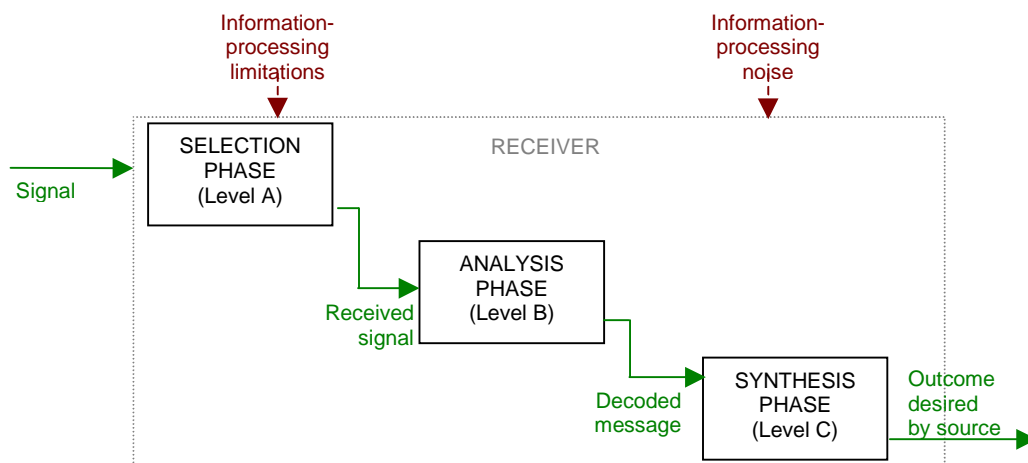


Figure 1. Idealized information-processing explanation for receiver learning transactions.

draws parallels between the instructional communication system and the process of crystal formation in chemistry.

Thus, Figure 2 eliminates the traditional boxes and arrows in favor of a grid of intersecting lines that represents learning phases and operations as an instructional message moves through the instructional communication channel. The

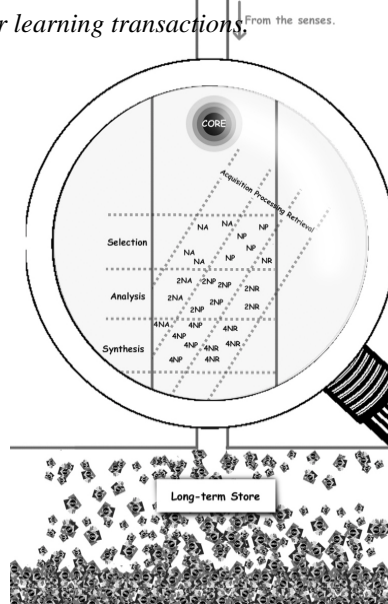


Figure 2. A representational illustration of the instructional communication system.

channel is drawn as the area between two parallel lines running vertically from the top to the bottom of the diagram. The message is represented as a set of increasingly lighter concentric circles (moving from inner *core* to outer circle). The areas between the lines running horizontally from left to right represent the three transactions or “phases” of learning —selection, analysis, and synthesis— identified for use in the earlier, linear model. This is the learner’s working memory. The areas between the channel lines running diagonally (from lower-left to upper-right) represent the three information-processing operations that the receiver uses at each phase of learning in order to process the instructional signal.

The dividing lines between acquisition, processing, and retrieval dissect the channel diagonally in order to illustrate how each operation is applied in varying amounts at each learning phase. Processing is depicted as the middle of the three because it relies on acquisition and retrieval to supply the information and memories it acts upon. During selection, processing calls upon acquisition heavily; in contrast, only the most salient memories are retrieved during selection. During analysis, processing is central —although acquisition and retrieval are also relatively active. During synthesis, processing calls upon retrieval most heavily, while only the most salient new stimuli are acquired.

The area at the bottom of the model represents long-term store, with its schema particles “suspended” and “fluid.” These schemas are retrieved from memory to help learners make sense of new information. The particles in the long-term store suspension are not disordered; related crystals naturally gravitate toward one another and may align to form more complex and interdependent structures. The extent to which particles remain suspended and fluid, however, depends upon how often they are “agitated.” Particles that have just recently been stored or retrieved from memory waft to the top of long-term store, carrying others around them along in their wake. This activity makes these memories easily accessible to working memory and likely to be among the first retrieved in later learning situations (Norman, 1982). Schema particles suspended in long-term memory will settle slowly if left stagnate. Unless schemas occasionally are retrieved from long-term store and the “silt” stirred up, they become too deeply embedded and are forgotten. Stagnate memories lack the fluidity to be applied to new learning situations.

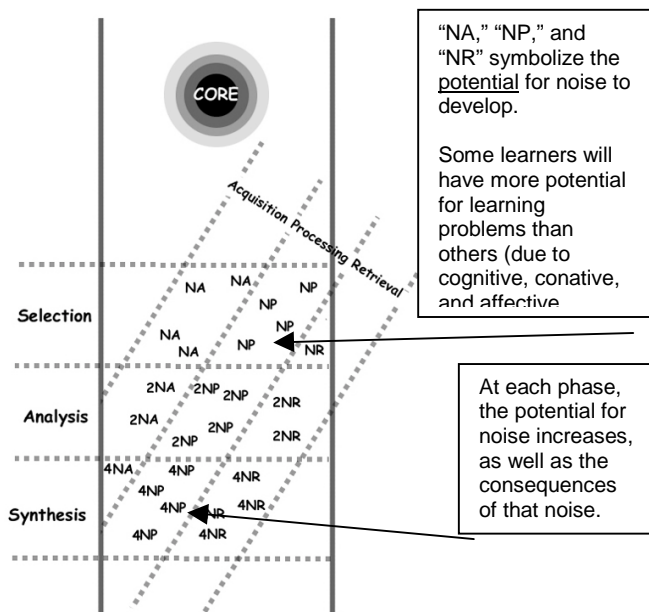


Figure 3. Redundant message enters channel filled with the potential for developing noise.

such letter codes here do not represent such elements.)

At each deeper phase of learning, the relative “strength” of potential noise as well as the ultimate consequences of that noise increase by some factor. For example, while it can be difficult to overcome acquisition noise at selection in order to gain a learner’s attention, it often is much harder to overcome acquisition noise in analysis in order to focus a learner’s attention, and harder still to hold a learner’s attention over time for synthesis. While there is no way to know the actual

Because of the inevitable differences among learners’ characteristic cognitive, conative, and affective traits, the instructional communication channel is always prone to noise (Corno & Snow, 1986). For example, the same instructional method that gains one learner’s attention may not gain another’s (Biehler & Snowman, 1982). Some learners will lack the prior knowledge they need to help them make sense of the new information (Rumelhart & Norman, 1981). Still other learners may be unable or unwilling to apply their knowledge mindfully when appropriate (Langer, 1989). The potential for acquisition, processing, and retrieval noise in the selection phase is depicted in Figure 3 as “NA,” “NP,” and “NR,” respectively. (Despite possible similarities between the letter code representations used in the model and the names of actual chemical elements,

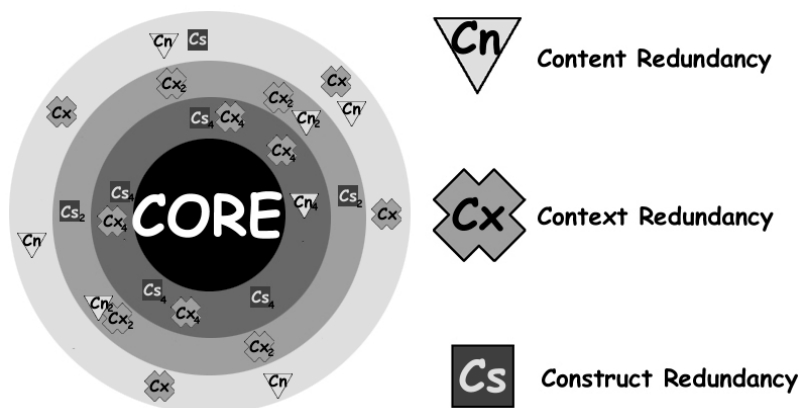


Figure 4. Message contains three layers of “solute” with varying amounts of content, context, and construct redundancy “molecules.”

proportions/concentrations of noise at each phase, for purposes of illustration, the authors depicted the potential for acquisition, processing, and retrieval noise as “NA,” “NP,” and “NR” in the selection phase, “2NA,” “2NP,” and “2NR” in the analysis phase and as “4NA,” “4NP,” and “4NR” in the synthesis phase. Similarly, because the proportion of acquisition, processing, and retrieval involved at each learning phase, acquisition noise potential at selection is depicted using 4 “units” as compared with 1 “unit” of acquisition noise potential at synthesis. Conversely, retrieval at selection is depicted as fairly low (1 “unit”) whereas it is comparatively high at synthesis (4 “units”). The potential for processing noise remains the same at each learning phase (4 “units”).

Figure 4 supplies a closer look at the instructional message. The black circle labeled “CORE” represents the entropic, core knowledge that the instructional message is intended to convey. The increasingly lighter circles around the core (moving from inside to outside) represent its layers of redundancy that have been “formulated” for each learning phase. Figure 6 depicts the ratio of content, context, and construct redundancy “molecules” that would be appropriate for the learning situation depicted in Figure 3. That means the number of redundancy molecules within each ring are balanced for the information-processing needs of its intended learning phase and the potential for channel noise given the audience and the content. Recall, however, that the proportions/concentrations used here are merely for illustration.

As depicted in Figure 5, when an instructional message enters the selection phase of working memory its first layer of redundancy dissolves. Depending upon the learner’s ability or willingness to exert information-

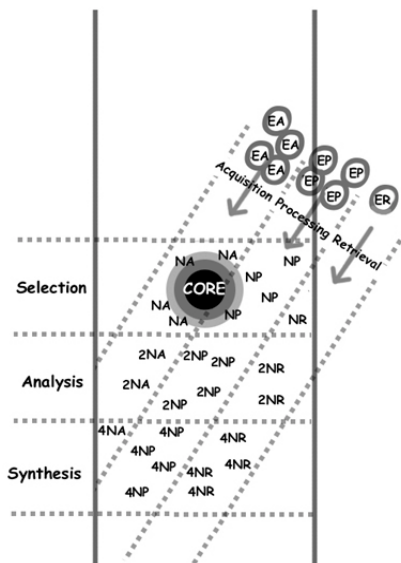


Figure 5. First redundancy layer dissolves stimulating selection-level information-processing.

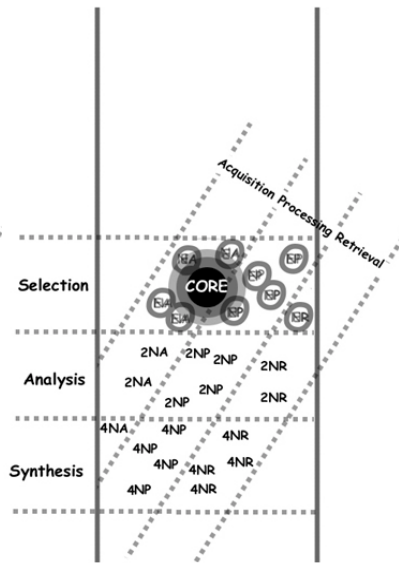


Figure 6. Information-processing effort “reacts” with potential noise and the redundancy in the message.

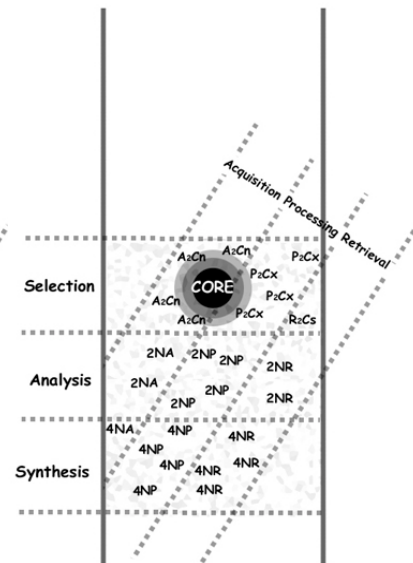
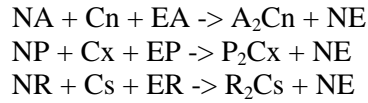


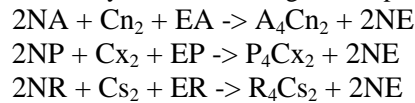
Figure 7. Noise potential is “neutralized.”

processing effort, the content, context, and construct *solute* stimulates the production of acquisition, processing, and retrieval *ions* (“EA,” “EP,” and “ER,” respectively). When these ions are added to a *solution* that already contains redundancy dissolved from the message (Cn, Cx, and Cs), and various forms of information-processing noise potential (NA, NP, and NR), three “chemical reactions” occur (Figure 6). These reactions theoretically could be depicted mathematically:



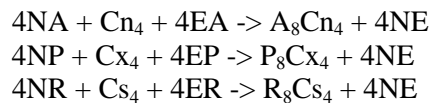
The first formula means that when the potential for acquisition noise is combined with content redundancy and the learner’s effort to acquire the material, the resulting products are gained attention ( $\text{A}_2\text{Cn}$ ) and residual positive affects of learning, such as improved attitudes and feelings of success, that serve as *catalysts* for continued learning (NE, as in “noise + energy”). The second formula indicates that when the potential for processing noise is combined with context redundancy and the learner’s effort to process the material, the resulting products are isolated relevant stimuli ( $\text{P}_2\text{Cx}$ ) and more *positive residual* (NE). The third formula indicates that when the potential for retrieval noise is combined with construct redundancy and the learner’s effort to retrieve schemas from long-term store, the resulting products are retrieval of the appropriate constructs from memory ( $\text{P}_2\text{Cx}$ ) and still more NE. The final outcome of successful selection-level processing is depicted in Figure 7. At this point in the instructional communication system, the learner is interested in the message and has selected it for further processing. Further, higher concentrations of NE make the working memory solution thicker, slowing the message and allowing deeper processing.

Similar reactions occur in the analysis phase. Once again, using our hypothetical proportions/concentrations, the analysis reactions might be depicted like this:



Analysis-level reactions yield focused attention ( $\text{A}_4\text{Cn}_2$ ), information organizing and categorizing ( $\text{P}_4\text{Cx}_2$ ), efforts to build upon existing knowledge ( $\text{R}_4\text{Cs}_2$ ) and even higher levels of positive residual (2NE). At this point in the instructional communication system, the learner is curious about the message and is actively analyzing its meaning. Further, higher concentrations of NE continue to make the working memory solution thicker and decrease message speed.

Finally, the synthesis reactions employing our hypothetical proportions/ concentrations, might look like this:



The product of synthesis-level reactions is attention held over time ( $\text{A}_8\text{Cn}_4$ ), elaboration upon the new information ( $\text{P}_8\text{Cx}_4$ ), construction of more transferable knowledge structures ( $\text{R}_8\text{Cs}_4$ ), and still higher levels of positive residual (2NE). At this point in the instructional communication system, the learner is engaged in the message and is affected by its larger meaning. Still higher concentrations of NE continue to “thicken” the solute and slow the message’s passage through the system, fostering deeper processing.

Thus, as each layer of carefully chosen redundant material dissolves, the message “solute” acts to “neutralize” the acquisition, processing, and retrieval noise in that phase. In Figures 5-7, the first layer of redundancy dissolves into the learning “solution” and, with the learner’s help, the solute counterbalances errors caused by acquisition, processing, and retrieval noise in the selection phase. Here, the instructional signal provides redundant message cues aimed primarily at helping the learner **select** the instructional signal. Similarly, the second layer of redundancy in an instructional message can reduce the effects of acquisition, processing, and retrieval noise in the analysis phase when the learner exerts information-processing effort. Now, the instructional signal includes message cues intended to help the learner **analyze** the message. In the final phase, the third layer of message redundancy, in conjunction with even greater information-processing effort on behalf of the learner, neutralizes acquisition, processing, and noise at the synthesis phase. Here, the instructional message includes cues that help the learner to **synthesize** the content of a message.





will crystallize along with the core during synthesis, depriving the *message crystal* of needed solute. Ultimately, the errant structures increase the uncertainty in the situation, making it difficult for the learner to separate the deprived core knowledge structure from the noise (see Figure 11).

The more likely scenario, however, is that the weight and density of a message with very little redundancy will cause it to pass through the system unimpeded and largely unprocessed. If a learner is not interested in, curious about, or engaged by what dissolves from the message, he or she will not exert the information-processing effort that slows it down at each learning phase for deeper processing and reflection. While what's left of the message core may actually end up somewhere in long-term store, its mass and velocity mean that—if it can subsequently be located—it may well be buried too far out of reach to be easily retrieved.

Like message schemas, the noise that crystallizes in the channel eventually begins to make its way into long-term store, leaving behind even more potential for noise in subsequent learning. When noise structures (misinterpretations, misunderstandings) find their way into long-term store, they can be difficult to extract later. Instructional technologies that are not “front loaded” to subdue acquisition, processing, and retrieval noise are unlikely to produce outcomes that match their goals (Dick & Carey, 1990). Effective instructional designers recognize this problem and build into the message the redundancies needed to resolve those problems should they occur. Sound may play a role in such design. This model may help to illustrate that role by clarifying the operations and limiting factors within the instructional communication system.

### **A Cautionary Note: The Function of a Model**

The model we propose is intended to help the reader conceptualize the role of redundancy in enhanced message transmission. Britt (1997) maintained that a model—through simplification, explicitness, and reformulation—provides an effective way to sort out the chaos of systems that are too complex to deal with directly. Because explicit systems models can show the repeating patterns and relationships among the parts, they can help one understand the true complexity of the problem or situation. Salisbury (1996) argued that to be useful, however, a model must represent all of the system's components and the relationships between them simply enough to be understandable. The model must reduce complexity and ambiguity sufficiently so as to make analysis and the prediction of system behavior possible. But simplifying real-world complexity poses a dilemma. If a model is too simplistic, the relationship of the model to its real-world counterpart becomes tenuous. When this occurs, predictions of system behavior based on the model can be grossly inaccurate. Thus, we cannot expect to model a system precisely. Modeling is not about precision but, instead, about tentatively determining which things are important to consider in capturing the essence of the system. A model cannot provide final answers. As knowledge is accumulated and relevant areas of the modeled system are clarified, the model is almost always modified.

We suggest that this model may prove useful in deciding how to incorporate message redundancy through the use of sound cues in instructional software. Before one can do that, however, the model's assumptions should be tested against what is known about “real world” instructional software. This should help to explicate the model and reveal more specific ways sound might be used to improve the effectiveness and efficiency of the instructional communication system.

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# **Preparing Teachers To Integrate Technology Using Constructionist Methodology: Don't Teach Me How I Know I Should Teach; Teach Me How I Want To Be Taught**

J. M. Blocher  
L. Sujo de Montes  
G. Tucker  
E. M. Willis  
Northern Arizona University

## **Introduction**

Currently, many educators suggest that learning can be enhanced if the learning environment includes more interactive, student-centered, and engaging activities where learners construct their understanding rather than more traditional methods of teacher-centered, direct instruction. Inherent is a paradigm shift from more historical teaching methods to an environment where teachers relinquish control and learners accept responsibility for learning. Many agree that this promotes more ownership and stimulates more meaningful learning. However, engaging in such a learning environment presents challenges for both the teacher, who designs, develops, and facilitates this complex environment, and learners who must interact and take responsibility for constructing their understanding.

This paper describes a study conducted by Northern Arizona University's Educational Technology faculty regarding training teachers for the integration of technology and the promotion of learner-centered instruction. Participants included traditional pre-service students enrolled in a required "Technology in the Classroom" course and veteran teachers engaged in professional development designed to provide instruction into the integration of technology into the classroom. Instruction modeled the integration of technology from a constructionist perspective, and provided participants the opportunity to engage in activities that utilized the integration of technology. The learning environment was designed to provide introduction to skills and practice exercises utilizing computer applications that could be later used within their teaching practice.

## **Constructivist/Constructionist Approach**

What is knowledge? How does one teach this knowledge to others? Looking at educational pedagogy from a very elementary approach, the way one answers the first question will determine how they approach the answer to the second. One can approach the answers from the standpoint that knowledge exists outside of the learner, there are fundamental truths and teaching is helping learners master them. If this is a person's view of knowledge, then teaching usually takes the form of direct instruction and the goals center around students acquiring and repeating factual information. Most printed textbooks are designed for, and many teachers are trained in, this model. Students usually read or are told factual information, and then repeat this information as a part of assessment. This model of knowledge, often referred to as the objectivist model, works well when the objectives to be met result in a type of informational memorization.

One can also view knowledge as something beyond a set of facts, or concepts, or laws that are to be memorized. One can possess a view of knowledge that incorporates an understanding of causes and effects involving ideas and actions that requires the use of higher-order or critical thinking skills. This view does not conceive knowledge as something that exists independent of a knower. Zahorik (1995, pp. 11-12) summarized this view of knowledge in the following way:

*"Knowledge is constructed by humans.* Knowledge is not a set of facts, concepts, or laws waiting to be discovered. It is not something that exists independent of a knower. Humans create or construct knowledge as they attempt to bring meaning to their experience. Everything that we know, we have made.

*Knowledge is conjectural and fallible.* Since knowledge is a construction of humans and humans are constantly undergoing new experiences, knowledge can never be stable. The understandings that we invent are always tentative and incomplete.

*Knowledge grows through exposure.* Understanding becomes deeper and stronger if one tests it against new encounters."

This model of knowledge is often referred to as the constructivist model. Constructivism's central idea is that human learning is constructed, that learners build new knowledge upon the foundation of previous learning. The constructivist model relies on cognitive psychology for much of its theoretical foundations and has roots in philosophy, sociology, and education. It is important to understand the implications this view of learning has for teaching. The Southwest Educational Development Laboratory News (SEDLetter) in August, 1996 stated:

"First, teaching cannot be viewed as the transmission of knowledge from enlightened to unenlightened....

Second, if learning is based on prior knowledge, then teachers must note that knowledge and provide learning environments that exploit inconsistencies between learners' current understandings and the new experiences before them....

Third, if students must apply their current understandings in new situations in order to build new knowledge, then teachers must engage students in learning, bringing students' current understandings to the forefront. Teachers can ensure that learning experiences incorporate problems that are important to students, not those that are primarily important to teachers and the educational system....

Fourth, if new knowledge is actively built, then time is needed to build it..."

In educational pedagogy, the reality of the situation is that, teachers find themselves in both the objectivist's camp and the constructivist's camp depending upon the learning objectives of the moment. There are times in our classrooms that our objectives are such that we are actively involved in the "transmission of knowledge from enlightened to unenlightened." There are others times that our learning objectives are such that we do our best to create situations where "students must apply their current understandings in new situations in order to build new knowledge." Teaching is often described as being an art. The art of becoming a master teacher can be seen as an awareness of when to be in one camp or the other and an understanding of how to be effective no matter what camp one is in.

In contemporary education, there has been added to this complexity of teaching and learning the concept of the integration of modern technology. For teachers who are at the moment in the objectivist's camp, technology becomes a tool for a more effective way of transmitting knowledge. In this context, the integration of technology usually takes the form of some type of PowerPoint® presentation or the use of some other multimedia presentation software to supplement teacher-centered instruction. But for those times when a teacher views knowledge from a constructivist perspective, the question then becomes, how can technology be effectively integrated?

In social and developmental psychology, according to von Glasersfeld (1994), constructivist models view the learner as a builder of knowledge, not a passive receptor, but an active constructor. Two important notions orbit around the simple idea of constructed knowledge:

"The first is that learners construct new understandings using what they already know. There is no *tabula rasa* on which new knowledge is etched. Rather, learners come to learning situations with knowledge gained from previous experience, and that prior knowledge influences what new or modified knowledge they will construct from new learning experiences. The second notion is that learning is active rather than passive. Learners confront their understanding in light of what they encounter in the new learning situation. If what learners encounter is inconsistent with their current understanding, their understanding can change to accommodate new experience. Learners remain active throughout this process: they apply current understandings, note relevant elements in new learning experiences, judge the consistency of prior and emerging knowledge, and based on that judgment, they can modify knowledge (SEDLetter, August, 1996)."

If learning is a constructive process, and instruction must be designed to provide opportunities for such construction, then how can technology be integrated into the instructional processes such that it promotes teachers to teach in "constructivists ways?" The answer may come from a series of research studies described as *constructionism*.

In the 1960's, Seymour Papert and colleagues initiated a research project on how children think and learn and to develop educational approaches and technological tools to help those children learn. From this beginning has evolved a theoretical foundation, which has become known as constructionism. The term constructionism, first

coined by Papert (1991), involves two main tenets. First, it affirms the constructivists' view of learning and asserts that knowledge is not simply transmitted from teacher to student, but actively constructed by the mind of the learner (Kafai and Resnick, 1996). To this constructionism adds the idea that people construct new knowledge with particular effectiveness when they are engaged in constructing *personally meaningful products* (Bruckman & Resnick, 1995). Thus constructionism involves two intertwined types of construction: the construction of knowledge in the context of building personally meaningful products (Kafai and Resnick, 1996). It is through this avenue of "constructing" that technology can be integrated into the instructional processes such that it promotes teachers to teach from a constructivist model.

## **Participants**

The integration of computer technology into PreK-12 education has been described as one way to promote a learner-centered environment where the computer acts as a tool that possesses a cache' of knowledge and the teacher introduces and moderates ill-structured problems and encourages methods for learner engagement. Described as both constructivist learning theory and constructionist methods, interactive learning activities within this environment include developing meaningful products through student publishing, access to vast resources, engaging in simulations, and utilizing communication systems for peer collaboration.

However, computer technology, specifically productivity software such as MS Office, Claris Works, and the variety of authoring tools are updated generally every other year. In addition, various computer networks are seldom configured the same, which provides a variety of pathways and location names for file management. Although there are many similarities between these tools and learners can develop crossover skills, developing instruction based upon any specific tool or application within any particular system seems unwise. Rather, it seems prudent to promote the learner's understanding of the concepts that are the foundation of the applications and file management systems. Therefore, it has been the goal for these authors, engaged in both new teacher preparation and professional development programs for in-service teachers, to model constructionist principals that utilize the integration of technology in a more student-centered learning environment. It is hoped that by providing this type of learning environment, the learners will enhance their teaching practice by realizing they can use these tools in any environment, regardless of platform, application, or network system.

Participants in this study included traditional pre-service students enrolled in a required "Technology in the Classroom" course and veteran teachers engaged in professional development designed to provide instruction into the integration of technology into the classroom. The learning environment was based upon constructionist principals where both groups of learners were engaged in developing meaningful products that provided an introduction to skills and practice utilizing computer applications that could be later integrated within their teaching practice. The authors also considered themselves participants in this study as their instruction modeled the integration of technology from a constructionist perspective, and provided participants the opportunity to engage in activities that utilized the integration of technology.

## **Pre-service Students**

All elementary education majors enroll in ETC 447, Technology in the Classroom, as a requirement of their program of studies. It is a three-credit hour course usually taken during the third or fourth year of their teacher education, and before they student teach. Classes are taught in a lab of 22 Motorola Macintosh clones, equipped with printers, scanners, a Proxima display unit, and digital cameras. A network that includes access to CD-ROM software, student and instructor folders, and fast access to the Internet and World Wide Web links these technologies. Eight to eleven sections of the course are offered each semester and summer sessions to accommodate traditional, cohort, and alternative partnership elementary teacher education programs.

ETC 447 has evolved from a skills-based course, in which students individually completed activities by following a manual of scripted instructions, to a classroom simulation of a Multimedia Content Development Company, where student teams collaboratively complete content-centered projects using carefully integrated technology tools. It is our vision to implement an educational technology course that models authentic practice through hands-on activities and social interaction. This teaching strategy enables our students to "do" technology and "be" desktop publishers and multimedia developers and database managers by using technology tools in a supportive learning environment.

## **In-service Teachers**

The veteran teachers in this study were a group of twenty-one elementary school teachers practicing at a school district in southern Arizona. They were screened and accepted into the eighteen-month technology professional development project with four university educational technology faculty. If accepted through the

application and screening process each participant received an equipped technology cart and software for their classroom in return for their long-term commitment to hands-on participation in technology integration activities and training.

To build cohesion, enhance teamwork, and stimulate ownership of the professional development project a systems approach to learning (Senge, 1990) was taken. The Learning Team, as they later called themselves, was given time during each visit to discuss and plan future topics for curriculum based upon their group decided needs. The educational technology faculty visited on site four times during each of the first two semesters, and then hosted the in-service teachers for a weeklong summer institute on campus. Future plans include four more visits in the 2000 - 2001 academic year to complete the professional development.

The twenty-one teachers participated in strategies similar to those utilized in the pre service ETC 447 model of technology integration. In self-selected small groups they "became" travel specialists or planners of a lecture series and practiced word processing, desktop publishing, database, and spreadsheet skills imbedded in the project. The teachers chose their travel destinations to investigate and promote, or lecture series notable speakers, so that the content was relevant to them. The final product was a group multimedia presentation of their project.

## **Data Collection**

This paper details a collaborative action research approach to (Oja & Smulyan, 1989) investigating teaching technology integration from a learner-centered constructionist perspective. Both quantitative and qualitative data were collected through self-report instruments, email communications, observations and anecdotal notes of instructional sessions, group meetings and personal interactions. The purpose of an action research approach is to provide a better understanding of the interactive processes and promote the improvement of conditions for the participants of the study. Therefore, data were collected from the role of observer/participant. This provided the opportunity to observe and help support the authors in fostering a better understanding and improve the learning process in this particular study.

Surveys, observations, email communications, anecdotal notes, and personal interactions provided both quantitative and qualitative data that gave a detailed account of learning experience regarding the instructional methods during the classes and professional development program. The qualitative data from observations, email communications, anecdotal notes, and personal interactions provided detail on the participants.

Quantitative data collected in the Center for Excellence in Technology Survey provided basic descriptions of the participating learners of this study. The Center for Excellence in Education Technology Survey is a self-report that provides information (5-point likert scale) regarding the learners' comfort using technology. Information on specific technology is also reported. For example, participants report on their self-efficacy using basic computer skills (i.e. word-processing, email, and CD-ROMs).

In addition, The Stages of Concern about the Innovation Questionnaire developed by Hall, George and Rutherford (1977) was used to measure the professional development participating teachers' process of being selected to be technology innovators for their district. This questionnaire assesses seven hypothesized stages of concern about an innovation that an individual moves through when adopting a process or product innovation, i.e., technology. The seven stages are: (0) Awareness, (1) Informational, (2) Personal, (3) Management, (4) Consequence, (5) Collaboration, and (6) Refocusing. This questionnaire utilizes an eight-point scale of 0, 1 (not true of me now), 2, 3, and 4 (somewhat true of me now), and 5, 6, and 7 (very true of me now). The progression from stage to stage indicates the participants' ideas that go from unrelated concerns about technology usage to the total involvement with technology and its impact on the learning process.

In the first stage, the Awareness stage, little concern about or involvement with the innovation is suggested. The Informational stage, the second stage, shows a general awareness of the innovation and interest in learning more detail about it. In the third stage, the Personal one, the individual is uncertain about the demands of the innovation, his or her role with the innovation and his or her adequacy to meet the innovation's demands. The fourth stage, Management, focuses the attention on the processes and tasks of using the innovation and the best use of information and resources. In the fifth stage, Consequence, the focus is on the impact that the innovation may have on the students' outcomes. Collaboration, the sixth stage, focuses on coordination and cooperation with others regarding the use of the innovation. Finally in the Refocusing stage, the seventh stage, the focus is on exploration of more universal benefits from the innovation, including the use of alternative ideas to the proposed or existing form of innovation.

## Discussion

There were many similarities between both the campus-based, pre-service group and the professional development group in regard to their self-efficacy of using computers. For example, there was no significant difference between the pre-service and the in-service teachers in their self-efficacy reports of computer use. As table 1 indicates, both groups demonstrated a high level of self-efficacy for using computers for general tasks – 4.201176471 and 4.11047619 out of 5.

	Pre-service Teachers n=34	In-Service Teachers n=22
Mean	4.201176471	4.11047619
Standard Deviation	0.532528359	0.67015279

*Table 1. Computer Use Self-Efficacy*

Participants in both groups indicated that they desired less constructionist methods. Interestingly, participants, at times, resisted the more open discovery learning methodology and indicated on several occasions that they would rather be provided with very specific "how to" skill instruction using the computers and software applications.

### The Professional Development Group

Several participants indicated that they wanted to know how to use the software, become "experts" or "gurus" before they learned how to integrate the technology into their teaching practice. They suggested that learning to use the computer and software was an independent learning objective different from learning how to integrate the technology into the classroom. As one professional development participant commented: "I need to understand how to use this equipment before I can learn how to integrate it into my teaching." Indeed, the professional development group on several occasions requested listed steps for using specific computer applications. This is particularly surprising as members of the professional development group, a) were chosen for the program based on their self-reported technology skills, b) demonstrated generally high self-efficacy for computer use skills, and c) demonstrated a Personal and Management stage at the 80<sup>th</sup> percentile on The Stages of Concern about the Innovation Questionnaire, suggesting that they have high technology-knowledge of innovating people who had already mastered technology.

The participating teachers were engaged in additional technology training sessions at the same time conducted by various other providers as well. Several individuals indicated that they were receiving step-by-step handouts and worksheets in their other training sessions and asked why they weren't being provided those during this professional development as well.

Indeed, their demand to learn more computer skills continued to the point that their district technology program director made available online skills training for the entire professional development group between the 4<sup>th</sup> professional development session and the week long summer session, as indicated by this email.

"I have 20 TEAM members signed up for Teacher Universe. The pre training session is set for Saturday, May 6, 2000 from 8:30 a.m. to noon. I will open up the training to 5 more people today. If you want to view the site before Saturday, go to <http://www.teacheruniverse.com> See you all Saturday!"

Their desire to have more application skill training was constant through out the professional development training sessions. During a discussion on the project bulletin board about their taking on a specific area to become an expert, as this teacher stated:

"I also think some of our [professional development group] members are feeling a little computer-deficient, or at least they lack confidence in their own skills. Maybe if we had had some application-based training going on concurrent to our class, it would have been less difficult."

Another teacher may have hit the nail on the head by responding:

"I think one of the reasons people are uncomfortable choosing an area of "expertise" is the term itself. I consider myself to be a damned fine teacher, but not an "expert." An expert in my mind is someone who knows everything about that topic – someone to whom I can go to for the nitty gritty. I am someone, though, that you could come to for advice on teaching. Maybe we need to consider a different term for 'expert'."

Interestingly, this suggests that in an area such as technology, which changes constantly, individuals may have a difficult time seeing themselves as ever being experts or having enough skills. Certainly the participating teachers of the professional development group demonstrated this. One of the NAU faculty members specifically tried to address this at one of the professional development group planning sessions with the teachers when he

stated; "At what point do you consider yourself an expert? I don't have all of the knowledge. I'm constantly learning new technology skills. I don't have all of the answers; I just have more than you at this point. You need to realize that you also have more knowledge and skills than others, and to them *you are a guru*." Indeed, the topic of "How do we get them to realize that this isn't about learning skills, but rather a shift in the learning paradigm?" was discussed often during project planning meetings by the NAU faculty.

Participants indicated on several occasions that they desired specific skill set instructions because they believed it would be easier to learn a step-by-step process rather than having the skills embedded into a more project-based method. Most interestingly however, during discussions of how they might integrate technology into their classrooms, the stated that they thought using the learner-centered environment (Travel Agency or Lecture Series Experts) that utilized imbedding the computer skills into a constructionist model utilized by the NAU faculty would be an excellent way to teach their students. This was in direct contrast to how they demonstrated, in many ways, that they preferred to be taught technology instruction.

### **The University Pre-service Group**

The purpose of providing more learner-centered instruction is to promote greater understanding of the skills and concepts. Students in the university technology course taught by the authors are provided with instruction based upon this constructionist model. Similarly to the professional development group, this group indicated their self-efficacy in basic computer use ( $m=4.201176471$  out of 5,  $sd=0.532528359$ ), but also demonstrated the desire to learn with greater emphasis on step-by-step methodology. The end of the semester student evaluations included comments, such as this student's:

"Less content – more explanation. More help sessions, possible written step-by-step instructions for programs and a frequently asked questions handout. More visual aids, such as handouts."

Another student commented that he would have preferred the methodology utilized by the adjunct faculty and stated:

I observed several other ETC 447 classes while working on class projects and noticed a big difference between my class and the others. Our class spent more time utilizing trial and error to learn material. Other classes spent time moving through material step by step. Our class could have benefited from a little more step by step attention to limit confusion."

These comments suggest that many students desired direct instruction. One student even suggested that he wanted more lecture time by stating; "Dr. T. is cool, but there may have been a little bit too much workload for the amount of lecture time used." Another student seemed to miss the point of "constructionism" entirely. "I would like to have this course be more classroom oriented. I will never build a computer program [lecture series project] again in my life. I can't think that this course is relevant to future teachers."

Not preferring or not understanding the learning methodology that was employed and modeled in this learning environment may have been frustrating, as this student stated: "This course forced me to learn a lot about computers. I had to figure out my programs by myself and this caused much frustration."

Furthermore, cooperative learning activities are built into the course through team projects and the faculty encourages peer support and collaboration. However, this was seen as not getting the information from the instructor. Indeed, this student commented:

"It was difficult to get assistance from either the teacher or the GA. Most of the teaching was done by the few students who actually understood what and how to run the programs, which they learned on their own or in other classes."

This student commented that: "Some things taught in the 1<sup>st</sup> part of the semester, I forgot later. It would be helpful if a handout of some type was given."

Even though these comments indicate that many students would have preferred more direct instruction and that they were frustrated, they also indicated that they learned a great deal. This student stated: "I probably have learned more about computers and technology in 3 months of this class than I have in 21 years of life." Another stated: "The course is a little overwhelming sometimes, but I really learned a lot." Interestingly, this student stated: "This was a great course that really helped me further develop my computer skills."

## Conclusions

Conclusions drawn from this study suggest that currently learners may not have enough experience learning with the integration of technology to feel comfortable to take responsibility for this type of learner-centered environment. The participants of this study, especially in the professional development group, may never have been taught from a constructionist paradigm. This could lengthen the time it takes for these learners to feel comfortable with having their instructor in the role of a facilitator of learning, rather than the giver of knowledge. For example, the professional development group presented a challenge for the NAU faculty not because of the lack of technology skills among some participants, but because of their lack of self-confidence of being an *expert*. Furthermore, the university pre-service students indicated their desire for more direct instruction and even commented on their frustration with having to "figure out the programs." However, for those students who saw themselves as experts, the learning didn't appear to be as frustrating. For example, the student who thought that the course was "great" and that it helped her "*further develop*" her computer skills. This indicates that she believed she already had some computer skills. Perhaps, her awareness of her self-efficacy gave her the self-confidence to explore and better supported her engagement in this type of learning environment.

This brings up new questions regarding the maturity or level of background knowledge needed to understand the concept of the integration of technology within the PreK-12 classroom. What does this say about how we prepare our future teachers or provide professional development for our in-service teachers, specifically in the complex area of computer technology? Perhaps as the professional development group member who stated, "Maybe we need to consider a different term for "expert," we educators need to help our pre-service and in-service teachers re-define expertise and try to instill greater self-confidence in their ability to learn the integration of technology into instruction. Although these learners may have not felt comfortable, they did indicate that they learned. Indeed, the professional development group even indicated that they would probably integrate technology into their teaching practice in a similar fashion. Because of the rapid development of computer technology, expert knowledge is constantly changing. Therefore, learners must continually learn by using their current skills and knowledge to explore new programs and technologies. Educators should focus on helping learners build upon their self-efficacy to support their inquiry within this new paradigm.

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# **Effects of Small Group Practice on Achievement and Continuing Motivation of Adult Re-Entry Students**

Susan A. Brewer  
University of Phoenix

James D. Klein  
Arizona State University

## **Introduction**

Research suggests that cooperative learning influences student achievement, attitude, and perception of social support and self esteem (Johnson and Johnson, 1996). The success of cooperative learning has been well-documented in studies with K-12 students, and to a lesser extent, with college students. However, there has been little focus on cooperative learning in the population of adult learners.

Adult college re-entry students may have an educational experience that is similar to traditional age college students since they are subject to the same course content and academic expectations. Springer, Stanne, and Donovan's (1999) meta-analysis of 39 studies of cooperative learning in undergraduate science, math, engineering and technology settings points to significant positive effects of small group learning on achievement, persistence, and attitude. Wedman, Hughes, and Robinson (1993) compared systematic cooperative learning to direct instruction with undergraduate education majors and found significant differences on learning outcome scores. Additionally, participants in this systematic cooperative learning setting rated working with a group as more beneficial to their learning than listening in class. Likewise, McDonald, Dansereau, and Spurlin's 1985 study of undergraduate psychology students revealed significant differences favoring a systematic cooperative strategy. The favorable difference in achievement was true for measures of both initial learning and for transfer to a subsequent individual learning situation.

On the other hand, Klein and Schnackenberg (2000) found that undergraduates working alone scored significantly higher than those working in cooperative dyads, when measured on knowledge items, but no differences on application items. Klein and Pridemore (1992) found no significant main effect in achievement for undergraduates working in groups or individually, but a significant interaction according to differences in need for affiliation on certain achievement measures. Klein, Erchul, and Pridemore (1994) investigated cooperative learning and type of reward with undergraduate education majors and found that students who worked alone performed better on achievement measures, with significant differences according to type of reward: task reward, performance reward, or no reward.

Adult re-entry students may have learning needs that are quite different from those of traditional college students. Brookfield (1986) and Knowles (1980) suggest that adult learners come into an education activity with an orientation different than younger, traditional students. They posit that adults are motivated to learn in situations where they can relate what they know from life experience to new information, and similarly use new information in service of real-life situations. Cooperative learning may provide an arena in which life experience can be shared among adult learners. Research conducted in specific populations of adult learners, therefore, should be considered along with research on college-level learning.

Thompson and Scheckley (1997) investigated preference for cooperative learning among baccalaureate (BSN) students, according to their status as traditional college students, adults with no prior nursing education, and adults with prior nursing education. For the most part, the preference for classroom teaching methods did not vary significantly between traditional college students and adults with no prior nursing education. However, the adults with prior nursing education rated their classroom experience with cooperative learning significantly higher than did either the traditional students or adults with no prior nursing education.

Cole and Smith (1993) found no significant differences in the achievement of adult students in business English classes, but did observe increased positive interactions, compared to the control group who participated in an interactive classroom where the teacher called on students at random. Cavalier, Klein and Cavalier (1995) found results in favor of cooperative learning for adults in a technical training setting. Trainees who used structured cooperative groups during technical training performed better on a posttest than did those who worked in unstructured cooperative groups. Additionally, there were significant differences favoring structured groups on four of nine attitude measures, structure groups exhibited increased social and cognitive behaviors.

The ability to learn while working in groups, and to be motivated by the experience of cooperative learning settings, may be influenced by status variables such as need for affiliation or sociability (McClelland, 1976; Jackson, 1974). A reasonable expectation is that high affiliation students prefer group work more than low affiliation students. Sutter and Reid (1969) reported that college student with high levels of sociability performed better using cooperative learning with computer assisted instruction. Need for affiliation as a status variable during cooperative learning has been investigated with mixed results. Predictably, Klein and Schnackenberg (2000) found that low affiliation undergraduates reported higher continuing motivation for working alone, and high affiliation students reported greater continuing motivation for working with another person. Klein and Pridemore (1992) found high affiliation students working alone scored significantly lower on application items compared to high affiliation students working individually, and low affiliation students in both group and individual conditions. Also, students who worked cooperatively, regardless of affiliation motive, reported significantly greater overall satisfaction than those who worked individually. Nakanishi (1988) studied undergraduate speech communications students working in cooperative learning groups that were experimentally manipulated to represent varying conditions of motivation. On measures of task-persistence, there were significant differences in favor of students who were prompted that the task was valuable and that a certain level of effort expenditure would lead to a certain level of performance.

The opportunity to work in small informal groups provides an avenue to interact with peers, fulfilling some of the needs of adult learners, and in particular, the needs of students with high affiliation motive. When observed for interaction behaviors within the cooperative treatment, Klein and Schnackenberg (2000) found that high affiliation dyads exhibited significantly more on-task behaviors, and also exhibited significantly more off-task behaviors compared to low affiliation dyads. Klein and Pridemore (1992) found that undergraduates working cooperatively spent more time on task than did those who worked individually, without regard to high or low need for affiliation. Cavalier et al. (1995) found significant differences in social and cognitive behaviors, with increased activity among the structured cooperative groups compared to unstructured cooperative groups. Cole and Smith (1993) observed increased camaraderie among students working in informal cooperative groups, noted in terms of willingness to help group members, expressing excitement over improvement in one another's test scores, and willingness to express that one did not understand a part of the content.

The purpose of the current study was to investigate the effect of informal cooperative learning and the affiliation motive on achievement, attitude and student interactions. The study attempts to extend previous research (Klein and Schnackenberg, 2000 and Klein and Pridemore, 1992) by examining the relationship between affiliation motive and interactions during informal cooperative learning, for the specific target audience of adult re-entry students.

## **Methods**

### **Participants**

In this study, participants were 109 undergraduate business majors enrolled at a private degree completion university for adult learners. University standards indicate that these students are a minimum of age 23, have been employed for two years, and have earned a minimum of 30 college credit hours upon admission.

### **Procedures**

Based on the affiliation scale of the Personality Research Form-E (Jackson, 1974), participants were identified as having a high or low affiliation motive. After blocking by high and low affiliation motive, participants were randomly assigned to one of two treatments—small group or individual practice. In the small group treatment, students worked in homogeneous triads (three with high affiliation motive or three with low affiliation motive) with shared materials, and in the individual treatment students worked individually with their own materials.

The experimental period consisted of two 20-minute lectures and two 40-minute practice sessions within the treatment conditions. The first lecture on the topic of organizational structure was conducted for the entire class, then participants moved to their small group or individual treatment conditions for a 40 minute practice session. After a break, all students returned to their regular classroom setting to receive a 20-minute lecture on the topic of employee motivation. Participants then moved to their same treatment conditions for a 40-minute practice session on this second topic. During both practice sessions, student interactions were observed and recorded. Upon completion of the second practice session, all participants returned to their regular classroom setting and were given a posttest and attitude survey. Participants in both groups were tested together in the same room and performed individually on the posttest, without the use of the workbooks, notes, or textbook reference.

## Results

Analysis of achievement scores among the four treatment conditions indicated no significant differences. The equivalency of achievement levels is likely due to the use of instructionally designed materials which included learning objectives, a timed presentation sequence for the instructor's lecture, a set of overhead transparencies to display content points, and student workbooks containing practice items aligned to the posttest.

There were, however, significant differences in attitude. Assessment of attitudes toward small group practice and individual practice included items regarding confidence, continuing motivation, in-class activities, and homework assignments, with six of the eight attitude items indicating significant differences. Participants in the small group condition reported greater confidence than participants in the individual condition,  $p < .05$ , and greater continuing motivation,  $p < .01$ . Results also revealed a significant interaction between practice condition and affiliation motive on three of the eight attitude items regarding enjoyment of the practice activity,  $p < .02$ , belief about one's own ability to learn,  $p < .05$ , and preference to work in groups during classroom activities,  $p < .02$ . For each of these three attitude items, follow-up analyses indicated high affiliation participants who worked in a small group had more favorable attitudes compared to high affiliation participants working individually, as well as compared to low affiliation participants working individually. Additionally, there was a statistically significant interaction on the attitude item regarding preference to work in groups for homework assignments,  $p < .05$ , with high affiliation participants preferring groups and low affiliation participants preferring individual work. Follow-up analyses indicated no significant differences among the treatment condition means on this item.

Regarding student interactions, high affiliation triads exhibited significantly more on-task behaviors (statements intended to accomplish the task, sharing materials, taking turns) than did low affiliation triads,  $p < .01$ . However, there were no significant differences in helping and off-task behaviors. The qualitative records of trained observers revealed that participants in the small group treatment condition were physically and verbally active during their timed practice, with behaviors such as "moved to the other side of the table" and "held up the organizational chart to demonstrate." Qualitative records for participants in the individual practice treatment also indicated some physical and verbal activity during their timed practice, with behaviors such as "commiserated about the assignment" and "read the newspaper when finished with the workbook."

## Discussion

The purpose of this study was to investigate the use of small group practice and affiliation motive on the achievement and attitude of adult re-entry students. Regarding student achievement on selected and constructed response items, no significant differences were found. Similarly, Cole and Smith (1993) found no significant differences in group v. individual work, while others found results in favor of working alone (Klein and Schnackenberg, 2000; Klein and Pridemore, 1992; and Klein et al. (1994). However, the benefits of formal and informal cooperative learning may not be limited to effects on achievement.

Attitudinal factors such as continuing motivation, confidence and satisfaction may well have an impact on academic success apart from achievement scores. Persistence to complete a course and maintain continuous enrollment is vital to adult student re-entering college after an absence of a few or several years. Results on five of the nine attitude measures in this study indicated that participants favored working in small groups. These findings are consistent with results of other researchers in undergraduate and adult learning settings (Klein and Pridemore, 1992; Cavalier et al., 1995; Thompson and Scheckley, 1997; and Klein and Schnackenberg, 2000). The results of one attitude measure, regarding homework assignments between classes, revealed an interaction between affiliation motive and preference for small group or individual work. As anticipated, high affiliation participants preferred group work and low affiliation participants preferred individual work. Klein and Schnackenberg (2000) found a similar interaction between affiliation and preference for group or individual work.

Several researchers have noted increased positive interaction behaviors during cooperative learning. Among the adult learners working in groups in this study, those with high affiliation motive were noted to exhibit significantly more on-task interaction behaviors than those with low affiliation motive. However, there was no difference in off-task behaviors, as was the case in Klein and Schnackenberg's (2000) study with undergraduates. Given the opportunity to participate in informal small groups, adult re-entry students may use the task as a means of affiliating.

Implications of this study point to the advisability of including cooperative learning activities in higher education for adult re-entry students. While individual achievement was not influenced by practice in either a small group or individually, continuing motivation and confidence were noted to be greater with a group experience. These attitudinal gains may positively support adult learners throughout the academic and social experience of completing an undergraduate degree.

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# Hypermedia-Based Problem Based Learning in the Upper Elementary Grades: A Developmental Study

Jonathan D. Brinkerhoff  
Krista Glazewski  
Arizona State University

## Abstract

*This paper describes the application of problem-based learning (PBL) design principles and the inclusion of teacher and student scaffolds to the design and implementation of a hypermedia-based learning unit for the upper elementary / middle school grades. Results suggest that PBL may be an effective instructional strategy for gifted and talented sixth grade students. Student scaffolding did not seem to impact achievement or student attitudes, however, teacher scaffolding appeared to increase teacher effectiveness, confidence and attitudes.*

## Introduction

Changing perspectives in curriculum and instruction over the last decade have focused increasingly on the need to revitalize K-12 instruction through a greater focus on understanding of concepts within a real-world context (Gallagher, Sher, Stepien & Workman, 1995). One means suggested for achieving this is problem-based learning (PBL). PBL advocates maintain that students engaged in such learning environments develop more positive attitudes toward learning (Sobral, 1995; Kaufman & Mann, 1997), tend to focus on meaning rather than recall, and achieve essentially the same knowledge level as those receiving traditional instruction (Gallagher & Stepien, 1996). These findings suggest that PBL environments could contribute to improving student learning in K-12 settings.

Implementation of problem-based learning is not without drawbacks, however, one of which is the difficulty associated with providing a sufficiently rich informational environment to support problem-based inquiry (Hoffman & Ritchie, 1997). Hoffman & Ritchie (1997) suggest that the expanding capacity of multimedia may represent one means for providing such a robust environment. Multimedia may afford additional benefits in PBL environments according to Spiro, Feltovisch, Jacobson, and Coulson (1992). They suggest that the multiple exposures to content multimedia provides may increase student learning in accordance with cognitive flexibility theory. Cognitive flexibility theory proposes that in open-ended learning environments, individuals may become overwhelmed initially by the scope of available information. As the learner's understanding of the problem and available resources develops, each additional exposure supports deeper understanding.

A second drawback associated with the implementation of PBL units centers on the lack of experience students and teachers have with learning within open-ended learning environments. For students, such unfamiliarity may result in confusion and uncertainty as to how to proceed (Sobral, 1995; Hoffman & Ritchie, 1997), while for teachers, unfamiliarity with the facilitator or knowledge resource role PBL methodologies require may pose an equally difficult challenge (Hannafin, Hall, Land & Hill, 1994). Hannafin, Land and Oliver (1999) suggest scaffolds, supports for learning efforts when engaging in open-ended learning environments, may enhance learner effectiveness. These scaffolds may take the form of tools, strategies and guides as means for addressing problems associated with these unfamiliar student and teacher roles.

The purpose of this study was to examine the following research questions:

1. Does hypermedia-based PBL represent an effective instructional strategy for upper elementary / middle school students?
2. What are student and teacher attitudes toward the PBL instructional unit?
3. How are student and teacher scaffolds utilized during implementation of the PBL unit?

## Method

### Design

Design of the hypermedia-based PBL unit was based on two models. The first was the design model for creating problem-based learning units developed by The Center@IMSA, formerly the Center for Problem Based Learning at the Illinois Math and Science Academy. The second was the scaffolding model for open-ended learning environments described by Hannafin et al (1999).

The design process began, as delineated by The Center@IMSA, by identifying conceptual and skill-based learning outcomes as well as the significant characteristics of the learners. For this study, the Arizona State Department of Education Curriculum Standards provided specific learning outcomes for sixth and seventh grade students. The next step was to identify an ill-structured, complex problem based on a real-world context which would provide maximum integrative curricular yield and learner appeal. The problem statement created for this study asks students to adopt the role of adventurer to plan a circumnavigation of the earth by balloon, a task addressing science, social studies, mathematics and English learning outcomes. The resulting unit was named *Up, Up & Away!*. The remaining steps in The Center@IMSA's design process were followed to identify relevant information resources, develop assessments for checking learners' understanding throughout the unit sequence, and build a teaching and learning template which supports learners' thinking throughout the inquiry process by structuring student problem solving through the following seven steps: meet the problem, identify what is known about the problem as well as what needs to be known, define the problem statement, gather and share information, generate possible solutions, evaluate the fit of possible solutions, and present the best fit solution in the form of a performance assessment.

While implementation of The Center@IMSA's guidelines and the suggested unit template provided some measure of learner and teacher support, the design team felt that additional scaffolds aimed at supporting specific aspects of student and teacher performance would likely contribute to increased achievement and attitudes toward the unit on the part of both students and teachers. To provide more detailed scaffolding, the design team turned to the scaffolding portion of the Hannafin, Land and Oliver (1999) model. This model categorizes scaffolds as one of four types: conceptual, metacognitive, procedural and strategic.

The design team first considered scaffolds for students, beginning with conceptual scaffolds. According to the Hannafin, Land and Oliver (1999) model, conceptual scaffolds guide students in what to consider. This guidance may take such forms as a graphical advance organizer or content outline showing superordinate and subordinate relationships. To provide scaffolding of this type, the *Up, Up & Away!* student interface was organized under four conceptual headings: Prior Attempts, Weather & Geography, News Articles and Balloon Design (Figure 1). Under each heading are links to web sites relevant to solving the unit problem.



Figure 1. Hypermedia Student Interface

Conceptual scaffolds may also recommend certain procedures or tools at particular stages of the problem solving process. Additional student conceptual scaffolds took the form of a variety of record keeping / data

collection forms designed to support completion of the unit problem. Planning a circumnavigation of the earth by balloon, the unit problem, was divided into three strands: designing a balloon, writing a travel plan, and creating a list of supplies. Students were provided a conceptual scaffold in the form of a data collection document for each of these strands. For example, the travel plan form guided students in their consideration of take off and landing points, countries to be crossed or avoided, determining the projected length of the flight, and choosing the most suitable hemisphere for the flight based on current jet stream winds.

The second type of scaffold described in the Hannafin et al (1999) model is metacognitive, which guides students in how to think as they complete a task. *Up, Up & Away!* provided no metacognitive scaffolding for students. A third type of scaffold, according to the Hannafin et al (1999) model, is procedural scaffolds which guide students in how best to utilize the features of an open-ended learning environment through such things as tutoring, pop-up help, or some other form of job aid. The design team felt that the *Up, Up & Away!* interface was simple enough that student procedural scaffolding was unnecessary beyond a teacher directed introduction to the interface. Lastly, the Hannafin et al (1999) model describes strategic scaffolds as guides for learners in analyzing or approaching a learning task or problem. The design team made a student strategic scaffold available for each of the three strands of the unit through the Resources button on the *Up, Up & Away!* interface. Selecting the Resources button took students to a menu page where they could choose an appropriate type of help (Figure 3). Selecting a specific help topic then took students to a strategic scaffold designed to support completion of a given strand of the problem (Figure 4). Students could also download the previously described conceptual scaffolds from these pages.



Figure 2. Resources Menu Page

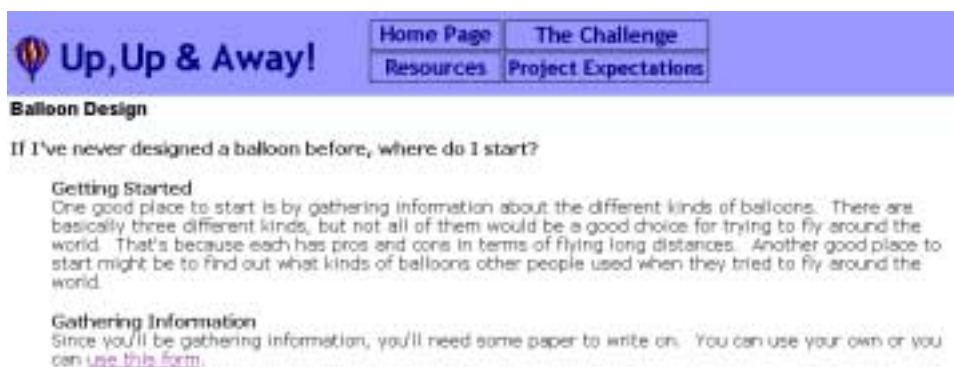


Figure 3. Balloon Design Strategic Scaffold

Once the design team felt scaffolds sufficient to accommodate student success had been incorporated into the hypermedia interface, attention was turned to supporting the teacher. Recognizing that the role of the teacher in implementing student-centered PBL instructional methods might represent an unfamiliar and intimidating situation, the design team focused on scaffolding as many instructionally sound strategies in the unit's teacher guide as deemed essential for teachers to be effective. Teacher scaffolds in *Up, Up & Away!* include conceptual and strategic types.

Conceptual teacher scaffolds guide instructors in what to consider at particular stages of the unit or lesson presentation. For example, according to The Center@IMSA, providing student feedback on progress toward solving the unit problem represents an essential teacher behavior in PBL environments. To support both this understanding and behavior, the design team provided student feedback forms for each of the three strands of the unit. An additional example concerns the necessity for abandoning the familiar role of information provider in favor of monitoring student progress and guiding student thinking. To support teachers in their role as facilitators of student knowledge construction, the design team included questions designed to support this behavior.

Teacher strategic scaffolds serve to guide in analyzing and approaching the unit implementation. According to Hannafin et al (1999), they can take the form of start-up questions or advice from experts. The design team provided a variety of such expert advice to support teachers unfamiliar with PBL teaching techniques, including such things as how to generate enthusiasm for the unit, group students for instruction, and provide feedback.

The next phase in the development process was to perform a formative evaluation. Two trials were conducted.

## **Trial 1**

### **Subjects**

Participants were forty, sixth grade students enrolled in two technology classes at an urban middle school and an instructor in his first year of teaching.

### **Materials**

Materials included the hypermedia-based PBL unit *Up, Up & Away!* and the *Up, Up & Away!* teacher guide.

### **Procedures**

The learning environment consisted of both a 25 station computer lab and the teacher's home room. The PBL unit *Up, Up & Away!* was loaded on the district server and available through a browser on the computers in the computer lab. Due to time constraints, only two strands of the unit, Balloon Design and Supply List were implemented. Students worked in informal cooperative groups of two to three for a total instructional time of approximately eight hours, at the end of which they turned in their final projects. Following completion of the two unit strands, students completed an attitude survey while the teacher participated in an exit interview.

### **Data Sources**

Data concerning implementation of the unit was collected through independent observation by two members of the development team.

Achievement was measured by scoring final student projects according to grading rubrics, one for each strand of the unit. The rubrics assessed quality and completeness of content. Three evaluators scored each student project independently. Final project scores were calculated by averaging the three independent scores.

Student attitudes were measured by a eight item attitude survey. Five Likert scaled items, arranged on a four point scale from Strongly Agree to Strongly Disagree, asked about such things as the ease of using the student interface, student effort in completing the unit, ease of finding information and feelings toward *Up, Up & Away!*. The attitude survey also included three free response items soliciting student opinions on what they liked best about the unit, what would have helped them do a better job of completing the unit, and what they felt should be changed about the unit.

Teacher attitudes were collected through an exit interview which solicited a broad spectrum of feelings and responses toward the *Up, Up & Away!* unit and teacher guide.

## **Results**

Observation data revealed student inattention and confusion in knowing how to proceed. Student scaffolds available through the interface weren't used. The teacher didn't support use of the scaffolds and spent a large amount of time trouble-shooting technical problems and tracking due dates for student projects. As a result, he was frequently disengaged from the students' learning process.

Achievement as measured by mean final group project scores was 45% for the Balloon Design and 10% for the Supply List.

Mean student attitude scores are shown in Table 1. Item one indicated that the majority of students felt working on



	Strongly Agree	Agree	Disagree	Strongly Disagree
1. Working on the <i>Up, Up &amp; Away!</i> project was fun.	17 %	48 %	20 %	15 %
2. It was easy to find the information I needed in order to complete the assignment.	20 %	43 %	10 %	27 %
3. I learned a lot while completing the <i>Up, Up &amp; Away!</i> assignment.	15 %	43 %	27 %	15 %
4. I worked hard on the <i>Up, Up &amp; Away!</i> assignment.	40 %	37 %	13 %	10 %
5. I would enjoy working on another project like <i>Up, Up &amp; Away!</i> .	22 %	22 %	18 %	38 %

Table 1. Trial 1 Mean Student Attitude Scores

*Up, Up & Away!* was fun. Item two revealed that a total of approximately 40% either disagreed or strongly disagreed that finding information necessary for solving the problem was easy. For the third item, over half the students felt they learned a lot while working on the project, while on item four, almost 80% either agreed or strongly agreed that they worked hard on the unit. Finally, while 44% agreed they would enjoy working on a unit like this again, 56% felt they would not.

Teacher interview data included an acknowledgment that he hadn't fully read nor used the teacher's guide. The teacher also recognized that he hadn't supported student use of the scaffolds available through the interface. The teacher confirmed that many students were inattentive during the introductory activities and suggested that the reading level of the introductory articles may have been too high. Despite these difficulties, the teacher expressed positive attitudes toward the unit overall and an intention to teach it again, this time with greater attention paid to reading and following the suggested instructional strategies in the teacher's guide.

## Discussion

There were several limitations to the first trial, among them the fact that only two of the three unit strands were completed and that the teacher neglected to fully implement the strategies contained in the teacher's guide. Combined results from the various data sources indicated that students were largely unsuccessful in attaining the unit goals. Nevertheless, results of Trial 1 did suggest means for refining the unit, as observation had revealed that without teacher guidance, students failed to explore the Help button with the result that many of the scaffolds available weren't utilized. The developers suspected that labeling the button "Help" was ineffective, as the common interpretation of help is generally software assistance, rather than content or learning assistance. Accordingly, the button was relabeled as "Resources". To address teacher concerns that the unit's introductory articles were too difficult, they were edited for readability and additional comprehension questions were provided to support student engagement. Following these changes, a second trial was initiated.

## Trial Two

### Participants

Sixteen students enrolled in a sixth grade gifted and talented program at a metropolitan elementary school in a large, southwestern city participated in Trial 2. The teacher was an 18 year veteran experienced in student-centered teaching techniques.

### Materials

Materials included the revised versions of the *Up, Up & Away!* unit and teacher guide.

### Procedures

The learning environment consisted of both a 27 station computer lab and the teacher's home room where a single computer was available. *Up, Up & Away!* was loaded on the district server and available through all the computers. All three strands of the unit were implemented over a period of four weeks. Students worked in informal cooperative groups of three to four for a total instructional time of approximately 20 hours. Upon completion of the unit, students presented their final projects during an evening assembly for parents. Following completion of the unit, students completed an attitude survey while the teacher participated in an exit interview.

## Data Sources

Data sources for this trial were identical to the first implementation.

## Results

During observations of Trial 2, the development team noted that the teacher used a variety of successful strategies such as actively focusing student activities and monitoring their progress. As a result, students appeared organized, aware of what to do, and confident of how to do it. Student use of the scaffolds available through the Resources button was limited, with most students opting to make notes on their own paper.

Results for student achievement revealed an overall mean score of 97.5% on the final projects as determined by grading according to the unit assessment rubrics. Mean student attitude survey results were largely positive (Table 2). With a ranking of strongly agree or agree, 100 percent of students felt that working on the unit was fun, they learned a lot while completing the unit, and they would enjoy working on another project like “Up, Up, & Away!”

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. Working on the <i>Up, Up &amp; Away!</i> project was fun.	71 %	29 %		
2. It was easy to find the information I needed in order to complete the assignment.	8 %	54 %	38 %	
3. I learned a lot while completing the <i>Up, Up &amp; Away!</i> assignment.	71 %	29 %		
4. I worked hard on the <i>Up, Up &amp; Away!</i> assignment.	64 %	36 %		
5. I would enjoy working on another project like <i>Up, Up &amp; Away!</i> .	86 %	14 %		

Table 2. Trial 2 Mean Student Attitude Scores

Ninety-two percent of students strongly agreed or agreed that using the hypermedia website was easy. However, 40 percent of students disagreed with the statement that it was easy to find information to complete the assignment.

Results of the teacher exit interview revealed a positive experience. The teacher indicated satisfaction with the learning students demonstrated and an intention to teach the unit again, although she stated a desire for individual achievement data as a means for measuring personal student knowledge gains. The teacher also reported she had read the teacher’s guide carefully and that the lesson design structure, as well as the teacher scaffolds, supported her presentation of content with which she had little experience or confidence. She ended by suggesting additional scaffolds that might further assist teachers.

## Discussion

Combined results of the various data sources in Trial 2 indicated students were generally successful in attaining the objectives in all three unit strands without making significant use of the scaffolds available through the Resources button. Student success may have been supported by the extensive use of teacher scaffolds designed to motivate and focus student attention and activity employed by the teacher. As the tryout population was composed of students identified as gifted and talented, however, it’s not possible to generalize their success to sixth grade students at large.

Based on observations and teacher input, additional changes were made to the unit following Trial 2. In terms of student scaffolds, a self-assessment form was added to assist students in evaluating their own progress. Also added was a Final Presentation Assignment Form detailing presentation expectations to encourage teachers to have students actively present their final projects rather than simply handing them in. Along with the Final Presentation Assignment Form, a Presentation Feedback Checklist was added to support both the teacher and students with giving feedback following final project presentations. The goal was not only to encourage teachers to require student presentations, but to support students in actively listening to their peers’ presentations. Additional teacher scaffolds added to the unit included a Student Progress Report form designed to support teachers in monitoring student progress and providing feedback. Also added was a unit review lesson, unit review question bank, and an objective posttest to allow measurement of individual student achievement.

## Implications

This study suggests that hypermedia-based PBL may be effective for gifted elementary students. It also suggests that success in this environment may be related to teacher experience with student-centered learning techniques. Student success may also relate to the depth and complexity of web sites included as information resources. Observational data of student behaviors, as well as attitude data showing that approximately 40 percent of students in both trials found locating information on the web sites difficult, suggests that linking more directly to web site pages containing relevant information rather than to a web site's introductory screen may better support student success.

In terms of teacher and student scaffolds and their effectiveness in a hypermedia-based PBL environment, this study suggests that while student scaffolds may not be necessary for student success, teacher scaffolds appear to be important for generating student interest and supporting teacher confidence. For example, the scaffolds providing expert advice for implementing the unit suggest a bulletin board as one means for generating interest. In Trial 2, when the teacher created a bulletin board as well as a Parent Involvement Newsletter inviting parents to a special end-of-unit presentation event, student interest was high. Additionally, the teacher indicated that the scaffolds in the teacher guide supporting presentation of the unit boosted her confidence in knowing how to begin the unit and engage students in a PBL environment.

## Further Research

To fully address the suitability of hypermedia-based PBL in the upper elementary grades requires additional study with subjects not identified as gifted and talented. To better measure unit effectiveness through individual learning gains, these students should be assessed not only on the basis of a group project, but with an objective based, individual posttest as well.

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# **Challenges Faced by Institutions of Higher Education in Migrating to Distance Learning**

Stephen L. Broskoske  
College Misericordia

Francis A. Harvey  
Drexel University

## **Abstract**

*This paper presents results of an intensive comparative case study of five colleges and universities using distance education. The study, through interviews with the president and other senior administrators and focus groups with faculty and administrators involved in distance education, found that issues related to faculty and other personnel, marketing, competition, budget, and planning were more significant for the success of distance education than technological issues. Implications for planning and implementing successful distance programs are presented.*

## **Opportunities and Challenges of Distance Learning**

Distance learning technologies offer many new opportunities for institutions of higher education. These opportunities include: (a) facilitating improvements in the teaching/learning process; (b) expanding the geographic reach of an institution's programs; and (c) facilitating more effective service of the student population, e.g., offer convenience, greater course selection, and academically richer programs (Smith, 1998).

While educational technologies are a means to facilitate learning, distance learning is more than just an instructional delivery medium. Distance education represents a significant change from traditional instruction (Means, 1994). Distance education breaks from traditional instruction by changing the social dynamics of education, bringing the school to the student (Holloway and Ohler, 1995). Traditional classroom models may not provide the best models for the distance classroom because distance learning is fundamentally different. Instructors cannot simply switch from traditional to distance delivery systems; instead, substantial planning and organization is required to teach in a distance learning environment (Martin & Bramble, 1996; Gibson & Gibson, 1995). Further, students need an orientation to strategies of how to learn effectively in a distance learning environment (Martin & Bramble).

Typically, many institutions begin a distance education initiative encouraged by the many potential benefits, influenced by their competition, and prompted by the fear of not being involved in distance education. Colleges and universities report entering into a distance education initiative without sufficient planning, without a clear mission for the program, and without realizing many of the challenges that will surface as they conduct their program.

## **Description of the Study**

This paper presents the results of a research study conducted in fall, 1999 to examine the challenges facing higher educational institutions in migrating to distance learning. The study consisted of five case studies conducted at higher educational institutions in Pennsylvania. Two institutions were large and three were small; two were public and three were private. Four of the five institutions had been identified as having considerable experience in distance learning.

At each institution the researchers interviewed the president and other senior administrators and conducted a focus group with administrators and key faculty involved in distance education. Participants in the study reviewed and analyzed a comprehensive model developed by the researchers for applying principles of organizational agility to distance learning.

Data from the individual and group interviews were analyzed using standard procedures for the analysis of case study data. The researchers investigated how institutions of higher education could strategically coordinate human resources, organizational dynamics, and distance learning technologies in a systematic way in order to gain and maintain a competitive edge in the educational market place, and in order to be more responsive to students.

## Major Findings of the Study

While many educational administrators focus on technological hardware and software issues, they may overlook more important issues that are integral to success of their institution's distance learning efforts. The authors found that the institutions studied considered technological issues to be of lower priority in designing and conducting an effective distance learning program. The more significant factors that emerged as vital to the success of a distance education program involved human factors, specifically: interpersonal dynamics, attitudes, organizational culture, styles of management, and styles of communication.

The following categories of concern in migrating to offering distance education emerged from the research study:

1. faculty issues;
2. academic issues;
3. marketing/competition;
4. budget/fiscal;
5. planning;
6. personnel issues;
7. technological equipment.

Each of these categories of concern will be examined in more detail in the following sections. Implications for planning and implementing successful distance programs will be presented and discussed.

### Faculty Issues

Faculty issues emerged as the major challenge facing institutions in migrating to offering distance education. Many faculty members joined their institutions without experience or knowledge in technology. Fearing changes in working conditions and potential loss of job security, many faculty resist learning about or using distance technologies. Some faculty members stated that they would retire rather than use technology in their classroom. Administrators found that they must work to educate faculty and to encourage them to participate in distance education. Overcoming faculty resistance to distance learning emerged as the major issue in conducting a distance learning program. For example, faculty resistance is visible in the influence of the faculty union within public institutions. Faculty unions complicate the course approval process for distance courses, pressure the faculty to not participate in distance learning activities, and lobby for significantly increasing financial remuneration for faculty participating in distance courses.

### Academic Issues

Faculty members mentioned many academic challenges to offering distance courses. Among these were the challenges of:

1. intellectual property rights;
2. having distance courses pass through the course approval process;
3. exam honesty for remote sites;
4. providing an adequate help desk to support students;
5. the need to provide orientation programs for distance learning students;
6. the need to address residency requirements for distance programs.

### Marketing and Competition Issues

Institutions were concerned with institutional reputation and image when it comes to offering distance education. They realized that distance education will expose the quality of their program, and they feared that offering a poor quality program may damage their reputation. While institutions felt pressure to get involved in distance learning, they were concerned with competing in a market against private, for-profit institutions that exclusively offer distance education. Institutions were concerned about their program mission and about specifically defining their niche regarding offering distance education.

### Budget and Fiscal Issues

All of the institutions mentioned budget issues quite frequently. Issues of special concern were ways to fund the high startup costs involved in distance learning and the funding the ongoing costs involved in offering distance learning programs. The need to use scarce resources more efficiently is prompting all of the institutions studied to identify their core competencies (those areas in which they excel), and to use these core competencies as the basis on which to enter the distance learning arena. Further, in order to function more efficiently and effectively in an increasingly competitive environment, all of the institutions presented evidence of seeking out partnerships

with other institutions where it enhanced their distance learning academic programs. All reported realizing considerable benefits from partnering, including increased efficiency, enhanced program efforts, and positive experience for faculty.

### **Planning**

Subjects at each of the five institutions studied reported that past planning for technology and distance learning was insufficient. Several institutions demonstrated a need for assistance in long-range, strategic planning for technology. Subjects from two institutions indicated failed attempts at strategic planning.

Subjects from two institutions expressed concern over their inability to finalize certain key decisions in this area. Further, subjects from two of the small, private institutions indicated a need to make definitive decisions, which if not made would seriously impede further institutional progress.

Two institutions indicated that planning receives more attention after an institution has been involved in distance learning for about two to three years, after personnel become more aware of the realities of distance learning and the need to invest in more conscientious planning. Although evidence of basic planning regarding distance learning was found in the two public institutions, as stated earlier, evidence of more careful, conscientious planning was found in the two small, private institutions.

### **Personnel Issues**

In addition to challenges related to faculty, challenges related to hiring and dealing with non-faculty personnel also surfaced in the study. Problems cited included difficulties in identifying and hiring qualified distance learning coordinators, which are related to the problem of offering competitive salaries for distance learning technical personnel. One institution reported hired a technology director who was ineffective in relating to and dealing with faculty. This person, apparently more concerned about the equipment than the people involved, prevented the faculty from practicing and using technological equipment, and set back the institution's distance learning efforts significantly.

### **Technological Equipment**

One definite challenge reported by all five institutions studied was designing and implementing distance learning programs is selecting, financing, and maintaining technological equipment. The selection of hardware and software also impacts on staffing decisions. More sophisticated hardware and software may provide greater capabilities for the distance learning program, but the potential advantages will not be realized if the additional competent staff support required and advanced faculty training are not provided at the same time. If the institution is planning on partnering with other institutions, then decision factors in the selection of equipment extend outside of the institution itself to its partners, in order to ensure compatibility.

## **Implications for Planning and Implementing Successful Distance Programs**

Analysis of the data collected from individual and group interviews with faculty and administrators at the five institutions of higher education studied provides support for a number of recommendations for effective practice of distance learning academic programs. These recommendations relate to faculty and staff support, program planning, and program organization. These implications will be discussed below.

### **Invest In and Support Faculty and Faculty Initiatives**

Individuals responsible for developing distance learning programs should attempt to harness the wealth of talent and expertise already available at their institution. Colleges and universities should invest in the faculty by providing ample training opportunities, by capitalizing on the interests of the faculty, and by providing support for faculty initiatives. The institution should create an atmosphere where faculty feel safe to experiment with using distance technologies in new ways. Faculty should be encouraged to explore how to take advantage of the unique capabilities of particular technologies to improve the teaching/learning process.

### **Initiate Dialogue with Faculty**

Be aware that overcoming faculty resistance to distance learning is a major challenge in conducting a distance learning program. Initiate a dialogue between faculty and administrators to determine and address the concerns of faculty regarding distance education. Be sensitive to faculty concerns about changes in working conditions and potential loss of job security.

Educate faculty about the importance of a distance learning initiative to the institution. Involve faculty and support staff by making available: (a) information that describes how effectively the institution is meeting its

mission; (b) information about strategic imperatives being planned and initiatives being undertaken; (c) information about the challenges and problems faced by the institution; and (d) information about the institution's financial stability. Help facilitate faculty's discovery of how distance learning supports the institution's mission, how it helps address particular institutional challenges, and how it adds to the stability of the institution.

### **Work to Overcome Faculty Resistance and Increase Faculty Buy-In**

Educate the faculty about the benefits of using technology in the classroom. Faculty are motivated by the ability to improve the teaching/learning process. Distance technologies hold great potential to enrich the classroom, to connect students with the larger research community, and to bring authentic examples into a lesson. Provide training opportunities to faculty to enlighten them about the benefits of using distance education technologies both for themselves (e.g., connecting with other colleagues, benefits to research) and for their students (e.g., improved access to information resources, networking within a larger community of scholars).

### **Engage in More Conscientious, Focused Planning**

Begin by defining a clear and focused mission for the distance education program. Capitalize on the sense of community on the campus. Open a dialogue between faculty and administrators to discuss the various issues, challenges, and implications that arise in offering distance education.

### **Hire Technologists with Strong Interpersonal Skills**

Technical support personnel with excellent technological knowledge and skills who do not also have excellent interpersonal skills will not be able to support faculty in learning to use distance learning technologies effectively. The interpersonal skills required include in particular the ability to empathize with novice learners and the ability to explain procedures using vocabulary the novice learner can understand.

### **Develop a Shared Vision**

Promote open discussion about distance learning programs involving all levels of the campus community, including faculty, students, and support staff. Do not establish a "top-down" directive. Instead, work cooperatively to produce a shared vision that the whole campus community has helped to develop. This approach will result in an increased number of individuals feeling ownership of the vision, and more people will support the vision.

### **Plan and Support Migration (Evolutionary Change) Vs. Revolutionary Change**

Evolutionary change is less threatening, is easier to implement, and is easier to sustain. Support this migration by investing in faculty training, by providing sufficient support staff, and by supporting faculty efforts.

### **Integrate Distance Learning Technologies into the Overall Academic Program**

Instead of viewing distance education as a separate entity, treat distance learning technologies as effective new tools to enhance the teaching/learning process. Invest in support staff, equipment, and training in order to make the atmosphere conducive for faculty to integrate these technologies into classes on a regular basis.

### **Provide Adequate Support Staff for Development and Delivery of Distance Learning**

Invest in hiring instructional designers and other technological support personnel to relieve faculty of dealing with the technological burdens involved in offering distance learning classes. This will enable the faculty to concentrate on substantive issues instead of becoming bogged down in technical operational details.

### **Revise Traditional Policies and Practices to Support Distance Learning Students**

Realize that distance learning is fundamentally different from learning in the traditional classroom. Consider traditional practices, services, and policies and how they may need to be revised to accommodate the needs of learners and instructors participating in distance education.

### **Match Distance Learning Technologies to Institutional Conditions and Needs**

Select distance delivery systems that provide an appropriate fit with the institution's mission and context. Before selecting delivery systems, ensure that the medium selected will effectively and efficiently address the needs of the institution.

### **Emphasize the Role of Distance Learning Technologies in Promoting Academic Goals**

In addressing the faculty, approach distance learning as a tool with the potential to improve the teaching/learning process. Do not approach it as a way to primarily advance administrative goals without regard to academics.

### **Elements of Successful Distance Learning Programs**

A further review and analysis of the data collected from the five institutions studied revealed a number of essential elements that were shared by all of the distance learning programs that seemed to be positioned for future success in offering productive distance learning programs:

1. Administrators opened a dialogue that involved the whole college community in planning and in developing a vision of distance learning.
2. Administrators were sensitive to the concerns of faculty. They addressed the concerns of employment conditions, job security, compensation, and the faculty's fear of learning and using new technologies.
3. Administrators committed resources to invest in the faculty. They sought to educate the faculty as to the benefits of using technologies, provided training opportunities, provided support for faculty in learning and using technology, and encouraged faculty exploration and experimentation.
4. The institutions attempted to integrate technologies into the traditional classroom to improve the teaching/learning process, rather than introducing new technologies only for distance learning programs. Distance learning was presented as an extension of the use of technology to promote teaching and learning, rather than a means to produce mass education more economically, to increase revenues, or to increase market share.
5. Administrators and faculty realized that distance learning was fundamentally different from the traditional classroom model, and would thus require a reconsideration of various traditional practices, policies, and working conditions. At the least, they openly dealt with these issues as they arose. At best, they initiated steps to determine in advance what these changes were and how they could best be addressed.

### **Conclusion**

While educational technologies are a means to facilitate learning, distance education is more than just an instructional delivery medium. In the process of offering distance education, the institutions studied either discovered or were beginning to discover that distance learning is fundamentally different from traditional instruction in the following ways:

- Distance learning involves addressing changes in historical practice and policy that have to date adequately supported the traditional classroom model.
- An effective distance learning program, by contrast, requires the application of new models of instruction, new instructional methodologies and skills, and new ways to learn effectively.
- Distance learning also involves a change in the ways students are served, the ways academic programs are marketed, and the ways in which instruction is organized and delivered.

In this new environment, educators have had to address many issues, including the following: (a) faculty compensation; (b) models of office hours and other faculty responsibilities; (c) intellectual property rights; (d) supporting students who rarely if ever visit the campus. Further, distance learning provides a vehicle for responding to the educational needs and demands of an information society by allowing instruction to: (a) change from a focus on teaching to a focus on learning; (b) change from memorizing information to harnessing it; (c) become more student-centered; (d) utilize authentic forms of assessment; (e) evolve beyond using the same instructional strategy for all students. The researchers hope that by exploring and exposing some of the challenges institutions face in planning, developing, and implementing academic distance learning programs, their research will help educational professionals realize that the problems they face are common to all institutions. It is hoped that the findings of this study, and the implications of those findings, will improve the practice of distance learning in higher education.

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# Using Technology to Enhance Understanding of Leadership

Tricia Browne-Ferrigno  
Rodney Muth  
Cynthia Choi  
University of Colorado at Denver

## Abstract

*This paper reports the findings of a comparative study of the content of electronic exchanges among members of learning communities to determine what kinds of online dialogue differences--if any--exist. The virtual learning communities compared are two cohorts within the same professional preparation program for teachers aspiring to become school leaders. The content area and instructor are the same for both cohorts; the significant variable is the mode of instructional delivery. One cohort received nearly all instruction through a distance-learning program. The other cohort meets together weekly and uses online activities for approximately 30 percent of instructional delivery. Comparative data used are online messages generated during the first semester of both programs in which leadership was the central focus.*

## Review of the Literature

Nearly 60% of the nation's higher educational institutions use information technology as a mode of instructional delivery (Lewis, Snow, Farris, & Levin, 1999). As universities increasingly use online learning networks, it becomes important to understand how online interactions support academic success (Cox, 1999). Online environments can enhance learning by shifting from a teacher-centered model in which the instructor is the source of knowledge to a learner-centered model in which peer support, interaction, and collaboration are emphasized (Beller & Or, 1998; Harasim, 1990; Lebow, 1993). Participants communicating within virtual environments use asynchronous dialogue to reflect, debate, critique, give feedback, question, answer, and engage in multiple other communicative behaviors (Henri, 1992; Mason, 1994). Because individuals interacting within a virtual setting share a range of intellectual responses similar to those in other modes of communication (Paccagnella, 1997), online learning activities have potential to provide rich opportunities for learning.

Skeptics of cyber-learning warn that it offers a potentially false or artificial sense of learning that diminishes individual capacity and leads to fragmentation (Heim, 1993). Proponents of instructional delivery through technology maintain that computers promote learning because ample time for quality feedback is available, provide a buffer for those less adept in face-to-face communications, and enhance spontaneity (Bresler, 1990). Some findings suggest that learning in virtual communities increases creative flow and collaborative possibilities (Green, 1996; Knox-Quinn, 1993). Because research about the implementation of successful online environments for learning is a new and evolving area (Cox, 1999), many questions remain unanswered.

## The ALPS Program: Cohorts in Professional Preparation

The Administrative Leadership and Policy Studies (ALPS) division within the School of Education at the University of Colorado at Denver (UCD) is authorized by the State Board of Education to offer training for aspiring school principals and administrators (Colorado Department of Education [CDE], 1997). Following the state adoption of professional standards in 1994, the ALPS faculty progressively revised its leadership education program into a problem-based (Ford, Martin, Muth, & Steinbrecher, 1997; Muth, forthcoming), active-learning (Muth, 1999), portfolio-assessed (Muth, Murphy, Martin, & Sanders, 1996) model. The leadership preparation program transformed from a series of on-campus courses into unique off-campus cohorts developed through school district partnerships. Because most ALPS cohorts are developed in partnership with local school districts, unique problems of practice emerge as potential projects and learning events (Martin, Ford, Murphy, & Muth, 1998). Partnership cohort sessions are held at district sites and jointly taught by university professors and administrative practitioners.

As a standards-driven program (Ford, Martin, Murphy, & Muth, 1996; Murphy, Martin, & Muth, 1994), the goal is to endorse graduates as competent professionals ready to assume roles as school leaders. The program is a sequence of four learning domains that concentrate on specific areas of school administration and connect to concurrent field internships. Individual and group activities within the domains center on four broad topics: (a) leadership, (b) school environment, (c) supervision of curriculum and instruction, and (d) school improvement. While each of the domains has an integrated set of field activities to connect content to practice, a 135 clock-hour

intensive internship provides additional immersion in practice and experience as an administrator. Thus, content learning is balanced with field experiences so that students gain clinical skill to recognize and solve problems of professional practice.

The adoption of a sophisticated online communication system by the UCD School of Education opened myriad opportunities to integrate online instruction and learning into the school's licensing programs. The FirstClass Client e-mail and conferencing system, sold by SoftArc and dubbed Colorado Educators Online (CEO), provides statewide service to the school, area districts, and educational associations. CEO "permits synchronous as well as asynchronous communications, easy file sharing, and Internet access" (Muth, 2000, p. 60) and allows creation of discussion sites known as conferences. Within a cohort conference, participants can post questions, comments, and responses viewed by all conference members. Subconferences facilitate completion of special online projects.

### **Same Program, Two Different Cohorts**

The two cohorts within the ALPS licensing program used in this comparative study are uniquely different. Common elements made it possible to link the two case studies for purposes of comparison of electronic exchanges: The same instructor taught the two cohorts during the same domain of the ALPS program. Within each of the CEO cohort conferences, it was easy to identify for analysis students' online messages within the leadership subconference. Hence, the student online exchanges within each of the cohort leadership subconferences in the CEO became the main data source link for this comparison

### **Virtual Learning Community: Distance Learning Cohort**

After intensive curriculum refinement, the ALPS division launched its first DL principal licensing cohort for students who live in areas of Colorado remote from any graduate licensing programs. Participants met together as a united cohort group only twice. The first cohort meeting was an eight-day orientation on the UCD campus in June 1999. An important reason for the face-to-face interactions was to "build a shared culture for a strong cohort and effective cluster groups" (Muth, 2000, p. 65). During the orientation, students selected membership to small support (cluster) groups that were determined by geographic locale and that met at the discretion of the members throughout the yearlong program. Significant blocks of time during the orientation session were used to provide students with instruction and practice in using CEO (Muth, 2000). The DL cohort returned to UCD in July 2000 for its second cohort-wide session. During those two days, students participated in reviews for the required state examination, portfolio defenses, program evaluation, and celebration ceremonies for the closing of the cohort.

Almost all instruction and group discussion in the DL cohort was conducted electronically through CEO. Sources of online interaction data available include (a) open cohort conference discussions and (b) chat room discussions. Personal communications not sent to the cohort's conference were not accessible. Additionally, course syllabi and calendars, student responses to mid-program telephone interviews, and student reflections recorded during exit interviews provide additional data sources.

### **Onsite Learning Community: Empowerment for Change in Urban Schools Cohort**

A university-district partnership was formed in a community within a short distance of downtown Denver. Like other urban school districts, the district faces multiple challenges beyond alleviating its current shortage of potential school principals and administrators: (a) state-mandated accountability measures, (b) political and public scrutiny of student scores and school report cards, (c) limited resources for implementing school renewal measures, and (d) a poorly developed, economically-stressed community support base. The name for this learning cohort, Empowerment for Change in Urban Schools, embodies the vision of its cohort leader for expanding leadership education and skills development into forms of collaborative leadership processes (Napier & Lowry, 1999).

*As in other ALPS university-district partnership cohorts, approximately one-third of the curriculum instruction in the ECUS cohort is delivered online. Consistent with the DL cohort, sources of online interaction data in the ECUS cohort conference include the open cohort conference discussions. Data collected through review of artifacts, responses to a questionnaire about CEO use, and researcher observation of cohort sessions provide additional data sources. A larger case study of the ECUS cohort is nearing the close of a year of data collection.*

### **Strategies for Comparative Analysis**

Since the two cohorts were in the same licensure program and lead by the same instructor, we assumed that the content and instructional activities within the leadership domains of the distance-learning cohort and the onsite cohort were similar in message substance. Therefore, we developed a coding system to analyze the posted messages in the subconference labeled by the course number for the leadership domain. Both the coding and analyses were

conducted manually. Where needed for further understanding, analysis also included review of cohort syllabi and assignment calendars, observation field notes of the ECUS cohort, and student responses to questionnaires.

### Coding Message Types

The display format of messages within CEO allows a viewer to discern quickly the differences between threaded discussions (groups of response messages linked to an initiated message by a common subject heading) and non-responded messages (to which no written reply was sent to the conference). Each of us began at the first message posted in the leadership subconference and classified messages either as a non-responded message (M) or as a group of messages within a threaded discussion (T). All files within a threaded discussion were chunked together and coded as one threaded discussion. Messages within each category were numbered in chronological order by date beginning with the first message to appear in the conference. For messages that evolved into threaded discussions, we classified the first message as an initiated message (I). All response messages, except the last in the series, were coded in one of three ways: R for a general response, Ri for a response directed to the initiator message, or Rr for a response to a respondent message within the threaded discussion. The last message in the threaded discussion was coded similarly to the response messages: C for the last message, Ci for a closing message that referred to the initiator message, and Cr for a closing message that referred to a respondent message. Hence, the coding of message types within threaded discussions shows the connecting patterns of the response messages.

### Coding Message Content

Two researcher assumptions about the online communication guided this comparative inquiry and defined the message content codes created and used. Message content codes used to identify specific references within the body of posted messages were developed based upon the following assumptions. First, the predominant content of instructor-generated messages was about online assignments. The instructor used CEO to clarify or redirect the assignment or offer suggestions for action. Despite training for both cohorts in the use of the university's electronic communication system (CEO), the instructor assisted students in overcoming uncertainty or confusion about using CEO during the early days of both cohorts. Thus, content codes were developed to flag content statements related to assignments, suggestions for action, and technical support. Second, cohort use of online communication to support student learning about leadership was different in the two cohorts. Message content codes were developed to identify references to leadership, self-disclosure statements (e.g., statements that begin with the words *I agree*, *I disagree*, *I believe*, *I think*), and professional responsibilities or experiences.

Table 1. Coding Key

Message Type	
Code	Description
I	Initiated message
R	Response (in general)
Ri	Response to initiator message
Rr	Response to respondent message
C	Close of threaded discussion (last message)
Ci	Closed as response to initiator message
Cr	Closed as response to respondent message
Message Content	
Code	Description
a	Reference to assignment (clarification, redirection, reminder, wrap-up)
n	Suggestion for action
r	Reference to professional responsibilities and/or experiences
s	Self disclosure: <i>I agree</i> , <i>I believe</i> , <i>I disagree</i> , <i>I feel</i> , <i>I found</i> , <i>I think</i>
t	Reference to technical support and/or trouble
L	Reference to leadership theory and/or practice

A matrix for analysis of online messages was also developed. Dates of initiated messages and closing responses in threaded discussions were recorded in the matrix. Permission to analyze online messages was obtained from all participants in both cohorts prior to beginning analysis. Thus, the analysis matrix identifies the type and content of each message generated by all cohort participants so that comparisons of student engagement were possible. An ordered triple lists the number of initiated, response, and closing messages made by each individual

within each group of ten messages. A composite totaling all messages posted by each cohort member within the examined conference was included on the last page of the analysis matrix for each cohort.

### **Additional Message Content Analysis**

As our analysis began to reflect marked differences in the type and content of messages, we realized that the use of electronic communication for instruction was not as similar between the two cohorts as we first thought. Needing clarification about the differences between the DL and ECUS syllabi, we asked the instructor if she had changed her online instructional strategies. We learned that she redesigned the online assignments in the ECUS cohort to encourage reflection and discussion in a cohort-wide online conferencing format. In the DL cohort, students were paired and thus shared their reflections and discussions in private messages, which were not available for review by fellow students in the cohort or for analysis by us. Therefore, we realized that our coding of only the posted messages in the leadership domain of the DL cohort failed to present a fair comparison. With this revelation, we analyzed student interactions within the five DL cluster group subconferences. Since cluster groups were created within geographic regions of the state as a way for students to support one another in face-to-face settings, we believed that a cluster group would provide opportunities for shared learning similar to those in the onsite cohort.

### **Comparative Findings: Some Surprises**

A cursory scan of online exchanges within the leadership domain of the two conferences indicated that the two cohorts engaged in markedly different types of virtual communication during the beginning six months of each program. Between June and December 1999, only 57 messages (also called files) were posted in the leadership domain of the DL cohort. Thirty-three of the 57 (58%) messages were instructor-generated. Conversely, although the ECUS cohort met together as a group almost weekly from January to July 2000, the cohort generated a total of 159 messages in the leadership conference. Of those 159 entries, only 20 (13%) were posted by the instructor. An important reason for these variations is due to the differences between the CEO conference structures for the two cohorts. Most of the DL student exchanges for the leadership domain were housed in cluster group subconferences. Nonetheless, the data record strongly suggests that the online interaction within the leadership domain of the DL cohort was less interactive when compared to the online communication among members of the ECUS cohort.

### **Content of Instructor Messages**

Data support our assumption that the predominant content within instructor-generated messages was about online assignments. Of the 33 DL messages posted by the instructor, 25 (78%) provided clarification, redirection, or reminders about assignments and 22 (67%) suggested action to be taken by students. Among the 20 ECUS messages initiated by the instructor, 13 (65%) referenced an assignment and 12 (60%) suggested student action. As the statistics show in Table 2 and Table 3, the instructor used CEO in both cohorts not only as an instructional tool, but also as a messaging system.

*Table 2. Instructor Use of Online Messages for Explaining Assignments*

Cohort Name	Number of instructor-posted messages	References to providing clarification, redirection, or reminders about work	Percentage
DL	33	25	78%
ECUS	20	13	65%

*Table 3. Instructor Use of Online Messages to Suggest Action*

Cohort Name	Number of instructor-posted messages	References to suggestions for action by students	Percentage
DL	33	22	67%
ECUS	20	12	60%

### **ECUS syllabus**

A review of the ECUS syllabus indicated that the instructor explicitly described the purposes for integrating online activities into the onsite cohort curriculum.

Traditionally, this domain has been facilitated in a face-to-face environment with some e-conferencing to supplement instruction. As part of an effort to increase accessibility to material away from the classroom and to leverage the advantages of face-to-face contact in the classroom time available, [the ALPS faculty] is converting more of the material into a computer-supported format. Thirty percent of the course material will be offered on-line, providing opportunity for small group discussions and individual reflection between face-to-face meetings . . . learning is both an individual and interactive process that involves identity development as well as interpersonal interaction . . . assignments [were organized] to provide extensive reading and study on one hand and intensive collaboration on the other. (Napier, 2000, p. 1)

The first e-conferencing assignment was presented verbally to the ECUS cohort during the second cohort session (January 31, 2000) and clarified during the third meeting (February 7, 2000). However, based upon a review of observational field notes and a search within the ECUS cohort conference, written directions for the first online assignment were not distributed during a cohort meeting or via an online message. Further, an interesting contradiction in our comparative findings emerged from analysis of the ECUS student comments on the recent questionnaire.

#### **ECUS student reflections about the online assignment.**

The student responses to a survey question about the online assignments in the leadership domain provided interesting contrasts in understanding. Nine of the 17 (53%) recalled that the task was to read assigned articles and books and write reactions and reflections generated by the readings. Five students either reported that they could not remember specifics about the assignments or they left the answer space blank. Another student wrote,

I'm not sure that I really understood why the assignment was assigned. I thought it was more of an inner reflection. I did not feel comfortable expressing my thoughts or feelings with the group. I had not built any trust.

While time often diminishes recollection of details, the fact that 6 of the 17 (35%) students in the onsite cohort could not recall the assignment raises a concern about assignment clarity. Students may have asked the instructor individual questions about the online activity during cohort meetings. However, clarifications about this particular assignment do not appear to have been shared with the entire cohort either in class or online. The lack of written instructions for the first online activity is markedly out of character with the number of other assignment messages posted by the instructor.

#### **An Unexpected Finding: Need for Technical Assistance**

During analysis of instructor messages in both cohort conferences, we noticed an interesting finding that emerged concerning the need for technical assistance. Students enrolled in both the DL and ECUS cohorts received training in the use of the university's electronic communication system prior to beginning online activities. Members of the DL cohort received intense, hands-on opportunities to practice using CEO in the university's computer laboratories during the cohort's eight-day program orientation. Online training for the ECUS cohort included a visual-display presentation by a guest speaker during the cohort's second meeting and one-on-one assistance provided by both the instructor and peers during two of the subsequent class meetings in a middle-school media center. Despite training in the use of the communication system, data indicate that students in both cohorts reported technical difficulties and received guidance from the instructor throughout the entire timeframe examined.

References to technical support or trouble appeared in 27 of the 57 (47%) of DL cohort messages. Eleven of the message types were non-responded messages generated by the cohort instructor. Six message types were threaded discussions initiated by different students with only the instructor responding. Only two of the threaded discussions concerning technology in the DL conference were initiated by students and responded to by peers.

References to technical support or trouble appeared in 14 of the 159 (9%) of the ECUS cohort messages. Three of the instructor-generated non-responded messages link technical support to another assignment. Eight student references to uncertainty about CEO appeared within both non-responded messages and threaded discussions among students during the first two weeks of the assigned online activity. The last reference to technical trouble made by a student was found in a response to an instructor's message about completing an online assignment. In this instance, the student wrote that he was unable to participate in one of the online activities because the system was off-line when he tried to complete his work.

A comparison of the number of references made by students about having difficulty using the online communication system or to the instructor providing technical assistance leads to interesting questions. Statistics are provided in Table 4.

*Table 4. Student Need for Technical Support*

Cohort Name	Total number of messages	References to technical support or trouble	Percentage
DL	57	27	47%
ECUS	159	14	9%

We became intrigued: Does the fact that half the messages posted in the early weeks of the DL cohort suggest that the students were more dependent or needy than the students in the onsite cohort? Or does the small percentage of references to using CEO in the ECUS cohort mean that technical problems were handled in class? It may be tempting simply to assume from the statistics that the DL cohort experienced and reported greater difficulty using the online communication system than the ECUS cohort did. However, ECUS student responses to a recent questionnaire about using CEO suggest that learning the online communication system created problems for students in the onsite cohort as well.

#### **ECUS student reflections about using CEO.**

Eleven of the 17 (65%) respondents stated that they did not encounter major difficulties using CEO. The range of challenges for five other respondents included simply not being able to log-on because of an incorrect spelling of user name to needing additional training from the CEO administrator or a spouse. However, one student reported significant difficulty and did not engage in online activities until two weeks after the assignment had been made. Once she learned to use the electronic communication system, she participated as actively as the majority of her peers.

I almost died learning CEO. It took several weeks to feel comfortable understanding and using the system. I first had to get hooked up to an Internet provider, then to a search engine to be able to use on my laptop. Then I had to load CEO First Class . . . [and] learn how to navigate around in the system. The class names were even foreign. I worked and worked until I became comfortable using the system.

#### **Student Learning through Online Activities**

Our quick scan of the data record (i.e., the number and types of messages in each leadership conference) suggested to us that participants in the ECUS cohort engaged in rich, dialogue-like exchanges within the leadership domain conference, which students in the DL cohort did not. DL students may have engaged in very similar discussions with another student in the cohort, but their exchanges occurred within private mailbox messages or subconferences. Thus, students in the DL cohort missed opportunities to share their learning and understanding with the group at-large.

#### **References to leadership.**

A review of the statistics shows how very different the contents of the messages are in each of the cohort conferences. The word "leadership" was used in 58 of the 139 (42%) ECUS student messages, but it appeared only 3 times in the 24 (13%) DL student messages. This finding both amazed and puzzled us. We purposefully selected the leadership domain conference in each cohort as the course for our comparative analysis, assuming that both cohorts followed a similar structure. We learned from the instructor that she observed the same phenomenon in the DL cohort leadership conference that we did. Thus, she purposefully made a dramatic change in the format of the online curriculum for the ECUS cohort in order to create a structure for sharing learning cohort-wide.

#### **References to self-disclosure statements.**

We measured the vitality of online communication by evidence of the number of times that students made self-disclosure statements in which they used the following phrases: *I agree, I believe, I disagree, I feel, I found, I support, or I think*. Self-disclosure statements appear in 110 of the 139 (79%) ECUS student messages and 14 of 24 (58%) DL student messages. An interesting observation is that only six instructor messages in the ECUS cohort contained self-disclosure statements. Conversely, the instructor used self-disclosure statements in 25 of her 33 (76%) messages in the DL cohort.

### References to professional practice.

Additionally, data indicate that students in the ECUS cohort attempted to connect what they were learning in the licensure program to their professional responsibilities or experiences. Fifty-one of the 139 (37%) student messages include reflections in which professional responsibilities are mentioned. None of the student messages in the DL conference make a reference to professional responsibilities or experiences. A summary of findings is presented in Table 5.

*Table 5. Student Learning through Online Activities*

Cohort	Number of student-posted messages	References to leadership	Made self-disclosure statement	References to professional experiences
DL	24	3	14	0
ECUS	139	58	110	51

### DL cluster groups.

The disparity between the leadership messages compelled us to look elsewhere in the DL cohort. Five cluster groups were formed during the orientation session of the DL cohort in June 1999 with the intent to build local communities of support for the geographically dispersed cohort members. An interesting finding is the incredibly wide range of student online interactions within the five cluster group subconferences during the entire yearlong program. The least active group posted only 35 messages while the most active one, known as WestSide, exchanged 344 messages. The other three cluster groups generated a total of 83, 67, and 64 files each. The range in quantity of exchanges among the five cluster groups poses interesting questions about group dynamics, which were not addressed in this inquiry. What is significant about this finding is that the WestSide cluster group was also the most social cluster group in the DL cohort. The intensity and volume of peer-to-peer interactions within the ECUS cohort and the WestSide cluster group suggest that peer-to-peer support and encouragement developed because of opportunities for face-to-face interaction. Analysis to date of the interaction within the DL cluster group subconferences shows a greater number of student exchanges than in the leadership conference. Although the messages within the DL leadership conference were somewhat stagnant, the richness of cohort activities became apparent within cluster group subconferences. References to leadership practices, professional growth, and the challenges of balancing the licensure program requirements with professional responsibilities were mentioned in the subconferences.

### ECUS student reflections about online learning.

Statistical analysis provides only one perspective of student reaction to the required e-conferencing activities. Thus, we returned to the ECUS questionnaire for more clarity of findings. Only 7 of the 17(42%) student responses to the recent ECUS questionnaire provided positive assessment of the online assignment. One of those students wrote a particularly enthusiastic evaluation.

I personally love this type of assignment. I believe that [it] is appropriate for the graduate level and gets people out of the "regurgitation of information" mode. As I observe others in the cohort, I detect that many are not dedicated to this method of learning . . . This assignment, however, [prodded us] to think deeply and investigate, evaluate and speculate.

An interesting observation about this student in cohort meetings is that over the past 10 months he rarely participated in face-to-face discussions. Like other more reticent students, he seems to prefer online sharing.

I appreciate the convenience of online discussions . . . the discussion topics and the venue allows people to be more introspective and share personally. I think there is a huge potential for online components.

Other students who enjoyed doing the online leadership activity wrote:

Definitely a new and fresh approach! I like [online activities] because you can sit at home and have time to reflect and write your thoughts.



I enjoyed the technological side of this assignment. Using a computer and the Internet to discuss class topics is very fascinating. Doing this kind of assignment, however, made me nervous because I had not explored myself as a true leader.

However, almost half of the ECUS cohort did not share the same reaction to being assigned online dialogue activities. Five students reported feeling overwhelmed, perplexed, worried, and even threatened about writing self-disclosing reflections.

I struggled with this assignment because I truly had not seen myself as a leader. I was apprehensive to put those words online for all to read.

I felt threatened because I was asked to expose my inner thoughts to 20 people that I did not know.

Approximately one-third of the respondents reported that they did not enjoy the online conferencing for other reasons. It was frustrating for some when peers did not respond to the messages they initiated in the hopes of beginning threaded discussions. Others voiced a preference for face-to-face discussions in which there is increased potential for peer interaction.

[Not receiving responses to posted messages] affected me by making me feel that what I had to say was not important. I also began to feel like "why should I even do this if it is not even read or responded to by anyone."

[Using CEO for assignments] is a nice up-to-date way of trading ideas and work. I would like to see it used more, but nothing beats face-to-face communication and learning.

### **Comparison of student engagement.**

A line-by-line analysis of type and content of student messages in each of the leadership conferences suggests that many students never fully participated. Analysis of student responses in the DL leadership conference matrix indicates that four students never posted a message there during the entire program. Analysis of the ECUS matrix shows that many students were hesitant during the early weeks to share self-disclosures with their peers. One student did not engage in the process until three weeks after the assignment was made. Among the four messages he posted in the conference, only one contains a self-disclosure statement. Another student did not post any messages until almost five weeks after the assignment was made. Of the seven messages authored by this student, only four contain self-disclosure statements.

### **Conclusions and Possible Questions for Discussion**

Comparative analyses of the online messages in both conferences strongly suggest that neither cohort spent time establishing ground rules for online behavior. What emerged during the process of online communication worked for some students, but not for others. Thus, the use of the online conferencing system as an instructional tool differed significantly between the two principal licensing cohorts.

The DL cohort used the CEO system more as a communication tool for discussion of logistical issues related to their learning and assignments rather than as a platform for academic discourse. Only one of the five cluster groups within the DL cohort sustained rich online communication throughout the entire program. Perhaps one reason for the online connectedness of this DL cluster group was the fact that the students initiated and sustained regular face-to-face meetings to support one another.

The onsite ECUS cohort used the CEO system as an instructional tool because the purpose for online activities was clearly delineated in the leadership course syllabus. Confusion about the first assignment arose for two reasons: (a) the assignment was not written and (b) some students had difficulties learning to use CEO during the early weeks of the program. Nonetheless, the majority of the ECUS students posted personal reflections and engaged in rich, peer-to-peer online discourse about their assigned readings and related their learning to professional responsibilities. In some ways their online dialogue rivaled discussions observed during weekly cohort meetings.

Because our study did not compare truly similar online learning environments or include large numbers of students, our findings are limited. Results of our analysis of the content of student messages provide important information to assist the ALPS faculty in the design of future distance-learning programs and online assignments within onsite cohorts. Student responses to the questionnaire about use of CEO in the professional preparation program contain some surprising revelations that can further assist in program modification. Adult learning styles

vary tremendously and thus accommodations need to be made so students have ready access to technical assistance in the use of information technology during the early weeks of a new program. Further, cohort norms need to be established early regarding participation in online activities.

Findings in our comparative study support the literature base and empirical evidence from other studies about online communication. A greater value is that our findings generated questions for discussion about the effectiveness of online learning activities.

### **Question One: Student Engagement in Online Activities**

Data from our comparative study show that not all students in the two cohorts readily embraced the idea of actively participating in asynchronous online dialogue. While some students in the ECUS cohort reported enjoying online activities, their peers revealed reticence for sharing personal views and reflections in the public domain of an online conference. Several students reported having technical difficulties during the early weeks of both programs. Further, three ECUS students posted three or fewer messages among a total of 139 student files, and four of the students in the DL cohort never posted a message within the leadership domain conference. A stated purpose for assigning online activities is to enhance collaborative learning. Therefore, if student participation is important for learning, then what type of monitoring does an instructor need to use to assess student online engagement?

### **Question Two: Online Conferencing and Student Learning Styles**

In face-to-face classroom situations, some students are very willing to share their thoughts and ideas openly as fuel for discussion and debate among peers. Other students prefer to listen and observe classroom exchanges and reflect about what was said. An instructor can notice facial expressions and body language to discern if quiet students are engaged in the classroom activity and even elicit responses through direct questioning. In a virtual environment, however, an instructor cannot always discern if "quiet" students are actively participating. The fact that a message has been opened does not mean that it was read. Therefore, what strategies can an instructor use to monitor active student participation in online activities?

While our comparative study of message content was intended to assist the ALPS faculty in the design of the next distance-learning cohort and the integration of more online activities in onsite cohorts, our findings suggest questions for discussion with larger audiences. We begin that larger dialogue with this presentation.

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# How To Develop Cognitive Flexibility In A WWW Course

Ana Amélia Amorim Carvalho  
University of Minho

## Abstract

*Cognitive flexibility is indispensable for applying knowledge to new situations. The development of this ability depends on certain conditions such as the attainment of a deep comprehension of the subject matter and the exposure to different knowledge representation. This paper focuses on these conditions and describes a study designed to foster the development of cognitive flexibility on a World Wide Web course.*

## Cognitive flexibility

Cognitive flexibility is the ability to change one's perspective, to categorize data and stimuli according to different properties, to find new connections among the elements of a whole and to interpret the same reality in different ways. It is also the ability to recombine elements of a representation, or to reorder the importance of elements in different contexts (Spiro et al., 1987). Flexibility in thinking allows subjects to move from one category to another and to modify their point of view (Guilford, 1967).

Spiro & Jehng (1990: 165) state: "by cognitive flexibility, we mean the ability to spontaneously restructure one's knowledge, in many ways, in adaptive response to radically changing situational demands". Moreover, "this is a function of the way knowledge is represented (e.g., along multiple rather than single conceptual dimensions) and the processes that operate on those mental representations (e.g., processes of schema assembly rather than intact schema retrieval)". According to these authors cognitive flexibility depends on the way knowledge is represented. Bearing this in mind, next session focuses on knowledge representation, particularly on complex knowledge representation.

## Knowledge representation

The representation of complex knowledge, according to several authors, has to avoid compartmentalization, simplification, and a single dimension of analysis (Barthes, 1970; Morin, 1990; Spiro et al., 1991). Multiple dimensions of analysis are necessary for developing cognitive flexibility that depends of having a diversified repertoire of ways of thinking about a conceptual topic.

"Interpréter un texte, ce n'est pas lui donner un sens (plus ou moins fondé, plus ou moins libre); c'est au contraire apprécier de quel pluriel il est fait" (Barthes, 1970: 11).

Cognitive Flexibility Theory (CFT) proposes principles that help to develop cognitive flexibility (Spiro & Jehng, 1990), such as "knowledge deconstruction" and "thematic criss-crossing". At this point it is important to stress that this theory is case-based. A case represents specific knowledge tied to a context. It may be a chapter of a book, a few frames of a film, an event. Cases may have different shapes and sizes, covering large or small time slices (Spiro & Jehng, 1990; Kolodner, 1993; Kolodner & Leake, 1996). Each case has to be divided in small parts, called mini-cases. Each mini-case is analyzed according to multiple dimensions or multiple perspectives: the themes. Themes are synonymous of principles or rules and they help to understand the complex knowledge. Each perspective or theme gives a new insight into the mini-case comprehension.

According to CFT there are two important paths to develop cognitive flexibility: "knowledge deconstruction" and "thematic criss-crossing". In the next section we describe the two paths illustrating them with an example: the web document "Cousin Basilio: multiple thematic Criss Crossings" (available at the following URL: [www.iep.uminho.pt/primobasilio](http://www.iep.uminho.pt/primobasilio)). ", for literary studies, we select a 19th century novel, "Cousin Basilio" written by Eça de Queirós.

## Two complementary ways of knowledge representation to promote cognitive flexibility

### Knowledge deconstruction

The notion of *knowledge deconstruction* is shared by R. Barthes, J. Derrida and R. Spiro and it stresses the importance of multiple perspectives to deeply understand a subject matter. According to CFT the process of knowledge deconstruction implies the selection of *themes* and *cases*. The case is divided in small parts, the mini-cases. For each mini-case it is necessary to identify the relevant themes. Then, for each applied theme a "Thematic Commentary" has to be written, explaining how each theme applies to the particular mini-case. This text (thematic commentary) should state clear ideas in a simple language and it should be short to be easily read in a computer screen (see figure 1).



Figure 1 - Mini-case and Thematic Commentary of "Cousin Basilio"

In the web course that we developed "Cousin Basilio: multiple thematic Criss Crossings", we identified nine themes to approach the novel. This novel has sixteen chapters that we grouped to constitute the cases (table 1). Each case was divided in small parts, the mini-cases. Then, we identified the relevant themes to each mini-case and we wrote the thematic commentaries (see table 1).

For example, four themes apply to the first mini-case of Case I (see figure 1). The Thematic Commentaries related to each of these themes, give different and complementary insights to the text. On figure 1, one can see, on the right side, a mini-case and below it the text of the first Thematic Commentary.

Chapters	Cases	Mini-Cases	Thematic Commentaries
I - III	I	8	37
IV - V	II	7	37
VI - VII	III	6	35
VIII - XIII	IV	9	36
XIV - XVI	V	4	15
Total	-	34	160

Table 1 – Components of the process of deconstruction of "Cousin Basilio"

As "Cousin Basilio" action is carried out in the 19th century, for each mini-case we included information about the epoch. This information focuses on clothes, furniture, transportation, writers, composers, operas or novels mentioned in the mini-case. This information includes not just text but also pictures and video clips.

Flexibility in applying knowledge depends on mini-cases being deconstructed (through themes and thematic commentaries; the user attains a deep understanding of that mini-case) and it also depends on rearranged structural sequences from different points of view or perspectives (thematic criss-crossings). Knowledge that have to be used in many ways has to be learned, represented and tried out in many ways.

### Thematic criss-crossing

The process of *thematic criss-crossing* is inspired in Ludwig Wittgenstein' book "Philosophical Investigations". According to Spiro & Jehng (1990), Cognitive Flexibility Theory generalizes Wittgenstein's metaphor of the criss-crossed landscape. The authors explained that "by criss-crossing topical/conceptual landscapes, highly interconnected, web-like knowledge structures are built that permit greater flexibility in the ways that knowledge can potentially be assembled for use in comprehension or problem solving" (Spiro & Jehng, 1990: 170).

After the selection of a theme (or a combination of themes), thematic criss-crossing guides the user through a sequence of mini-cases (of different cases) and thematic commentaries to which the selected theme applies. For example, figure 2 exemplifies the process of thematic criss-crossing. In that example it is used the first traversal: "Denouncement of decadence". The sequence presented to the user does not have to respect the cases sequence (figure 2), but it has to be meaningful and give a deeper and multifaceted understanding of the theme.

Case I	Case II	Case III	Case IV	Case V
	1			
	6	8		4
	3			
2			5	
	7			
			10	
			9	

Figure 2 - Thematic Criss-Crossing (Denouncement of decadence)

"The same content material is covered in different ways, at different times, in order to demonstrate the potential flexibility of use inherent in that content" (Spiro et al., 1988: 379).

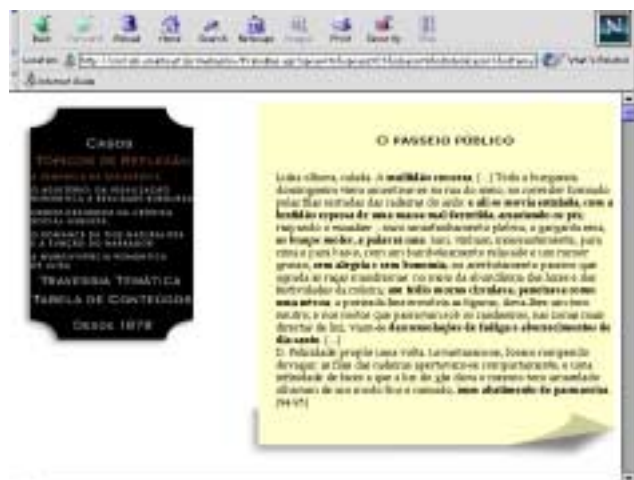


Figure 3 - Thematic Criss-crossing (mini-case)

Both processes are complementary in the kind of learning promoted, and they have to be explored alternately. As users explore the mini-cases and the thematic criss-crossings, they will be familiar with some mini-cases that they can read for different purposes. Bearing this in mind we decided to use the bold style to give evidence to several expressions, sentences or words that are relevant to the thematic criss-crossing (see figure 3). In a glance the user identifies the mini-case, then he/she will focus on the bold text.

### The importance of cognitive flexibility to knowledge transfer to new situations

Transferring knowledge to new situations is a very demanding task. This level of transfer is considered to be the most difficult and is referred to as "far transfer" (Gick & Holyoak, 1987). It is necessary to master a subject and have the ability to restructure the knowledge to fit or solve the new situation, e.g., it is necessary to have cognitive flexibility. The mentioned authors consider also two other levels of transfer: "self transfer" or knowledge reproduction and "near transfer" where there is a similarity between the new situation and others analyzed.

### Structure of the World Wide Web Course

We developed a literary studies course in the web to support the study of a novel, "Cousin Basilio", that describes the social life in Lisbon in the 19<sup>th</sup> century (<http://www.iep.uminho.pt/primobasilio>), as we mentioned above. During the design phase we took in attention the utilization of icons and colors that helped to recreate the 19th century ambience in the web document "**Cousin Basilio: multiple thematic criss-crossings**". For example, the Thematic Commentary background is an ancient official Portuguese stationery and the mini-cases background represents an old (yellow) page, inviting the user to pursue due to its slightly rolled page on the right corner (figure 1).

Menu1	Main1
Menu2	Main2
Footer	

Figure 4 - Web site areas

The web pages are structured according to three main areas (figure 4). From top to bottom, we have the Menu 1, that is the Main Menu. If we select an item on this menu the information will be available on the Main 1 (figure 1). Then, on the area below, we have the Menu 2. This menu is dynamic because the items available on this menu depend on the options selected on the Menu 1. The item selected on the Menu 2 will be available on the Main 2 (see figure 1). The last area is called footer, and besides copyright information and e-mail address, there is also the possibility of the user to write his/her personal notes, clicking on the pen (see figure 5).

The menu 1 offers four options: *Cases* (knowledge deconstruction); *Thematic Criss-Crossing*; *Search*; and *Table of Contents*. On the menu 2 we have access to "*thematic commentaries*", information about the *Context* of the 19<sup>th</sup> century and about the text (mini-case) of the novel, and a general description about the nine *Themes* selected for approaching the novel. Some mini-cases have pictures that help to understand Lisbon scenarios or some ancient transportation or even some ancient furniture that helps to recreate and understand that century. Other mini-cases have a video that presents information about the novel. Finally, at the end of Menu 2, we have *References*, listing all authors mentioned in "thematic commentaries" or in the general description of Themes.

Instructions are provided to the user each time he/she selects an item (path) on the Menu 1. These instructions in blue simulate well-designed handwriting (figures 5 and 6).



Figure 5 - Instructions to the user

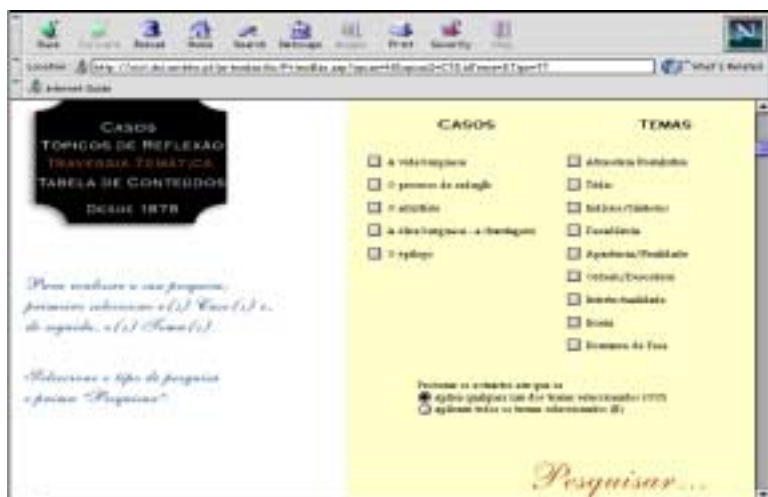


Figure 6 - Search (cases and themes)

The home page has an image of an ancient book. It gives access to the Help page. On this page, one may obtain information about the approach used to the novel and about the options available on both menus. If the coins are pressed, one has access to the login page (figure 7). User name and password will be required. This document is access free, however, the password is needed to save one's own notes (during a month from last access). Feel free to look. These web pages are discrete and simultaneously appealing. Most of the web courses available have a high text density, which is not motivating for the user! Why aren't we exploring the web multimedia potentialities?





Pre-test	CFT	NTC	Z corrected for ties	Statistical significance
Total	15.19	13.58	-.511	p=.6091 NS
Reproduction	14.59	14.38	-.071	p=.9434 NS
Near transfer	15.44	13.25	-.699	p=.4846 NS
Far transfer	14.48	14.04	-.260	p=.7951 NS

Table 2 - Pre-test statistical analysis (Mann-Whitney U test)

Pre-test results show that there is no statistically significant difference ( $p=.6091$ ), the groups are similar before being submitted to treatment (table 2).

Intermediate test	CFT	NTC	Z corrected for ties	Statistical significance
Total	18.03	9.79	-2.62	p=.0087 S
Reproduction	14.75	14.16	-.186	p=.8531 NS
Near transfer	17.87	10	-2.51	p=.0121 S
Far transfer	18.12	9.66	-2.71	p=.0066 S

Table 3 - Intermediate test statistical analysis (Mann-Whitney U test)

During this study, students have done an intermediate test. Results pointed out to statistically significant difference achieved in the test ( $p<.05$ ) as in near and far transfer questions. There is no statistically significant difference in the reproduction questions, perhaps because the knowledge to be applied to these questions was the same on both documents.

Post-test	CFT	NTC	Z corrected for ties	Statistical significance
Total	18.12	9.67	-2.69	p=.0071 S
Reproduction	14.50	14.50	0	p=1 NS
Near transfer	17.66	10.29	-2.35	p=.0189 S
Far transfer	17.12	11.00	-2.02	p=.043 S

Table 4 - Post-test statistical analysis (Mann-Whitney U test)

Post test results show that there is statistically significant difference ( $p=.043$ ) that gives evidence to the development of cognitive flexibility on the group of subjects exploring the CFT web document. This result shows the importance of thematic commentaries on knowledge transfer to new situations (table 4). CFT group has better results in near and far transfer questions. As on the previous test, both groups achieved similar results in these question,  $p=1$ .

Most of subjects (66%) considered the session in the lab indispensable and 34% of subjects considered that the information available on "help" was clear enough to explore the document. In what concerns users' opinion about the web document, 58% considered it "accessible to use" and 42% considered it "easy" to learn to use. On the first session, most of them (58%) felt oriented in the web document and 37% felt disoriented; on the following sessions all feel oriented, excepted one subject who felt disoriented.

Most of them (84%) considered the reading proposed to the novel "interesting" and 16% considered it "acceptable". They mentioned that they (95%) felt actively involved in this learning process. Their preferred path is the deconstruction process (Cases).

Subjects' opinion about web courses for further learning is a positive one (74%), however some would prefer a combination of face-to-face meetings and distance learning.

## Conclusion

The knowledge representation used in this study to promote cognitive flexibility gives emphasis to knowledge deconstruction and to thematic criss-crossing. This complementary approach to complex knowledge representation used by Cognitive Flexibility Theory led us to study what is the importance of "thematic commentaries" (this is the focus of the deconstruction process) in learning and in cognitive flexibility. Results give

evidence to the deconstruction process to develop cognitive flexibility, i.e., to the importance of "thematic commentaries" to knowledge transfer to new situations.

Although subjects' computer literacy was low they felt it was easy to use the web document and to navigate in. They liked its design and structure.

They are receptive to participate in web courses for further learning, but some would prefer a combination of face-to-face meetings and distance learning.

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# **Learning Science Concepts at a Distance in Preservice Teacher Education: Results of a Pilot Study**

Christina Wotell Charnitski  
College of Misericordia

Francis A. Harvey  
Drexel University

## **Abstract**

*This paper will report the findings of the first phase of a multi-phased research project that is aimed at examining preservice teachers' development of science concepts when learning (a) takes place at a distance, and (b) is facilitated by videoconferencing technology. This study will build on the work that was done by Lansdown, (Lansdown, Blackwood, and Brandwien, 1971) and validated at Boston College (Trainor, 1978) and at Harvard University (Harvey, 1980) that demonstrated the validity, effectiveness and evaluative power of an investigation/colloquium approach to students' development of science concepts in a face-to-face learning environment. The pilot study investigated the use of the investigation/colloquium approach (a series of student-directed explorations with hands-on materials followed by colloquium discussions facilitated by an adult leader) by ten students at two sites connected by videoconferencing technology. Results of the pilot study, analyzed using standard qualitative analysis procedures, indicated that Vygotskian group socio-cultural learning (particularly the development of science concepts) could take place effectively when the groups are in separate locations connected by videoconferencing technology.*

## **Introduction and Need for the Study**

This paper reports the findings of a pilot study which was the first phase in a project designed to investigate and validate techniques for using videoconferencing technology to promote the development of preservice teachers' science concepts. The ultimate goal of this three-phased study is the development of a curriculum matrix (content, material, and procedures) that will facilitate science concept learning at a distance. The study will be used to examine the efficacy of using videoconferencing technologies to improve science concepts in preservice teachers by (a) supporting innovative course configurations that may increase preservice teachers' access to pedagogically sound science instruction, (b) extending professional collaboration between preservice and inservice teachers; and (c) promoting quality continuing education that is accessible and affordable.

The results of the Third International Mathematics and Science Survey (IEA, 1996; NSB, 1998) raised serious concerns about science education in the United States. The data collected from the TIMSS demonstrated that the U.S. science curriculum lacks focus and depth (NSB, 1998; Schmidt & Wang, 1999; Valverde & Schmidt, 1998). Schmidt and Wang (1999) stated:

One of the most salient and powerful policy implications from the TIMSS is the essential role of the curriculum in the teaching and learning of math and science. The TIMSS achievement results suggest a disturbing pattern: the relative standing of U. S. students compared with other countries declines from fourth to twelfth grade. The U.S. science curriculum over these same grade levels has been characterized as highly repetitive, lacking coherence, and not focusing on rigorous content as defined internationally. (online)

Schmidt and Wang suggested that the failure of the U. S. students in science may well be the consequence of "...the mile wide inch deep curriculum, the largest textbooks in the world, and a splintered vision of what children should learn about science." (online) They further noted that U.S. textbooks "...play a major role in the splintering or fragmenting that occurs in U. S. science education." (online) They argued that the problem with textbooks cannot be underemphasized since teachers in elementary or middle school who do not have strong science backgrounds view and teach science directly from the textbooks.

Research literature suggests that most U.S. elementary and middle school teachers lack the content knowledge and confidence needed to teach science (Berg, Huinker, & Neuman, 1993; Rice & Corboy, 1995) . According to Rutherford and Ahlgren (1990):

Few elementary school teachers have even a rudimentary education in science ... Unfortunately, such deficiencies have long been tolerated by the institutions that prepare teachers, the public bodies that license them, and the schools that hire them....

A revised curriculum is needed in both the content and the delivery of preservice science courses if we are to prepare teachers who have a firm understanding of the basics of science (AAAS, 1994; Berg et al., 1993; Harris, 1993; Tolman & Campbell, 1991).

Measuring learner achievement has been a major focus of studies in interactive video-based learning (Moore, Thompson, Quigley, Clark and Goff, 1990; Payne, 1997). A vast body of research literature generally acknowledges that there is no significant difference in learner achievement between students who participate in instruction at a distance and students who participate in traditional settings. Yet, the validity of this body of research has been called into question (Cohen, Ebeling, & Kulik, 1981; Moore et al., 1990; Phipps & Merisotis, 1999; Russell, 1996; Schlosser & Anderson, 1994). Phipps and Merisotis, 1999 stated that there is rising evidence that much of the existing research that has examined student achievement in distance learning is weak and largely anecdotal.

Most research on distance learning has treated learner achievement as an all-inclusive term that does not distinguish between higher and lower level thinking skills. Vygotsky (1986) identified concept development as the ability to (a) form linkages between concepts without reference to concrete or sensory impressions, (b) verbally define the concept in abstract terms, and (c) apply the concept to new situations which must be considered in abstract terms. Clearly, learner achievement that is a measure of concept development as defined by Vygotsky is far different than learner achievement that is a measure of lower level cognitive skills such as the student's ability to identify, order, or compare lists of items.

This paper will report the findings of the first phase of a three-phase study that was conducted in March-April 2000. The participants included undergraduate students from College Misericordia's Teacher Education Program who were enrolled in a science methods class. A unit on waves was taught using the investigation/colloquium model. Half of the students participated from the videoconferencing facilities at College Misericordia (Dallas, PA) while the other half participated from King's College (Wilkes Barre, PA).

Preliminary findings suggest that preservice teachers can learn science concepts at a distance when connected by videoconferencing technology using the investigation/colloquium method of instruction. Other preliminary data offer insights into procedural changes for the second phase of the study which will take place in September of 2000.

## Method

A considerable body of literature (e.g., Lenning & Ebberts, 1999; Moller, 1998; Mukhopadhyay, 1997; Palloff & Pratt; Stone & Sulino, 1997) has suggested that a key element in successful distance learning is the formation of a synthetic class relationship. A synthetic class relationship is one in which the students come together as one cohesive community of learners. In a successful distance synthetic class relationship, students feel and act as part of one group whose members just happen to be situated in various geographical locations. The verbal and nonverbal socio-cultural interactions evident in a synthetic class relationship are consonant with Vygotsky's emphasis on the socio-cultural aspect of concept development. This pilot study was conducted in the late spring of 2000. The study was designed to extract information from the socio-cultural elements in the learning environment by focusing on the patterns of interaction between and among participants during the colloquium segments of each videoconferencing session.

The research took place at a small, private, four-year college in Northeastern Pennsylvania and included a baseline assessment of the participants and four one-hour videoconferencing sessions. The study participants included 10 volunteer preservice education majors who had completed their core science requirements but had not yet fulfilled their science methods requirement. Five of the students participated from the college videoconferencing facilities and five students participated from a videoconferencing facility approximately 10 miles from the campus. Students were designated as being same-site or other-site, which was determined by the physical presence or absence of the instructor.

The instructor was a physics professor who has a background in science education, and regularly co-teaches the science methods courses with a teacher education faculty member. During the study the instructor was physically present at each site for two sessions. Additionally, an activity aide was present at the other site (i.e., remote) who simply handed out materials and did not interact with the students during the sessions.

The study consisted of a baseline assessment and investigation/colloquium-based lessons that were facilitated by videoconferencing technologies. The baseline assessment consisted of a short one-on-one interview of the participants to establish their baseline knowledge of waves. Participants were asked an open ended question (i.e., "What can you tell me about waves?"), and a follow up question (i.e., Is there anything more you can tell me?). The participants exhibited wave concept understanding below an upper elementary level.

The experimental sessions were comprised of four one-hour investigation/colloquium sessions that were delivered using videoconferencing technologies. The first three videoconferencing sessions began with the instructor introducing manipulable materials that would allow the participants to physically explore wave phenomena. The materials used were: (1) slinkies; (2) string telephones; (3) oven racks suspended by strings. After the instructor introduced the materials, the students were given ten minutes during which they engaged in hands-on investigations using the materials. At the end of the ten minutes of investigation, the instructor called both groups together to participate in a fifteen-minute colloquium. The colloquia were student-directed, with the instructor merely acting as a facilitator to the discussion. The purpose of the colloquia was to have the participants discuss their observations and attempt to verbally make sense of their investigations. Among other things the colloquium participants asked questions, gained insights from each other, and came up with new ideas about how further investigation may help them find answers to their questions. Following the colloquium the participants engaged in another ten minutes of hands-on investigation, which was again followed by a fifteen-minute colloquium. During the final week, the session structure remained the same (i.e., ten minutes of investigation followed by fifteen minutes of colloquium) however, the participants watched video segments that demonstrated wave concepts instead of working with manipulable materials.

All sessions were audiotaped and videotaped. Written transcriptions were made from the tapes. Colloquium statements were analyzed using Harvey's (1980) scoring scheme. Verbal interactivity was analyzed by numerical occurrences relative to the directionality of the statement. Each statement was coded as: (1) a response to a statement from either the same site or the other site; (2) a statement directed to either the same site or the other site.

## Results and Analysis

Informal analysis of the participants' statements from the colloquia associated with the hands-on investigations demonstrated that students at both the same-site as the facilitator and at the remote site developed higher-level concepts. The participants' statements were analyzed using Harvey's (1980) scheme, which is based on Vygotsky's levels of concept development. The statement analysis indicated an increase in students' higher level thinking statements (i.e., pre-concept) and a decrease in lower level thinking statements (i.e., complex) over the three sessions. In addition, the student's responses became more concise and focused as the sessions progressed and the total number of student statements decreased with each session.

Instructor (facilitator) statements also decreased over time which corresponded with a decrease in student statements directed to the instructor. Instructor statements accounted for 29% of the total statements during the first session and 8% of the statements in the final session. Total student statements (same-site and other-site) directed to the instructor (facilitator) decreased from 51 during the first session, to 26 during the second session, to one during the final session.

Extensive verbal interaction occurred both within sites and between sites, and the interactions between sites increased over the three colloquia. Figures 1 through 3 present the number and types of responses made by subjects during the three sessions to statements from the facilitator, from subjects at the other location, and from subjects at the same location. Figures 4 through 6 present the number and types of statements directed by subjects to the facilitator, to subjects at the other location, and to subjects at the same location.

Table 1

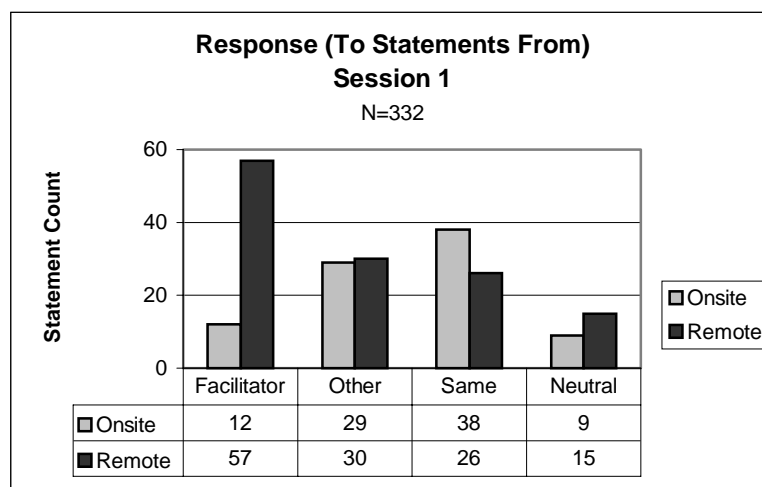


Table 2

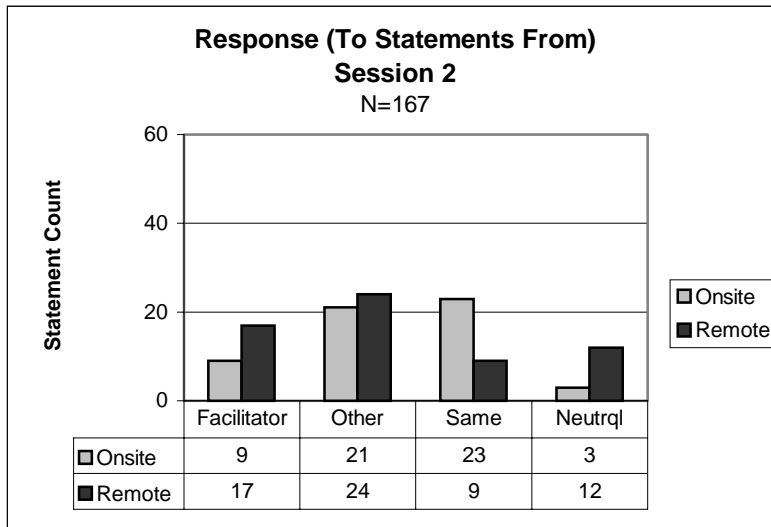


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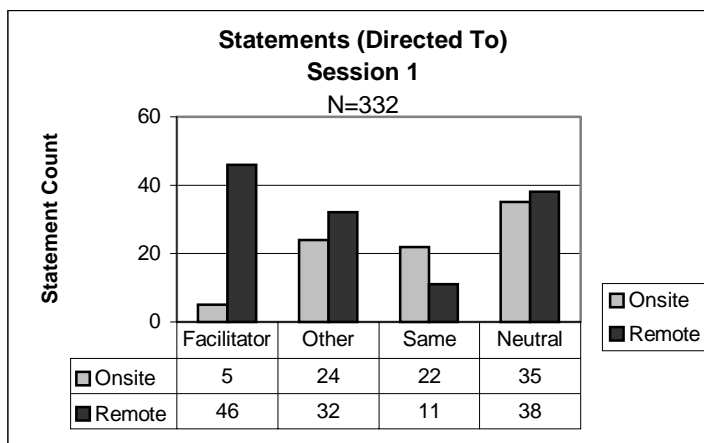
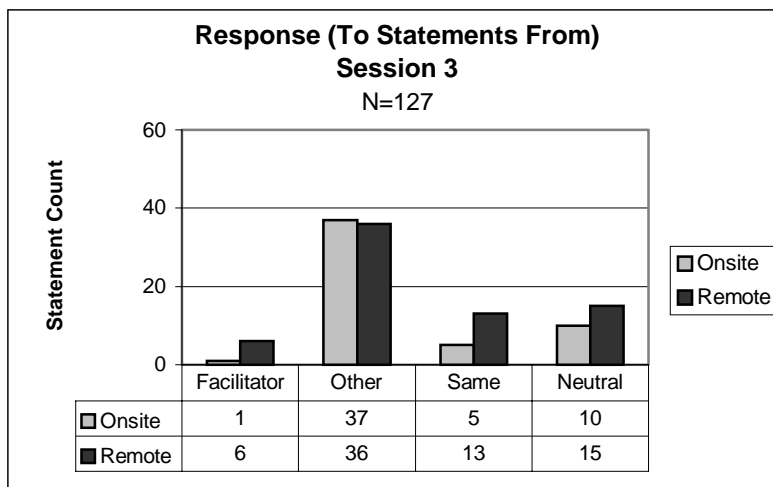


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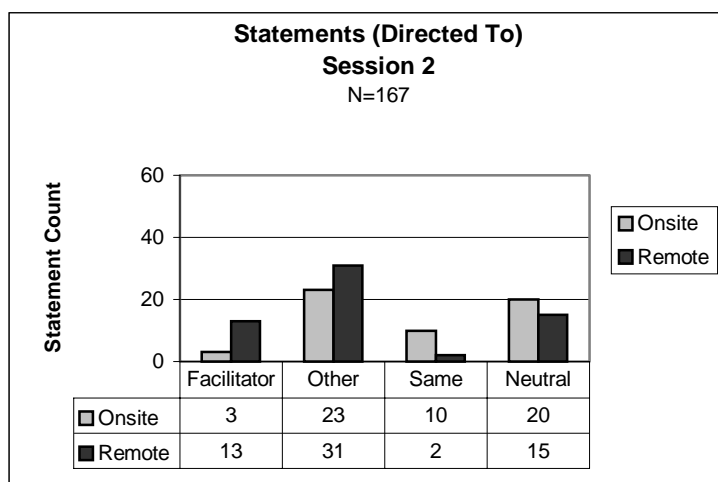


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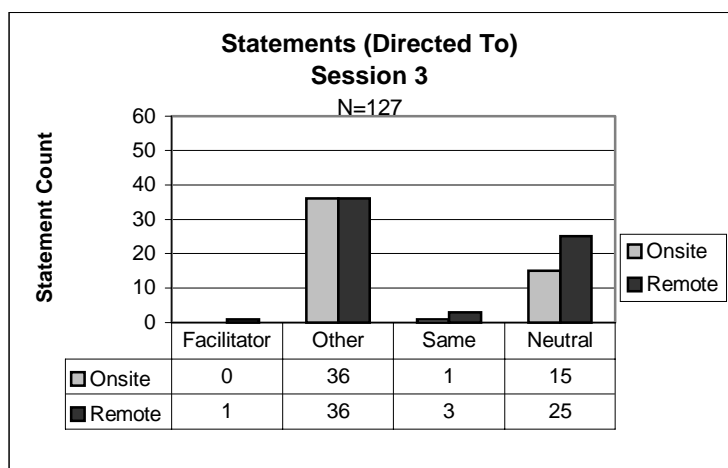


Table 6

## Discussion

The main emphases of science reform appear to be consistent with Vygotsky's socio-cultural theory of learning. The initial findings of this study suggest that the unique characteristics of videoconferencing technology make it a promising medium for delivery of effective Vygotskian-based learning in teacher education. All indicators point to videoconferencing at both the studio and desktop level becoming more generally accessible, and therefore, more likely to be used in educational settings involving K-12 students.

Recently, the validity and reliability of much of the existing research on the use of videoconferencing has been called into question. This has left a paucity of reliable research that explains the phenomena related to teaching and learning via videoconferencing. Many critical questions remain unanswered. Further, the development of higher level thinking skills and concept formation is at the heart of the science reform recommendations; yet the existing body of literature fails to make a distinction between higher and lower level thinking skills as they relate to student achievement.

Videoconferencing and other distance technologies alter the classroom dynamics sufficiently to warrant a cohesive research effort that examines the mediating factors that affect student concept development when learning takes place at a distance. The results of this study suggest that the investigation/colloquium approach, which has proven successful in the traditional classroom, may be useful in videoconferencing learning. The final two phases of this research project will further test and refine the preliminary findings of this study.



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# Formative Research on the Refinement of Web-based Instructional Design and Development Guidance Systems for Teaching Music Fundamentals at the Pre-college Level

Dr. Wen-Hao Chuang  
Multimedia Innovation Center  
The Hong Kong Polytechnic University

## Abstract

*Recent advancements in computer and Internet technologies enable universities to implement cost-effective Web-Based Instruction (WBI) and to provide open learning environments 24 hours a day, 7 days a week. While more and more WBI courses are continually being developed, little attention is being paid to effective, systemic, and systematic WBI design and development. Collis (1996) mentions “WWW-based course environments are rapidly appearing, before there has been time for much theoretical development with respect to guidelines for their design” (p. 26). Although there are some general guidance systems focused on WBI design and development process, much of the knowledge about these guidance systems is tentative and lacking in details. The purpose of this research, therefore, is to improve these guidance systems and to provide more detailed and useful guidelines in a special context.*

*This research first synthesized several general WBI design and development guidance systems. Next, the formative research methodology was used to improve that synthesis. A case was chosen for this study, the context being the teaching of music fundamentals at the pre-college level. Efforts were made to identify which guidelines were or were not useful in this case and which guidelines might be beneficial to modify, delete, or add in this context. Both on-site and online interviews, observations, and document analyses were conducted with all developers involved in this WBI project.*

*As a result of this study, the synthesized general WBI design and development guidance system was revised for best fit with this case. These revisions are the major findings of this research. Discussion of each guideline and a final summary of the results were also made. Recommendations for practitioners and future research directions were also discussed. This new guidance system was intended not only to guide future practitioners in this field, but also to provide a theoretical framework for future research and theory development.*

## Background of the study

The single case in this study is a project called “Music Fundamentals Online (MFO).” According to the MFO project director, the typical undergraduate core in music schools in the United States consists of a four- or five-semester sequence of parallel courses in music theory and in musical skills (dictation, sight singing, keyboard, etc.), followed by one to two years of music history.

	1 <sup>st</sup> semester [Fundamentals]	2 <sup>nd</sup> semester
Year 1 (Freshman)	Theory and Literature I (T151), Musical Skills I	Theory and Literature II Musical Skills II
Year 2	Theory and Literature III Musical Skills III	Theory and Literature IV Musical Skills IV
Year 3	Theory and Literature V Musical Skills V	
Year 4	History I	History II

Table 1: Core curriculums at a typical music school (Isaacson, 1998)

An important part of the core courses is prior mastery of music fundamentals. The term “music fundamentals” refers to knowledge and skills associated with basic music literacy. Typically it includes the ability to read treble and bass clefs, to write and identify scales, intervals, key signatures, and chords, and to know basic elements pertaining to music notation, rhythm, and meter. It also usually includes basic aural skills, such as recognition of intervals and chord types, the ability to write down simple pitch and rhythm patterns, and a limited

amount of sight singing. Although it is important to have basic music skills before entering music schools, many students entering college who plan to have music as their major lack mastery of these basic skills. Take Indiana University for example. The MFO project director pointed out that over half of the students beginning the core curriculum lack proficiency in this area. Other institutions report figures ranging from 20-80% with 50% being typical (Isaacson, 1998). These students, therefore, require remediation.

Removing this deficiency at the college level is very expensive for both students and music schools—US\$420-\$1300 per student per semester as of 1999 for tuition at Indiana University (depending on the residency status), plus textbooks and other costs. It is expensive for the music schools, too, because schools need to hire extra instructors and allocate educational resources (classrooms, musical instruments, equipment, and so on) for this course. It is, therefore, to the student's and to the school's advantage that students arrive on campus with a solid grounding in music fundamentals. As a solution to this problem, Indiana University has taken the challenge and is developing an innovative WBI remediation course (MFO) in the hope of replacing the present classroom-based music fundamentals course. Students who register in MFO will devote four to six weeks to complete the whole course online. Upon completion of the prototype, the MFO program will be available during the summer before students enter college/music schools.

## **Guidance Systems of WBI Design and Development**

WBI is still in its infancy, and there is little research about WBI design and development guidance systems. A number of general-purpose guidance systems for WBI design and development, though general in nature and not usually intended for complex WBI courses, can illustrate both the trends and process involved. To limit the scope of the study, some guidance systems that focused mainly on GUI issues or product issues (e.g., Collis, 1997; Boyle, 1997; Harasim, Calvert, & Groeneboer, 1997; Hedberg, 1997; Santi, 1997; Dillon & Zhu, 1997; Horton, 2000) were intentionally omitted in this literature review because they are more product-oriented. Following are some of the general WBI design and development guidance systems.

### **Berge's Guiding Principles in WBI design**

Berge (1998) first defines design as "planning the instructional programme events--building the blueprint to guide development and tryout" (p. 38). This definition is similar to Wien and Gunter's "design" stage of WBI (Wien & Gunter, 1998).

Berge also limits the scope of his WBI design guiding principles and excludes some of the guidelines for on-line moderating and teaching (more product-oriented). According to Berge (1998), rules such as "find unifying threads," "present conflicting opinions," and "a facilitator should encourage the participants to introduce themselves," are intentionally left out in his guiding principles as they are too narrowly focused on implementation and delivery of on-line teaching.

Berge (1998) made some key assumptions before presenting his guiding principles in WBI design. These key assumptions include:

- Learning is a lifelong process that is important to effective participation in cultural and economic life in a democratic society.
- Learning involves the development of a broad range of skills, knowledge, and, particularly, attitudes that can be and should be fostered in both formal and informal learning environments.
- Learning involves a social construction of knowledge. (Berge, 1998, p. 32)

He then listed eight guiding principles for WBI design and categorized them into three groups (Berge, 1998).

- **Pedagogical**
  - Define/describe and list the purpose(s) for each activity, level and type of social and instructional interactivity, and feedback that is desired.
  - Define the levels of teacher-control, guided-teacher-control, student control and group-control that are desired regarding each activity.
  - Density of content should be inversely related to the amount of synchronous communication within the Web-based educational learning environment.
- **Technical/support**
  - Recognize that while on-line environments such as the Web permit multiple-media, currently text and graphics are the easiest to use.
  - Use the principle of technological minimalism.
  - Adequate technical support and training for both student and instructor is essential.

- **Social**

- An important goal of web-based learning is the creation of an environment of co-operation and trust among students and the instructor.
- In general, synchronous communication is more expensive than asynchronous. Still, both synchronous and asynchronous modes of communication are important web-based tools in teaching and learning (Berge, 1998, p. 33).

First of all, among all of Berge's guiding principles, some of them seem to be rather descriptive and lack detailed instruction or action to tell practitioners what to do and how to do it. For example, the guideline "Density of content should be inversely related to the amount of synchronous communication within the Web-based educational learning environment" does not include further instruction about "how to do it." This guideline is also considered to be somewhat product-oriented, as a more process-oriented guideline would be "Analyze the density of content to be taught within the Web-based learning environment." The other descriptive guideline is "Recognize that while on-line environments such as the Web permit multiple-media, currently text and graphics are the easiest to use." Also, since this is a general-purpose WBI design guidance system, some of the guiding principles tend to be general or imprecise. For example, the second principle in the pedagogical group can also be an ISD principle and not specifically a WBI design principle. There are many different genres of WBI courses. Some WBI courses are more like on-demand CBI (Clark, 1996) or CMI delivered via the Web. Whether all WBI courses require social activities as Berge suggested (in his assumption) is debatable. It will be beneficial to improve these guiding principles in a specific context based on formative research.

### **Welsh's Event-Oriented Design (EOD) Model for WBI**

As Welsh (1997) pointed out, "those designing instruction that uses the Web as the primary means of communication between class participants need instructional development models that take into account the current and future capabilities of the Web, as well as its evolving limitations" (p. 159). Welsh first mentioned that any instructional design model for WBI must meet the following criteria:

1. It must be systematic, and therefore useful as a standard online course development methodology.
2. It must be adaptable to different educational disciplines and to differing pedagogical orientations.
3. It must be technology independent, incorporating technologies in wide use for instruction, as well as new technologies such as the Web.
4. It must be useful in traditional contexts so faculty can recognize the benefits of the design approach in instructional contexts other than WBI (Welsh, 1997, p. 160).

According to Welsh (1997), the EOD model involves consideration of three elements that draw from the fields of distance education and instructional design. These three elements are "asynchronous vs. synchronous learning, specification of performance objectives and the determination of instructional strategies for meeting objectives, and specification of information technologies best suited to meet instructional goals in distance contexts" (p. 160).

In the EOD model, first a course is conceptualized as a series of individual modules. Each module is comprised of a series of instructional events, each of which results in students meeting specific performance objectives. In summary, designing for WBI using the EOD model involves the following steps:

1. Specify instructional goals and performance objectives of the course using traditional instructional design methods.
2. Sequence performance objectives and chunk them into a series of instructional modules, each of which results in students meeting objectives. While instructional modules need not be equal in duration or scope, parallel structuring can establish a comfortable rhythm for the students and instructor.
3. Divide each module into a series of instructional events
4. For each event, specify event types: full synchronous, limited synchronous, or asynchronous.
5. For each event, specify appropriate Web-based technology to enable the event. Care should be taken to choose only from Web-based technologies available to the instructor and all students.
6. For each event, develop Web-based content where needed and define procedures that ensure smooth completion of the event.
7. Engage in formative evaluation and pilot testing as necessary to verify that each event, as well as the course as a whole, is robust pedagogically and procedurally (Welsh, 1997, p. 162-163).

Although Welsh (1997) does not define what he means by "parallel structuring," according to this article (Welsh, 1997), he was referring to the sequencing and chunking of the course modules (e.g., similar sequencing

structure, duration, or scope for each instructional module). While Welsh's EOD model tries to model WBI after traditional classroom-based instruction, I agree with other scholars (Khan, 1997; Relan & Gillani, 1997) that WBI may have the potential to be more flexible and powerful (e.g., more individualized or personalized instruction) than traditional classroom-based instruction. Also, although ideally it would be great to have a guidance system that is adaptable to different educational disciplines and to differing pedagogical orientations, this is a goal that cannot be easily achieved. To be more adaptable to different educational disciplines and to differing pedagogical orientations, a guidance system sometimes tends to be more general and lack specifics and details for a certain context. The EOD model can also benefit from formative research and more case studies for further improvement.

### **Gibson and Herrera's Case Study**

Gibson and Herrera (1997) did a case study "How to go from classroom-based to online delivery in eighteen months or less: A case study in online program development." They described how a traditional undergraduate classroom-based course was redesigned to online delivery and the several stages of design and development. This study provided the following recommendations (guidance) for the WBI design and development process:

1. Decide upfront if your goal is to simply put some courses online or to design an entire online program. If the former, the resources needed are much less. If you are not sure whether your faculty or administration or even your technical system will support an online program, start by developing a few courses and offering them to current students
2. Use an existing course of studies, hopefully one that you have had much success with so that you are not doing curriculum development and learning how to teach online at the same time.
3. Identify enthusiastic faculty champions right away. Faculty support is the most important element; you cannot succeed without it. We recommend that you choose only full-time faculty at the outset; bringing in outsiders will forever diminish the status of the program to "continuing education."
4. Allocate the financial resources to pay your faculty developers. Online development is very time consuming, and although you are providing new, marketable skills to the faculty participants, there is an opportunity cost to them.
5. Treat your developers as a team; hold frequent meetings. They need to share ideas and help each other stay focused. There is much frustration during the learning curve. Reinforce their work and recognize their accomplishments at every opportunity.
6. Make sure that technical support is readily available to faculty and students. This includes having the right software and hardware provided to faculty and, most importantly, having technical people ready to help the faculty whenever they may need it. Build in this same level of technical support for students when the classes begin.
7. Do whatever you can to assure that your university has an adequate online library. Students taking online classes are doing so for the freedom from logistical boundaries. The online library services, for example, provide students immediate access to a wide variety of full-text journals as well as e-mail, fax and regular mail access to everything else. (Gibson & Herrera, 1997, p. 5)

Compared to Berge's and Welsh's guidelines, Gibson and Herrera's guidelines are more detailed and specific, but also more situational. For example, if a WBI course is focusing on drill and practice (e.g., CMI delivered through the Web), it might not need to have an online library. Some of these guidelines (e.g., number seven) are also more product-oriented. These guidelines can benefit from further evaluation, and improvements can be made to provide more guidance.

This review of literature reveals that current guidance systems for WBI design and development are too general and lack detailed guidance. Some of the guidelines are also descriptive and do not offer detailed instructions about how to "do" it. For a practitioner who wants to create a WBI course in the context of music education at pre-college level, the general guidance systems reviewed above simply cannot provide sufficient guidance. Therefore, these general guidance systems can benefit from more empirical case studies for further refinement and improvement, especially for a specific context.

## **Methodology**

### **Phase I: Synthesis of WBI Design and Development Guidance Systems**

There were two phases in this study: an initial synthesis which focuses on theory creation, and formative research which focus on theory improvement. During the phase of initial synthesis, all of the guidelines from

different WBI design and development guidance systems were kept in their original form but were organized into four categories: technology, pedagogy, implementation, and others. Similar guidelines were also grouped together for easier comparison. The initial organization was suggested by one of the developers to facilitate the brainstorming process during the formal interview sessions. This organization later was revised (as suggested by Reigeluth) based on chronological order as we thought this would help the practitioners more.

## **Phase II: Naturalistic Formative Research Study and Rationale**

The purpose of this phase was to try to suggest improvements for the synthesized guidance system based on the empirical evidence gathered in a single case study, the context being in the teaching of music fundamentals at the pre-college level. The formative research methodology was chosen. Formative research is a type of developmental research or action research that is intended to improve a design theory for instructional practices or processes (English & Reigeluth, 1996; Reigeluth & Frick, 1999). It was originally derived from formative evaluation, which has the primary goal of improving an instructional product while it is being developed in order to achieve the objectives for which it was designed (Beyer, 1995; Dick & Carey, 1996). Reigeluth and Frick (1999) further point out that “for an applied field like education, design theory is more useful and more easily applied than its descriptive counterpart, learning theory” (p. 633). The focus of formative research, therefore, is to improve a design theory (instructional theory) and to provide detailed prescriptive guidance.

## **Results**

After comparing and triangulating the developers’ comments with other data sources plus my own synthesis and observations, a revised set of guidelines was generated. This revised set of guidelines was then sent to each developer for further comments and elaboration. Some of these guidelines were shifted to different phases based on developers’ further comments, but no new guidelines were added. The following guidelines are the final results. Note that “New” stands for new guideline generated from the formative research, “Mod” stand for modified guidelines (from original source), and “Orig” stand for original, unchanged guidelines.

### **[Analysis and Planning Phase]**

- Evaluate all possible instructional solutions. (New)
  - Conduct a survey to see if other schools have similar instructional problems and see if they already found a good solution to the problem.
  - If other schools have found a good solution, evaluate their solution to see if it fits into your own situation. If no schools have a good solution, evaluate other possible solutions.
  - Justify the technologies or solutions you choose.
  - Analyze cost/benefit issues beforehand.
- Assess the readiness of the community. (New)
  - Make sure that the intended audience has the proper equipment and Internet connections to access the WBI course.
  - Make sure that the intended audience will accept WBI as an instructional approach.
  - Make sure that the host institution has the proper network infrastructure to support the WBI course.
- Secure in advance the financial resources to pay your developers. (Mod)
  - Develop a detailed budget to accurately anticipate costs.
- Get support from faculty members and other stakeholders. (Mod)
- Identify enthusiastic faculty champions right away, and get them involved with the project. (Mod)
  - Choose only full time faculty at the outset.
- Decide upfront whether to implement an entire course online or just selected lessons. (Mod)
- Use an existing course of studies for your curriculum development if possible. (Mod)
- Start by developing small modules and test them at early stages of development. (Mod)
- Conduct a task analysis, and list all required tasks in as much detail as possible. (New)
- Treat your developers as a team; hold frequent meetings. They need to share ideas and help each other stay focused. There is much frustration during the learning curve. Reinforce their work and recognize their accomplishments at every opportunity. (Orig)
- Make sure that the project director knows about current computer/web-based technology. If not, find an interface person who can explain things to the director and act as a bridge. (New)

- The project director should be one of the developers or part of the development team if possible. (New)
- Make sure that all developers are familiar with the content and have experience teaching with the content area if possible. (New)

#### [Design Phase]

- Write down your instructional objectives in detail and list resources required. (Mod)
- When possible, use an existing course as a model to develop your instructional modules to speed up the design process. (Mod)
- Conceptualize a course as a series of individual modules, with each module comprised of a series of instructional events. (Orig)
- Sequence performance objectives and chunk them into a series of instructional modules, each of which results in students meeting objectives. When possible, employ *parallel structuring* to help establish a comfortable rhythm for the students. (Orig)
- For each event, specify appropriate technology to enable the event. Care should be taken to choose technologies available to all students. (Mod)
- Create a safe, non-threatening, and reliable online learning environment for the learners.
  - Make sure the learners feel comfortable performing at an early stage of learning.
  - Use early encouragement and reassurance to help the learner feel comfortable about making initial mistakes.
  - Build up trust between learners and the online learning system. The system should be reliable enough so that students can trust the online learning technology and don't have to worry about losing their completed tasks.
- Engage in formative evaluation and pilot testing as necessary to verify that each event as well as the course as a whole is robust pedagogically and procedurally. (Orig)
- Define/describe and list the purpose(s) for each activity level and the type of social and instructional interactivity and feedback that is desired. (Orig)
- Define the levels of teacher/computer control, student control, and group control that are desired regarding each activity. (Mod)

#### [Development Phase]

- Build up a knowledge-sharing and proactive working culture and promote innovation in your development team. (New)
- Evaluate and choose adequate course authoring/development tools at early development stages. (New)
- Hire courseware developers who are familiar with the course authoring/development tools you choose. (New)
- Build a simple group Intranet to share design documents among team members. (New)
- Use an Instant Messenger program (or other communication tool) when necessary for better team communication. (New)
- Subscribe to or monitor newsgroups/listservs of the development tools you are using. (New)
- Make sure that staff engagement and commitment are happening in your team, as it is very important to the success of the WBI design and development process. (New)
- Use the minimum technology required to achieve the instructional objectives. (Mod)
- Keep the online media (e.g., multimedia files) size as small as possible. (Mod)
- Develop a sub-system in your WBI to capture each student's problem solving process. This sub-system should be able to: (New)
  - Keep a history of students' correct answers.
  - Determine if mastery has been reached. The mastery criteria can be made of three parts:
    - A minimum number of problems that must be attempted
    - A maximum history list length (often the same as minimum number of problems to try)
    - A minimum percent correct of the problems being counted.
- Test your prototype on multiple platforms and browsers at early stages of development. (N)
  - Be aware that web pages on different browsers and different platforms can look very different.
  - Identify any cross-platform compatibility problems as early as possible.

- Provide adequate technical support for students in a Web-based instruction environment. (N)
  - Provide email or telephone technical support to answer students' technical questions.
  - Build up a knowledge base for the most frequently asked technical questions.

## Conclusions and Recommendations

### Conclusions

It was not possible to examine all aspects of WBI design and development guidelines and generate a perfect guidance system by synthesizing several general WBI design and development guidance systems and analyzing empirical evidence in a single case study. Therefore, this study is just a beginning, and more studies are needed to further confirm and elaborate the findings in this study.

First, as Powell (2000) mentioned:

Choosing Internet technologies to deliver training should occur only after careful consideration of a number of factors. These factors include what is taught, who is taught, where the learning takes places, how the teaching is supported, and when the teaching takes place. (p. 1)

Schools that are interested in WBI should analyze every possible solution before making the decision, as WBI might not be the best solution in a lot of situations and learning domains. Most of the media choices are done not for instructional purposes, but for implementation purposes (Powell, 2000).

Every WBI needs to be supported by instructional theory. Kulp (1999) identifies three instructional models and relates each to the learning objectives for which it is best suited (see Table 2).

	Instructional Model	Learning Objectives	Learner Activity	Collaborative?
1	Instructor centered	Information transfer	Passively receiving	No
2	Learner centered	Skill acquisition	Actively interpreting, practicing, questioning, challenging, discussing	Yes
3	Learning team centered	Mental model change	Collaboratively creating new knowledge	Yes

*Table 2: Instructional models and learning objectives (Kulp, 1999)*

According to Kulp (1999), the most common genres in WBI courses are learner-centered topics. Students interact with material in the course web site in somewhat the same way they would with a computer-based training (CBT) self-study course (Kulp, 1999). They actively interpret information and experience in order to create new knowledge or build new work products of some type. Based on this assumption and Gordon's "Music Learning Theory," we can hypothesize that most of the guidelines supported by this case can also be useful in creating other skill-based WBI courses, although more research is needed to confirm this hypothesized generalization. For other skill-based pre-college remedial WBI courses, the guidelines provided in this study might also be useful.

Secondly, in this study, not many guidelines were rejected. This indicates that most guidelines were useful based on the empirical evidence for this case. Some guidelines were refined to better fit in with this context of creating a WBI course at the pre-college level. One of the major findings in this study is additional guidelines and further elaboration of the original synthesized guidance system in this specific context. Also, some "holes" in the original synthesized guidance system were found, and new guidelines based on the experience from this case study were identified to fill those holes. But note that in a single case, there can be no evidence for further generalization; therefore the results cannot be generalize beyond this case. Only hypothesized generalizations can be offered, as mentioned above.

Finally, As Reigeluth and Frick (1999) pointed out:

It should be patent that the development and testing of design theories is not a one-trial endeavor. It is a matter of successive approximations. Such theories continue to be improved and refined over many iterations (p. 635).

Further studies are needed to further refine and elaborate the findings generated in this study.



## Recommendations

The recommendations in this study fall into two categories: recommendations for future WBI practitioners and recommendations for further study. For developers, I recommend to apply guidelines supported by this study that best fit in with your own project and to apply them with caution. Even though I pointed out the contextual influence, and the elaborated and new guidelines in this study look promising, this is just one case study. For a single case study, generalization can't really be made beyond the context of music fundamentals instruction because of lack of other research to support those generalizations. Further studies are needed to confirm those findings before we really have confidence in their generalizability.

Further study is recommended to continuously elaborate and refine the WBI design and development guidelines for the context of teaching music fundamentals at the pre-college or college level. As this study only covered the design and development phases, there is still plenty of room for further elaboration and refinement in this context, especially to include guidelines for the implementation and evaluation phases. Secondly, I recommend future research to address other learner age groups and the content areas. For example, WBI might be a good solution/medium for pre-college or college learners, but how about younger or older learners? Also, how about other types of music courses such as music history or advanced music theory courses? Will the WBI design and development guidelines concerning these different content domains or age groups be different from the guidelines provided in this study? Further research in this area can help us get a sense of the generalizability of the guidelines supported by this study. Finally, the product of the MFO project--the WBI course--also needs some research. At the time of this writing, the MFO team was just about to start their larger-scale final beta testing of its prototype and will have more revisions in the future. So further formative research on the ongoing MFO project is highly recommended to generate product-oriented guidelines. This is an important part of my research agenda for the near future. Other recommended product-oriented research directions include:

1. Learning styles and WBI: Learning styles deal with characteristic styles of learning. Kolb (1984) proposes a theory of experiential learning that involves four principal stages: concrete experiences, reflective observation, abstract conceptualizations, and active experimentation. He also postulates four types of learners: assimilators, divergers, convergers, and accommodators. For example, Kolb (1984) points out that an accommodator prefers concrete experiences and active experimentation. Pask (1988) also has described two learning styles: serialist and holist. According to Pask (1988), serialists prefer to learn in a sequential fashion, whereas holists prefer to learn in a hierarchical manner. As WBI is more flexible and powerful in the way that it can provide more *individualized* or *personalized* instruction, it will be interesting to conduct research to investigate what kind of instructional strategies or approaches would be most effective in a WBI product and their relationship with different cognitive and learning styles.
2. Music aptitude and WBI: In the past, musical ability was often viewed in all-or-none terms: some are blessed with "talent," others must do without. Recent research (Gordon, 1993; Baney, 1999), however, reveals that music aptitude, like all human characteristics, is normally distributed in the population. Relatively few have high aptitude, a similar number have low aptitude, and the majority of persons fall somewhere in the middle of the "bell curve" with average aptitude. In another words, most persons have the potential to achieve in music. It will be interesting to see how people with different music aptitudes interact with Web-based courses such as MFO. More research is recommend to find out the relationship between music aptitude, music learning theory (Gordon, 1997), and WBI.

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# Concept Learning Through Image Processing

Lauren Cifuentes  
Yi-Chuan Jane Hsieh  
Texas A&M University

## Abstract

*This study explored computer-based image processing as a study strategy for middle-schoolers' science concept learning. Specifically, researchers examined the effects of computer graphics generation on science concept learning and the impact of using computer graphics to show interrelationships among concepts during study time. Educators are encouraged to prepare learners to use computers to visualize concepts during study time. An orientation to visualization skills can prepare students for using visual techniques to represent interrelationships among concepts.*

## Background and Theoretical Perspective

Computer graphics software such as AppleWorks™ and PhotoShop™ have become pervasive in today's schools. Such software allow students to access a variety of tools that help them draw and paint objects to visually organize and represent what they know. Student-generated interpretative illustrations can help clarify the profound concepts expressed in texts and facilitate the comprehension of abstract concepts. When students are able to manipulate images during knowledge construction, they tend to engage more in the meaning-making process and understand and remember concepts better than through the traditional transmission approach of instruction (Jonassen, 2000). Additionally, students' graphic representations of what they know, can provide products for teacher feedback.

One approach for knowledge construction commonly used by students is concept mapping (Anderson-Inman & Ditson, 1999). Concept mapping refers to the "process for representing concepts and their relationships in graphical form, providing students with a visually rich way to organize and communicate what they know" (p.7). Research has suggested that students can study efficiently by generating concept maps (Anderson-Inman & Zeitz, 1993). Also, Cifuentes (1992) found that students who visualized interrelationships among concepts in their hand written study notes performed significantly higher on a test ( $p = .02$ ) than those students who did not show such interrelationships. Concept mapping can be fostered through computer-based software such as Inspiration™. Additionally, images can be manipulated to show interrelationships with image-processing software such as AppleWork's™ drawing and painting tools. These visualization tools can be regarded as "mindtools" to extend and reorganize learners' cognitive structures during learning (Jonassen, 2000). Learners can use graphic conventions for organizing their thoughts as they construct knowledge of concepts (Dodge, 1998). Computer-generated graphics created by learners offer several advantages over pen and paper such as ease of subsequent revision and generation of sophisticated looking graphics by students with undeveloped artistic skill.

## Objectives

This study explored computer-based image processing as a study strategy for middle school science concept learning. Specifically, researchers examined the effects of computer graphics generation on science concept learning and the impact of using computer graphics to show interrelationships among concepts during study time.

## Methods

The 87 students engaged in this study were volunteers taking junior high school science classes at a rural, public, junior high school. They had previous skill with AppleWorks™ draw and paint software.

Quantitative and qualitative methods were used to investigate the research topic. Potential participants were the entire 7<sup>th</sup> and 8<sup>th</sup> grade student body of a rural school in Texas. However, some of those students did not turn in consent forms, some were absent for part of the treatment, and others were absent for testing. Therefore, 87 students participated in the complete study. Science classes were randomly divided in half from both the seventh and eighth grades so that approximately half of the student body were assigned to the control group ( $n = 46$ ) and approximately half of the student body were assigned to the experimental group ( $n = 41$ ). The groups were comparable across age, gender, and ethnicity. The control group consisted of 50% seventh graders and 50% eighth graders. 59% were male

and 41% were female. 54% percent were Caucasian, 24% percent were African-American, and 22% percent were Hispanic. The experimental group consisted of 44% seventh graders and 56% eighth graders. 49% were male and 51% were female. 51% percent were Caucasian, 34% percent were African-American, 10% percent were Hispanic, and 5% identified themselves as a mixture of races. Participants were assigned to one of two groups, one receiving treatment and one for control, in a post-test-only-control-group design. Posttest scores were compared across groups. In addition, student's study strategies were compared qualitatively to help explain the impact of graphics on learning. The four data sources included: (a) immediate recall test, (b) students' study notes, (c) students' computer files, and (d) a Web-based "Study Strategies Questionnaire".

*Quantitative aspect:* All participating science courses were placed in a hat and drawn to randomly assign them to the two treatment groups:

- ◆ **Control group**-- received print-based, verbal material on a science concept (General Properties of Matter) and were given 50 minutes for unguided, independent study prior to the test. Students had access to computers during study time. At the end of the 50 minutes students kept both their study notes and reading material. The next day, and prior to taking the test, students handed in their study notes.
- ◆ **Experimental group**—participated in a workshop consisting of three 50-minute training sessions on how to manipulate and generate computer graphics during study time using materials developed by the researchers in AppleWorks™, Photoshop™, and PowerPoint™. They then received the same print-based, verbal material that the control group received. It was on a science concept (General Properties of Matter) and students were given 50 minutes to study prior to a test. At the end of the 50 minutes students kept both their study notes and reading material. The next day, and prior to taking the test, students handed in their study notes.

The three 50-minute workshop sessions on how to manipulate and generate computer graphics during study time had the following objectives: for students to be able to (a) recognize underlying structure of text (interrelationships), (b) illustrate underlying structure, (c) relate new concepts to prior knowledge, (d) highlight distinctive features, and (e) use graphics for review. The researchers facilitated the workshop. They modeled visualization of concepts using 7 underlying structures, gave the students a turn with each of the 7 underlying structures, modeled direct representation of concepts and highlighting distinctive features, gave the students a turn with direct representation and highlighting, and gave students 15 short texts to visualize. They encouraged students to keep their graphic representations and use them for study and review.

After taking the immediate recall test, participants filled in a Web-based "Study Strategies Questionnaire" that asked them to rate the extent that they had previously been exposed to the information in "General Properties of Matter?" To determine if groups varied in their prior knowledge of the textual material, a t-test was conducted. No difference was found. The questionnaire also asked students to describe in detail the steps that they took to prepare for the test. The testing instrument for immediate recall contained 30 multiple-choice items. All students took the immediate recall test at the end of their 50-minute study to determine the effects of the experimental treatment.

In addition, all participants' study notes and printouts of computer graphics were collected. Participants were asked on the Web-based survey to describe in detail the steps that they took to prepare for the test. The researchers rated the participants as visualizers or nonvisualizers based upon the students' study notes and study strategies reported on the survey. We classified students as visualizers if they used the computers to construct visuals while they studied for the test and/or reported that they highlighted or drew while they studied. We classified students as nonvisualizers if they did not create visuals or highlight during study. The effects of treatment and application of visualization during study time on immediate recall were then estimated by comparing scores using planned contrasts in a general linear model.

The design avoided effects of initial bias, previous testing, maturation, instrumentation, regression, selection, and mortality because groups were randomly assigned and were not pretested.

*Qualitative aspect:*

We applied content analyses approaches, as described by Emerson, Fretz, and Shaw (1995), to the study notes, computer files, and survey results. During and upon completion of data collection, we used the two-phase process of content analyses, open coding and focused coding.

## Results

The ANOVA revealed a negative treatment effect. The control group performed better than the experimental group and there was no statistical difference between the scores of visualizers and nonvisualizers. In addition, there was no interaction between group and strategy on students' performance.

In this case, computer-based image processing was not an effective study strategy for science concept learning. Middle school students were unable to identify or represent underlying structure. They claimed that visualization was too hard for them and they expressed lack of motivation. They were distracted by the computers and the fun software and were distracted by graphics tools. They spent their time creating irrelevant images and generated visuals that involved inefficient use of time.

The students who received the workshop in visualization as a study strategy did not perform better on the test on "The General Properties of Matter. Several environmental factors affected the impact of the workshop. Workshop time was insufficient and students had difficulty internalizing the visualization as a study strategy while they studied. Students were unable to manage their time for studying the entire text and meanwhile draw meaningful visuals to foster their understandings.

In addition, the students who visualized concepts while studying did not perform better on the test. They often spent time visualizing what they already knew rather than grappling with a new concept. The visuals generated by students were often inappropriate or misrepresented concepts and therefore could not facilitate concept learning (see Tables 1 and 2).

*Table 1*  
*Descriptive Statistics for Groups*

Group	Strategy	Mean	Std. Deviation	N
<b>Control</b>	<b>Nonvisualizers</b>	14.11	5.48	36
	<b>Visualizers</b>	14.00	4.57	10
	<b>Total</b>	14.09	5.25	46
<b>Experimental</b>	<b>Nonvisualizers</b>	10.33	4.56	18
	<b>Visualizers</b>	13.30	3.30	23
	<b>Total</b>	12.00	4.13	41
<b>Total</b>	<b>Nonvisualizers</b>	12.85	5.45	54
	<b>Visualizers</b>	13.52	3.67	33
	<b>Total</b>	13.10	4.84	87

Table 2  
ANOVA for Effects of Treatment and Visualization

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Group	88.230	1	88.230	3.996	.049*
Strategy	36.061	1	36.061	1.633	.205
Group * Strategy	41.883	1	41.883	1.897	.172
Error	1832.425	83	22.077		
Total	16954.000	87			

R Squared = .091 (Adjusted R Squared = .058) \* significance  $p \leq .05$

We delivered the workshop in a naturalistic, rural school setting. Therefore, many unexpected environmental occurrences affected the delivery of the workshop. For instance, we encountered electrical failure in the projector, and were unable to model visualization processes on the presenter computer. We had to adopt “plan B” and use overhead transparencies. Of course, this meant that we were unable to model using graphics tools for visualization. All during the workshop, electricians and teachers came in and out of the computer lab to address the technological problems, or students would ask to go to get water or go to the restroom. Some students talked and visited with each other rather than focus on learning and some did not participate in parts of the workshop because of illness, extracurricular activities, or loss of interest. Additionally, the arrangements of the projector and students’ workstations (chairs, tables, computers) were so inharmonic that students’ positions had to shift to look at the presenter, projected images, and their computer screens alternately. Furthermore, because several computers in the lab were out of order, many students had to share computers with each other. Similarly, access to printers was limited. Only four out of the twenty computers were connected to the classroom printer, which made the preservation of students’ work difficult. Students could not incorporate Web graphics into their visualizations because none of the computers were connected to the World Wide Web.

Moreover, the middle schoolers were extremely distracted by the software on the computers, especially the multimedia authoring software. Students tended to easily create sounds and irrelevant images on their computers. In addition, the 7th and 8th grade students spent a lot of time generating playful graphics or visuals that did not help them build their understandings. They did not make good use of their time for studying the entire assigned text. They tended to take the fun and easy route by visualizing what they already knew rather than grappling with a new concept. Several students said that they found identifying the underlying structure of the text to be quite difficult and we found that most students were often unable to create appropriate representations of new concepts. Most students were either unwilling or incapable of thoroughly and accurately representing texts. When, for instance, they were asked to represent the periods included in the Mesozoic Era, one student neglected to draw arrows in her timeline to indicate continuity and did not include the Mesozoic Era in her graphic. She also placed the periods in the wrong order on the timeline indicating her lack of understanding (see Figure 1). Another student misrepresented the visual of an iceberg. He was enthusiastic about drawing an iceberg, but ignored the text’s main idea that only a small part of an iceberg is above the waterline and the rest of an iceberg is under water (see Figure 2).

Text to visualize: The Scientists divide the Mesozoic Era into three periods. The oldest period is called the Triassic Period. The middle period is called the Jurassic Period. The youngest period is called the Cretaceous Period.

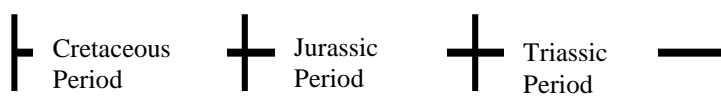
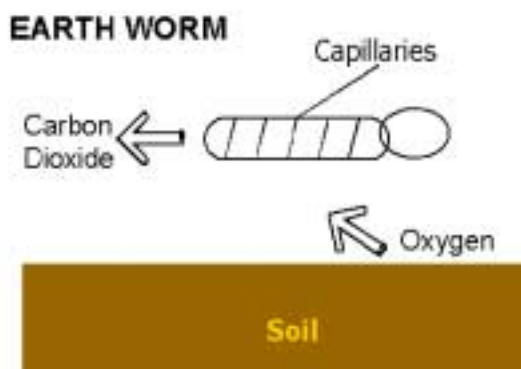


Figure 1. The misrepresentation of chronological information.



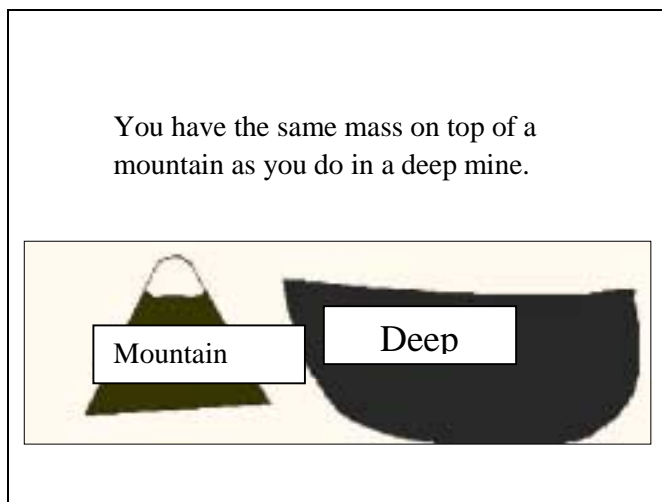
*Figure 2. The misrepresented concept of icebergs.*

On the other hand, some workshop participants successfully identified and visualized the underlying structure of the text they were studying. For instance, most students were able to successfully represent the sequence of the moon phases as well as chronology of periods within eras. Also, many students were able to directly represent concepts. For instance, one student generated a direct representation of how the earthworm breathes (see Figure 3).



*Figure 3. Student-generated visualization of the earthworm's respiratory process.*

In general, the processes of identification of the underlying structure of concepts presented in texts and subsequent creation of visual representations associated with those concepts required a lot of time and effort from students. Such strategies facilitate memory because they involve the learner at a high level of cognitive processing by demanding extensive learner-effort. The visualization process helped most of our participants think hard about what they needed to learn, and learning that was not measured on the test resulted from such thinking. When students were able to extract meaning from text and generate representative images, they built their complete understandings. For example, as one student tried to understand that weight of an object changes according to altitude, but that mass remains the same, he generated a computer graphic accurately conveying an object with the same mass on a mountaintop and in a deep mine. Such kinds of visualizations concretized what students cognitively comprehended, and helped them clarify meaning of science concepts (see Figure 4).



*Figure 4. Student-generated computer graphic*

### **Educational Significance**

We discovered that learner generated graphic representations of concepts provided a rich resource for the students' teachers. Representations of learner's understandings provided teachers with a way of knowing whether or not students grasp concepts. Teachers suggested that if students can not visualize the concept, perhaps they don't thoroughly understand the concept.

In summary, we delivered a visualization workshop designed to help learners use computer graphics to construct meaning while they study. When delivering visualization workshops in the natural setting of schools, problems are bound to arise. Technical failure, human interruptions, lack of active participation, limited access, distraction by alternate tools or games on computers, and differences in learners' abilities each affect the success of a workshop. Middle schoolers are unsophisticated learners and require guidance toward effective visualization. In our workshop, in spite of problems associated with the natural setting of a school, students engaged actively in the meaning-making process of studying while we provided scaffolding. Students who successfully formulated mental representations of concepts and then concretized those representations as computer graphics applied a strategy for spending time thinking in order to learn.

Still, they require cognitive apprenticeship and expert modeling of identifying the underlying structure of concepts. Given the 3-day workshop, students were unable to internalize the visualization methods as part of their study strategy. Most students were cognitively not ready to generate meaningful computer graphics while they study the textual information. They were more likely to highlight the important points by typing those words or sentences on computer than producing visuals concretizing those concepts. Middle schoolers might need extensive practice in constructing their own concept representations while receiving expert feedback regarding their appropriateness.

The 7<sup>th</sup> and 8<sup>th</sup> grade students who participated in our workshop were not sophisticated visualizers. They needed expert modeling of identifying underlying structure of texts. It is essential to have all students engaged in the diverse practice of constructing their own concept representations while receiving expert feedback regarding their appropriateness. Additionally, the instructor should teach students in the sequence of increasingly complex tasks. When the learning task becomes more and more difficult for students to handle independently, the aids of peers and the close scaffolding of the instructor are of great importance.



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# A Connectionist Model of Instructional Feedback Effects

Roy B. Clariana  
Pennsylvania State University

## Abstract

*This experimental investigation provides empirical support for the potential of a connectionist approach to predict instructional feedback effects. Posttest data from high school students is compared to values predicted by the delta rule. Results and implications are provided.*

Learning involves the interaction of information provided by instruction with existing information already in the learner's memory (Ausubel, 1968; Bruner, 1990). When a learner commits to a lesson response, that response reflects the learner's immediate understanding of that instructional instance, thus initial lesson response (ILR) provides a measure of a learner's existing information.

Describing what happens to memory traces of ILRs that are errors is necessary for determining whether errors interfere with attaining correct responses, and so is one key to understanding how feedback works. Clariana (1999) has suggested that a connectionist approach using the delta rule can be used to predict posttest memory activation levels of ILR errors and of correct responses for immediate and delayed feedback. This investigation provides data that supports his approach. But first, what is a connectionist approach?

## Connectionist Description of Feedback Timing Effects

Connectionist models apply various mathematical rules within neural network computer simulations in an effort, among other things, to mimic and describe human memory associations and learning. The theory includes several families of models, such as simple feedforward networks, pattern associators, multi-layer networks with backpropagation, competitive networks, and recurrent networks, that differ slightly in how the nodes of the network are interconnected, but which differ greatly in the kind of processing that they are able to do (see McLeod, Plunkett, & Rolls, 1998, for more detail). Neural networks have been shown to be capable of pattern matching, pattern completion, retrieval by content, recognition, prototype extraction, and classification to name a few (Haberlandt, 1997).

For example, Seidenberg and McClelland (1989) trained a computer neural network to read aloud all English monosyllabic words (about 3,000 words). After 250 training epochs, the model could correctly pronounce 97% of the 3,000 words in the training set. This neural network was able to accomplish this task without a local lexical store and more importantly without being given a set of rules. Elman (1993) trained a neural network with sentences rather than words, and was able to show that the network could satisfy long-distance grammatical dependencies (matching syntax). Plunkett and Marchman (1993; 1996) have modeled early lexical development which parallels that observed in children. Their neural network model that produces past tense forms of regular and irregular verbs has challenged the language acquisition orthodoxy that language learning depends on both innate pre-wiring of the system and on learning symbolic rules of the language.

Among a number of connectionist learning rules, the delta rule (Shanks, 1995; Widrow & Hoff, 1960) is one of the simplest and most common that includes the effects of feedback on learning. The delta rule describes the change in association weight, termed  $\Delta w$ , between an input unit and an output unit at each learning trial, as:

$$\Delta w_{io} = \alpha a_{in} (t_o - a_{out})$$

where  $\alpha$  is the learning rate parameter,  $a_{in}$  is the activation level of input units,  $t_o$  is the desired response (the  $t$  refers to "teacher", in this case  $t_o$  is item feedback), and  $a_{out}$  is the activation level of the output units (Shanks, 1995). In instructional terms, learning is an increase in association, that is, an increase in  $\Delta w_{io}$  between the stimulus ( $a_{in}$ ) and the correct response ( $a_{out}$ ), with a relative decrease in association, that is, a decrease in  $\Delta w_{io}$  for incorrect responses.

To apply the delta rule in this study, following Clariana (1999), this investigation assumes that lesson average item difficulty values are reasonable estimates of the association weights of the correct responses. Item difficulty ( $p$ ) is defined as the proportion ( $p_g$ ) of individuals who answer an item ( $g$ ) correctly (item difficulty notation convention from Crocker & Algina, 1986). For example an item difficulty of .20 indicates that 20% of the learners responded correctly to that item. Item difficulty values range from 0.00 to 1.00 with low values indicating difficult items and high values indicating easy items. Using lesson average item difficulty values as a group's estimate of the initial lesson item  $a_{out}$  association weight seems reasonable in that lesson item difficulty is the actual averaged probability of selecting that alternative as the correct response during the lesson for that population of

learners. To our knowledge, this is the first investigation to utilize lesson item difficulty values as a measure of input and output activation levels.

In the delta rule equation, feedback impacts learning in the term  $(t_o - a_{out})$ . Customarily, the values for  $t_o$  and  $a_{out}$  are constrained between 0 and 1 (McLeod, Plunkett, & Rolls, 1998). The value for  $t_o$  equals 1 if the activation level of the output unit matches the desired response (i.e., with correct responses) and  $t_o$  equals zero if the activation level of the output unit does not match the desired response (i.e., with incorrect responses). So with correct responses the association weight increases since  $(1 - a_{out})$  is positive, while with incorrect responses the association weight decreases since  $(0 - a_{out})$  is negative.

In other words, when feedback is provided as part of the responding instance, correct responses are strengthened and incorrect responses weakened. The amount of increment or decrement can be determined by the delta rule. Thus, given lesson item difficulties (initial  $a_{out}$ ), the delta rule should be able to predict posttest item difficulties ( $a_{out}$  after feedback). What values would the delta rule provide for ILRs for immediate and for delayed feedback? In the present investigation, first the delta rule would predict that for correct lesson responses, memory of ILRs and of correct responses would be strengthened in general for both immediate and delayed feedback, since  $t_o = 1$  and so  $(t_o - a_{out})$  is positive. Second, for lesson errors, the ILR association with the item stem would be weakened for immediate feedback since  $t_o = 0$  and  $(t_o - a_{out})$  is negative, but not for delayed feedback.

For delayed feedback, the connectionist model would predict that ILR errors would actually be strengthened. In associative learning in living systems, there is a small window of time while the specific input pattern is activated lasting probably less than 4 seconds (Shanks, Pearson, & Dickerson, 1989) when those associations can be strengthened or weakened. Immediate feedback provides the necessary teacher feedback information within this time frame while delayed feedback does not. Specifically, with delayed feedback, since corrective feedback is not immediately provided, the learning rule association process would act as though the error response is correct, thus strengthening the association weight of the error (see Figure 1).

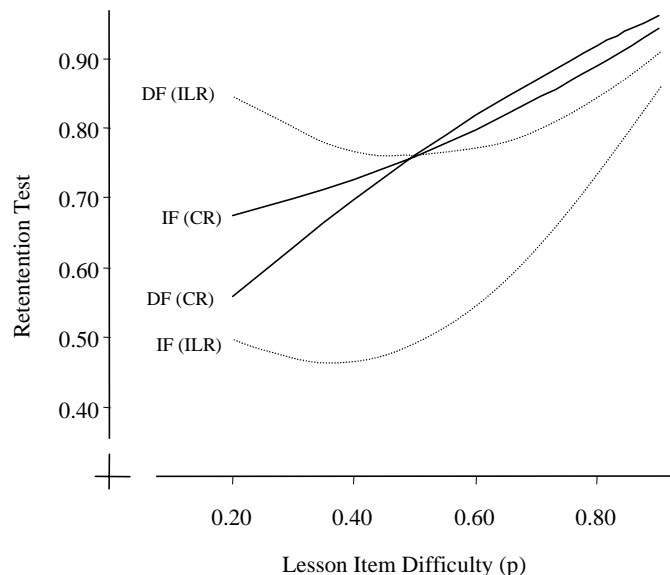


Figure 1. Predicted retention test values generated by the delta rule across a range of lesson item difficulty values (from Clariana, 1999). Predicted retention test memory of Initial Lesson Responses (ILR) are shown as dashed lines and Correct Responses (CR) are shown as solid lines for delayed feedback (DF) and immediate feedback (IF).

Based on the connectionist model of feedback timing described by Clariana (1999), several hypotheses can be stated: (1) Retention test memory of ILRs will be considerably greater for delayed feedback than for immediate feedback at all item difficulty levels (see dashed lines in Figure 1). (2) Both types of feedback will obtain the greatest lesson to posttest gain with difficult lesson items. (3) Retention test memory of correct responses will vary across the range of possible lesson item difficulty values for the delayed and immediate feedback forms, with immediate feedback slightly better than delayed feedback with more difficult lesson items and delayed feedback slightly better than immediate feedback with easier lesson items (see the solid lines in Figure 1).

In addition, it may be possible to separate any observed effects of immediacy versus multiple-exposures by including a type of feedback, multiple-try immediate feedback (MTF), which has aspects of both (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Clariana, 1993). MTF is like the more common form of immediate feedback (single-try feedback, STF) in terms of immediacy of feedback timing. But in terms of multiple explicit stimulus exposures, multiple-try feedback is like delayed feedback (DF), at least with lesson errors.

## Method

The available sample for this study included students from three high school social studies classes ( $n = 87$ ) from a small town in a northeastern state. The students were mostly sophomores, with a few juniors. A number of students chose not to participate, some were absent, a few forgot to return their signed consent forms, and three students' data were dropped due to incomplete data, yielding a final sample of 52 students. The final sample contained more females (71%) than males.

The computer-based lesson material consisted of eight reading passages and 36 five-alternative multiple-choice questions from the Nelson-Denny Reading Test, Form E (Brown, Bennett, & Hanna, 1981; with permission of the publisher). These text passages and questions were chosen based on the quality of the text and questions, their high reliability, the availability of extensive test reliability metrics, and content appropriateness for this audience. Field trials by the developers involved more than 14,000 students (Brown, Bennett, & Hanna, 1981). Currently, these materials are extensively used in the field and are readily available from the publishers.

The 36 questions consisted of 18 verbatim questions and 18 inferential questions, similar to Peeck and Tillema (1978). Verbatim questions relate directly to one proposition in the instructional text. For example, the text may say, "Daytimes Robert Browning walked with Elizabeth's little dog Flush, but he seldom could be lured from his home evenings", with the associated verbatim question, "Flush was the name of the Brownings': A. cat B. dog C. canary D. gold fish E. thrush?". Inferential questions relate to multiple propositions in the text and can be answered by considering the passage as a whole. For example, the inferential question, "The authors of this passage placed most attention on the Brownings: A. literary efforts B. personal relationship C. social contacts D. problems E. early meeting?", can be answered by considering the entire passage. Thus, inferential questions have many indirect connections to the instructional text, while verbatim questions have one or only a few direct connections to the text.

The computer-based lessons were developed in HyperCard and delivered on MacIntosh computers. The three alternative computer-based lessons were identical except for the type of feedback that was presented after the learner responded to multiple-choice questions. For all treatments, each of the eight text passages was presented in turn in scrolling text windows. After reading a text passage, the learner would respond to either four or eight five-alternative multiple-choice questions (the longer passages had more questions). The learner would then proceed to the next text passage reading the text and answering the questions at his or her own pace. Simple navigation buttons along the bottom of every screen allowed the learner to easily move back and forth between text and questions at any time.

The three alternate treatments were delayed feedback (DF), single-try immediate feedback (STF), and multiple-try immediate feedback (MTF). Note that since retention test memory of initial lesson responses is a dependent variable in this study, in order to prevent rehearsal of initial lesson responses, the final feedback screen for each item in all three treatments did not include item distractors (Sassenrath & Yonge, 1969; Sturges, 1969).

The STF treatment provided the correct response immediately after one learner response, whether the response was right or wrong. After a response, an arrow would point to the correct alternative and the learner was told "Right" when correct and "No, here is the answer" when wrong. In either case, the stem and correct answer were displayed, the item distractors were not shown. The MTF treatment provided the correct response immediately after a correct response like STF. However, with an incorrect response, the learner was told "No, try again" and continued to select answers until the correct response was selected, then an arrow would point to the correct response and the learner was told "Right". Then the stem and correct answer were displayed, the item distractors were not shown. Note that STF and MTF are identical when the learner's initial response is correct, but obviously differ when the learner's response is incorrect. The DF treatment required the learner to respond to questions and

move on without any immediate feedback. After all text passage and questions were completed, then all of the items were presented again in the original order. Only the correct responses were shown with each question, the distractors were not shown, and the student could only read the display. Thus the DF feedback screen displays were identical to the final feedback screen displays provided for STF and MTF, only the DF feedback screen displays were presented after the entire lesson rather than immediately with each item.

The purpose and requirements of the study were explained in three classes of students all taught by the same teacher. Those students choosing to participate collected consent forms to be signed by a parent or guardian. About a week later, participants moved to the school computer room during their social studies class, and were randomly assigned to one of the three computer-based treatments, STF, MTF, or DF. One day later, participants completed the paper-and-pencil 24-hour retention test in class.

The retention test given a day after the lesson was designed to measure memory of initial lesson responses and of the correct responses. This paper-based retention test used the same 36 multiple-choice items that were used in the computer-based lesson. These 36-items fell into two groups of 18 items each, verbatim and inferential. These two groups were further blocked into three categories by lesson item difficulty, easy ( $M = .87$ ), mid-range ( $M = .72$ ), and difficult ( $M = .50$ ), with each block containing six items. The associated reading passages were not made available to the students during retention testing. There were four or five questions on each 8.5- by 11-inch page. Each question had two blanks, one blank labeled “1st” for the initial lesson response and one blank labeled “C” for the correct response.

The retention test contained the following instructions, “Note that each question has two blanks. The first blank is a check to see if you can remember the first answer that you gave during the computer lesson. The second blank is for the correct response to the question.” These instructions were read aloud by the teacher. The teacher answered questions about how to complete the test, and then students were given as much time as needed to finish.

The total amount of time spent completing the lesson was also of interest. Lesson time data for each student was collected by the computer program, and included total time from the display of the first screen until the student exited the lesson.

## Results

Dependent variables were lesson time, and retention test recognition memory of initial lesson responses and of correct responses with two kinds of questions (verbatim and inferential) across three levels of lesson item difficulty (difficult, mid-range, and easy). These data were analyzed by separate analysis of variance, and probabilities were evaluated more conservatively using Greenhouse-Geisser and Huynh-Feldt corrections automatically provided by the SYSTAT 8.0 (1998) analysis package. Lesson time data and retention test means and standard deviations for each treatment group at each item kind and difficulty level are provided in Table 1.

Lesson scores were analyzed as a check of initial group equivalence. The random assignment was judged successful with overall lesson scores of 24.4 (of 36 maximum) for the STF group, 25.4 for the MTF group, and 25.5 for the DF group. The comparison of these means using analysis of variance was non-significant,  $F(1, 51) = 0.43$ ,  $p = .65$ .

Retention test data were analyzed by a mixed  $3 \times (2 \times 2 \times 3)$  analysis of variance with one between-subjects factor, feedback condition (DF, MTF, or STF), and three within-subjects factors, type of response (retention of initial lesson response and of the correct response), kind of question (verbatim and inferential), and lesson item difficulty block (difficult, mid-values, and easy). The interaction of feedback and type of response was significant,  $F(2, 49) = 7.15$ ,  $MSE = 0.023$ ,  $p < .01$ . Follow-up Scheffe' test showed that the DF treatment group mean for ILR ( $M = 0.84$ ) was significantly larger than the STF group mean for ILR ( $M = 0.73$ ), no other mean comparisons were significant.

Table 1

Lesson time data (in seconds), and lesson and retention test means and standard deviations (in parentheses) for each treatment group for each item kind and difficulty level.

Treatment	Lesson time	Item difficulty	Lesson		Retention Test			
			V	I	ILR-V	ILR-I	CR-V	CR-I
STF ( $\underline{n}$ =18)	1577 (280.6)	Difficult	0.46	0.44	0.66	0.66	0.67	0.83
			(0.20)	(0.10)	(0.18)	(0.26)	(0.22)	(0.18)
		Mid-range	0.85	0.57	0.76	0.67	0.79	0.67
			(0.07)	(0.13)	(0.18)	(0.19)	(0.18)	(0.21)
		Easy	0.92	0.82	0.87	0.78	0.91	0.84
			(0.08)	(0.11)	(0.12)	(0.18)	(0.09)	(0.12)
MTF ( $\underline{n}$ =17)	1554 (332.5)	Difficult	0.51	0.55	0.71	0.67	0.71	0.72
			(0.20)	(0.16)	(0.24)	(0.17)	(0.20)	(0.21)
		Mid-range	0.77	0.65	0.79	0.72	0.81	0.74
			(0.07)	(0.04)	(0.18)	(0.16)	(0.17)	(0.17)
		Easy	0.91	0.83	0.86	0.81	0.91	0.81
			(0.09)	(0.09)	(0.12)	(0.18)	(0.12)	(0.18)
DF ( $\underline{n}$ =17)	1899 (409.9)	Difficult	0.48	0.55	0.80	0.81	0.68	0.68
			(0.18)	(0.14)	(0.18)	(0.22)	(0.25)	(0.27)
		Mid-range	0.85	0.65	0.84	0.78	0.85	0.78
			(0.06)	(0.07)	(0.15)	(0.18)	(0.14)	(0.21)
		Easy	0.94	0.78	0.93	0.87	0.89	0.82
			(0.05)	(0.08)	(0.09)	(0.16)	(0.10)	(0.17)

Note. Lesson time is in seconds; standard deviations in parenthesis; V = Verbatim questions, I = Inferential questions; ILR = remembers initial lesson response; CR = recognize correct response; STF = Single-try feedback, MTF = Multiple-try feedback, DF = Delayed feedback. Each item difficulty range is the average of 6 items.

A significant effect was obtained for kind of question,  $F(1, 49) = 8.29$ ,  $MSE = 0.035$ ,  $p < .01$ , indicating that the verbatim retention test mean ( $\underline{M} = 0.80$ ) was greater than the inferential retention test mean ( $\underline{M} = 0.76$ ), which simply reflects the lesson values for verbatim ( $\underline{M} = 0.74$ ) and inferential ( $\underline{M} = 0.65$ ) questions. Next, a significant effect was obtained for question difficulty,  $F(2, 98) = 32.20$ ,  $MSE = 0.035$ ,  $p < .01$ . The retention test means for each item difficulty level are: easy items ( $\underline{M} = 0.86$ ), mid-range difficulty items ( $\underline{M} = 0.77$ ), and difficult items ( $\underline{M} = 0.71$ ). As with kind of question above, these retention test values simply reflect lesson values which are: easy items ( $\underline{M} = 0.87$ ), mid-range difficulty items ( $\underline{M} = 0.72$ ), and difficult items ( $\underline{M} = 0.50$ ). Though these findings are significant, they have little practical meaning.

The three-way interaction of feedback, type of response, and question difficulty was significant,  $F(4, 98) = 3.52$ ,  $MSE = 0.015$ ,  $p < .01$ . To further examine this complex three-way interaction, two separate follow-up ANOVAs of retention test data are reported below, one of initial lesson response data and one of correct response data. But first this three-way interaction is graphically compared to the delta rule predicted values (see Figure 2) to set the stage for the follow-up analyses.

Since the observed retention data shown in Figure 2 consists of multiple-choice questions, these data were corrected for guessing in order to be consistent with the predicted values. The correction for guessing formula from Nitko (1996) is corrected score =  $R - W/(n-1)$  where  $R$  is raw score,  $W$  is number wrong, and  $n$  is the number of multiple-choice alternatives. The lines showing the predicted and observed retention for initial lesson responses (left panel of Figure 2) are highly similar in both magnitude and form, suggesting that the connectionist model presented by Clariana (1999) may adequately account for 24-hour retention of initial learner responses. The lines showing the predicted and observed retention of correct responses (see right panel of Figure 2) are generally similar in shape but are not similar in magnitude. Specifically, the predicted correct response values over-estimate the observed values.

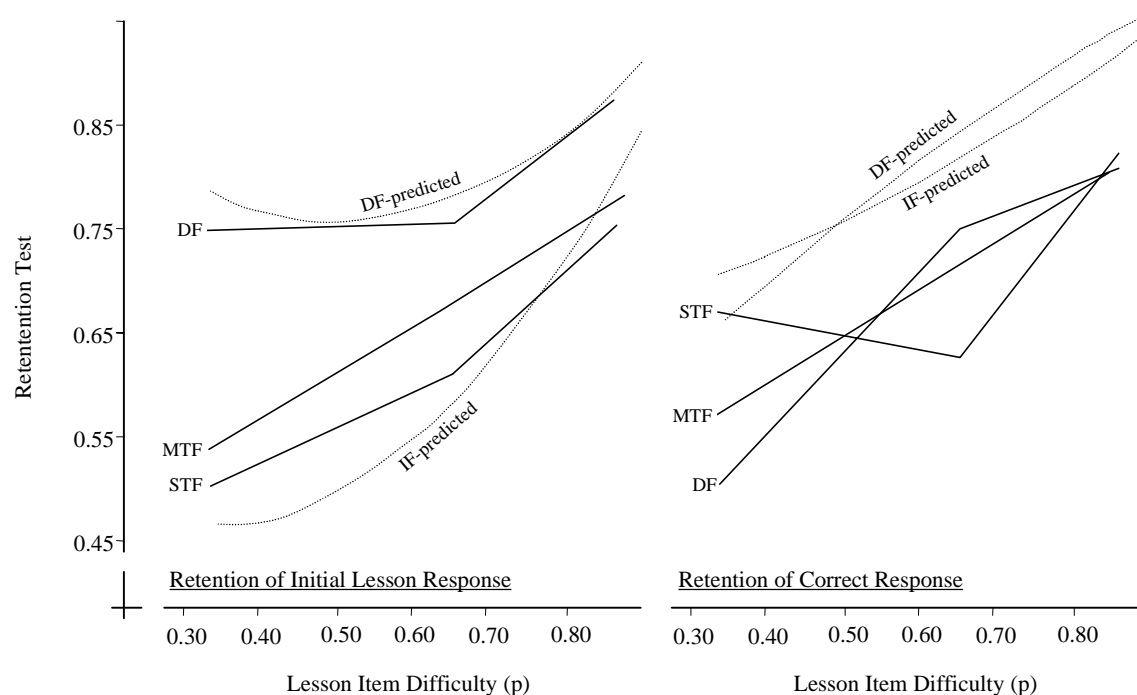


Figure 2. Lesson Response and Correct Response predicted retention test values (dashed lines) for immediate feedback (IF) and delayed feedback (DF) compared to observed data corrected for guessing (solid lines) for delayed feedback (DF), multiple-try feedback (MTF), and single-try immediate feedback (STF)

#### Follow-up Analysis of Retention Test ILR Data

Retention test ILR data were analyzed by a mixed  $3 \times (2 \times 3)$  analysis of variance with one between-subjects factor, feedback condition (DF, MTF, or STF), and two within-subjects factors, kind of question (verbatim and inferential) and lesson item difficulty (most difficult, mid-range, and easy). A significant effect was obtained for feedback,  $F(2, 49) = 4.13$ ,  $MSE = 0.081$ ,  $p < .05$ , as already reported above that retention of ILRs was greater for DF compared to STF (see Figure 2), in addition MTF was more like STF than like DF.

A significant effect was also observed for kind of question  $F(2, 49) = 8.24$ ,  $MSE = 0.024$ ,  $p < .01$  and for item difficulty blocks  $F(2, 98) = 20.24$ ,  $MSE = 0.025$ ,  $p < .01$ . Retention test memory of ILRs for verbatim questions ( $M = 0.80$ ) was greater than memory of inferential questions ( $M = 0.75$ ). Retention test memory of ILRs for difficult items ( $M = 0.72$ ) and for mid-difficulty items ( $M = 0.76$ ) was less than memory of easy items ( $M = 0.85$ ). As above, though these two findings are significant, they have little practical meaning.

#### Follow-up Analysis of Retention Test Correct Response Data

Retention test correct response data were analyzed by the same mixed  $3 \times (2 \times 3)$  analysis of variance. Three findings reached significance. A significant effect was obtained for item difficulty blocks,  $F(2, 98) = 24.74$ ,  $MSE = 0.025$ ,  $p < .01$ . Scheffe' tests show that retention test memory of correct responses for difficult items ( $M = 0.71$ ) and for mid-range items ( $M = 0.77$ ) were both less than memory of easy items ( $M = 0.87$ ), a finding of little practical interest.

More importantly, the interaction of feedback and item difficulty was significant,  $F(4, 98) = 2.54$ ,  $MSE = 0.025$ ,  $p < .05$  (Greenhouse-Geisser  $p = 0.05$ ; Huynh-Feldt  $p = 0.04$ ). Although this disordinal interaction was directionally consistent with the delta rule predictions, with STF best for difficult items and DF best for easy items (see right panel of Figure 2), follow-up Scheffe' test obtained no significant differences for type of feedback within each question level. Thus the hypothesized differences between DF and STF at different item difficulty levels were too small to be considered reliable.

The interaction between kind of question and lesson item difficulty was significant,  $F(2, 98) = 7.62$ ,  $MSE = 0.023$ ,  $p < .01$ . Though inferential lesson questions appear to be slightly more effective than verbatim questions for difficult lesson items, follow-up Scheffe' test obtained no significant differences for type of feedback within each

question level. Thus a possible instructional advantage of inferential questions over verbatim questions (per Merrill, 1987) is too small to be considered reliable.

## Discussion

The first hypothesis was confirmed that retention of initial lesson responses is greater for delayed feedback compared to immediate feedback across all item difficulties, but especially with difficult lesson items. The association weights of ILR errors increased (see dashed line in Figure 2). Further, the observed retention of initial lesson responses for STF and DF were very similar to their corresponding delta rule predicted values (see left panel of Figure 2). This finding provides empirical support for the potential of a connectionist model to predict instructional feedback effects.

The practical value of hypothesis one for instructional design is that in some learning situations, it is critical to remember initial lesson responses, especially if answers are not absolutely "right" or "wrong" but serve as learning transitions to broader understanding. For example, in discovery learning situations, learners are required to remember and use previous responses. In such cases, delayed feedback or even no feedback would allow learners to maintain initial lesson responses at a greater rate than with immediate feedback. On the other hand, immediate feedback involves a trade-off between increasing correct response associations at the expense of forgetting other responses, and these other responses are likely more meaningful to the learner even though "incorrect". In the many situations where it is critical to strengthen the correct response and diminish the incorrect response, then immediate feedback would be better.

The second hypothesis that feedback has its greatest effect with difficult lesson items was confirmed. Lesson to retention test change at each lesson item difficulty block expressed in effect sizes ( $\underline{ES}$ ), calculated as the difference between lesson and retention score divided by the standard deviation of the lesson score, are: for easy lesson items,  $\underline{ES} = -.06$ , for mid-range lesson items,  $\underline{ES} = .35$ , and for difficult lesson items,  $\underline{ES} = 1.17$ . Previous studies have provided the groundwork for this finding by showing that feedback has its greatest effect with difficult items (Sturges, 1978). For example, Bangert-Drowns, Kulik, Kulik, and Morgan (1991) state, "If feedback's primary importance is the correction of errors, then one would expect to see larger effects for instruction with higher error rates. This is exactly what happens" (p.230). Thus, future feedback investigations must consider and control lesson item difficulty, or else results may be confounded by lesson difficulty.

The third hypothesis, that feedback timing interacts with lesson item difficulty, was not supported. However the mean differences were in the right direction with STF best with difficult items and DF best with easier items (see the right panel of Figure 2). This result could be anticipated in that lesson items were not difficult enough to produce the interaction, the average lesson item difficulty for the most difficult question block in this investigation was  $\underline{M} = 0.50$ . Note that the delta rule predicted difference between immediate and delayed feedback would be most pronounced for lesson item difficulties less than about 0.40 (see Figure 2), and are actually predicted to be identical for lesson item difficulties near 0.50. Thus, to adequately test this hypothesis, an unusually difficult lesson would be required. Pragmatically, for computer-based lessons that use multiple-choice questions of reasonable difficulty, immediate and delayed feedback groups should obtain similar posttest scores, with perhaps a slight advantage for delayed feedback.

Though the delta rule predicted ILR values well, this approach overestimated posttest correct response values. Using trend analysis, the values  $\alpha_{in} = 0.5$  and  $t_o = 0.85$  will adjust the delta rule predictions for posttest correct responses to more closely match the observed data. Future investigations should consider whether these variables of the delta rule are more constant for classes of learner response, or are more variable, perhaps related to individual learner variables.

What are the effects of feedback immediacy and of multiple exposures? MTF was much more like STF in retention test memory of ILRs indicating that feedback immediacy acts to reduce memory of ILR errors, a retroactive interference effect. But MTF rather than clearly mirroring STF (immediacy) or DF (multiple item exposure) generally fell midway between STF and MTF, indicating that both feedback timing and number of exposures combine or interact to impact retention test memory, especially for memory of correct responses. This combination or interaction of immediacy and multiple-exposures is of theoretical interest, and so should be addressed by additional experimentation.

The findings of this study involve only retention test recognition learning outcomes and should not be generalized to other types of learning outcomes, such as recall. Additional research should consider the application of a connectionist model for predicting the effects of feedback on higher-level learning outcomes.

As a footnote, Kulhavy and Stock (1989) have described an information processing explanation of feedback effects based on servocontrol theory (which describes the interaction between system output, sensors, feedback from the sensors, and mechanical devices that impact output). Their model views learner's response



confidence as a metacognitive component that controls or at least strongly influences how feedback information is processed by the learner. So far (since Sturges, 1978), response confidence studies have shown mixed results (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Mory, 1992; 1994), so whether response confidence serves a metacognitive function in feedback processing is unknown. Requiring a learner to consciously consider the confidence of every lesson response would obviously alter the expected and normal pattern of a lesson, for example increasing the amount of time the learner takes with each item. Further, asking the learner for response confidence at each lesson response may be distracting, and could disrupt the learning process. Also, it has been suggested by Mory (1994) that learners' self-report of response confidence is inaccurate in some cases (see also Metcalfe, 1986). For these reasons, response confidence was not used in this present investigation. However, response confidence could serve as a logical alternative measure of initial lesson output activation level,  $a_{out}$ , in the delta rule calculations. Thus, future investigation of the possible metacognitive effects of response confidence may obtain added insight by applying a connectionist model.

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# **The Effect of Field Dependence and Color-Coding on Female Student Achievement of Different Educational Objectives**

Francis M. Dwyer  
Penn State University

David M.(Mike) Moore  
Virginia Tech

## **Abstract**

*The purpose of this study was to examine the effects that level of field dependence and differentially coded instructional materials (black and white and colored) had on female student achievement of different educational objectives. One hundred twenty six college level students participated in the study. On the Total criterion measure significant achievement differences occurred in favor of Field Independent students. A non significant interaction between color-coding and field dependence was found on the Total Test scores. Significant differences in achievement were also found in favor of females who received the color-coded version of the Total Test. These results confirm previous results relating to the importance of field dependence in learning situations and stimulates the necessity for further more sophisticated research to systematically analyze the unique contributions that color-coded instructional strategies might have in facilitating the achievement of female students.*

## **Introduction**

A great deal of interest has focused on the concept of learning style as it relates to the way in which individuals process information (Bjorklund, 1989). The learning style concept grew out of the research on how people perceive, interact with and organize information received from the world around them. Results from similar research suggest that individuals differ in how they approach a learning task (Moore, 1985; Moore & Bedient, 1986; Reardon & Moore, 1988) but that these variations do not reflect levels of intelligence (Woolfolk, 1993). Instead they have to do with the "...preferred ways that individuals have for processing and organizing information and for responding to environmental stimuli" (Shuell, 1981, p. 46). Probably the most extensively researched cognitive style, which has the widest application to educational problems, is known as field dependence/independence (Witkin, et al., 1962). The field dependence/independence continuum, as it applies to learners, describes the degree to which learners will interact with a visual presentation, that is, whether the learner will merely interact with the visual as presented or will he/she analyze, reorganize and synthesize the instructional field to make the content more meaningful and memorable (Jonassen & Grabowski, 1993). Field dependent individuals, when presented a visualized presentation tend to modify the structure but accept and interact with it as it is presented. They tend to fuse all segments within the visual field and do not view or interact with the visual components discretely. Field independents tend to act upon a visual stimulus, analyzing it when it is organized and providing their own structure when it lacks organization. The findings of most studies in the literature examining achievement indicate a superiority of FID students over FD student in terms of performance (Canelos, Taylor, & Gates, 1980; Witkin, et al., 1977).

Although many studies have examined the effects of visual attributes on learning (Dwyer, 1978, 1987) few have studied the effects of varied visual attributes on specific cognitive learning styles. Research has shown that color-coding helps learners organize or categorize information into useful patterns, which enables them to interpret and adjust more readily to their environment. It was hypothesized that color-coded visuals would be more effective than black and white-coded visuals in enhancing the solvent visual cues, thereby making them more identifiable and instructional to field dependent learners. The color-coding would attempt to compensate for the restructuring skills absent in the field dependent learners and subsequently lead to deeper information processing and increased achievement. This hypothesis seemed plausible since field dependent learners tend to be global in perception and would be most inclined to take advantage of the increased structure provided by the color-coding. In a study on gender preference in imagery, Rogers (1995b) found that "girls like colors, boys like action." Likewise, Freedman (1989) reported when using computer graphics fifth- grade girls were more concerned than boys with using color and color combinations. Previous research has verified the superiority (Dwyer, 1978, 1987) of color-coded visuals

over black and white illustrations in facilitating achievement of specific types of learning objectives. However, although it has been found that males are generally more field independent than females (Witkin, et al., 1971) it was not known whether color-coding (B&W and Color) and field dependence interact or whether color-coding might positively effect the field dependency of females by enabling them to more effectively and efficiently organize and structure instructional content.

## **Statement of the Problem**

Specifically, the purpose of this study was to examine the effect that color-coding (B&W and Color) has on the achievement different educational objectives of female students categorized as field dependent or field dependent.

## **Method**

One hundred twenty six female students enrolled in basic education courses at The Pennsylvania State University and Virginia Tech University participated in this study. Students were classified as field dependent, field neutral, or field independent as a result of their performance on the Group Embedded Figures Test (GEFT), (Witkin, Oltman, Raskin, & Karp, 1971) and were divided into the different levels based on their mean achievement level on the GEFT.

Each student in each treatment received the Group Embedded Figures Test (GEFT) (Witkin, et al. 1971). The GEFT is a group-administered, 25-item test administered in three timed sections (2, 2, and 5 minutes each). Students must trace one of eight simple figures embedded in figures of greater complexity. Reported reliability is .82. Students participating in these studies were classified as field independent (FI), field neutral (FN) in field dependent (FD) based on their performance on the GEFT. The grand mean for this study was 13.22 with a standard deviation of 4.17. Students achieving one-half standard deviation above the grand mean were considered to be FI while students achieving one-half standard below the mean were considered to be FD. Field neutral students were those achieving one-half standard deviation on either side of the mean. The range of scores achieved on the GEFT was 17.

The subject content for the studies consisted of a 2,000 word instructional booklet on the anatomy and functions of the human heart. Each booklet contained nineteen illustrations, which were designed to illustrate the content. The illustrations in the black and white version contained black and white coded line drawings, which highlighted the information and process being presented. Students receiving the color-coded treatment received the same visuals as did students receiving the black and white treatment; however, several different colors were used to highlight the information being discussed. After receiving their respective coded treatments each student then received a battery of four individual tests (drawing, identification, terminology, and comprehension) and were then were combined into the 80-item Total criterion score. These tests were designed to measure achievement of different types of educational objectives. The major independent variables in the study were the effect that B&W and Color-Coding of information had on the information processing strategies of male and female students identified as processing different levels of field dependence (FI, FN, FD).

## **Criterion Measures**

The following description of the Criterion Tests, adapted from Dwyer (1978, pp. 45-47) illustrates the types of instructional objectives assessed in this study, summarized into the Total Criterion Score.

### **Drawing Test.**

The objective of the drawing test was to evaluate student ability to construct and/or reproduce items in their appropriate context. The drawing test provided the students with a numbered list of terms corresponding to the parts of the heart discussed in the instructional presentation. The students were required to draw a representative diagram of the heart and place the numbers of the listed parts in their respective positions. For this test, the emphasis was on the correct positioning of the verbal symbols with respect to one another and in respect to their concrete referents.

### **Identification Test.**

The objective of the identification test was to evaluate student ability to identify parts or positions of an object. This multiple-choice test required students to identify the numbered parts on a detailed drawing of a heart. Each part of the heart, which had been discussed in the presentation, was numbered on a drawing. The objective of this test was to measure the ability of the student to use visual cues to discriminate one structure of the heart from another and to associate specific parts of the heart with their proper names.

## Terminology Test

This test consisted of items designed to measure knowledge of specific facts, terms, and definitions. The objectives measured by this type of test are appropriate to all content areas that have an understanding of the basic elements as a prerequisite to the learning of concepts, rules, and principles.

### Comprehension Test.

Given the location of certain parts of the heart at a particular moment of its functioning, the student was asked to determine the position of other specified parts or positions of other specified parts of the heart at the same time. This test required that the students have a thorough understanding of the heart, its parts, its internal functioning, and the simultaneous processes occurring during the systolic and diastolic phases. The comprehension test was designed to measure a type of understanding in which the individual can use the information being received to explain some other phenomenon.

## Total Criterion Score

The items contained in the above noted individual Criterion Tests were combined into a composite test score (Total Criterion Test). The purpose was to measure total achievement of the objectives presented in the instructional unit. This was the unit of data used in this study for analysis.

## Analysis

A 3x2 analysis of variance was used to analyze student achievement in the Total Criterion Test. The range of scores possible on this test was 0-80. Main effects considered were cognitive style (field dependent (FD), neutral (N), and field independent (FI)), color-coding (color and black & white) and gender. Interactions among cognitive style, color-coding and gender were also of interest. The alpha level was set at .05 for the analysis. The Kuder-Richardson Formula 20 Reliability coefficient of .92 was computed for the Total Criterion Test from a random sampling of prior studies (Dwyer, 1978, p 47).

## Results and Discussion

The results achieved on the Total Test supports the expected contention that field independent learners ( $M=60.51$ ) were superior to field dependent learners ( $M=45.20$ ) in the cognitive processes they in processing information related to different types of learning objectives use ( $F(2,)=12.14, p < .05$ ). See Table 1 for means and standard deviations.

There was a significant main effect on color-coding ( $F(1,122)=8.92, p < .05$ ), the analysis of variance conducted on performance data achieved by female students on the Total Criterion Test. The analysis indicated that females who received the color-coded treatments ( $M=57.95$ ) achieved significantly higher scores on the Total than did female students who received the black and white coded treatments ( $M=49.61$ ). The analysis further indicated that no significant interaction existed ( $F(1,122)=1.77, p > .05$ ) between field dependence and color-coding. See Table 1 for means and standard deviations.

*Table 1. Means and Standard deviations. Field Dependence*

Effect	Count	Mean	Std. Dev.
FD	45	60.51	11.28
FN	49	53.55	14.52
FD	34	45.21	15.92

*Table 2. Means and standard deviations. Color and Black and White*

Effect	Count	Mean	Std. Dev.
Color	64	57.95	14.09
B&W	64	49.61	14.85

## Discussion

The results of this experimental study support the contention that field independent and field dependent learners differ in the cognitive processes they use as in the effectiveness of these cognitive processes as measured on tests measuring different educational objectives. This study found where female FI and FD students reviewed either black and white coded or color-coded treatments, the field independent students scored significantly higher than did field dependent students on the Total Criterion Test. These results support prior research (Moore, 1986) which found that field independent learners tend to score higher on criterion measures which require the acquisition of information from visualized instruction and are used to assessing visually complemented instruction. This finding is also consistent with the previous reviews of the literature that have concluded that field independent learners exhibit an active, hypothesis testing strategy toward learning, whereas field dependent learners tend to employ a more tentative or spectator approval to learning (Witkin et al, 1971). The results also indicated that the use of color-coding of visualization did not provide sufficient structuring of the critical information to alter the information processing level of field dependent learners.

It was expected that the color-coded treatments would make the relevant cues more explicit, thereby improving their performance. The results support this hypothesis. Students who viewed the color-coded materials scored significantly higher than did students viewing the black and white materials, thus supporting the argument that color-coded materials can be of instructional support at least to female students.

These findings indicating that color-coded materials to be more effective for females than the black and white coded materials are among the first findings which lend support to the possibility of differential information processing within the gender domain. It leads to the hypothesis that the color-coded materials may have instigated an active hypothesis testing strategy toward learning, where the students utilized the inherent color-coding strategy to organize and structure the information being presented.

Additionally, the results may have been reinforced if the students were made aware of the intent of the coding structure and/or were given a orientation session as to how they might employ the coding strategies to improve their information acquisition. Under these circumstances the color-coded treatments might have been even more effective in communicating the explicit learning criteria to the learners.

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# **Journeys of Learning: Policies to Promote Change With Technology in Educational Organizations**

Dan Eastmond  
Western Governors University

Ms. Gloria Steele  
Technology & Innovations in Education (TIE)

## **Abstract**

*Learning organizations are discussed within business and industrial frameworks, yet educational enterprises have sought similar revitalization. Today's K-12 and university systems grapple with change, particularly that of telecommunications technology. This session reports on several Midwest US initiatives to foster learning organizations. These projects demand greater inter-institutional collaboration as leaders purposefully create learning networks.*

## **Introduction**

Authors like Peter Senge, Chris Argyris, Victoria Marsick, and Karen Watkins have been conducting research about learning organizations for the past several decades. While their published principles make sense for leaders in business and industrial settings -- the organizations within which they conducted their studies -- these same policies and practices must be translated appropriately into educational settings. This session presents the journey of several educational initiatives that have embraced organizational change, intentionally working to develop individual educator, school, district, consortium, and statewide capacity with technology within school and university settings. The presenters, who work in different educational institutions and levels but who collaborate at the State level on one of these projects, will explain the implementation of concepts about learning organizations into a K-12 and teacher education environment, especially involving instructional technology.

## **Dimensions of a Learning Organization**

A learning organization has been defined as one that is "continually expanding its capacity to create its future" (Senge, 1990, p. 14). Such enterprises require continuous learning at all organizational levels, plus procedures to share new knowledge so that the organization improves (Marsick & Watkins, 1999). Within organizations, learning takes place at the individual, team, and institutional levels with connections made outside to professional associations, communities, and the global environment. Learning also takes place through various methods: formal education, training and staff development, informal learning, and incidental learning (Marsick & Watkins, 1990). Features within the organizational environment, such as incentives, communications, and information technology effect the capability of an organization to learn too.

## **Leadership Policies for Learning Organizations**

Policy development toward creating and sustaining learning organizations by visionary leaders provides the greatest impact. These leaders not only share their own conceptions of organizational possibilities, they encourage others to contribute to that vision, and they follow through with implementation of policy and procedures. Although leaders may be found at the top, a shared vision involves leaders and advocates of systemic improvement at all levels of the organization. Such leaders attend to the changes happening outside and within the organization; they seek to maximize the flow and sharing of information by creating knowledge management systems; and they promote learning throughout the organization by setting priorities, encouraging self-directed learning, and noting the individual and group contributions through incentives and recognition (Marsick & Watkins, 1999).

Leaders must foster a supportive environment of trust and shared responsibilities without fault-finding, where tacit assumptions can be challenged and double-looped learning can take place (Argyris, 1999). Senge, et al (1999) provide practical suggestions for policy at each stage of the progression of a learning organization's development. When initiating a learning organization, leaders make time for innovation, garner support, show the relevance of the initiative, and personally exemplify the changed attitudes and behaviors of the five disciplines. To sustain the transformation once a learning organization has been successfully launched, leaders seek to overcome fear and anxiety, find ways to accurately measure impact of change initiatives, and integrate the innovation within



the organization -- unifying divisions that often emerge. As a learning organization becomes fully established, Senge, et al challenge leaders to diffuse innovative change throughout the organization as governance, strategies, and purposes are re-examined and modified.

The school is not now a learning organization as Michael Fullan and other writers remind us. Rather, characteristics such as irregular waves of change, episodic projects, fragmentation of effort, and grinding overload is the lot of most schools. The vast majority of change efforts are misconceived because they fail to understand and harness the combined forces of moral purpose and skilled change agency. The challenge for all educators is to work toward greater understanding of the new work of principals and teachers as they transform their schools from bureaucratic organizations to thriving communities of learners (Fullan, 1998). Recent education publications and initiatives tell the story of increased momentum among education entities to embrace concepts of learning organizations.

## **Impact of Technology on Educational Enterprises**

Perhaps no innovation of the past century has pervaded our society like the telecommunications technology revolution. Within the past five years the World Wide Web has been commercialized with a global business economy emerging. Similar infusion of telecommunications is radically changing the face of education. For example, one third of higher education institutions in the United States offered distance education courses in 1998; roughly 60 percent of these were delivered via the Internet (U.S. Department of Education, 1999). Public schools throughout the country are being equipped with computer labs, networked classroom computers, and interactive television technologies. Throughout the country various projects and centers are funded to integrate these technologies appropriately into the curriculum. The South Dakota stories and projects shared in the work of this study support the momentum of school change through technology.

## **The Learning Organizations for Technology Integration (LOFTI) Project**

One exemplary project is the Learning Organizations for Technology Integration (LOFTI) Project, a five-year major grant to the State of South Dakota from the U.S. Department of Education for staff development with technology. Begun in 1998, the LOFTI Project aims to provide educators with the knowledge, skills, and abilities essential for teaching and learning in a changing technological world. Technology requires a great deal of collaboration among organizational players, and it is the catalyst for systemic change within smaller projects undertaken by the various educational organizational players. Thus the LOFTI Project networks educators at all levels -- K-12, distance consortia, university, and teacher education -- to share resources and learning about technology.

The LOFTI Project has organized summer academies, known as "Technology for Teaching and Learning " (TTLs) to develop and improve individual educator knowledge, skills, and abilities within specialized roles. Hundreds of teachers, administrators, and technology coordinators are participating in one to three week-long, intensive TTLs for advanced technology skills, networking, technology for administrators, or distance learning technology. The Project is unique because it seeks to intentionally incorporate the five disciplines of learning organizations (Senge, 1990) into its goals of statewide technology integration within education.

One subgroup of the project consists of four showcase schools who have been selected to integrate technology completely into the educational process as a model to others. University players, another subgroup, direct their efforts primarily toward faculty improvement and curriculum development in teacher education using technology. Similarly, the LOFTI Project funds five K-12 consortia that had been set up within the State for distance education to expand their services and improve participating teachers in developing technology skills. The South Dakota Board of Regents and the State Department of Education and Cultural Affairs have teamed up to provide a 15 hour telemediated inservice curriculum for technology using the State's newly formed Electronic University Consortium (see below). The Project is led by the Technology & Innovations in Education (TIE) Office in Rapid City. TIE coordinates several leadership groups for the project, such as: (1) the Design Team which handles the day to day operations of LOFTI; (2) the Steering Committee, made of up representatives of each organizational player, it defines policies and procedures; (3) the Evaluation Team, led by an external evaluator from Maine, this group measures the project's success in meeting its goals and objectives; and (4) the Awareness, Advocacy, and Advise ment group is made up of strategic State government, business, and educational partners who provide input in LOFTI Project direction and promote it to other groups.

## **Discover South Dakota**

Discover South Dakota is a multi-dimensional telecollaborative curriculum and professional development initiative. The three major strands of work within the project focus on the design and implementation of (1) student telecollaborative curriculum, (2) a professional development model for Discover South Dakota teachers, and (3) a professional development model for school principals.

Students participating in Discover South Dakota are organized in both classroom-based learning communities and on-line learning communities where they engage in tasks constructed around identified academic content standards, technology standards, and information literacy standards. The curriculum is framed in the study of South Dakota with an integrated, project-based design for learning. Students conduct research, communicate and collaborate with experts and students across the state, and publish to the Discover South Dakota web site. Students make use of e-mail, threaded discussion, and chat features of the telecommunications environment while conducting their work. Partnerships with other education related entities throughout South Dakota, including university pre-service students and teachers, South Dakota Cultural Heritage Center programs, and a variety of experts, are critical to Discover South Dakota curriculum work.

During the 1999-2000 year, fourth, fifth, and sixth grade students in 210 classrooms across the state participated in the Discover South Dakota curriculum experience.

A project-embedded approach has emerged as a professional development model for teachers implementing Discover South Dakota. This model consists of a web of professional development connections available through multiple delivery systems. It includes combinations of face-to-face and on-line experiences that take advantage of both synchronous and asynchronous features of telecommunications. These are supported with print materials, site visits, and technical assistance. Through evaluation of the design and implementation of components of this professional development model, the project seeks to further our understanding of powerful combinations for maximizing the success of teachers implementing telecollaborative teaching and learning in classrooms. In particular, data to study inhibitors and facilitators to this model are being collected.

The Discover South Dakota leadership strand is built on the premise that school leaders are key to successful implementation of innovations in schools. The work for school leaders is organized around a problem-based learning framework focused on project-embedded, just in time delivery of professional development. The overarching problem positions Discover South Dakota as a technological innovation being implemented in their respective schools. In order to examine their current practices, participants engage in a series of topics and activities designed to correlate with the activities of teachers and students during the ten week implementation of Discover South Dakota. This component was conducted as a pilot during the 1999-2000 year and will be scaled up during 2000-2001. Data are collected to study connections between successful implementation of Discover South Dakota by teachers when school leaders are participating in this companion professional development experience.

## **Connecting the Schools**

The Connecting the Schools (CTS) project is the follow-up endeavor to Governor Bill Janklow's Wiring the Schools project ([wts.state.sd.us](http://wts.state.sd.us)). Wiring the Schools established a solid local area network (LAN) and electrical infrastructure in the K-12 school buildings across South Dakota. CTS is building on that foundation for the creation of a statewide video and data intranet to improve the educational opportunities for K-12 students in South Dakota. CTS has 3 distinct phases:

1. Equipment seeding
2. Network infrastructure
3. Distance learning

The equipment seeding is a one-time distribution of hardware and software to insure that schools have a quality LAN infrastructure to build upon. Many schools will go from having little or no technology to a level that will allow them to quickly leap into the 21st century! The equipment phase began in May 1999 and will conclude in September 1999. The network infrastructure named Digital Dakota Network (DDN) provides a frame relay or ATM T1 to approximately 400 public school buildings in the state. The general rule is that elementary schools (K-6) receive frame relay and that grades 7 - 12 receive ATM. The frame relay circuits deliver data communications (e.g., Internet, World Wide Web, e-mail) and the ATM circuits deliver data and video. Telecommunications companies in the State are installing interactive video room systems in the distance learning classrooms.

E-mail and web hosting services are also being provided. Dakota State University is providing these services under contract to the CTS project. Thin client technology will serve Exchange collaboration tools to

teachers and administrators across the state. Web hosting will allow the publishing of district, school, teacher, classroom and student information.

The distance learning phase of the project will remove limitations for students and provide them learning opportunities regardless of geographic location. The video conferencing service will provide two-way audio and video communications to an estimated 200 schools across the state. The distance learning phase is going to take significant cooperation and planning amongst South Dakota schools. The scheduling, curriculum sharing, and communicating of available resources is absolutely vital to the success of this phase. The distance learning services will be available in September of 2000.

## **Electronic University Consortium**

Still in its planning stages, the Electronic University Consortium (EUC) seeks to coordinate the efforts of South Dakota's six regential institutions toward off-campus and distance provision of courses and programs. It will establish a single Web point of contact for students to access a variety of services -- from admissions, registration, billing, and transcript services through the delivery of courses and library services. The EUC will coordinate the curriculum development effort of the various institutional members while avoiding unnecessary duplication. In new curricular development, its focus will be on meeting the information technology needs of business, industry, medicine, government, and K-12 enterprises. Its outreach will be to those who cannot conveniently attend classes on a regular college campus. A fifteen credit hour telemediated teacher education curriculum developed through the LOFTI Project provides an impetus for other EUC curricular development.

## **Observations and Reflections**

This presentation information summary concludes with some of our reflections about the successes, growth, and challenges provided by the technology initiatives and efforts towards organizational learning reported in this paper. Although we have been involved in variety of organizations, this is the first time we have seen the major educational players in the State come together ostensibly for the purpose of collaboration, teamwork, and shaping its future capacity building through creating learning organizations with technology. Several times yearly, Statewide meetings focus on various aspects of building learning organizations, and those in local leadership positions of the LOFTI Project are uniquely placed to facilitate the greater understanding and buy-in to these concepts. Many of the innovations with technology overlap with LOFTI, such as the Discover South Dakota, Connecting the Schools, and the Electronic University Consortium, giving educators first-hand experience with collaboration and initiative development with technology.

The positive aspects of learning organization building are pronounced. These projects are benefited by visionary leaders who make the building of learning organizations a top priority. Besides the practical day-to-day projects undertaken by various project members, these initiatives facilitate greater discussion about technology and the future that it plays in the educational future of the State. Slowly but surely a vision of exciting possibilities is emerging where South Dakota educational enterprises are not only about to better serve their citizens through technology, but they are also able to reach out nationally and globally to become a greater player in the global telecommunications economies of the future.

There are still numerous challenges that have yet to be faced and overcome. First, Statewide cooperation is often hampered by politics, competition over limited resources, and mistrust that equitable outcomes will result. These assumptions are only just beginning to be recognized and openly confronted at LOFTI and other project meetings. For example, in February 2000 the broad-based, Steering Committee, looked at teamwork within its various members. Without exception, a pre-session survey revealed that individual members felt better about their own contributions toward participation, collaboration, flexibility, sensitivity, risk-taking, commitment, facilitation, and openness than they did of other members. They felt that the Committee was only moderately effective as a high performance team, and that its members did not know or allow others to share their individual talents and skills. The descriptor most chosen to represent their feelings about participating was "challenging," and several of the survey comments were directed toward the building of greater trust for this learning organization to improve (Survey Results of LOFTI Steering Committee, 1999).

Technology has often become the focus and end in and of itself, rather than a means towards building our future. Educators still struggle to translate the concepts and disciples for learning organizations from the business world to that of education. The "bottom lines," "customers," and "productivity measures" are quite different. It is still difficult to create local visions of larger regional or statewide learning organizations when educators are pressed to accomplish their daily tasks as efficiently as possible without tangible rewards visible for collaboration and sharing. It is also difficult to systematically build shared vision, personal mastery, mental models, team learning,

aligned with systems thinking (Senge, 1990) and embracing features made possible through new technology-rich learning environments.

In closing, it is an exhilarating time to be participating in the creation of learning organizations within education involving technology. This paper highlighted several initiatives within the State of South Dakota that are directed toward this end. It brought together theories about leadership policies to create learning organizations that have surfaced in the literature and reported upon the progress and challenges faced by those working with these ideas in educational technology initiatives within the state of South Dakota today.

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# Uses of the World-Wide Web by Adolescents in Public Schools

Samuel E. Ebersole  
University of Southern Colorado

## Abstract

*This study was designed to explore how some students in ten public schools view the WWW and how their attitudes and opinions affect their use of this new medium in an educational context. An exploratory principal components analysis of forty use statements resulted in an eight factor solution. Additionally, student responses to a computer-administered survey instrument were collected and analyzed revealing significant differences in the way that students describe their use of the WWW. Gender, grade level, and amount of time spent using the WWW were used to create between-group comparisons of the WWW use categories that made up the computer-administered survey instrument. The final phase of data analysis was a content analysis of sites visited by students. A total of 123,071 URLs were collected from the computers used to administer the computer survey instrument. These were reduced to a total of 500 sites that were reviewed by media specialists. Students were found to be visiting commercial sites at a much higher proportion than those in other domains. Also, the commercial sites received the lowest rating for "suitability for academic research" of all the domain names. And while students reported their purpose for using the WWW as "research and learning" fifty-two percent of the time, the coders found only twenty-seven percent of the sampled sites to be "suitable" for that purpose.*

## Introduction

This [PC/Internet] technology promises to have a far larger and more serious impact on our society than the introduction of television, possibly as great an influence on history as the industrial revolution or the printing press. Television primarily involves only leisure time; this technology will affect work, school and play—personal, family and business relationships. Surveying the Digital Future: How the PC and Internet Are Changing the World.

The introduction of a new medium into society has frequently been a flash-point for media effects research focusing on children and adolescents (Wartella & Reeves, 1985). In each case children have been recognized as a special audience, one that deserves special consideration (Dorr, 1986; Wartella, 1995). The introduction of television prompted numerous studies (e.g., Schramm, Lyle & Parker, 1961), and provoked much discussion and public debate over its proper place in society. The effects of the media on children's mental development has been a common theme (e.g., Van Evra, 1990; Winn, 1977). From early on, media effects researchers have focused the attention of the nation on the media's dysfunctional effects. From the Payne Fund studies on the effects of motion pictures (e.g., Charters, 1933; Dale, 1935) to Dr. Fredrick Wertham's (1954) exposé of comic books to the Surgeon General's (1972) report on television and violence, social scientiara have examined how the media have served to undermine the positive influences of family and social institutions (McLeod & Reeves, 1980; Wartella & Reeves, 1985).<sup>1</sup>

Researchers exploring the effects of educational media, however, have argued from a similar set of assumptions to reach dramatically different conclusions. Instead of exploring the possible negative effects of the media, proponents of "powerful effects" have heralded the positive effects promised by the use of educational media in the classroom (e.g., Kozma, 1994; Salomon, 1978). The history of educational technology, specifically the use of mass media in an educational context, is infused with promises of revolutionary proportions (Cuban, 1986). Access to books, instructional motion pictures, radio, and more recently television and interactive multimedia has been envisioned as the panacea for all that ails our educational system. The use of the World Wide Web in the classroom is only the latest in a long history of mass media technologies that have been embraced by the educational establishment. Libraries, along with the liberating technologies of the postal service and telephones, were once envisioned as facilitating the elimination of schools (Illich, 1970).<sup>2</sup> Educational films, radio and television programs, and educational computer software have all been employed with similar hope and optimism. The belief that the Web will lead to the promised land is but the most recent manifestation of this technological utopianism.

## Statement of the Problem

The Internet, and more specifically the WWW, is being eagerly adopted by school districts, administrators, and teachers almost without exception. However, the use of the WWW in the classroom marks the first deployment of an educational medium in which the end user can access a virtually unlimited breadth of content. Hecht (1997) argued, "having the Internet in the classroom is like equipping each classroom with a television that can be turned on at any time and tuned in to any of 100,000 unrestricted channels, only a tiny fraction of which are dedicated to educational programming (and even those have commercials)." McNealy (1999) voiced a similar concern when he wrote, "Right now, putting students in front of Internet terminals is no better than putting them in front of TV sets. It may even be worse" (p. 17A). And while the resource is huge-Lawrence and Giles (1999) estimated 800 million web pages-some have argued that only a fraction of the millions of Web pages hold any educational value for this K-12 audience (see, for example, Bennett, Wilkinson, & Oliver, 1996; Kirk, 1996; Tillman, 1998).

This raises some interesting questions regarding the use of the WWW in an educational context. Even students who seek out educational content may be thwarted by the very attributes heralded by WWW proponents, e.g., the WWW's breadth and depth of information. Research into selective exposure, defined as "behavior that is deliberately performed to attain and sustain perceptual control of particular stimulus events," (Zillmann & Bryant, 1985, p. 2) has raised questions about new media technologies that provide an abundance of choice and place even greater control over consumption in the hands of the consumer. In a nonlinear medium, when educational content is sometimes packaged as "edu-tainment," what is to prevent students from skipping over the "education?" Preliminary data collected during a pilot study (Ebersole, 1999) indicated that for middle and high school students accessing the WWW from computers in public schools, the most frequently visited sites were those that were also the least educational. And while "research" was the most frequent response to the question "why are you using the WWW at this time?" content analysis of the sites visited suggested that "looking for something interesting" was the more likely explanation for the majority of sites visited.

## Significance of the Study

There have been calls for research to determine the effect of computers with Internet access on student achievement (Kozma & Quellmalz, 1996). Linda Roberts, Director of the Office of Educational Technology, spoke at the SchoolTech Exposition and Conference and reminded educators of the need to collect data that will support or reject the spending of billions of dollars for computers and wiring (Mendels, 1998, April 27). A recent US Department of Education report (National Center for Educational Statistics, 1997) concluded by listing four challenges that remain for educators and school districts as they embrace this new educational technology. The challenges are: technical support for hardware and software; teacher training and development; "increasing effective use of the Internet to enhance student learning; and protecting students from inappropriate material on the Internet". Research into the use of the WWW in public schools has important implication for local, state, and national policy and funding initiatives. While a study such as the present one is only a small step in the quest to assess the value of this new medium, it is important in that it permits identification of the motivations of individual users. The study can also help to identify crucial points where intervention may be necessary in order to realize the WWW's full potential as an educational resource. Once we understand what motivates students to utilize this medium, we can better design incentives that encourage educational use and discourage use that distracts students from that goal.

## Theory: Uses and Gratifications

According to Rice and Williams (1984), "the new media provide fertile test beds for many of our theories and models" (p. 55). One mass media theory that has repeatedly been cited as holding promise for the analysis of new media is uses and gratifications. In addition to the article by Rice and Williams, articles by Williams, Strover and Grant (1994), Newhagen and Rafaeli (1996), Morris and Ogan (1996), and December (1996) have also included references to the suitability of uses and gratifications for new media research. As an "active audience" theory, uses and gratifications provides a vantage point from which to look at the ways that audiences respond to the breadth and depth of information that is made available by these new media. Newhagen and Rafaeli (1996) have suggested that uses and gratifications theory may be especially useful because of the "mutability" of the Web, or what Newhagen calls its "chameleon-like character" (p. 11). The diversity of content is much greater for the WWW than for traditional electronic media. While television, radio, and to a lesser degree print media are subject to regulatory and societal scrutiny, the WWW is virtually unregulated. Because of this, the WWW literally has something for everybody. The fact that this range of material is available at school, library, workplace, and home would suggest that potential uses for the Internet may far exceed those provided by other media.

Few studies have taken a uses and gratifications approach to studying the Internet and even fewer have narrowed their focus to look at the WWW (e.g., Charney, 1996; Stetter, 1997; Yoo, 1996, and Kaye, 1998). December (1996) identified "communication, interaction, and information" as the three broad categories for why people use the Internet. Charney (1996) concluded from a study of university students that the Internet is used "to keep informed, for entertainment and diversion, to maintain communication, and to look at the sights and sounds of the Net" (p. 88), but most frequently for entertainment-diversion (p. 90). A 1995 study of college students' WWW usage resulted in "six motivational categories: entertainment, social interaction, passing the time, escape, information, and Web site preference" (Kaye, 1998, p. 34). According to the 9th WWW User Survey conducted by Georgia Tech (GVU's 9th WWW user survey, 1998), the WWW's youngest users (11-20) use the web mainly for "entertainment" (81%), "education" (70%), "time wasting" (67%), and "personal information" (60%).

## **Methods**

Combining qualitative and quantitative approaches, this study employed open-ended questions, interviews, two types of survey research, and content analysis of WWW sites visited by students. Some of the data was collected with the active participation of the subjects, while other data was collected using passive data collection techniques. Using multiple methodologies allowed for increased richness of data and a clearer picture of the phenomena under investigation.<sup>3</sup>

## **Subjects**

The population for this study was comprised of middle-school and high-school students at selected public schools in five districts in a western state. The districts were selected in consultation with the state's Department of Education to reflect a cross-section of schools in urban and rural settings that have Internet access. The participants for this study were selected using two different approaches. For the first survey, which was administered on paper, a stratified convenience sample was employed. At one middle school and one high school in each district a class representing each grade (sixth, seventh, eighth, ninth, tenth, eleventh, and twelfth) was selected to take the paper survey. The second survey was administered electronically at the computer. Students attending middle and high schools in these districts have access to the WWW using computers available in the schools' media centers. However, not all students had parental permission to access the WWW. Only students who had been granted parental permission and who had signed and submitted the required forms to their local school administrators were permitted to access the computer-administered survey. Of these, participation in the second phase of the survey was voluntary and by self-selection. The survey was installed as the default home page in the media centers for a period of time sufficient to gather approximately 100 responses from each school.

## **Survey Data Collection**

The two primary survey instruments employed in the current study will be referred to as the "paper survey" and the "computer survey." The paper survey is a 75-item survey instrument that was administered to students in their classrooms at selected public middle schools and high schools. The paper survey contains sections designed to measure the students': 1) affinity for the WWW, 2) assessment of the value of the WWW for various purposes, 3) skill level for computer and WWW use, 4) use of the WWW, 5) avoidance of the WWW, and 6) demographics. Following this, the computer survey was administered to the students at the time and place of their access to the WWW—specifically the school's media center or library. The computer survey is comprised of just four questions: grade, gender, how much the student uses the WWW, and the student's purpose for using the WWW at this particular time. This survey was intentionally kept very short in order to prevent student frustration and a perception of "time-off-task" that may have jeopardized the support of school administrators.

## **Passive Data Collection Design for This Study**

December (1996) and Newhagen and Rafaeli (1996) recognized the fact that the Internet provides excellent opportunities for data collection. As Rafaeli noted, any social scientist who has looked at an Internet server must be struck by the research possibilities present in the data that is passing through that computer (p. 6). In order to take advantage of this unique feature of the WWW, the design of this study calls for passive data collection to follow the survey research. Both Netscape Navigator and Microsoft's Internet Explorer browsing software generate a cache or "global history" file that resides on the user's hard drive and which retains a list of addresses (Uniform Resource Locators or URLs) of WWW sites last visited. This list of URLs listing WWW pages and graphics visited most recently is extensive and can be thousands of sites long.

At the beginning of the data collection phase the cache files on the computers in the schools' Media Centers were deleted. At the end of the collection period the cache files were copied to a disk and the data prepared for analysis. A total of 123,071 URLs were collected from the more than 80 Macintosh and Windows personal computers on which the survey instrument had been installed. First, the number of occurrences of web sites from the five generic top-level domains (commercial [.com], educational [.edu], governmental [.gov], network [.net], and organizational [.org]), and the United States (.us) domain was recorded. In order to facilitate content analysis of the sites visited, URLs ending with .gif and .jpg were first stripped from the list and then a UNIX grep script was written and applied to the remaining sites to reduce the list to the number of randomly selected sites that could be evaluated and coded given the time and resources available. The subsequent 500 URLs were then collected into a single WWW page and two educators/media specialists, one male and the other female, from a nearby school district were asked to analyze these WWW pages and serve as evaluators. The pages were assigned a "use" category based on the same choices that had been presented to the students on the computer-administered survey and were rated for "suitability as a source for academic research" on a scale of 1-3: 1 = not suitable, 2 = questionable, and 3 = suitable. The evaluators were instructed to look at each WWW page with consideration for the grade level of the students being studied.

## Results

Respondents to the paper survey ( $n = 791$ ) ranged in age from 10-21 years ( $M = 14.45$ ) and were enrolled in the 6th grade (12%), 7th grade (130, 17%), 8th grade (123, 16%), 9th grade (14%), 10th grade (15%), 11th grade (12%), and the 12th grade (16%). Average self-reported grade point average (GPA) was 3.28, and 51% were male. Ethnicity of respondents is as follows: American Indian (2%), Asian (3%), Black (9%), Hispanic (16%), White (69%), and other (2%). Respondents to the computer-administered survey ( $n = 1083$ ) were enrolled in the 6th grade (5%), 7th grade (21%), 8th grade (19%), 9th grade (14%), 10th grade (15%), 11th grade (12%), and the 12th grade (16%). Of these, 59% were male.

### Attitudes towards the WWW

Questionnaire items 1 through 5 were statements designed with the goal of determining the students' affinity for the WWW. This was operationalized by summing five Likert-scale responses with results ranging from 5-25 ( $M = 12.57$ ,  $SD = 4.12$ , Cronbach's  $\alpha = .83$ ). The statement "Using the WWW is very important to me" received the strongest support ( $M = 3.05$ ) while the statement "I would feel lost without the WWW" received the least ( $M = 1.97$ ).

The next set of items was designed to explore the students' beliefs about the WWW-in particular the WWW's value as a source of information, entertainment, and as a means of communication. As a source of information ( $M = 1.68$ , 1 = excellent, 4 = poor), students rated the WWW as "excellent" 44% of the time, "good" 46% of the time, "fair" 9% of the time, and "poor" 2% of the time. As a source of entertainment ( $M = 1.90$ ), students rated the WWW as "excellent" 36% of the time, "good" 42% of the time, "fair" 18% of the time, and "poor" 4% of the time. And as a means of communication ( $M = 1.78$ ), students rated the WWW as "excellent" 42% of the time, "good" 42% of the time, "fair" 14% of the time, and "poor" 3% of the time. Based on these responses, students rate the WWW highest for information, followed by communication, and then entertainment.

The most common response to a general question asking overall skill at using computers was "good" (47%), followed by "average" (30%), "excellent" (20%), and "below average" (3%). Additional questions asked students how long they have been using the WWW, how many times per week, and how many hours per week they use the WWW. To the question, "For how long have you been using the World-Wide Web?" the most common response was "1-2 years" (32%), followed by "more than 2 years" (29%), "6 mo.-1 year" (23%) and "less than 6 months" (17%). To the question, "Approximately how many times per week do you use the World-Wide Web?" the most common response was "1-2 times" (35%), followed by "less than 1" (28%), "3-5 times" (23%), and "more than 5 times" (15%). And in response to the question "About how many hours per week do you use the World-Wide Web?" respondents answered "1-2 hours" (34%), "less than 1" (33%), "3-5 hours" (20%), "6-10 hours" (9%), and "10+ hours" (5%).

An additional four items assessed the respondent's skill at using the WWW. Students' self-reported skill at using the WWW was operationalized as the sum of responses to four Likert-scales. Skill at using the WWW ranged from 4 to 20 ( $M = 13.86$ ,  $SD = 3.25$ , Cronbach's  $\alpha = .78$ ).

Students were also asked to indicate the locations where they access the WWW. The 625 students who responded to question 20 indicated the following places were used to access the WWW; home (69%), school (61%), friend's house (32%), public library (23%), and, other (11%).



## Reasons for using the WWW

Questionnaire items 21 through 60 addressed reasons why students might choose to use the WWW. These items were generated from statements made by middle school and high school students who responded anonymously to an open-ended question asking them to list several things "that the World-Wide Web is good for." Additional use statements were taken from fill-in-the-blank responses to the computer survey questionnaire in the pilot study.

Because of the paucity of research in uses and gratifications of the relatively new WWW, exploratory factor analysis (SPSS Principal Components Analysis with Varimax rotation) was employed to group these use statements into categories. A preliminary principal components analysis was performed on an incomplete data set in order to arrive at a list of "use statements" that became part of the computer-administered survey instrument. Those seven use statements were: "for research and learning," "to communicate with other people," "for access to material otherwise unavailable," "to find something fun or exciting," "for something to do when I'm bored," "for sports and game information," and, "for shopping and consumer information." Once the complete data set was collected via the paper survey instrument, another principal components analysis was conducted. This time the result was eight factors with eigenvalues greater than 1.0 accounting for a total of 58% of the total variance. These factors differed slightly from those derived from the earlier analysis.<sup>4</sup> (see Table 1).

*Table 1*

Items	FAC1	FAC2	FAC3	FAC4	FAC5	FAC6	FAC7	FAC8
Factor 1: Research and Learning (eigenvalue = 10.57, variance after rotation = 14%)								
Because it is a good source of news	.488	.237	-.048	.117	.266	.141	-.165	.238
To complete homework assignments	.553	.063	.114	.031	.296	-.336	.392	.047
To get up-to-date facts and information	.445	.195	.026	.080	.214	.224	-.117	.397
To learn how to use computers better	.423	.307	.172	-.095	-.019	.206	.195	.074
To learn new things †	.501	.554	.140	.019	.132	.045	.009	.082
Because it provides a new outlook on learning	.727	.264	.149	.000	.067	.113	-.045	.015
Because it's educational	.749	.237	.054	-.071	-.024	.110	-.047	-.052
To find articles and references	.675	-.115	-.008	.035	.270	.241	-.086	.071
Because it is an excellent source of information	.682	.118	.085	.126	.233	.025	-.090	.056
To find out what's going on in the world	.566	.175	.227	.269	-.058	.256	-.037	.196
So that I can do better in school	.763	.190	.140	.077	-.048	-.014	.077	.007
To conduct research for class	.766	-.061	.009	.026	.214	-.046	.013	-.046
Factor 2: Easy Access to Entertainment (eigenvalue = 3.73, variance after rotation = 9%)								
Because it's so easy	.185	.521	.049	.203	.286	-.007	-.161	.256
Because it's fun	.094	.746	.129	.281	.148	.037	.091	.091
To learn new things †	.501	.554	.140	.019	.132	.045	.009	.082
To play games †	.036	.434	.102	.325	.028	.030	.537	.068
Because it's exciting	.238	.712	.180	.177	.063	.084	.130	-.001
For entertainment †	-.002	.508	.212	.467	.149	.076	.190	.077
To find interesting things	.351	.573	.117	.121	.206	.237	-.007	.024
Because computers are cool †	.226	.453	.105	.428	-.075	.331	.094	-.096
Factor 3: Communication and Social Interaction (eigenvalue = 2.19, variance after rotation = 9%)								
To chat with other people	-.030	.033	.716	.220	.241	-.103	.161	.122
To find people	.086	.101	.637	.056	.104	.027	.158	.232
So that I can have foreign language friends	.168	.232	.594	-.034	-.129	.221	-.089	.110
To email friends	.096	-.005	.520	.263	.279	.082	-.079	.184
To talk with people from around the world	.145	.156	.788	.061	-.020	.123	.038	.011
To meet new people	.116	.106	.801	.165	-.003	.135	.009	.063

Factor 4: Something to Do When Bored (eigenvalue = 1.68, variance after rotation = 7%)								
For entertainment †	-.002	.508	.212	.467	.149	.076	.190	.077
For browsing	.266	.185	.109	.510	.254	.239	-.007	-.022
Because it gives me something to do	.018	.258	.186	.761	.055	.045	.100	.104
When I'm bored	-.003	.152	.155	.796	.085	-.017	.064	.106
Because computers are cool †	.226	.453	.105	.428	-.075	.331	.094	-.096
Factor 5: Access to Material Otherwise Unavailable (eigenvalue = 1.53, variance after rotation = 6%)								
To find things not in the library	.240	.060	-.020	-.004	.652	-.041	-.063	-.088
Because it is convenient	.143	.198	.131	.264	.537	.041	-.088	.170
To download software and other free stuff †	-.115	.177	.217	.042	.425	.438	.302	.153
Because I can access things otherwise unavailable to me	.167	.178	.119	.086	.617	.280	.067	.020
Factor 6: Product Info and Tech Support (eigenvalue = 1.17, variance after rotation = 5%)								
To download software and other free stuff †	-.115	.177	.217	.042	.425	.438	.302	.153
To get product information	.197	.102	.136	.040	.245	.489	.044	.125
To get information about games †	.011	.292	.067	.272	-.012	.467	.511	-.002
To get technical support	.348	.097	.261	.127	.064	.610	.148	.096
Factor 7: Games and Sexually Explicit Sites (eigenvalue = 1.09, variance after rotation = 5%)								
To get sports information and statistics †	.243	-.002	-.018	.072	-.072	.194	.439	.413
To access sexually explicit sites	-.191	-.001	.058	-.001	-.032	.055	.672	.077
To play games †	.036	.434	.102	.325	.028	.030	.537	.068
To get information about games †	.011	.292	.067	.272	-.012	.467	.511	-.002
Factor 8: Consumer Transactions (eigenvalue = 1.08, variance after rotation = 4%)								
For shopping and making purchases	.001	.023	.247	.054	-.015	.089	.107	.701
To look up music and concert information	.020	.138	.268	.084	.102	-.010	.092	.674
To get sounds, pictures, or animations for projects *	.259	.360	.077	.091	.366	.097	.180	.199
Cronbach Alpha (for scale)	.887	.844	.823	.813	.601	.653	.617	.577

\* Denotes item that did not meet the criteria for factor loading

† Denotes item that loaded highly on two factors

### Correlation Analyses

Following the independent-sample t tests, Pearson product-moment correlation coefficients were computed among the eight WWW use scales and three variables measured at the interval level. The three variables that were correlated with the eight factors were grade, affinity for the WWW, and skill level at using the WWW. Not surprisingly, both affinity and skill are positively correlated with every type of use as defined by this study. The few significant correlations between grade and uses suggest that students in the lower grades are more likely to say that they use the WWW for easy access to entertainment, for something to do when bored, for product information and technical support, and for games and sexually explicit sites. Likewise, students in the higher grades are more likely to say that they use the WWW for access to material otherwise unavailable. A significant negative correlation was obtained between grade level and affinity for the WWW ( $r = -.15$ ,  $p = .001$ ). This suggests that as respondents increase in age and grade level, they become less enamored of the WWW. Note, however, that this reduction in affinity for the WWW does not appear to result in less use with increased age. The correlation between grade level and skill level was not significant ( $r = -.02$ ,  $p = .717$ ). The lack of correlation between grade and skill level may be

accounted for by the likelihood that students rated their skill level against that of their peers rather than against an objective scale.

### **Reasons for avoiding the WWW**

In addition to seeking reasons why students choose to use the WWW in a school setting, questions were asked in an attempt to discover possible reasons why students would choose to avoid using the WWW. Ten avoidance statements were presented to students who were asked to respond on the same agree/disagree scale. An analysis of the avoidance statements suggested that face-to-face interaction with peers is the leading reason given for not spending time using the WWW. Other important factors included several statements about negative issues commonly attributed to the WWW, e.g., pornography, illegal activity, and other users who may have suspect motives. And while schools often have fast connections to the Internet, these users appeared to be consistent with the general population of WWW users who perceive the WWW to be too slow, especially when downloading graphically intensive sites. On a positive note, the social stigma that has been associated with computer expertise—i.e., that "computers are for nerds"—does not appear to carry much weight with these respondents.

### **Results of the Computer-Administered Survey**

Unlike the nearly even split by gender in the paper survey, the respondents to the computer-administered survey were slightly more than 59% male. This could indicate that males are heavier users of the WWW at school, or that they were more likely to respond to the survey. While the breakdown of respondents by grade level to the paper and computer surveys was identical for high school students, there was a substantial difference in the number of sixth, seventh, and eighth grade students responding to the two surveys. The reduced percentage of sixth grade students responding to the computer-administered survey was explained in part by the fact that one district did not provide Internet access to sixth grade students. Because there was no way to prohibit multiple responses from students responding to the computer-administered survey, the data reported here should not be interpreted as representing unique students, but rather as sessions at a computer.

In response to the question asking the average amount of time spent using the WWW each week, the most common response was, "less than 1 hour per week" (36%) followed by "1 to 2 hours per week" (23%), "3 to 5 hours per week" (18%), "more than 10 hours per week" (17%), and "6 to 10 hours per week" (6%). Respondents to the computer-administered survey gave the following reasons for using the WWW: "for research and learning" (n = 541, 52%), "to communicate with other people" (n = 74, 7%), "for access to material otherwise unavailable" (n = 55, 5%), "to find something fun or exciting" (n = 85, 8%), "for something to do when I'm bored" (n = 56, 5%), "for sports and game information" (n = 65, 6%), and, "for shopping and consumer information" (n = 10, 1%). In addition, 165 students (16%) chose not to select from the seven options presented. Of these, 94 students elected to write-in a response to this question. The write-in responses offered by students to explain their purpose for using the WWW were grouped into categories as follows: specific research topics (n = 20), sexually explicit material (n = 20), games and amusements (n = 14), general research and learning (n = 11), combinations of things (n = 10), communication (n = 5), and other unclassified (n = 14).

### **Content Analysis of Sites Visited**

Because there are normative expectations for media content consumed in school for educational purposes, content analysis of sites visited by students was employed to better understand the nature of the content being consumed. Of the 123,071 URLs collected, 77% (n = 94,426) were from the .com domain, 5% (n = 6,289) were from .net, 5% (n = 5,704) were from .org, 4% (n = 4,842) were from .edu, 1 percent (n = 1,640) were from .gov, 1% (n = 1,403) were from .us, and 7% (n = 8,767) were from another or unidentified domain name. These numbers stand in contrast to the distribution of domain names that makes up the current state of the WWW. According to the latest survey of WWW domain names by host count, conducted by Internet Software Consortium in January of 2000, the actual make-up of the WWW is not as heavily skewed towards the commercial domain sites as the student sample would suggest (see Table 2).

Table 2  
Domain Names by Host Count

Domain Name	Number of sites*	% of total (com, net, edu, us, org, gov)	% of 123,071 Web pages visited by students
com (commercial)	29075185	50.4	77
net (network)	18305485	31.7	5
edu (education)	6313781	10.9	4
jp	2680659		
uk	2240216		
us	2062653	3.6	1
mil	1908413		
de	1778831		
ca	2153807		
au	1181376		
org (organization)	1063901	1.8	5
nl	839912		
fr	867981		
gov (government)	842854	1.5	1
Total	57663859	99.9%	93% (7% = other)

\*Source: Internet Software Consortium, January 2000

The next step was a more detailed content analysis of randomly selected WWW pages visited by students. Once intercoder reliability was established at an adequate level ( $\alpha = .92$ ), the 500 randomly selected WWW pages were analyzed for educational value and use category. The "suitability" rank most often assigned by the evaluators was "not suitable" ( $n = 262$ , 57%), followed by "suitable" ( $n = 135$ , 29%), and "questionable" ( $n = 65$ , 14%). The use category most often assigned by the evaluators was "for research and learning" ( $n = 126$ , 27%), followed by "access to material otherwise unavailable" ( $n = 102$ , 22%), "to find something fun and exciting" ( $n = 76$ , 17%), followed by "for shopping and consumer information" ( $n = 61$ , 13%), "for something to do when I'm bored" ( $n = 45$ , 10%), "for sports and game information" ( $n = 30$ , 7%), and finally, "to communicate with other people" ( $n = 22$ , 5%).

When compared to the use categories self-reported by the students responding to the computer-administered survey there is clearly a disparity between the way that students and media specialists view the content and potential use of these WWW sites. Students' self-reported uses of the WWW was as follows: "for research and learning" ( $n = 541$ , 52%), followed by "to find something fun and exciting" ( $n = 85$ , 8%), "to communicate with other people" ( $n = 74$ , 7%), "for sports and game information" ( $n = 65$ , 6%), "for something to do when I'm bored" ( $n = 56$ , 5%), "for access to material otherwise unavailable" ( $n = 55$ , 5%), and finally, "for shopping and consumer information" ( $n = 10$ , 1%).

The disparity between self-reported uses of the WWW and evaluators' assessments of actual sites visited invites several possible explanations. First, as an audience-centered theory of media use, uses and gratifications allows for individual interpretation of content. It should not be surprising that students and media specialists frequently envision different uses for the same Web site. Second, students may be responding to the survey with answers that they believe are socially acceptable. Even with the anonymity provided by the computer survey technique, students may feel some pressure to respond in a manner that is congruent with the stated purpose of the WWW in school as elaborated in the school district's Acceptable Use Policy—namely, academic research. However, there may be another factor at work here. It could be that students are starting out with the intention to conduct academic research, but are finding themselves frustrated or distracted by the other offerings so readily available on the WWW.

The analysis comparing domain and "suitability for academic research" indicated low ratings for .com and .net, with higher values for .org and .gov (see Table 3). In fact, the most frequently visited domain name (.com) had the lowest educational value and one of the least frequently visited domain names, (.gov), had the highest educational value as determined by the evaluation of the media specialists.

*Table 3*  
*Mean Suitability for Academic Research of Sites by Leading Domain Names*

Domain Name	(N)	Mean suitability for academic research as assigned by coders *
.com	(410)	1.59
.org	(25)	2.78
.edu	(16)	2.44
.net	(12)	1.75
.gov	(9)	3.0
.us	(5)	2.0
other	(23)	1.94

Note: \* 1 = not suitable, 2 = questionable, 3 = suitable

## Discussion

In order for educators and researchers to evaluate the benefit of WWW use by students in public schools it is necessary to begin by attempting to understand how students perceive the WWW, what they use it for, and what gratifications they receive during periods of access. This research explored the active and goal-directed use of the WWW by middle school and high school students in 10 public schools located in five public school districts. Consistent with the study's exploratory nature the results included the identification of gratifications sought from this new electronic interactive medium within a school setting. While this study did not provide answers to questions about the effect of WWW usage on student performance it did provide answers to a more fundamental set of questions. Two survey instruments were used to assess the following: students' affinity for the WWW, the amount of time spent using the WWW, students' self-assessed skill level, their beliefs about the relative value of the WWW as a source of both information and entertainment and as a means of communication, and their reasons for using or not using the WWW. And finally, student use of the WWW was monitored by sampling actual sites visited and by content-analyzing these sites for educational value.

Granted there is much excellent information available on the WWW. But as this study's content analysis of sites visited seems to indicate, students frequently are either not looking for it, or if they are, are unsuccessful in finding it. It is quite possible that users who approach a Web search with instrumental intentions may soon find themselves distracted by the entertaining and diverting offerings available. The ease with which one can travel to any corner of the vast Web can be both a blessing and a curse. And this is not a unique observation. A study of 6th and 9th grade science students found that without substantial guidance and assistance, students were often unsuccessful in locating useful academic information on the WWW (Lyons, Hoffman, Krajcik, & Soloway, 1997). According to the researchers, "one overall theme is clear from the data: students need a tremendous amount of support to be successful in online inquiry" (p. 12).

## Commercialization of the WWW

The commercialization of the WWW and the growth of online advertising is another area of growing concern for educational technology advocates. The disproportionate use of commercial WWW sites by students in this study is just one indicator of the potential exposure of children to advertising. Students are often unaware of the questionable nature and value of information from commercial WWW sites. Lyons et al. (1997) found that students "often choose a commercial site (.com in the URL) over a government (.gov) or education (.edu) site" (p. 21-22), an observation supported by this research.

While unregulated advertising itself is cause for concern, the unique capability afforded by the WWW to collect user information and track usage raises even greater concern. The Zap Me corporation announced a program to give free computers with satellite-based Internet service to schools in exchange for the opportunity to include advertising in a corner of the monitor. In a New York Times article dated February 25, 1999, Richtel described the Zap Me system, which tracks the user's "grade level, sex and Zip code" in order to "dish out age and sex-appropriate advertisements" (p. G7). At the time of the article the company had "given computers to 55 schools in eight states." This kind of targeted advertising and the collection of user data for commercial purposes should be of concern not only to privacy advocates but also to educators and parents who are concerned about the negative effects of consumer-driven culture.

## **Socialization**

More than a decade ago Rosengren and Windahl (1989) wrote, today's moral panics about videos, cable, satellites, computer games and the like, may concern rather ephemeral phenomena. It may be true that for some time media novelties may have a capacity to spell-bind children, preventing them from other, perhaps better, activities. But it is probably also true that such an influence will be transient and will be greatly reduced or even vanish as the "new" media find their place in society. (p. 250)

While some of the moral panic spoken of by Rosengren and Windahl may have faded, it appears obvious that the "new" medium of the moment, the WWW, has simply attracted, and perhaps amplified, the concern that was once focused on the old media. According to Stephen Kerr, professor in the College of Education at the University of Washington,

The Net's beauty is that it's uncontrolled... It's information by anyone, for anyone. There's racist stuff, bigoted, hate-group stuff, filled with paranoia; bomb recipes; how to engage in various kinds of crimes, electronic and otherwise; scams and swindles. It's all there. It's all available... That's the antithesis of what classroom kids should be exposed to. (quoted in Oppenheimer, 1997, p. 61)

Concern about inappropriate material available on the WWW is one reason for the widespread use of acceptable use policies. Perhaps the issues of greatest concern focus on the presence of hate speech, sites promoting violent behavior and the means to carry out violent activities, pornography, and sexually explicit material. The unregulated nature of the WWW and its diversity of content providers serves to ensure the widest possible range of content. While other educational media are controlled by the school teachers and administrators who make decisions about what books, videos, and magazines to place in the media collection, the unfiltered WWW has been made available to students who frequently operate on an honor code of self-regulation.

## **Limitations**

The most obvious limitation of this study is the sample and the methodology employed in its selection. Use of non-probabilistic sampling for schools chosen and self-selection of students taking the computer-administered surveys are acknowledged as restricting the generalizability of this study. Because of the non-random nature of the sample, generalization to the larger population of US adolescents is discouraged. However, this study aided in the identification of several motivations for use of the WWW at school and these offer heuristic value for future research.

As Charney (1996) found using a similar approach to study college students' use of the WWW, a complicating factor is that student use of this medium is confounded by use that has been assigned by a teacher. Unlike uses and gratifications studies of other media, use of the WWW, especially in a school setting, is a mixture of uses motivated by personal interest as well as those prescribed by authority figures. In this study there was no way to differentiate student use that was self-motivated versus use that was encouraged or even mandated by teachers.

Also, because of the need to protect the anonymity of respondents, students were not identified in a way that allowed comparisons between the two survey instruments. Neither were comparisons possible between the responses to the survey instruments and the content analysis of WWW sites visited by students. A research design that allowed for anonymous tracking of responses from one survey instrument to the next, and then tied WWW sites visited to a specific anonymous respondent, would have added heuristic value to the study.

On a related note, the analysis of sites visited by students did not take into account sites that were visited accidentally or for only a short period of time. It is quite possible that sites ranking low on "suitability for academic research" were visited only briefly while more suitable sites were visited for longer periods of time, or even printed for later use.

## **Conclusions**

In the opening chapter of *Failure to Connect*, Healy (1998) stated: "Today's children are the subjects of a vast and optimistic experiment" (p. 17). Referring to the use of computers for educational purposes, Healy argued that computers raise more questions than they answer and concluded with a call for accountability and common sense. Cuban (1996) had a similar response and couched his assessment in an historical context.

First, techno-reformers' claims for what new machines can do are so inflated that public expectations continually get disappointed. Overselling has been (and continues to be) part of a familiar American cycle of creating a crisis, naming schools or teachers as a problem, and putting forward new machines (film, television, computers) as the best solution. Yet each technological innovation has had, at best, an uneven record in entering schools and classrooms. Why?

Based on this exploration of WWW use in school, several findings would appear to have policy implications for schools using or making plans to use the WWW for educational purposes. First, while students believe the WWW to be a valuable source of reliable information, their use of the WWW suggests other motivations. Analysis of sites visited indicated that by nearly a two-to-one margin students visited sites rated "unsuitable for academic research" versus sites rated "suitable." Seeking out "pleasurable experience" appeared to win out over "learning information" (Swanson, 1992) when students were given access to the WWW within the school setting. Furthermore, the types of sites visited most frequently, i.e., commercial sites, were rated as having the lowest educational value.

Also of note is the incongruity between students' self-reported use of the WWW and the uses suggested by the analysis of sites visited by students. Either students falsely reported their intentions or intervening variables affected the process of searching for and obtaining relevant information. One untested hypothesis to emerge from this study is that the best of intentions may be confounded by the ease with which students can access a myriad of competing sites that vie for their attention. Another possibility is that the students' understanding of research is more broadly defined and includes looking for content that has little or no relationship to traditional academic pursuits.

When it comes time to evaluate the appropriateness and effectiveness of media technology in the schools media effects researchers cannot have it both ways. Either media effects are real and the potential benefit of educational media must be balanced by constant vigilance against access to WWW sites that are at best a distraction and at worst a hindrance to the educational and social development of our children. Or, media effects are limited and mediated by user motives, attitudes, and use patterns, and any potential benefit of educational media in the schools is contingent on the proper psychological and sociological predictor variables. If this is the case, attention to these factors must be a top priority and WWW access must be implemented with the goal of creating the proper climate for learning to occur. In either case WWW literacy efforts-teaching students how to most effectively use the best resources on the WWW-are sorely needed. Since picking and choosing only the best WWW resources for students is not a viable option, giving students the tools to make wise decisions about media content is crucial.

## Endnotes

1 According to Wartella and Reeves (1985) the first recorded instance of concern about media's effect on children was Plato's warning about storytellers in *The Republic*.

2 One could argue that Illich (1970) envisioned the WWW as an educational resource long before its time when he wrote, "The current search for new educational funnels must be reversed into the search for their institutional inverse: educational webs which heighten the opportunity for each one to transform each moment of his living into one of learning, sharing, and caring" (pp. xix-xx, emphasis in the original). Illich continued, "We need research on the possible use of technology to create institutions which serve personal, creative, and autonomous interaction and the emergence of values which cannot be substantially controlled by technocrats. We need counterfoil research to current futurology" (p. 2). In describing an alternative to school, Illich might have been describing the modern listserv or chat forum: "The most radical alternative to school would be a network or service which gave each man [sic] the same opportunity to share his [sic] current concern with others motivated by the same concern" (p. 19). The great difference, however, between what Illich envisioned and what WWW advocates are promoting is the locus of responsibility.

3 For the full study, including survey instruments, see Ebersole (1999).

4 It is interesting to note that the list of "uses" is similar those found by researchers exploring the uses and gratifications of "old" media. Information, entertainment, social utility, passing the time, and other traditionally defined uses of the media are present with some distinctions made possible by the interactive nature of this new medium.

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# Responsive Instructional Design: Scaffolding the Adoption and Change Process

Peggy A. Ertmer  
Purdue University

According to the most recent report of the National Center for Education Statistics (NCES, 2000), 99 percent of all public school teachers now have access to computers or the Internet in their schools. However, despite this growing presence of technology, teachers all over the country continue to grapple with both practical and philosophical problems posed by the integration process. Nearly 70 percent of teachers still report not feeling well prepared to use computers and the Internet in their teaching (NCES). According to the 1998 Technology in Education Report (Market Data Retrieval), only 7 percent of schools, nationwide, boast a majority of teachers at an advanced skill level (i.e., able to integrate technology into the curriculum). Even among our newest teachers, instructional use is not as high as might be expected. Although beginning teachers report wanting to use computers, they often find it difficult to do so when so much of their time is consumed by the routine tasks of teaching and managing their classrooms. The use of computers, then, becomes an extra task which, although seen as important, is of lower priority than more basic activities (Hruskocy, 1999; Novak & Knowles, 1991).

Clearly, the growing increase in teachers' technical skills is insufficient to guarantee the effective use of technology in the classroom (Carvin, 1999; Marcinkiewicz, 1994). Through previous research efforts (Ertmer, 1999; Ertmer, Addison, Lane, Ross, & Woods, 1999; Ertmer & Hruskocy, 1999; Hruskocy, Cennamo, Ertmer, & Johnson, 2000) we have identified a number of challenges that teachers face as they begin to integrate technology within their curricula. Besides a host of technical and logistical questions (e.g., How does this software package work? Where and when should we use computers?), more subtle issues, related to teachers' pedagogical visions and beliefs, as well as their perceived confidence for using technology, are also known to impede meaningful classroom use.

Assuming that most designers and staff developers are fairly well-prepared to provide technical skills training for teachers *who want it and are prepared to learn from it*, this paper focuses instead on how designers might work with teachers who either don't want training or are not prepared to learn from it, or both! This paper, then, emphasizes the role that teachers' beliefs play in the adoption and change process and specifically discusses how those beliefs might be addressed through teacher development efforts. Elsewhere (Ertmer, 1999) I have described how teachers' beliefs may function as second-order barriers to change (i.e., barriers that are intrinsic to teachers and that challenge fundamental beliefs about current practice). Again, I am assuming that designers are capable of helping teachers deal with first-order barriers, those that are extrinsic to teachers and which include skills training and equipment needs. Even if these assumptions are false, second-order barriers are still likely to present the biggest challenges to those charged with coaching/assisting reluctant teachers/adopters.

## Teacher Beliefs

In summarizing research on teachers' beliefs, Pajares (1992) noted that "there is a strong relationship between teachers' educational beliefs and their planning, instructional decisions, and classroom practices" (p. 326). In particular, teachers' beliefs about their *ability to use computers* in instruction may be key, given the role self-efficacy is proposed to play in determining behavior. In a recent study by McKinney, Sexton, and Meyerson (1999), participants with lower efficacy beliefs expressed concerns typical of those in an early stage of change (self-concerns) while those with higher efficacy had concerns that were more characteristic of later stages of change (impact-concerns).

Self-efficacy refers to personal beliefs about one's capability to learn or perform actions at designated levels (Bandura, 1997). According to Bandura, self-efficacy is based, not solely on the level of skill possessed by an individual, but on judgments about what can be done with current skills. As such, self-efficacy is thought to mediate the relationship between skill and action. Simply put, without skill, performance isn't possible; yet without self-efficacy, performance may not be attempted. According to Bandura, "beliefs of personal efficacy constitute the key factor of human agency" (p. 3). Thus, teachers who have high levels of efficacy for teaching with technology are more likely to participate more eagerly, expend more effort, and persist longer on technology-related tasks than teachers who have low levels of efficacy.

So what does this mean to designers and others who are responsible for teacher development? How can we design professional development experiences that address teachers' second-order barriers, or more specifically, that build teachers' efficacy for using computers in instruction?

### **Addressing Efficacy Beliefs through Design Efforts**

Consider the following scenario: A new principal has just assumed leadership of the local high school and has some fairly strong ideas about how technology should be used within her school. The high school building is well-equipped, having all the necessary resources. The principal approaches you, as an instructional designer, to help her people get up to speed. She admits that many of her staff are not convinced of the need for technology in their teaching, but believes that if you present a few good reasons why technology should be used, they will jump on board. Where do you begin?

Researchers in the area of self-efficacy (c.f., Schunk, 2000) describe four primary sources of information that can influence judgments of efficacy: vicarious experiences (observing models), social persuasion ("I know you can do this!"), physiological indicators (emotional arousal, relaxation), and personal mastery (successful task completion). However, teachers may be more or less influenced by each source of information depending on a host of other factors--their current skill level, their beliefs about teaching and learning, their attitudes towards computers in general, and so on. For example, providing models of exemplary users may not be effective for teachers whose confidence and skill levels are at the low end of the continuum. In fact, the use of this type of efficacy information may prove detrimental for teachers who can't imagine ever attaining these high levels of use (Snoeyink, 2000). Instead, teachers with low skill and confidence levels may need to experience a few small-scale successes in order to establish even an *initial* level of efficacy.

Acknowledging that teachers in any given school are likely to represent a range of levels of confidence, skills, and teaching beliefs, designers can not expect to implement a one-size-fits-all training program. Still, within each stage of development (novice - expert), growth in one area is likely to be related to growth in other areas. Thus, by increasing confidence, skill, or a change in beliefs, we may be able to support teachers' efforts toward adoption and use. Certainly, growth in skill and growth in confidence have been demonstrated to be positively correlated (Ertmer, Evenbeck, Cennamo, & Lehman, 1994). Furthermore, there is some evidence to support the idea that pedagogical beliefs and technology use are also related (Becker & Riel, 1999) and that as teachers use technology more their beliefs become more constructivist-oriented (Dwyer, 1996).

Consider the following teachers who are likely to comprise part of the teaching staff at the local high school:

*Teachers with low skills and low confidence.* Low skills and low confidence typically translate into resistant or reluctant teachers who see no reason to initiate change in their classrooms. Trying to convince these teachers that they need to use technology is pointless; strategies that worked to convince early adopters are not likely to work with late adopters. According to Moore (cited in McKinzie, 1999), "crossing the chasm between these groups (early and late adopters) requires a mammoth campaign that includes special attention to the vastly different needs, perspectives, and demands of the late adopters." Whereas social persuasion may be a great strategy for convincing early adopters, this strategy usually won't work with late adopters.

Neither is it likely that teachers at this level will be swayed through vicarious experiences, or observing successful others. Teachers at this level are not ready to embrace, or even consider, technology integration ideas. Although many educators have suggested that technology training efforts should focus on the conceptual and pedagogical levels (Carvin, 1999; Clouse & Alexander, 1997), others disagree (Milone, 2000; Snoeyink, 2000). Stapel (cited in Milone) explained, "In the past, I think we made a mistake by rushing too quickly into the integration phase of staff development. In many cases, teachers just weren't ready" (p. 58).

Of the four techniques recommended for increasing self-efficacy, personal mastery is likely to be the most beneficial for novice computer users. Experiencing even small success can increase confidence. Furthermore, establishing relevancy may convince reluctance users to "have a go." A designer in the situation described earlier might begin with the teachers' own personal or instructional needs as one way to create relevance. Perhaps the teacher has a nephew or a grandchild who is having a birthday--would she like to send a virtual bouquet? What particular classroom issues are consuming the teacher's time? Could technology ease some of the load by allowing her to easily modify newsletters or student progress reports or calculate weighted grades? Is there a particular concept that is hard for her students to grasp that could be demonstrated through a simulation? The idea is to find out what the teacher needs and then collaboratively develop a plan that efficiently meets those needs. Similar to the idea of creating an individual educational plan (IEP) for each student, a designer might consider co-creating an individual teaching/technology plan (ITP) with each teacher. As with any good instructional design, designers are advised to start with what teachers know and then use strategies that meet their unique learning needs.

*Teachers with medium skills and medium confidence.* Teachers at this level have typically achieved some level of competence with technology but may not have found the desire or means to bring these tools into the classroom. Because they have at least an initial level of confidence, they may be at a point where they will benefit from observing similar others who have achieved higher levels of use. These applications no longer seem out of reach for these teachers and may now serve as inspiration. Training emphases and methods that were appropriate for novice technology users (step-by-step procedures, skill building) are not likely to be as effective for intermediate users. Teachers at this level may benefit from shadowing similar others, do-it-yourself manuals, and collaborative efforts. While skills will need to be continually refined and updated, it's not as important to focus development efforts strictly on skills; skill instruction can now be embedded within meaningful projects or relevant tasks.

Teachers at a medium skill level are probably just starting to imagine some specific classroom applications and may not be able to extrapolate from ideas used at other grade levels and in other content areas (Snoeyink, 2000). Thus, it may still be important at this level to include concrete ideas for the teacher's grade level and content area. A designer charged with helping teachers at this level will need to have a strong working knowledge of various curricular standards, or have ready access to someone who can help translate these standards into workable technology solutions. Unfortunately, this is not nearly as easy as it sounds.

## Responsive Instructional Design

In the following section, I propose a model of teacher development that builds on, and responds to, teachers' unique needs, specifically those with lower levels of skill and confidence. I propose that this model represents a responsive approach to instructional design; that is, training needs are described in terms of users rather than instruction, and instructional decisions are based on users' goals and needs, not those of designers or instructors. Although the model is similar to the ADDIE approach, each step requires that more attention be paid to users' perceived needs and goals. This suggests a greater need for both communication and analysis skills. Steps in the model are described below.

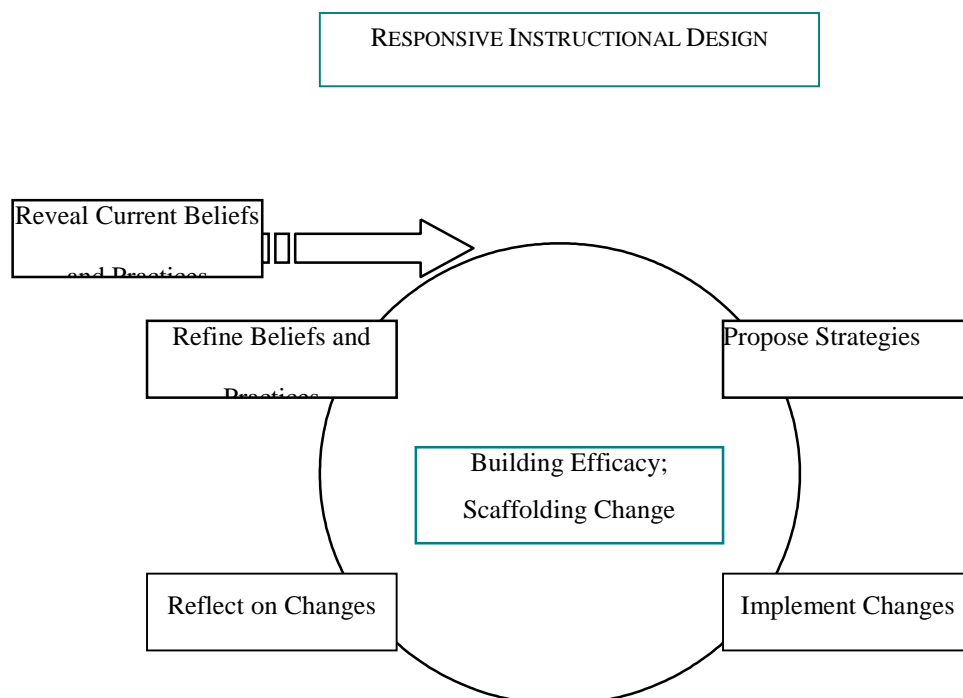


Figure 1. A Model for Responsive Instructional Design

*Reveal.* Responsive instructional design is based on the assumption that teachers are more likely to embrace pedagogical and classroom change if these changes address the real issues they face in practice. Teachers are encouraged to reveal the goals they want to accomplish in their classrooms, the barriers that hinder their work, and the instructional and/or administrative concerns they have, *unrelated to technology*. Teachers also are asked to

reveal their beliefs about teaching as well as the incentives that motivate them to teach. At these early stages of technology adoption and use, the focus is not on technology skills or needs. Teachers are encouraged to consider their needs as both teachers and learners prior to considering their needs as technology users. Teachers and designers work collaboratively to develop an individual teacher profile, followed by the development of an individual teaching/technology plan (ITP) in the next step. Thus, an individual teacher profile might include information about teachers' 1) classroom practices, 2) classroom context, 3) perceived issues and barriers, 4) beliefs about teaching, 5) motivation for teaching, as well as 6) preferred ways of learning and teaching. By beginning with teachers' perceived needs, we remove the focus from the innovation and place it instead on teaching practices and the important issues teachers face.

*Propose.* During this step, teachers and designers co-develop an individual teaching/technology plan by considering various means for meeting specific needs identified in the teacher profile. After reviewing the issues teachers face, designers help translate these important questions into technology-based learning opportunities. Depending on the type of support teachers request or require, different types of support should be offered (one-on-one consulting, just-in-time training, formal classroom training, peer collaboration and observation, etc.). Some strategies will work more readily and be more appealing than others, depending, at least to some extent, on the barriers teachers describe. Different barriers (e.g., lack of confidence vs. lack of support) typically suggest the use of different strategies. For example, if teachers mention not yet feeling comfortable with technology, they probably are not ready to begin using technology in the classroom. Instead, they need to increase their personal comfort through increased individual and personal use. By acknowledging and helping teachers work through specific first- and second-order barriers, we help them identify strategies that work for them and simultaneously build confidence in their ability to address future barriers.

*Implement.* As teachers' test their ideas in their classrooms, they experience first-hand what works and what doesn't. As Maddin (1997) emphasized, "the real learning begins in your classroom" (p. 56). Information obtained through direct experience is one of the most powerful means to shape future practice. Because self-efficacy is a fluid construct, it changes with new experiences. While early success can raise efficacy, early failures may lower it. For this reason, it is probably important that reluctant teachers experience as much success as possible during their first few attempts to use technology within the classroom. Additionally, teachers should set realistic goals for themselves since they will measure their success by how closely they meet the goals they have set (Pintrich & Schunk, 1996). It is not critical that reluctant teachers implement a highly sophisticated lesson with lots of bells and whistles. What's most important is that they are successful. Risk and surprise need to be eliminated, or at least greatly controlled.

*Reflect.* Kagan (1992) explained that changes in teachers' beliefs are rarely the result of reading and applying research findings. Teachers base most of their ideas on their own and others' experiences. In order to promote professional growth in novices, Kagan recommended that teachers' awareness of their own beliefs be raised followed by experiences that challenge those beliefs and promote integration of new ideas into current belief systems. Such reflection initiates the revision process. After implementing new ideas or tools in the classroom, the teacher takes time, with or without the designer, to reflect on the teaching/learning processes and outcomes achieved. Teachers consider how the teaching and learning that occurred compared to what was expected. As teachers realize that their "ability to successfully utilize technology has increased, they are motivated to attempt to learn more about technology, its uses, and benefits" (George & Camarata, 1996, p. 51). However, as with most teaching experiences, there are usually many opportunities for improvement. Teachers should be encouraged to focus their reflections primarily on what the students did or did not do in response to the lesson. Based on this information, teachers can consider what changes need to be made to effect the types of student performances or levels of thinking desired.

*Refine.* In this final step, teachers are encouraged to discuss their instructional changes with others and consider the overall usefulness and effectiveness of the changes they have initiated. Based on conversations with others, teachers are encouraged to outline their next steps for development. This may include implementing a revised version of the lesson, adding one more idea to the lesson, or reading relevant literature to examine what others have done. Revisions made after each iteration are not likely to be substantial; however, continual refinements, over time, can add up to noticeable differences. As teachers continue to converse with others about how they addressed a relevant issue in their classrooms, as well as the results they obtained, they initiate, in effect, new cycles of development.

## Relationship of Model to Current ID Practices

Designers who have been trained to design programs/instruction using the instructional systems approach already have the basic tools they need to work with teachers and students in a responsive manner. For example, using analysis tools, we determine teachers' goals for their students, their classrooms, and themselves. We identify the specific supporting (or limiting) contextual factors in the environment in which teachers currently apply their skills. As part of a learner analysis, we identify teachers' current levels of skills and confidence. Given these goals and current skills, we determine the gap that exists, and then identify specific needs that must be met. As part of the design and development process, we devise instructional strategies, materials, and job aids that will meet teachers where they are and start to move them forward toward the goals they have identified. As teachers implement new skills within their classroom practice, we have the opportunity to co-reflect on what is working and what is not, and to make adjustments (in both training and implementation) to better achieve the intended outcomes. Ongoing evaluation allows teachers and designers to determine the effectiveness of selected approaches and to make revisions that bring us closer to our mutual goals.

Even though the design steps for the ADDIE and the responsive ID models are similar, designers need to be aware of critical differences, including the different starting points and the increased involvement of the end-users. To summarize, some specific suggestions for instructional designers who intend to assist teachers with their technology efforts include:

- 1) Ask teachers about their visions and goals for their classrooms. What do they want to be able to do? What are their priorities for teaching and learning?
- 2) Listen to teachers' specific needs. What kind of barriers do they encounter? What do these barriers suggest about their readiness for technology use and the strategies that may be needed to assist them at different levels?
- 3) Co-create flexible solutions. Be prepared to meet changing needs. Be sure that problems and solutions are rooted in teachers' work. Use the reveal-reflect-refine cycle described above.
- 4) Adapt innovations to fit teachers' needs. Teachers are great adapters--help them locate and select programs or software that will work for them and their particular set of students.

## Conclusion

A number of researchers have suggested that training strategies should be varied to meet the needs of teachers at different levels of technology use (Dwyer, Ringstaff, & Sandholtz, 1991; Sherry, Billig, Tavalin, & Gibson, 2000). Given the long-term nature of the integration/adoption process, it is recommended that staff developers/instructional designers meet implementation needs in a responsive fashion--that is, through "iterative interventions" (Frame, 1991) that meet and challenge individual teachers at their current levels of use. As teachers face changing needs, the strategies designed to meet them must also change. Furthermore, different strategies are likely to be more or less effective for people with different levels of efficacy. It is important not to discourage teachers who have low levels of confidence by surrounding them with others who are much more experienced and confident. By designing development programs that start with the concerns that these teachers have, and helping them experience some initial success in solving their own problems, we have a better chance of making headway in the adoption process.

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# Assessing Adaptive Instructional Design Tools and Methods in ADAPT<sup>IT</sup>

Deniz Eseryel  
University of Bergen, Norway

J. Michael Spector  
Syracuse University

## Abstract

*ADAPT<sup>IT</sup> is a European project within the Information Society Technologies programme that is providing design methods and tools to guide a training designer according to the latest cognitive science and standardisation principles. Adapt<sup>IT</sup> addresses users in two significantly different domains within the aviation industry: aircraft maintenance training and air traffic control training. Because these two subject domains are quite different and those who perform associated tasks also differ in significant ways, it is our hypothesis that outcomes will generalise to other complex domains and users. The methods integrated into ADAPT<sup>IT</sup> are based on van Merriënboer's (1997) four component instructional design model. This paper reports the needs assessment procedures and outcomes associated with the effort and indicates how they are informing the evaluation plan.*

## Introduction

ADAPT<sup>IT</sup> is a European project coordinated by the Dutch National Aerospace Laboratory (NLR). The effort falls with the European Commission's Information Society Technologies programme (IST; see <http://www.cordis.lu/ist/> for additional details) and includes as partners: NLR, the Open University of the Netherlands, the University of Bergen, Seven Mountains AS, EuroControl, the Swedish Air Traffic Control Academy, and Piaggio Aerospace. The project began in January 2000 with an extensive needs assessment of training designers within the aviation industry and in other business and industry sectors that involved training of complex skills. The early literature review and training requirements analysis indicated that the most appropriate and relevant methodology was the four component instructional design model (van Merriënboer & Dijkstra, 1997). Before discussing the ADAPT<sup>IT</sup> needs assessment and its implications for implementation and evaluation, we would first like to orient the reader with a brief overview of the European Commission's research programmes and IST.

The European Commission's Fifth Framework research and development programme extends from 1998 through 2002. IST is a single, integrated research programme within that framework that builds on the convergence of information processing, communications and media technologies. IST has a budget of approximately 3.6 billion Euro, and is managed by the Information Society Directorate General of the European Commission (one of 20 commissioners in the EC). The strategic objective of the IST is to realise the benefits of the information society for Europe both by accelerating its emergence and by ensuring that the needs of individuals and enterprises are met. It is managed by the European Commission, with the assistance of the IST Committee consisting of representatives of each Member and Associated State. The Commission and the IST Committee are supported in their work by an IST Advisory Group of some 25 members who are highly experienced in this field. They provide independent expert advice concerning the content of the IST work programme, which includes research and development.

The IST Programme has four inter-related specific objectives concerning individuals, enterprises, multimedia technologies and enabling technologies. For the private individual, the objective is to meet the need and expectation of high-quality affordable general interest services. For Europe's enterprises, workers and consumers, the objective is to enable individuals and organisations to innovate and be more effective and efficient in their work, thereby providing the basis for sustainable growth and high added-value employment while also improving the quality of working life. In the sector of multimedia content, the key objective is to confirm Europe as a leading force, realising its full potential. For the enabling technologies, which are the foundations of the information society, the programme objective is to drive their development, enhance their applicability and accelerate their take-up in Europe.

ADAPT<sup>IT</sup> addresses all four objectives but is tightly focussed on instructional design methods and tools as a critical enabling technology. The next section contains a brief overview of the effort, the approach taken and the associated work plan.



## **Advanced Design Approach for Personalised Training-Interactive Tools (ADAPT<sup>IT</sup>)**

The overall goal of this effort is to create and validate effective training design methodologies, based on cognitive science and the integration of advanced technologies, so that Europe can better meet the many challenges of the information society of the 21<sup>st</sup> century. The aviation industry is targeted for this research and development effort as it is a key industry in which Europe has been an active leader. Two quite different training areas (air traffic control and aircraft maintenance) are involved so as to insure generalisability of the methodology and tools to other subject areas and industries.

This project bridges the gap between complex training problems and new technological possibilities by developing and validating a training design framework to guide the use of state-of-the-art cognitive approaches within advanced training systems. A central requirement for the design methodology is that it provide for development of a personalised training and education trajectory. This includes a specification of training models that account for and adapt to trainees' performances, attention strategies, and workload. Another important requirement for efficient training of flexible skills for complex tasks is to maintain a close and natural relationship between knowledge learning and skill acquisition activities for both individuals and teams (van Merriënboer, 1997; van Merriënboer & Dijkstra, 1997).

This project is developing a personalised training design methodology, providing associated design tools for efficient realisation of that methodology, and validating the methodology in different training domains and with different trainee-levels. The validation will be performed in the context of aircraft maintenance and air traffic control. Current challenges for aviation training relate to the increasing complexity of dynamic task environments, increasing time constraints, and increasing demands for cognitive and information-managing tasks. As technology takes over or automates many basic tasks and adds functionalities to operational systems, the result is that more demand is placed on humans to perform higher level and supervisory tasks. The problems within aviation training are exemplary of highly complex and automated task environments that require flexible skills and are likely to forecast training problems in other professional domains.

The project proposal is for 36 months beginning January 2000, with an estimated total of 175 person-months required for completion. The effort is broken into these 9 work packages:

1. Project management
2. Literature search
3. Design needs analysis
4. Specifications for method and tools
5. Development of method and tools
6. Validation of the design process
7. Validation of the learning process
8. Standardisation
9. Integration, final report and recommendations

Validation partners from the aviation industry (Piaggio, EuroControl, and the Swedish Air Traffic Control Academy) will directly benefit from the training design methodology and associated tools. These partners provide a real-world setting and associated support for testing the design, development, and validation of the design methodology and training developed according to that methodology. The design process is user-centered and involves the validation partners throughout the process. The process is iterative so that initial designs, methods, and tools can be refined in close association with the requirements and needs of the targeted industry users and beneficiaries. At the end of the effort, the validation partners will have in place validated training modules as well as a cadre of training design specialists knowledgeable and skilled in the use of the newly developed design methodology and tools.

## **Training Design for Complex Cognitive Skills**

One of the major aims of ADAPT<sup>IT</sup> is to create a harmonised training-design tool for dealing with tasks requiring complex cognitive skills, which can be defined as “skills for which the learner must invest considerable time and effort to acquire an acceptable mastery level and for which qualitative differences in performance exist between novices and experts” (van Merriënboer & Dijkstra, 1997, p.427). Training of complex cognitive skills are becoming increasingly important in today's society where routine tasks (recurrent skills) are mostly automated by machines. As a consequence, complex cognitive tasks, which cannot be taken over by machines, form the basis of training needs in industry. Examples of such complex cognitive skills are air traffic control skills, fault-management

skills, and computer-programming skills. One of the main characteristics of such skills is that their acquisition is a lengthy and effortful process. In other words, they are hard to learn. There are many constituent skills involved and at least some of those constituent skills involve problem solving and qualitative reasoning, requiring a deep understanding of systems and processes. In addition, the ability to integrate and coordinate the constituent skills involved is critical to reaching acceptable performance. Traditional instructional design models (e.g., Dick and Carey, 1996; Gagné, Briggs, & Wager, 1992) are particularly weak when it comes to the design of training programs for the multidimensional, complex learning required in highly demanding technical domains (Schneider, 1985). Other alternative models, while useful at a high level, are typically too generic and fail to provide specific guidelines (e.g., Gustafson & Branch, 1997; Tennyson, 1995) or there haven't been validated in the aviation industry (e.g., Kieras & Polson, 1985). Therefore, the ADAPT<sup>IT</sup> methodology is based on van Merriënboer's Four-Component Instructional Design (4C/ID) model. The 4C/ID model involves a training design method that has been empirically validated in the aviation industry (van Blanken & van der Pal, 1999). This method is scenario-based and makes the acquisition of complex cognitive technical skills the primary target and foundation of the training analysis and design method.

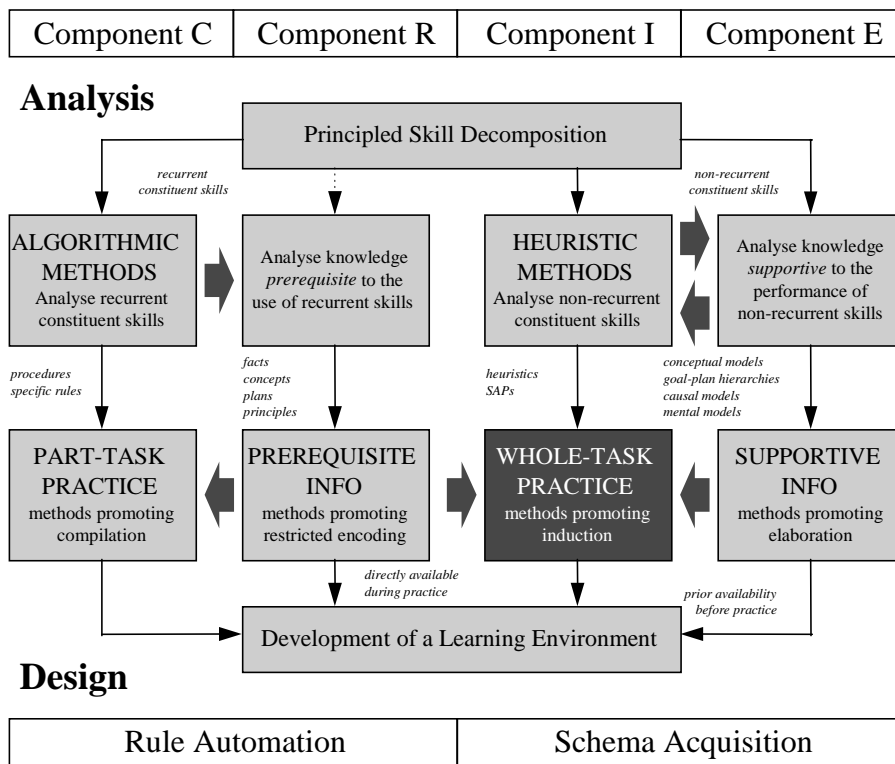


Figure 1. Overview of the 4C/ID-model, adapted from van Merriënboer (1997).

The model's systematic approach to the development of training is represented in Figure 1. The model provides guidelines for the design of training programs in highly complex domains and consists of four layers: (1) principled skill decomposition; (2) analysis of constituent skills and related knowledge; (3) selection of instructional methods; and, (4) development of a learning environment. These layers prescribe and contextualise the activities that instructional designers should perform in order to produce effective training for complex cognitive skills. Layers 1 and 2 involve the analysis of a complex cognitive skill; layers 3 and 4 involve the design of a training strategy and learning environment for that skill. It should be noted that although the layers are represented in a linear order, real world applications are much less well-ordered and often involve iterations. Tennyson (1995) also emphasizes this, as well as the associated contextualised activities of designers.

Ideally, the application of the model starts with principled skill decomposition, where the complex cognitive skill is decomposed into a hierarchy of its constituent skills and categorized according to their desired exit behaviours and related types of learning. This phase assumes that a proper needs analysis has been conducted and

the general goal or terminal objective of the training has been identified. Briefly speaking, in the principled skill decomposition phase, this general goal is further decomposed into a skills hierarchy that reflects the more specific constituent skills that enable the performance of the whole skill. The general idea of such a skill hierarchy is that “learning the constituent skills lower in the hierarchy might facilitate the learning or performance of the skills higher in the hierarchy” (van Merriënboer, 1997, p.86). The creation of hierarchies has been a long-standing practice in many instructional models (Dick & Carey, 1996; Gagné et al., 1992), but this particular hierarchy is focussed entirely on complex cognitive skills.

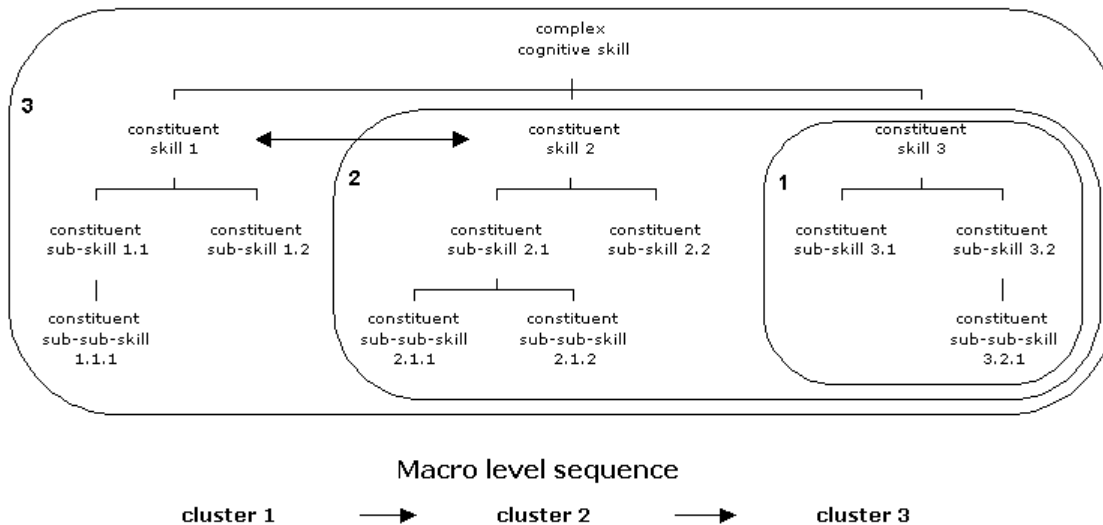


Figure 2. Generic example of a skills hierarchy and its division into skill clusters

For many tasks, all of the constituent skills of the complex cognitive skill cannot be trained simultaneously, so the skills hierarchy is divided into clusters. This clustering is called macro-level sequencing. The clusters may be seen as “parts” of the complex cognitive skill and each cluster contains a fairly large, meaningful set of interrelated constituent skills. Each cluster may require from 20 to 200 hours of training. Also, every cluster of subskills should represent an authentic task that an expert would perform in practice. Figure 2 shows an example of a skills hierarchy and how it is used to form skill clusters. At the top of the hierarchy is the complete complex cognitive skill. The downward links represent the skills that are prerequisite for mastery of the skill above. For example, to be able to perform skill 2, one should be able to perform subskills 2.1 and 2.2. From left to right, a temporal order is depicted. For example, for the complete performance of skill 2, one first performs skill 2.1 and then skill 2.2. Skills on the same level that are connected with a double arrow are performed concurrently. In the example, a backward chaining approach is applied to order the skills clusters. This means that the cluster of skills that is trained first is the cluster that is usually performed last when an expert performs the complete complex skill.

Once the constituent skills are described along with performance objectives, categorized (recurrent, non-recurrent), and sequenced, the next layer in the model deals with the analysis of those identified constituent skills, relationships between them, and knowledge structures underlying the performance of the complex cognitive skill and its constituent skills. This analysis primarily refers to the procedures or rules that underlie expert knowledge. Briefly, in this phase four different analyses take place: (1) analysis of recurrent constituent skills as strong methods; (2) analysis of non-recurrent constituent skills as weak methods; (3) analysis of prerequisite knowledge to perform recurrent skills; and, (4) analysis of supportive knowledge to perform non-recurrent constituent skills. Different task analytical techniques are prescribed by the model for each of these analyses (van Merriënboer, 1997). It is important to note that this layer translates into meso-level sequencing which specifies the order in which case types (i.e., categories of problems or worked-out examples) should be included in the training sequence for the skill clusters defined during macro-level sequencing. In other words, this sequencing provides a first global blueprint for the contents of a training program, providing a sound basis for the subsequent design of a learning environment. The outcomes of the analysis conducted in this second layer are heuristic methods - systematic approaches to problem solving (SAP charts). These charts indicate: the sequence of non-recurrent skills; the supportive knowledge

involved; rules and procedures for performing recurrent skills; prerequisite knowledge required to be able to perform procedures and apply rules; and sets of case types in a progression of simple to complex versions of the whole skill within the cluster.

After analysing the complex cognitive skill and each of its constituent skills, the training strategy should be composed. This coincides with the third layer in the model, where instructional methods for the design of whole-task and part-task practice as well as for different types of information presentation before and during practice are specified. Again four different activities take place depending on the category of the constituent skills at hand: whole-task practice, supportive information, prerequisite information, and part-task practice. The design of whole-task practice, in this layer, mainly refers to specifications of examples (problems and their solutions) and problems (incomplete examples) that the learners will be confronted with during training. This process should aim at promoting “a rapid development of highly situation-specific, automated rules by knowledge compilation. Instructional methods that are suitable for to reach this goal are often associated with repeated imitation and drill; learners are invited to mechanically and consistently repeat performance” (van Merriënboer & Dijkstra, 1997, p. 437). The key learning process to be promoted is induction - mindful abstractions of cognitive schemata that are useful to solving problems in the domain of interest. This is based on the premise that giving learners examples helps them construct mental frameworks that they can use when encountering similar problems in the future. The design of whole-task practice results in the first blueprint of the training program, describing what the learners will be required to do during the training. Figure 3 depicts the basic blueprint of a training program resulting from macro-level, meso-level, and micro-level sequencing. From the viewpoint of the designer, it is basically a hierarchy with the complex skill at the top followed by three sequencing levels: (1) skill clusters; (2) case types; and, (3) specific whole-task problems. This basic skeleton serves as the backbone for other design activities where additional practice for recurrent constituent skills and information is presented in order to support the acquisition of either non-recurrent or recurrent constituent skills. In other words, the training program blueprint is a hierarchy of:

- *skill clusters* (“whole tasks” - macro-level sequence);
- *case types* (the simple-to-complex cases of the whole task - meso-level sequence); and,
- *specific problems* (the problems or worked-out examples in each type of case and in each skill cluster - micro-level sequence).

This basic blueprint as presented in Figure 3, is then further elaborated to reach a complete description of the training program with the other activities in the third layer, which provide:

- additional part-task practice that may be necessary to reach the required exit behavior for particular recurrent constituent skills (part-task practice);
- information that is prerequisite to the performance of recurrent constituent skills, as performed either in a whole-task or part-task context (prerequisite info/JIT presentation); and,
- information that may be helpful to the performance of non-recurrent constituent skills, which are only performed in a whole-task context (supportive info for elaboration and understanding).

The model further provides detailed guidelines for instructional strategies and tactics for the presentation of information for each of the four components: whole-task practice, part-task practice, just-in-time information, and supportive and strategic information that need to be elaborated by the learners (van Merriënboer, 1997). Once, appropriate strategies and tactics are selected in the third layer, the designer moves to the fourth layer to compose a training strategy containing the selected instructional methods; this process results in a detailed blueprint for the learning environment. This layer prepares the designer for the transition from the design phase to the development phase. Since 4C/ID is an instructional design model, not an instructional development model, it does not provide detailed guidelines for the development of instructional materials. The model should be integrated with and embedded in an instructional development model during its implementation.

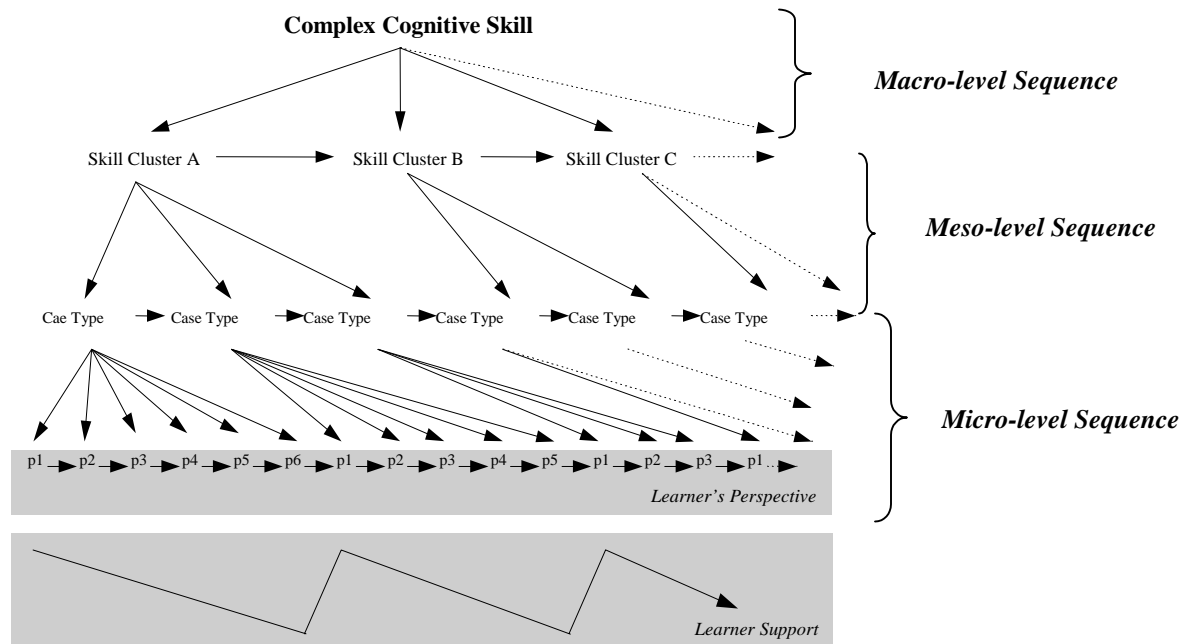


Figure 3. A generic blueprint for the training program showing the skills hierarchy, adapted from van Merriënboer (1997).

Overall, the ADAPT system aims at this integration. The result be a more time-effective instructional design process that increases the possibilities for re-usability of intermediate design products. Within the system, the ADAPT method that will guide the design phase will be based on the 4C/ID model just described but also integrate models of workload for aviation training development. In order to reach sufficient levels of standardisation and generality, designers will be supported in the proper and efficient use of the methodology by means of an interactive computer-based tool - automated instructional design support - ADAPT<sup>IT</sup>. One of the innovative aspects of ADAPT<sup>IT</sup> is that it will assist designers and design teams in decomposing and analysing a complex skill to-be-taught in such a way that alternative learning tasks can be developed that vary on the degree of cognitive load imposed on the learner. The ADAPT method will address the whole range of training design while including the aspects of 'intelligent tutoring' that relate to cognitive load theory.

### Training Designer's Needs

Although the ADAPT methodology will be mainly based on the 4C/ID model it will be different from the 4C/ID method in two ways. First, it will be tailored to the needs of actual designers or design teams in a variety of training domains, economical sectors, and company sizes. Second, it will be extended to become a personalised training approach. In order to achieve the former, current practice in designing training for complex cognitive skills had to be identified. The project team realised this through three different data sources. First, the literature on training designer's needs was reviewed. Training designer's needs are defined as the requirements that have to be met in order to change and improve current design practice. These requirements refer primarily to instructional design practitioner's perceived needs for support to use and apply instructional design theories and models. In addition to the literature review, designer's needs were identified by means of questionnaires and interviews. The design of the questionnaire was a collective effort based on focus groups with project and subject experts. It consisted of the following sections:

1. Background information (information on the company and the responding designer);
2. Outcomes of training (the tasks, skills, knowledge and attitudes for which training is designed);
3. Training design method (the products of the training design process, both intermediate and final);
4. Instructional design tools (the tools that are used to design training); and,
5. Desired tool characteristics (the ideal characteristics and functionality that respondents would like to have).

A total of 150 questionnaires were sent out by targeted e-mail, and 18 were returned. The respondents came from different sectors: education, transport, business, and manufacturing. In addition to the questionnaires, extensive

interviews with training designers were also conducted in order to gather more detailed information on current training design practices, the problems that are encountered and the desired support and specific needs during the training design process. The interview consisted of the following sections:

1. General information (information on the company and the interviewee);
2. Training design process (the training design process in general and the products of the training design process - both intermediate and final products);
3. Training design characteristics (the content of the training, the instructional principles used, etc.);
4. Co-operative design and design teams (the structure of a design team, the disciplines involved in a typical design team, the way in which a typical design team works, etc.); and,
5. Instructional design tools (the tools that are used and ideal characteristics of an instructional design tool).

Each interview took at least three hours. The target group was training designers who are actively involved in the design of training for complex domains. The interviews were conducted by two people, one to provide direct eye contact and ask questions and one to record answers and prompt for specific questions if needed. A structured interview instrument guided the interview process to insure that all respondents were asked similar questions. In total 11 interviews were conducted in the following sectors: 1 naval college, 3 air traffic control centres, 2 aircraft maintenance organisations, 1 telecommunications organisation, 1 information technology company, 1 training consultancy organisation and 1 distance education company. Unlike the questionnaires that produced data in one format, the more in-depth interviews were intended to provide detailed and rich information about company design practices. As interviewee background and companies differ substantially, the interviews were loosely structured in the sense that questions were open and no pre-defined answer categories were supplied. This was intended to stimulate the interviewer towards more natural, personal and company-specific responses, and this aspect was a complete success. Nevertheless, some structure was provided for the interviewer by a list of questions and themes to be addressed. Interviewer instructions were also provided since there were multiple interviewing pairs. This was intended to increase the compatibility between the interviews and over the variety of questions asked. The interviews not only yielded more detailed information, but, more importantly, they yielded an impression or feeling of current design practice, which did not emerge from the questionnaires.

The emphases during these data gathering efforts was on the difference between current and ideal training design practice, on the problems experienced during the design process, and on the ideal characteristics of an instructional design tool. In analysing the results, our interest was on the common themes that arose. In general, it can be concluded that current training design practice differs from that what is described in most instructional design models (e.g., Gustafson & Branch, 1997). Activities are carried out selectively and often partly and are characterised by implicit and intuitive methods as suggested by Tennyson (1995). The analysis phase is not carried out explicitly and in detail, mostly due to constraints involving time and resources. The design phase appears often to be combined with the development phase and often happens implicitly as part of the development and implementation of training.

Looking at the background of training designers, most designers have an operational background and are not specifically trained or educated in instructional design or training systems. Specific instructional design models or principles are rarely explicitly used by designers with an operational background. However, many basic ideas and some instructional design principles seem to be intuitively understood and used. These principles are not explicitly or systematically applied to a training plan or design blueprint.

In general, training is not designed in formally structured design teams. The most important actors in a team are subject matter experts and instructors, who typically design the training. Collaborative design does not seem to take place explicitly.

In answering the survey questionnaires and extended interviews, respondents indicated that the most significant and desired characteristics of an ideal instructional design tool are related to:

- targeting actual designers with an operational background;
- using non-academic language;
- providing practical worked-out examples;
- supporting an explicit, structured and systematic design process (especially for the analysis, design and evaluation phases);
- providing guidance in bridging the gap between current and ideal design practice;
- addressing the relational aspect during the training design process (setting up teams, involving users, teamwork, communication, etc.);

- providing support/guidance in applying educational design principles;
- providing methods for file management and version control;
- linking together the different training design products;
- making information easily re-usable and retrievable; and,
- allowing different degrees of freedom (e.g., from structured to non-sequential design).

The interest in structure, reusability, and relevant examples is consistent with the literature search conducted for this project and with the experience of project experts. Some respondents questioned the merit of such a tool as opposed to current design practice; these respondents are most probably the most experienced of those interviewed and are justifiably concerned with regard to the a tool constraining the application of their advanced knowledge and skills. ADAPT<sup>IT</sup> should therefore be set up in such a way that designers quickly become aware of and are convinced of the additional value of ADAPT<sup>IT</sup>, while allowing advanced users to integrate their own knowledge and skills. In addition, designers must be able to design training more quickly (increased efficiency) and to design better training (increased effectiveness) with ADAPT<sup>IT</sup>.

### **Assessment within ADAPT<sup>IT</sup>**

The project is addressing two additional kinds of assessment issues: (1) validating the tool against the theoretically-based design methodology upon which it is based; and, (2) demonstrating the effectiveness of the tool and the method in terms of learning outcomes. The outcomes of the needs assessment phase described above have led to specific method and tool requirements that are being integrated into the first prototype. Field tryouts with users in real-world settings will then lead to a second iteration and refinement of the method and tool. The project will assess the usability and utility of the refined method and tool by aviation industry practitioners. In addition, the project will content a quality assessment of the design blueprints produced as well as an effectiveness assessment of the training developed according to those design blueprints. As was the case with the Experimental Advanced Instructional Design Advisor effort (Spector, 1995), ADAPT<sup>IT</sup> intends to improve both efficiency and effectiveness.

Additional requirements for ADAPT<sup>IT</sup> have not been emphasised in this paper since the focus has been on the assessment methods and their implications. However, it is the intent to include a number of design advisors, customised to the appropriate enterprise setting. In the aviation industry, safety requirements are paramount and these must be emphasised in all training, both for maintenance technicians as well as for air traffic controllers. Moreover, there are aviation industry standards for the portability of training set by the Aviation Industry Computing Consortium (AICC) in addition to the IEEE standards being developed for meta-data in technology-based training. Finally, there are generic instructional design standards established independently by the International Board of Standards for Training, Performance and Instruction (ibstpi - see <http://www.ibstpi.org>) that ADAPT<sup>IT</sup> is committed to include. The overall assessment of ADAPT<sup>IT</sup> will include an external evaluation of how well the method and tool adhere to these various sets of standards.

### **Conclusions**

While there have been efforts in the area of automated support for instructional design (Spector, Polson, & Muraida, 1993), what has been missing in this area are sufficiently elaborated design models with associated guidance and frameworks that are appropriate for the design of training for complex cognitive skills. The ADAPT<sup>IT</sup> project is intended to fill this gap in the set of methods and tools available to instructional designers. The outcome of the needs assessment phase strongly suggests that the demand for such an integrated method-tool combination is highly desired by business and industry. The user-centred process adopted for this project insure that these real world needs will be addressed in the project and its products. The assessment of European designers described in this paper has resulted in a set of design requirements that will also be used for evaluating the final outcomes of the effort.

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# Evaluating Distance Learning: Feedback from “Distressed” Students

Christopher Essex  
Kursat Cagiltay  
Indiana University

## Abstract

*This paper presents the results of a student evaluation of a web-based distance education course offered by a major university in the midwestern United States. The findings of this study found that some students experienced what Hara and Kling (2000) call distance education “distress” and that, while they found the course to be a satisfactory educational experience, their online interactions were judged to be less than ideal.*

## Introduction

Almost all students from elementary to higher education are educated in a lecture based educational system. The communication patterns and characteristics of face-to-face lecture based environments can be quite different from those found in a distance education environment. For example, in a web-based distance education environment, all verbal and non-verbal communication cues, traditionally found in a face-to-face environment, disappear. In this new environment, supportive teacher-student interaction and student-student networking become very important. Although many argue that the web can be a good environment for delivering sound educational experiences, currently there is very little solid research to identify key issues to making online distance education experience a satisfying one for students. We hope that this research’s results will contribute to the efforts to close this gap.

## Purpose of the Study

This study examined some of the factors that contribute to student satisfaction in web-based distance education courses. In this study, by examining several factors based on Kirkpatrick’s Four Levels of Evaluation (Kirkpatrick, 1998), the researchers explored students’ responses to the instructor, activities and materials of a fully online, graduate-level course. The researchers compared their findings to those obtained by Hara and Kling (2000), and used their definition of “distress” to discuss students’ negative feedback regarding their online course experience.

## Statement of Significance

As stated by Keegan (1996), and Reeves in Khan (1997), there is not enough and quality research on several important aspects of web-based distance education. This research effort will attempt to evaluate student satisfaction regarding an online course based on a common structure for measuring student reaction to a course or training effort, Kirkpatrick’s Four Levels of Evaluation. It is hoped that this evaluation effort will help other online instructors and course designers in their efforts to design online courses that will be effective and satisfying to their students.

## Literature Review

The term “distance education” or “distance learning” refers to the teaching-learning arrangement in which the learner and teacher are separated by location and/or time (Moore, 1990). The World Wide Web (WWW) is a distributed, hypermedia based, platform independent, architecture for sharing information. Web-based education is defined as education delivered in whole or in part using the Web and related technologies (Khan, 1997). There are many other similar terms used to describe web-based education, such as: online courseware, learnware, distance education online, etc.

Through the years, distance education has taken advantage of current technologies, incorporating into the teaching and learning environment telecommunication technologies such as radio and television broadcasting, audio and video recording, live, two-way interactive audio, video. More recently there has been a huge growth in the use of synchronous & asynchronous computer-based interaction tools on the Internet or the World Wide Web (WWW) (Moore & Kearsley 1996). Today, Internet-based distance learning is one of the most rapidly growing aspects of education and training in the world.

While many argue that there is promising future in the use of the Web in education, there is no satisfying answer for the question of how this technology can best be used to approximate, or better, the traditional on-campus classroom experience. As stated by Windschitl (1998) and Moore (1990), much of the published work about distance education has been anecdotal descriptions of activities such as setting up on-line mentoring programs or how to get students involved in collaborative web-based activities with other schools. However there is not much solid research on the evaluation of Internet-based distance education.

Much attention was recently given, including an article in the *New York Times*, to a study by Hara and Kling (2000) that focused on the frustration expressed by to students in an online distance education course, an extreme level of frustration that Hara and Kling refer to as ‘distress.’ Certainly, the results of this study should concern distance educators and administrators at institutions that offer distance education courses. But as the *New York Times* article stated, “The report looks at just one class -- and a small one at that -- so it is not a survey of distance education courses as a whole, and few if any generalizations can be drawn from it.” Further studies looking at the experiences of online distance education students need to be performed before any serious judgments of the pros and cons of this new educational delivery system are made. The present study will, we hope, add to the body of knowledge about how students experience this new type of college course.

### **Definition of “Distress”**

Hara and Kling (2000) defined distance education ‘distress’ as “situations that the students...find particularly troublesome.” They found five main causes of distress for the distance students in the graduate-level online course they evaluated:

- Social Isolation
- Overwhelming Email Communication
- Lack of Instructor Feedback
- Technical Problems
- Ambiguous Instructions

In this study, we will evaluate a similar graduate-level course and see if the students report the same causes of distress.

### **Research Methods**

This study focuses on student evaluations of an online, graduate-level course offered by the School of Education at a large midwestern state university. The class size was not large: 11 students were registered for the course that semester. The instructor for the course under study was a native English speaker, and had previous experience as an online educator, having taught this course and one other course through online means in previous semesters. Students were located in Indiana, Hawaii, Iowa, Tennessee, North Dakota, and Sweden. Because the online course would not have class meetings in a physical location, it was impossible for the researchers to gather data from observation in class and interviews with students. Therefore, the researchers designed web-based questionnaires that would allow us to collect our raw data via the Internet.

The researchers utilized a five-step process for developing these questionnaires:

- Interviewed instructor
- Reviewed course content/activities
- Developed questions based on Kirkpatrick’s Four Levels of Evaluation
- Developed online survey instruments
- Integrated surveys into course website

In order to ensure a high percentage of student response, the researchers arranged with the instructor so that the students would have to complete the forms before they went on to the next activity. If students had asked not to fill out the form, the researchers would have allowed them to access the next unit without submitting the form, but none of the students pursued this option. In this way, the researchers were able to get response to our forms from all the students that were actively working on the course requirements. Two students were unable to complete the evaluation: one dropped the course, and one was ill.

The questions on the survey instruments, as noted above, were based on Kirkpatrick’s Four Levels of Evaluation (Kirkpatrick, 1998). Each of the levels focused on a different aspect of student response to the course. Our definitions of the four levels are as follows:

- *Level 1 (Student satisfaction):* Student satisfaction towards instructor, methods and content
- Course materials
- Course activities

- Instructor performance
- Overall rating for course
- *Level 2 (Student learning)*: Students' gain in knowledge and skills
- *Level 3 (Transfer of learning)*: Students' application of knowledge and skills to real job/school environment
- *Level 4 (Cost/benefit impact)*: Analysis of efficiency and effectiveness of the program from both the school's and students' point of view

It is important to note that for all of these levels, we were only able to measure the students' estimation of the degree to which the course satisfied their requirements for each level. In particular, for Level 3 (Transfer of Learning), we could only measure the students' opinions regarding whether or not they would be able to transfer their learning to other settings; we were not able to actually measure whether or not this transfer occurred, or would occur.

## Results Of The Study

In this section of the paper, we present the results of the student course evaluation. The following paragraphs describe the most significant findings of our study. Overall, the student responses can be summarized as follows, broken down into positive and negative feedback:

### Positive Student Feedback

#### *Level 1:*

Overall, students gave positive comments regarding this course.

#### *Level 2:*

The students reported a moderate level of learning.

#### *Level 3:*

Students expected professional benefits in the future from taking the course.

#### *Level 4:*

Students responded that the course cost them more money than on-campus course, but saved them time. The majority of the students felt that the cost/benefit ratio of the course was very favorable.

Overall, student reaction to the course was positive. In their evaluations, they provided us with some positive comments about the course. Most students were very confident that they had accomplished the learning objectives of the course. Students expected professional benefits in the future from taking the course. The majority of the students commented that the course saved them the time and effort of coming to campus to take a course in the traditional manner.

### Negative Feedback: 'Distress'

#### *Level 1:*

Many students were not very satisfied with their interactions with the instructor.

#### *Level 2:*

A small number of students were not well prepared for the technological requirements of this course, which caused them frustration.

#### *Level 4:*

Students responded the course cost them more money than an on-campus course. Also, some students cited decreased time to spend with their family and on their work as an opportunity cost of the course. One student stated, "I have little time for my family. (...) Much time is spent with the mechanics of the course, which includes posting on work on websites and submitting it." Another student said, "I have been forced to reduce some of my time at work."

#### *Levels 1, 2, 3:*

One student, in a moment of "distress," made the following statement: "I am totally frustrated. I absolutely do not know how this class is organized and how to access the information I need. I hate Long Distance education and I never plan to do this ever again. It has made me rethink even using the Internet in my class at school. I hate this. I hate this. I hate this."

In their findings, Hara and Kling noted two primary sources of students' 'distress': technological problems, and the instructor's online communication practices. Our study found the same issues were the primary concerns of the students in this course.

The course required students to navigate through various websites, send and respond to email messages, and use a web-based conferencing tool for class discussion purposes. Some students reported difficulties with utilizing the technologies required for these tasks. A few students complained about the way the course website, which was developed by the instructor, was structured.

In this course, many students were not very satisfied with their online interactions with the instructor. While the students recognized the instructor's knowledge of the subject matter, the majority of the students (5 of 9 respondents) did not give positive evaluations of their online interactions with the instructor.

In comparing our findings with those of Hara and Kling, our students reported that they shared 3 of 5 causes of 'distress' with the students in the Hara and Kling study.

- Social Isolation (not found)
- Overwhelming Email Communication (not found)
- Lack of Instructor Feedback (found)
- Technical Problems (found)
- Ambiguous Instructions (found)

Thus, the majority of the causes of 'distress' were the same for both courses.

## Recommendations

After a careful review of the student responses to the course evaluation instruments, and our analysis of the causes of distance education student 'distress,' we have developed the following recommendations for online course instructors.

- The instructor should review her practices in responding to students' email and web-based conferencing posts, to ensure that she is providing sufficient and appropriate feedback.
- The instructor should specify the technological requirements in the syllabus, and arrange for technical support.
- The instructor should conduct a usability tests on the course requirements and other instructions to ensure that they are clear and non-ambiguous.
- Even though the students did not report that social isolation was a major factor causing 'distress', we recommend that, due to its prevalence in the Hara and Kling study, the distance education program should provide an on-campus face-to-face orientation for its distance students. For students that cannot be on-campus, a videotape should be provided.

## Limitations

The research design for this study faced a number of limitations, chief among them being a limited time frame for administering the evaluation. Other limitations were:

- Small sample size (though entire class)
- Education students may be atypical
- Lack of follow-up evaluation
- Lack of ability to measure Level 3 (Transfer of Learning)

## Conclusions

Of course, as with Hara and Kling's study, the generalizability of the data in this survey is necessarily limited because it is only based on the student evaluations of one course. But as more online courses are delivered, and more students have the opportunity to voice their opinions on the pedagogy and technology of these courses, the researchers feel that it is important that their responses are shared with distance education instructors and administrators of online programs.

Based on the experiences of the students in this online course, the researchers have two primary recommendations for others developing such courses.

First, to ensure that the students feel "The Pains of Innovation" as Hara and Kling refer to it, to the least degree possible, the instructor should clearly specify the technological requirements at the outset of the course and should supply, or arrange for others to supply, the necessary technical support.

Second, more attention also needs to be paid to developing and refining methods of moderating and monitoring online discussions with students. The researchers suggest that instructors should review their practices

regarding responding to students' email and web-based conferencing posts, so ensure that they are providing sufficient, appropriate, and reasonably prompt feedback.

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# **Win-win: Students Using Instructional Design Skills to Teach Faculty to Integrate Technology in Teacher Education**

Catherine P. Fulford  
Ariana Eichelberger  
University of Hawaii at Manoa

## **Abstract**

*A win-win partnership has been created in the University of Hawaii Educational Technology Master's program allowing graduate students to try out their new skills by teaching faculty to integrate technology. These efforts have been in concert with USDOE Preparing Tomorrow's Teachers for Technology [PT3] and Eisenhower grant projects designed to provide professional development for a new designation of "technology intensive" courses. Workshops and individual assistance are provided by graduate students in practicum and internship courses.*

Students in instructional design and technology programs learn valuable skills that can be transferred to the real world of work. However, this transfer may be less than successful if appropriate guided opportunities are not provided to bridge the gap from school to work. A win-win situation has been created in the University of Hawaii's Educational Technology (ETEC) master's program that allows graduate students to try out their new skills by teaching College of Education (COE) faculty to integrate technology into their courses.

After completing core courses in educational technology including one year of instructional design, students are required to take an Educational Technology Practicum. The practicum provides students a guided setting for trying out their new skills in a real-world experience. This model may be typical of many programs, but what is unusual is the partnership that has been formed by graduate students and faculty to provide a valuable service for the College of Education. In this course, students work as a group to design technology workshops.

These efforts have been in concert with the US Department of Education's "Preparing Tomorrow's Teachers to Use Technology" and Eisenhower Professional Development Fund grant projects in the Educational Technology department. These projects have been designed to provide professional development for a new designation of "technology intensive" (TI) courses.

Each year the graduate students in the Educational Technology Practicum have unanimously chosen to continue conducting technology workshops to hone their instructional design skills and provide the service to the COE faculty. To maximize involvement, the practicum course enrollment is purposefully kept small, ranging from five to ten students.

Students in the course are ETEC majors who have completed their first year. Required in the first year are courses in which students use a variety of media to analyze systems, conduct needs assessments, explore change theories, create instructional hierarchies and write formal instruction. Practicum students come from a variety of backgrounds. As most Educational Technology courses are taught in the evenings, many students have full time jobs or are practicing teachers. The varying experiences they have outside of the department bring numerous viewpoints and skills to the group.

Students are allowed as much leeway as possible in determining and carrying out their design plan. The only requirements are that they follow standard design procedures. Educational Technology students in the first year use Dick and Carey's (1996) systems approach for designing instruction. The practicum gives students the opportunity to directly apply this approach to the real experience of designing and conducting workshops.

The first step of the Dick and Carey model is assessing need and identifying goals. In order for the practicum to be win-win, students identify their own needs and goals as well as those of the faculty. Initial class discussions are ones in which students identify their WIIFMs or "what's in it for me?" They discuss what they would like to learn and ultimately like to get out of the course. Students also identify skills they have in the group especially with regard to technology knowledge that can be shared with the faculty.

The win-win situation is fostered by the students considering their own needs concurrently with those of the faculty. Needs analysis studies of the faculty have been conducted frequently in the College of Education to find out how technology is being used, identify the training needs of faculty, and provide recommendations for the future growth of technology applications in the COE. The most recent study was conducted in 1999 by Ho, Sherry, Speitel, & Walton.

Responses from the faculty regarding what technologies they feel are relevant and interesting become a valuable guide for the students. Students now match what they would like to teach and learn with what the faculty want to learn. From this teaming emerge the student goals for themselves, the practicum and for teaching the faculty.

Instrumental in this planning phase are Dick and Carey's second and third steps, analyzing content and audience. Students must consider the faculty and themselves as the audience in order for the situation to remain win-win. This is when they begin to reconcile what the faculty want to gain and what they themselves want to gain from this experience. Resources are an important factor when determining content. Questions asked at this point are: What equipment do we have available to us in the department? What equipment do faculty have available to them in their departments? Who within the group has the skills to teach what the faculty want to learn? Where can we locate resources and expertise outside of our group? With these questions answered, a series of topics for the workshops are conceived and scheduled across the semester. An average of 5 workshops are scheduled over each practicum semester giving students initial planning time and a week between each workshop event.

Workshop topics covered in the Fall 2000 semester include: Online collaboration supported by WebCT, Electronic portfolios, Inspiration, the mind mapping software, Dreamweaver for web authoring, Adobe Acrobat, and preventative computer maintenance, among others. The Fall 2000 group also organized an open house event for the COE's Technology Learning Center. Past groups have conducted mini-conferences featuring break-out sessions with faculty members who technology intensive courses.

Students must now recruit for and advertise the workshops. Email messages, fliers in faculty boxes and word of mouth are the most common methods of advertising. Registration rates provide the students with informal data on what the faculty are truly interested in. Barring scheduling conflicts and other commitments, students assume that workshops with high registration rates are covering topics more relevant and interesting to faculty than those which are not being registered for. Well designed registration forms will also collect additional information about participants' skill levels, position and interests.

The fourth step of the Dick and Carey model, writing objectives, is now completed. The COE needs assessments in which faculty have rated their confidence and skill levels with specific technologies prove again to be a valuable resource. Based on the skill levels reported by faculty and the topics that have been decided upon, objectives are written for each workshop. Students must also take into account how much content can reasonably be covered in the two-hour workshop time period. An example of an objective from a Microsoft Word workshop is "participants will be able to save a Microsoft Word text file in HTML format." A Photoshop workshop example is "participants will be able to import layers from other files."

Students now take Dick and Carey's fifth step and develop their test or evaluation tools. Evaluations are directly aligned with the objectives for each workshop and are administered at the end of each workshop. Surveys are the most common instrument used and look primarily for changes in the affective domain. Faculty report on their confidence levels with technology before and after the workshop, rank the personal relevance of the information presented and comment on their interest in the topics and guest speakers. Questions are directly aligned to the content presented in each workshop. It is important to note that students are encouraged to make the evaluation instruments non-threatening to faculty and to avoid making faculty members feel they are being tested. Students are also encouraged not to solicit information which may be perceived as judging the guest speakers. Appropriate space is allotted for suggestions and comments from the faculty on how to improve and revise further workshops.

Dick and Carey's model now calls upon the students to develop a strategy. Students are reminded to review Smith and Ragan's (1993) organizational, delivery and management components of instructional strategies. Organizational aspects encompass the scope and extent of content. Content is made specific and thought given to how thoroughly it can be covered in the workshop time period. Delivery components include issues of appropriate media selection and workshop style. Appropriate media compliment and enhance workshop topics. Depending on content, one or more of the following delivery styles is chosen: student presentations, guest speakers, hands-on activities, discussions, and use of examples or non-examples. Student presentation of content most often involves multimedia presentation software such as PowerPoint. Content is usually demonstrated step by step while the faculty observe or follow along with paper-based materials.

Guest speakers are a popular way for students to provide faculty with examples of real classroom applications for the technologies presented. Guest speakers are chosen for their motivational style and positive attitudes as well as their personal and innovative methods of technology integration. The goal of having a guest speaker is to motivate and stimulate the faculty to generate ideas about technology integration in their own classrooms.

A common workshop agenda begins with a guest speaker followed by student presentation of content using multimedia presentation software. This portion of the workshop tends to occur in a classroom-style setting. Following a short break, the workshop moves to the teaching lab where participants can work individually or in pairs on computers to practice the technology applications. This type of workshop has proven to be a successful blend of the technology integration issues the ETEC department students and faculty want to teach and the hardware and software specifics the COE faculty want to learn.

Hands-on activities are popular for most workshops. The COE has two teaching labs, one Macintosh and one IBM compatible in which hands-on activities can be conducted. Each room has approximately 20 computers. Hands-on activities provide participants with the opportunity to practice their new technology skills while the practicum students act as helpers. When faculty have been provided opportunities to attend workshops solely regarding integration, response has been lower than when integration issues are paired with hands-on activities in which they learn hardware and software specifics. Participants have reported that hands-on activities increase their confidence levels with technology and are more exciting than presentations alone. The practicum situation, with 5 to 10 students available, presents the opportunity to provide one-on-one assistance during the instruction.

Discussions are considered for a workshop when content may relate to but not be specifically based on technology skills. For example, a discussion about technology standards and their application in the classroom might be more appropriate than a hands-on activity about the same topic.

Students may also employ the use of examples and non-examples to demonstrate effective applications of the content they present. While guest speakers provide examples of a positive technology applications, students may also consider the use of non-examples or negative applications of technology. Non-examples present a negative usage of a technology with the intent of reinforcing the validity of positive usages.

In conjunction with determining what types of media, materials, speakers, and format should be used, students must also address the management and practicalities of facilitating the events. Good management strategies become imperative at this time. Tasks include but are in no way limited to locating and reserving facilities and equipment and soliciting and confirming guest speakers. Students now decide not only how the workshops will be managed but how they will manage themselves as a group to achieve the goals they have set for themselves. They create extensive task lists and checklists then assign roles to members of the group. Different groups organize themselves differently. Some groups have found it beneficial for all group members to work on and contribute to each workshop while some groups assign individuals as leaders of particular workshops with the rest of the group acting as support to that leader. The assignments of these roles tend to have long term impact on the success of the practicum. Although students are encouraged to and do revise throughout the course these initially assigned roles tend to remain consistent throughout the semester. The most success has occurred when roles are assigned which align with an individual's strengths as well as their WIIFMs. For example, a student that would like management experience often becomes an overall leader of the group. A student with extreme stage fright and a desire for better presentation skills may not be the most appropriate person to be the main presenter for workshops. On the other hand, the instructor may encourage this person to be a presenter at least once to provide a learning experience and opportunity to develop those skills.

Following the progression of the Dick and Carey model students then develop materials for the workshops. Bearing in mind the delivery style and content of the workshops, accompanying materials are created ranging from web to paper-based instructional booklets. Multimedia presentations are most often used to present content and demonstrate software applications. The design of materials incorporates a variety of instructional styles. Some workshops may use instructional materials during hands-on activities while participants follow along step by step. Other materials are designed to be used after the workshop. An example of an after-workshop resource is instruction on advanced features of a technology which were not addressed in the workshop. Other after-workshop resources have included workshop series web sites with general information, workshop schedules and PDF files of workshop materials. Fall 1999 semester's web address is <http://www2.hawaii.edu/~ganne/PauHana>. Students are encouraged to be "resource linkers" when developing materials, locating available existing resources and materials and incorporating them into their own.

The production of materials brings up issues of theme and appearance. This issue most often reflects the management style of the group. Groups who are extremely collaborative with all group members working on all workshops tend to devise on an overall theme and look for the workshop series and accompanying materials while groups in which leaders emerge for specific workshops may develop different looks for different workshops. Accompanying materials have included advertising fliers, registration forms, evaluation surveys, instructional booklets, web sites, agendas and certificates of acknowledgement given to guest speakers.

Dick and Carey's model stresses that formative evaluation and revisions take place throughout the design process. When the practicum workshops have been developed, formative evaluation is conducted through



rehearsals. A “dry-run” of each workshop is one of the few requirements of the course. The opportunity to go through all materials and instruction in real time and in the actual setting provides students with practice that improves their presentations and workshops dramatically. The group and the instructor observe and participate in the workshop rehearsals. Following rehearsal, presenters critique themselves on aspects they felt were problematic and the rest of the group is encouraged to provide additional opinions. They catch many mistakes and timing misjudgments. Lastly, the instructor provides feedback and suggestions. Rehearsal sessions take place one week before workshop events and students make final revisions throughout the week.

The course period is 2.5 hours long and workshop sessions are 2 hours. The extra half hour is used for set-up prior to and breakdown after the event. Details overseen by students for workshop events include registration tables, pre-printed nametags for participants, sign in sheets and refreshments. Students dress more formally for workshops than they do for class. Workshop participants are asked to complete evaluation forms at the end of each workshop. Students provide “prizes” such as candy for those who complete evaluation forms to raise the turn-in rate. Following each workshop the instructor and the practicum group conduct another formative evaluation session, or “de-briefing”. They discuss what went right and what went wrong. Participant evaluations are reviewed and discussed. Students reflect on the process of planning and conducting the workshop and suggestions are offered as to what will make the next workshops better.

The last stage of the practicum course and the Dick and Carey model concentrates on summative evaluation. Students are required to produce a final report about the course. In it they include the objectives for each workshop, their WIIFMs or “what’s in it for me” statements, what went wrong and what went right in each workshop, their reflections and suggestions for future workshops and all the original materials they created in the course. This document is addressed to the next practicum group as advice from those who just went through the process. Examples of what went right and wrong statements for an Avid cinema workshop include: “I’m glad I created a personal timeline to help me get all my tasks done, especially for the day before the event. I’m also glad I used templates in the workshop that faculty could use. I should have tested the hands-on part on the workshop day. I should have practiced more to make my timing smooth”. Reflections about the course include statements such as: “Listening to team feedback is important, I learned to ask for help from the team, and I learned the importance of preplanning”. Examples of suggestions for the future include: revise, revise, revise, plan ahead, delegate small tasks out to the whole team, and rehearse, rehearse, rehearse. Some practicum groups have created fliers with “10 tips” for the next group offering advice and suggestions of how to get started and what to avoid in the planning and execution phases of the workshops.

Over the four years the course has conducted faculty workshops, student evaluations have been consistently high and the course is always full. Faculty in the department who employ students who have been through the course report that these students tend to have excellent presentation skills and high levels of confidence. Workshop sessions are consistently well attended and evaluations positive. In this way the process is win-win. Students get a real world design and presentation experience and the faculty get free, in-house technology workshops tailored specifically to their needs.

Following the practicum workshops, faculty are recruited to be involved with grant projects and redesign their courses to be technology intensive. The grants provide student technology consultants who meet weekly with the faculty members for one-on-one mentoring to help them achieve this goal. The National Council on Accreditation of Teacher Education (1999) suggests that mentoring and providing feedback is an effective method of professional development in technology integration.

The student consultants, who are primarily students in the Educational Technology masters program, again, have an opportunity to use instructional design skills in their approach to faculty mentoring. As consultants they: (a) conduct individual needs assessments of faculty members, (b) set goals for the professional development; (c) provide expertise in creating a revised curriculum; (d) assist in improving technical skills to help faculty members reach their technology integration goals; and (e) provide encouragement and guidance in course design and technology integration. The goal and final product of the mentoring is a technology intensive course proposal in which the faculty member outlines how they have restructured one or more of their courses using the technology intensive standards. These standards directly parallel the International Society for Technology in Education (ISTE) standards and were developed through a grant project at the University of Hawaii in 1996. The essence of a TI course is that both the instructor and student are actively using technology in the teaching and learning process. An example of a redesigned TI course would be one in which students and instructor are communicating via email, the instructor is using multimedia software to present content in class and students are giving multimedia presentations in place of papers. Redesigned courses also often include the inclusion of web based activities such as electronic bulletin boards, chat rooms, threaded discussions and web site construction, or digital video and electronic portfolios.

Based on grant project evaluations and course evaluations, students and faculty have greatly increased their skill levels and their confidence with technology and its integration in the classroom. This partnership has created a synergistic effect that is best described by Covey (1994). "Win-win means that agreements or solutions are mutually beneficial, mutually satisfying. With a win-win solution, all parties feel good about the decision and feel committed to the action plan."(p.117) The evaluations by both faculty and students have confirmed that their partnership meets this ultimate goal.

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# **A Comparison of Collaborative Learning and Audience Awareness in Two Computer-Mediated Writing Environments**

Barbara Gaddis  
Harriet Napierkowski  
Nadyne Guzman

University of Colorado at Colorado Springs

Rodney Muth  
University of Colorado at Denver

## **Abstract**

*In this study, we examined differences between two populations of composition students over the course of a semester in their perceptions of collaboration as reported in pre- and post-surveys. In addition, using an assessment rubric we developed, we examined students' audience awareness as demonstrated in their writing. Both groups of students were taught by the same instructor and had the same writing assignments; both classes incorporated a pedagogy of collaborative learning to help students develop a sense of belonging to a discourse community; and both sections used networked computers as learning, writing, and communication tools. The distinguishing variable between the two sections was the absence of face-to-face communication among students in the online class. In our study, we posed the following research questions: In a comparison of students in a on-campus networked writing class with students in an off-campus online writing class, (a) Do students differ in how they value collaboration during the writing process? (b) Do students differ in how they address audience needs in their writing products? (c) Do students differ in their level of satisfaction with their learning experience? Conclusions from this study are the following: (1) Online students tend to be more independent learners, valuing collaboration less than do on-campus students; (2) Online interaction appears to increase audience awareness in students' writing. (3) Students in both sections reported positive experiences with their respective classes.*

The field of composition has undergone two significant paradigm shifts in the last twenty years: from a focus on the product of writing to a focus on the process, and from a focus on the writer as a solitary individual to a focus on the writer as part of a discourse community, "a group of people with similar goals and interests who constitute themselves with a characteristic language" (Bruffee, 1993, p. 223). A more recent development, the use of computer-mediated instruction in the college composition classroom, has facilitated both paradigm shifts.

At the University of Colorado at Colorado Springs (UCCS), for example, all writing classes are taught in networked-computer classrooms, where students interact both through face-to-face and through computer-mediated communication. In this environment, students have increased opportunities to engage in the writing process through collaborative partnerships with other students. The networked computers become conduits for linking students with one another, thereby extending the discourse community in the classroom through a second framework via cyberspace: shared virtual "chambers" where continued interaction takes place and where a repository of student work, both individually and collaboratively produced, resides as a catalyst for further dialectic.

At the same time, universities are experimenting with the delivery of writing courses exclusively via distance learning, without face-to-face interaction. In the fall 1999 semester, UCCS joined the ranks of these universities by delivering one section of freshman composition as an online course.

## **Computer-Mediated Communication**

Computer-mediated communication (CMC) changes both the quality and quantity of communication by allowing time for critical reflection and greater involvement in discussion than is allowed in the traditional classroom, where one or two students may monopolize the conversation (Berge, 1995; Fishman, 1997; Wells, 1992). Group conferencing appears to decrease the emergence of a group leader, allowing more students a greater role (Harasim, 1990; Warschauer, 1997). Student-directed conversation and participation level is higher in the CMC classroom, which shifts the role of the teacher from content expert to facilitative guide (Wells, 1992). CMC thus enhances peer-to-peer discussion (Jonassen et al., 1995), and participation is fairly evenly distributed among students. Students report that they work harder and produce higher quality work, since work is visible to their peers (Oblinger & Maruyama, 1996). In addition, computer conferencing tools foster critical thinking and active learning

by providing an electronic space for reflective journal writing, critical analysis, and peer and instructor facilitation (Bonk & Reynolds, 1997). Instructors are able to observe students' contributions to discussion, obtain a record of the discussion for future feedback, participate in the discussion to model critical-thinking skills, and ask questions to coach critical thinking, providing expertise when necessary (Wagner & McCombs, 1995).

## **Collaboration**

Collaboration enhances connectivity and socio-emotional commitment to the learning process by involving students as active participants in the learning process (Sharan, 1980; Oliver & Reeves, 1994). Students achieve greater cognitive development working together than they do working individually (Sharan; Oliver & Reeves). Collaboration can contribute to the active construction of meaning, through idea generating (divergent thinking), idea linking (convergent thinking), and idea structuring (categorization and classification) (Harasim, 1990). Online collaboration, with its emphasis on both reflection and interaction, can amplify the process of knowledge construction (Warschauer, 1997). Collaborative problem solving, involving both conversation and issue-based discussion, supports intentional learning and develops critical-thinking skills (Duffy, Dueber, & Hawley, 1998). Web-based tools such as e-mail, electronic partnerships, project-based learning, and synchronous or asynchronous conferencing foster collaborative learning (Bonk & Reynolds, 1997).

## **Advantages and Limitations of Asynchronous Collaboration**

While the effectiveness of these collaborative tools has not been extensively studied, asynchronous communication and online collaboration have some recognizable strengths and weaknesses. Strengths of computer-mediated collaboration include student enthusiasm, more time on task, and student satisfaction (Shotsberger, 1996; Kerner, Penner-Hahn, Berger, & Dershimer, 1997). Students appear to like CMC, find the instructor is more accessible, and find problem-based learning and case-study learning more useful than they are in a traditional classroom. Disadvantages include communication anxiety, feelings of disconnectedness from conversational thread, and frustration over delayed feedback. Additionally, making decisions from group consensus can be time-consuming (Harasim, 1990; Warschauer, 1997), while software and hardware problems may limit interaction (Oliver & Reeves, 1994). One of the biggest drawbacks to asynchronous collaboration is the lack of visual and verbal cues provided by face-to-face interaction. (Lehman, 1995).

## **Online Students vs. Traditional Students**

A comparison of online and traditional students shows that online students learn on average as well as traditional students, with respect to midterms, finals and grades. More mature and better students learn more, while students who lack good study habits and have difficulty writing and reading learn less (Harasim, 1990). Self-discipline is a crucial element of success in online learning. Hiltz (1990) examined learning in online and traditional classes using pre-/post-questionnaires, case studies, institutional data, interviews with students and faculty, and survey of dropouts. She found no significant difference between mastery in the online class and traditional classrooms. In fact, the grades for students in the online computer science class were better than the grades for traditional students. She concludes that online students learn as well as traditional students. Simonson, Schlosser, and Anderson (1994) concur: Students who are motivated, prepared, and intelligent can potentially learn as much online as in a traditional classroom. While attrition rates are generally higher for online students, researchers have found little correlation between performance outcomes and individual characteristics, especially for mature learners (Kember, 1990).

## **Collaborative Learning, Writing, and Audience Awareness**

Collaborative learning in higher education has been underused and frequently misunderstood. Bruffee (1993) posits that knowledge is a social construct, that learning is a social process, and that writing is central—not ancillary—to collaborative learning and the construction of knowledge. In addition, Oakeshott (1962), Sergiovanni, (1996), Latour and Woolgar (1986) all emphasize the importance of social dialectic in the construction of knowledge. The use of technology in the teaching of writing has also been widely discussed (Hawisher, LeBlanc, Moran, & Selfe, 1996). However, although researchers have documented a variety of benefits from the integration of technology in the composition class (Carbone, 1993; Klem & Moran, 1992; Mason, Duin, & Lammers, 1994), the data about writing improvement are less clear.

Current approaches to audience include historical studies (Willard & Brown, 1990; Willey, 1990), studies of writers' audience awareness during the writing process (Moffett, 1968), studies of audience as a discourse community (Enos, 1990; Raftery, 1990; Roth, 1990; Mangelsdorf, Roen, & Taylor, 1990), and links between audience awareness and syntactic and lexical features (Rubin & O'Looney, 1990). This interest in audience is related

to the increased focus on examining composition from a social constructivist perspective (Bruffee, 1986). In addition, an ongoing debate centers on whether writers “invoke” a fictionalized audience or “address” an actual audience. Scholars agree, however, that actual readers can have a powerful effect on writers (Long, 1990; Ede & Lunsford, 1984; Porter, 1992).

## **Research Design and Methodology**

In this study, we examined differences between two populations of composition students over the course of a semester in their perceptions of collaboration as reported in pre- and post-surveys. In addition, using an assessment rubric we developed, we examined students' audience awareness as demonstrated in their writing. Both groups of students were taught by the same instructor and had the same writing assignments; both classes incorporated a pedagogy of collaborative learning to help students develop a sense of belonging to a discourse community; and both sections used networked computers as learning, writing, and communication tools. The distinguishing variable between the two sections was the absence of face-to-face communication among students in the online class. In our study, we posed the following research questions: In a comparison of students in a on-campus networked writing class with students in an off-campus online writing class, (a) Do students differ in how they value collaboration during the writing process? (b) Do students differ in how they address audience needs in their writing products? (c) Do students differ in their level of satisfaction with their learning experience?

Our rationale for focusing on audience awareness was quite simple: One of the hallmarks of critical thinking and thus of good academic writing is the ability to examine an issue from various perspectives, to take into account opposing views, to be aware that one is writing not for oneself but for an audience of readers who have multiple perspectives and often considerable skepticism toward the writer's perspective. The best way to increase one's credibility with a skeptical audience is to acknowledge readers' likely questions, concerns, and objections and to address them, summarizing opposing views fairly, and responding to those views either through concession or carefully crafted rebuttal (Rogers, 1961). Fundamentally, the writer's obligation is not to create barriers between herself and the reader but rather to build bridges—to find common ground. As beginning writers, first-year college students have difficulty doing this, largely because they are locked in their personal perspectives, often viewing the world in a dualistic, “right and wrong,” lens (Perry, 1970; Perry, 1985). Collaboration during the writing process helps students expand their awareness of audience and thus, presumably, helps them improve this important aspect of their writing.

Objectives of the freshman composition are to improve students' research and argumentative writing skills and to help students gain confidence in their writing ability. Peer response sessions on papers-in-progress were an important course component, promoting collaborative learning and heightened audience awareness. To promote collaborative learning in both the on-campus and the online sections, students used FirstClass software, a communication and conferencing package that facilitates students' ability to collaborate with peers and to engage in the various stages of the writing process. For the on-campus students, the computer classroom was equipped with 24 networked PC workstations arranged around the perimeter of the classroom, along with an instructor workstation connected to a video display projector. Students in the on-campus section ( $N = 18$ ) met twice a week in the networked classroom. Students in the online section ( $N = 15$ ), on the other hand, with the exception of an initial and final on-campus meeting, completed all their interactions with peers and the instructor online.

But whether students were enrolled in the on-campus or the online class, they were able to access their virtual classroom space, including assignments and work-in-progress by students in the class, both from home computers and from computers in open labs on campus. In both classes, the instructor gave the students a brief introduction and a written instructional guide to the technology itself. Additionally, since this was a second-semester course, most of the students had had previous exposure to FirstClass in their first semester of composition and were thus familiar with the software from the start of the semester.

To determine demographic differences between the students in the on-campus and the online class, we compiled profiles of students in the two sections from survey questions (age, gender, GPA, grade level, work load, family status, technical expertise, and experience) and from the University Student Information System (SIS). Significance in this study was set at  $p = .05$ .

### **Procedure for Measuring Students' Attitudes toward Collaboration**

Besides providing demographic information, students in both sections completed pre- and post-surveys (Fowler, 1993; Ehrmann & Zuniga, 1997) regarding their attitudes toward collaboration, responding to questions on a 6-point Likert-type scale. To increase face validity of these items, we distributed the instrument to twelve experienced composition faculty in the UCCS English Department Writing Program who reviewed the items and made suggestions.

### Procedure for Measuring Students' Performance in Audience Awareness

To determine differences in demonstrated level of audience awareness, the first and final papers—out-of-class, research-based argumentative papers—were collected from all students in both sections. For control purposes, students were given the same assignments for the first and final papers. We wanted students to write on two topics at a similar level of “strength of opinion.” To determine this, we polled the students in the pre-survey, asking them to rank six topics on a scale of one to five, “one” representing indifference to a topic, and “five” representing a strongly held position on a topic. The two topics with the most similar means were gun control and capital punishment. Not only were the means similar (gun control topic  $\bar{X}$  = 3.6429, 1-5 scale; capital punishment  $\bar{X}$  = 3.6667, 1-5 scale), but students also had relatively strong positions on these issues, so we reasoned that these two topics would require similar levels of cognitive challenge for students in addressing an opposing audience. The first paper assignment instructed students to take and support a position on the issue of gun control, while the final paper assignment instructed them to take and support a position on the issue of the death penalty. In both cases, students were instructed to address an audience that disagreed with the position they took on the issue. The writer’s purpose was to gain the readers’ respect, if not their assent, for the position argued.

The papers were coded using a random numerical coding system and were assessed by three experienced readers who first completed a “norming” of six of the papers, randomly selected (Elbow, 1996). The readers assessed the papers based on a nine-item rubric, using a primary-trait six-point criterion-referenced scale (Walvoord & Anderson, 1998) that we developed. The nine items include six elements of audience awareness important in argumentative writing, the genre focus of English 141: purpose, empirical support, logical appeal, ethical appeal, emotional appeal, and treatment of opposing views. These are based on Aristotle’s *logos*, *ethos*, and *pathos*, on Toulmin’s (1958) model of informal reasoning, and on Rogerian rhetoric (Rogers, 1961). We also examined three additional elements considered standard in essay assessment: organization, syntax, and grammar. Trimble (2000) argues that these additional elements do in fact fall under the rubric of audience awareness, and that writing for an audience is less effective in the absence of control in these areas. Inter-rater reliability scores for the rubric elements ranged from 0.66 to 0.89.

### Results and Discussion

The online class was significantly older ( $M$  = 28.36 years) than the on-campus class ( $M$  = 20.5,  $F$  = 13.167,  $p$  < .01), and a significantly higher portion of the online students were married ( $p$  < .01). Although age was correlated with other demographic variables, such as the number of dependents, employment hours, and credit hours, these other variables were not significantly different between the two sections.

Online students and on-campus students did not differ significantly in academic background. Students had comparable grade point averages, TSWE scores, SAT-English scores, ACT-English scores, and grades in English 131, the prerequisite composition course for English 141. Students in both sections were similarly comfortable with computer technology, Internet access, and CyberClass usage. However, several interesting motivational differences between the sample populations were evident. Online students ranked themselves higher on self-discipline than did on-campus students, but they planned to devote fewer hours studying for the class. This difference is significant, even when age was used as a covariate ( $F$  = 6.473,  $p$  < .01). In addition, online and on-campus students had different motivations for taking the class that they selected. Online students cited convenience, while on-campus students cited the good time block as being the primary reason for choosing the particular section.

### Collaboration Survey Results

At the beginning of the semester, students in both sections held similar views of collaboration, with no significant difference in overall collaboration scores between the two sections. However, online students’ collaboration scores were significantly lower at the end of the semester than they had been at the beginning, suggesting a decrease in their valuing of collaboration as the semester progressed. This finding is in contrast to the literature that suggests that electronic communication enhances a sense of community (Harasim, 1990). In our study, online students valued community less, believed less strongly that knowing other students in the class improved learning, and exhibited less preference for face-to-face communication over written communication.

Factor analysis of the 25 collaboration survey items resulted in two factors, accounting for 42.589% of the variance. The reliability for this instrument was  $\alpha$  = .8910. Factor one (“valuing peer feedback on work in progress”) contained twelve items, while factor two (“sense of belonging to a discourse community”) comprised four survey items. Using ANOVA, we found no significant differences on either the pre- or the post-survey for factor one: Whether they were enrolled in the online or the on-campus section, no significant differences emerged in how students valued peer feedback on work in progress either on the pre-survey or the post-survey. We also calculated

the difference between sections in the amount of change in attitudes in factor one. While the scores for the online students went down over the course of the semester ( $M = -2.33$ ) and the scores for the on-campus students went up ( $M = .357$ ), the difference between groups in the amount of change was not significant ( $F = 1.21, p < .282$ ).

Analysis of responses towards factor two items indicates that feeling connected was significantly less important to the learning experience for online students than it was for on-campus students. While the scores for the online students went down over the course of the semester ( $M = -1.38$ ) and the scores for the on-campus students went up ( $M = 2.00$ ), the difference in the amount of change was not significant ( $F = 2.451, p < .130$ ).

### Audience Awareness Rubric Results

In examining the survey results, we were primarily interested in students' attitudes and self-perceptions. In examining students' final papers, we shifted our gaze from attitudes to actual writing performance, focusing particularly on students' demonstrated audience awareness. We wanted to see if any differences emerged in students' writing depending on whether students collaborated on their papers in a face-to-face environment or exclusively online.

We compared scores on the nine elements of the audience awareness rubric, on both the first and the final papers. In spite of the lack of face-to-face collaboration, online students scored significantly higher on eight of the rubric elements on the first paper and on all nine of the elements on the final paper, as can be seen in Table 1:

Table 1

*Comparison of Means in Audience Awareness Between Sections*

Rubric Element	Online	First Paper <u>M</u>			Final Paper <u>M</u>		
		Online	<u>M</u>	<u>Dif</u>	Campus	<u>M</u>	<u>Dif</u>
					ampus		
1. Purpose	13.07	10.56	2.51*	13.60	10.67	2.93**	
2. Empirical evidence	13.20	10.44	2.76*	14.33	10.89	3.44**	
3. Logical appeal	12.73	10.33	2.40*	14.67	10.11	4.56**	
4. Ethical appeal	12.53	10.22	2.31*	14.47	10.56	3.91**	
5. Emotional appeal	12.73	10.94	1.79*	14.13	11.44	2.69**	
6. Treatment of Opposing Views	11.07	9.06	2.01	13.20	10.29	2.91*	
7. Organization	12.67	10.89	1.78*	14.00	9.44	4.56**	
8. Syntax	13.60	11.06	2.54*	14.33	10.78	3.55**	
9. Grammar	13.20	10.89	2.31*	14.27	10.78	3.49**	

\* $p < .05$ . \*\* $p < .001$

In addition, students in the online section showed a significantly greater amount of change in logical appeal, ethical appeal, and organization than did the on-campus students. From the data, it would appear that students in the online section developed better audience awareness skills, such as use of logical, ethical, and emotional appeals, and treatment of opposing views, as the semester progressed, while the corresponding on-campus students did not. Neither section improved significantly in organization, syntax, or grammar. Scores on these three elements actually decreased for the on-campus section, although the decrease is not significant.

### Age as a Confounding Independent Variable in Audience Awareness Rubric Results

Age had a moderate relationship to audience awareness scores on the first paper ( $R = 0.452, p < .01$ ) and on the final paper ( $R = 0.522, p < .01$ ), and a moderate relationship to the final course grade ( $R = 0.437, p < .05$ ). When age was used as a covariate, we still found significant differences between the two sections with respect to ethical appeal, logical appeal, and organization.

### Satisfaction Level Results

Students in both sections reported positive experiences with their respective classes, with similarly favorable evaluations of the instructor, with the on-campus section evaluations being slightly more favorable, but not statistically significant. Rating for the instructor in the on-campus section was an A, and in the online section, an

A-. One area in which students in the two sections differed significantly was in their perceptions of the course workload. Students in the online section perceived the workload as being more difficult ( $M = 6.23$ ) than did the on-campus students ( $M = 5.14$ ), even though the syllabus, schedule, course assignments, and deadlines were identical for the two classes, and the actual workload was identical. One explanation is that online students had significantly lower expectations of time to be spent studying as well. It could be that the contrast between their perception of the workload and the actual workload made the actual workload seem heavier. But in spite of the fact that the online students believed that they had a higher workload than students did in the on-campus class, online students overwhelmingly indicated that they would prefer to take an online class to an on-campus writing class.

### Limitations

The most important limitation to this study was the fact that students self-selected into the networked and online classes, and thus did not represent a truly random sampling of populations. Additionally, the small sample size makes generalization speculative. However, as a preliminary study of online versus on-campus writing classes, the research reported in this paper was fruitful for us and provides a sound basis for further exploration on collaboration and audience awareness in computer-mediated freshman writing classes.

### Conclusions

The results of this study indicate that students who enroll in an online class have characteristics that differentiate them from students who don't select into an online class. Another conclusion that we can draw from this study is that online students tend to be more independent learners, valuing collaboration less than do on-campus students. Additionally, as indicated by the higher scores in audience awareness on students' final papers in the online section, even when the scores were covaried for age, students can learn as well in an online class as in an on-campus class. Online interaction among students thus appears to increase audience awareness in students' argumentative papers. This in itself is a surprising finding. We speculated that students in the on-campus section would have the advantage of having online interaction along with face-to-face interaction. Nonetheless, this advantage did not translate significantly into improvement in students' papers while improvement among the online students was significant in several elements of audience awareness. With the increasing emphasis on distance learning, this study points to a need for further investigation of the pedagogical implications of teaching undergraduate writing courses online.

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# Conceptual Change in Chemistry Through Collaboration at the Computer

Barbara Gaddis  
David Anderson  
University of Colorado

## Abstract

*This study examined the effect of computer-mediated collaboration on conceptual change in organic chemistry. Students in second semester organic chemistry laboratory performed a virtual experiment using air-sensitive alkyl lithium reagents. Students were randomly assigned to work individually at a computer (N = 21) or to work in peer dyads, with one computer per pair of students (N = 22). Dyad pairs were also assigned randomly. Prior to treatment assignment, all students took a pretest to establish baseline knowledge of organic concepts and laboratory technique. Post tests were administered immediately following treatment and one week later. The results showed that collaboration at the computer significantly improved conceptual understanding of organic theory, but did not significantly affect knowledge of laboratory techniques. This may be a result of co-construction of knowledge, negotiating shared understanding, and resolution of peer conflicts (Crook, 1994; Tao & Gunstone, 1999). Retention scores were also higher for the peer dyads, but not significantly so.*

## Collaboration, Computers, and Conceptual Change

While collaborative learning has been generally recognized as improving learning (Bruffee, 1993) (Chickering & Ehrmann, 1987; Dunlap & Grabinger, 1996; Johnson & Johnson, 1990; Sharan, 1980) in higher education, it has been underutilized, particularly in the science disciplines. Collaborative learning in organic chemistry has shown promising results in the lecture as well as in the laboratory (Browne & Blackburn, 1999; Glaser & Poole, 1999; Hagen, 2000).

## Collaborative Learning

Collaborative learning is defined by Tao and Gunstone (1999) as “two (or more) students working together on a task that neither could do on their own prior to the collaborative engagement” (p.40). Damon and Phelps (1989) claim that collaborative learning is beneficial for tasks requiring “new insights, conceptual shifts, and the development of deep knowledge structure” (p. 40). To Saltiel (1998), the relationship between partners is as important as the knowledge being sought (p. 6). In collaborative partnerships, students help each other to accomplish more than they ever would have been able to do working individually; the partners have a shared goal or purpose; and the partners experience mutual support, respect, and loyalty. These three characteristics differentiate collaborative partnerships from merely working together or cooperation.

However, working together does not insure working effectively. Damon and Phelps (1989) describe two characteristics—equality of engagement and mutuality of engagement—that define positive collaborative peer relationships. For optimal peer learning, both partners should contribute relatively equally with both partners discussing their ideas and opinions explicitly. Crook (1994) asserts that peer collaboration offers three cognitive benefits—articulation, conflict and co-construction. Articulation refers to explicitly expressing latent ideas. Conflict refers to the processes that partners undergo to reconcile conflicting and discrepant ideas. Having resolved the apparent discrepancies, students co-construct knowledge based upon shared knowledge, scaffolding each other to greater understanding (Tao & Gunstone, 1997). The importance of each of these factors to the learning process is not clearly understood. Dunlap and Grabinger (1996) claim that collaboration facilitates learning by enabling students to go beyond their “zones of proximal development” (p. 79). Being able to share with others helps reduce risks and provides a better learning experience. Collaboration also helps students see how others solve problems and provides feedback.

## Computer-mediated Collaborative Learning

Collaboration at a distance has recognizable benefits. Computer-mediated communication provides increased time for reflection (Berge, 1995; Fishman, 1997; Wells, 1993), greater equality between participants (Warschauer, 1997), greater participation, and improved work (Oblinger & Maruyama, 1996). Warshnauer (1997) reports that computer-mediated collaboration produces cognitive gains, due to the dual attributes of reflection and interaction.. While most of the research on computer-mediated collaboration has focused on online interactions

occurring either asynchronously or synchronously in chat groups (Berge, 1995; Herrmann, 1995; Koschmann, 1996; Koschmann, Feltovich, Myers, & Barrows, 1992), relatively little research has examined the effect of face-to-face collaboration at the computer on learning. However, it is clear that benefits can accrue from one-on-one communication in the classroom via the computer (Roschelle, 1992; Tao & Gunstone, 1997; Warschauer, 1997). These benefits may include increased conceptual understanding and decreased misconceptions.

### **Conceptions and Misconceptions**

Far from being a blank slate when students come into the science classroom, students enter the classroom with preconceived ideas and theories, many of which are incorrect (Carter & Bodner, 1987; Crosby, 1987; Driver, 1989; Griffiths & Preston, 1992; Liggitt-Fox, 1997; Osborne & Cosgrove, 1983; Peterson & Treagust, 1989; Strike, 1983). One approach to reducing misconceptions is by confronting students with discrepant events, showing the mismatch between the current conception and the confronting phenomenon (Posner, Strike, Hewson, & Gertzog, 1982; Strike & Posner, 1985, 1992). Computer laboratory simulations can provide such discrepant events, improve conceptual understanding and thereby reduce misconceptions.

### **Computer Simulations**

Numerous attributes of computer simulations have been identified from recent literature. Computer simulations can replace experiments that use hazardous materials (Smith, Jones, & Waugh, 1986); reduce cost (Fletcher, Hawley, & Piele, 1990); replace experiments that occur too quickly or too slowly to be done in a regular laboratory period (Herron & Nurrenbern, 1999); reduce cognitive noise, so that students can concentrate on the concepts involved in the experiments (Clariana, 1989); provide feedback to enhance conceptual understanding (Chickering & Ehrmann, 1987); provide dynamic animations to emphasize the molecular level of chemical reactions (Williamson, 1992; Williamson & Abraham, 1995); allow rapid data collection (Vining, 2000); permit students to generate and test hypotheses (Joolingen & Jong, 1991); engage students with high level of interactivity (Grosso, 1993); present a simplified version of reality by distilling abstract concepts into their most important elements (White, 1993; Windschitl & Andre, 1998; Zietsman & Hewson, 1986), making abstract concepts more concrete (Rieber & Parmley, 1995); standardize instructional pedagogy, teaching, and content across multiple lab sections (Hilosky, Sutman, & Wang, 1997); actively engage students in scientific inquiry (Grosso, 1993); reduce ambiguity and help identify cause and effect relationships in complex systems (Clariana, 1989); serve as pre-laboratory preparation to aid understanding of the lab (Bobbert, 1982); foster problem-solving skills (Katkanant, 1990; LaJoie, 1993); promote critical thinking skills (Bonk & Reynolds, 1997); help students learn about the natural world through seeing and interacting with underlying scientific models that would not be readily inferred through first-hand observation (Krajcik & Lunetta, 1987); and promote conceptual change (White, 1993; Windschitl & Andre, 1998). From this literature, computer simulations clearly have the potential of improving conceptual understanding of chemical principles and theories and teaching laboratory skills.

If collaboration and computer simulations each enhance conceptual understanding, can learning from computer simulations be improved by collaboration at the computer? The present study was an attempt to answer this question.

### **The Study**

The Virtual Organic Laboratory is a series of computer simulations designed to mirror a real organic chemistry laboratory. In the Virtual Organic Lab, students perform experiments, analyze results using spectroscopy and chromatography, and write results in their notebooks. However, the Virtual Organic Lab contains chemicals and equipment to do experiments that would be too costly or too hazardous to do on a large scale in the real laboratory. Among the virtual experiments developed thus far are oxymercuration-demercuration, alkyl lithium addition, and hydrogenation using a Paar hydrogenator.

### **Attributes of the Virtual Organic Laboratory**

The simulations incorporate three characteristics of effective learning: animation (Rieber, 1990; Rieber & Parmley, 1995; Williamson, 1992) interactivity (Borsook & Higgenbotham-Wheat, 1991), and feedback (Azevedo & Bernard, 1995). Animations of reaction mechanisms provide learners with step-by-step pathways, demonstrating lecture concepts. Students can visualize electrons forming new bonds and bonds being broken. Experimental procedures are both animated and interactive: Students watch animated demonstrations of laboratory techniques, then set up their own equipment by dragging to the appropriate spot. They mix reagents, conduct experiments, and isolate and purify products, mirroring the very processes they would do in the laboratory

During the simulation, students receive continual feedback for both correct and incorrect choices. Students receive points for each aspect of the program that they do correctly, such as correctly calculating the theoretical yield or remembering to take the stopper out of the separatory funnel before draining. At the conclusion of the simulation students receive a detailed scorecard showing their performance in twenty categories.

The effectiveness of the simulations in improving conceptual understanding of the reaction mechanism and improving technical understanding of laboratory techniques was verified by a pilot project during Fall, 1999. Students using the simulation had significantly higher scores than students who did not do the simulation ( $X_s = 8.82$ ;  $X_{ns} = 3.83$ ;  $F = 21.45$ ,  $p = 0.001$ ). However, these scores were still unacceptably low. In an effort to improve learning outcomes, we decided to investigate how collaboration at the computer affects conceptual understanding.

### Design of the Study

During Spring, 2000, students in each organic chemistry laboratory section were randomly divided into two treatment groups with one group of students ( $N = 21$ ) working individually on the computer simulation and the other group of students ( $N = 22$ ) randomly paired into peer dyads. The dyad pairs worked collaboratively on one computer simulation. Prior to treatment assignment, students took a pretest to assess extant knowledge and understanding of organic reaction mechanisms, inert gas chemistry, alkyl lithium reactions, and other organic chemistry techniques. The students also completed a survey to assess their attitudes about collaboration and the laboratory. After doing the simulation, students completed a post test and attitudinal survey.

### Results of the Study

Prior to treatment, the two groups of students were comparable, with no significant academic or attitudinal differences between the two groups. Both groups had similar pretest scores ( $X_c = 29.9\%$  and  $X_i = 36.5\%$ ). Grades in the previous semester lecture were similar ( $X_c = 3.49$  and  $X_i = 3.59$ ), as were the grades received in the previous semester organic chemistry lab ( $X_c = 3.56$  and  $X_i = 3.51$ , out of 4.00). Both groups held similar views about the importance of collaboration ( $X_c = 3.52$  and  $X_i = 3.52$ , out of 5.00) and organic chemistry laboratory ( $X_c = 2.55$  and  $X_i = 2.52$ , out of 5.00).

After treatment, however, there were some significant differences in performance on the post test, with students in peer dyads significantly outperforming students who worked individually ( $X_c = 63.2\%$ ,  $X_i = 54.9\%$ ,  $F = 7.920$ ,  $p < 0.01$ ). Peer dyads significantly outperformed individual users on conceptual questions relating to the reaction mechanism ( $X_c = 83.0\%$  and  $X_i = 64.9\%$ ,  $p < 0.01$ ). The students in peer dyads also scored higher on questions relating to laboratory techniques and instrumentation; however the differences were not significant ( $X_c = 59.6\%$ ,  $X_i = 54.0\%$ ,  $p > 0.05$ ). The results imply that understanding organic theory requires different learning strategies than does laboratory technique understanding. Conflict (Cook & Cook, 1998) and peer discussion (McMillan, 1997; Winiecki, 1999) may aid student understanding of complex mechanisms. Collaboration at the computer facilitates this type of peer interaction. On the other hand, gaining laboratory expertise and understanding the practicalities and theory behind laboratory techniques and instrumentation may not benefit as much from discussion and the learning advantages of peer discussion may be partially compensated by individual use of the simulation.

A retention test was administered two weeks after the simulation laboratory sessions. Again, students in peer dyads outperformed students who worked individually on both the mechanism and laboratory techniques sections of the retention test. However, due to the small number of questions in both sections, the differences between the groups were not significant and no generalizations can be drawn.

Interestingly, although pretest scores were moderately correlated to grade in first semester organic chemistry class, post test scores for both groups were not significantly correlated to grade students received in the first semester organic chemistry class. This result suggests that computer simulations improve scores for lower performing students. This result contradicts the research of Vaidyanathan and Rochford (1998) who found that students who performed well on lecture exams also performed well in computer simulations.

### Attitudinal Results

There were no significant differences in attitudes towards the computer simulation: ( $X_c = 18.4$  and  $X_i = 19.4$ ,  $F = 0.870$ ,  $p = 0.357$ ). Both groups of students thought they had learned well from the computer simulation, with the majority of students agreeing that the Virtual Organic Laboratory simulation had helped them understand the mechanism and reactivity of organic lithium reactions (69.7%), the techniques of conducting air-sensitive reactions (95.3%), and the theory and practice of extractions (81.4%). The percentages refer to the percent of students strongly agreeing with the indicated statements. Both groups were also very positive about using the computer simulations, with 93.0% of all students strongly agreeing that the Virtual Organic Laboratory simulation

was fun and 85.7% of the students wanting to use the simulations used for other experiments. Over half of the students (62.8%) indicated that they felt as though they had carried out a real laboratory experiment and 69.8% believed that doing the simulation was a better learning experience than doing an actual laboratory experiment. Factor analysis was performed to understand students' preference for computer simulations over laboratory experiments. Two factors were isolated that explained students' satisfaction with computer simulations. Factor one ( $\alpha = 0.8696$ ) related to confidence: Doing the simulation improved students' confidence in doing lab work. Factor two ( $\alpha = 0.8932$ ) related to time: Students thought that doing the simulation made learning more efficient and saved time. There were no significant differences between the collaborative and non-collaborative groups in either factor.

## Conclusions

Two general conclusions can be drawn from this research. First, students who work collaboratively at the computer gain greater understanding of mechanisms and reactivity than students who work alone. Working together gives students an opportunity for peer conflict, discussion, and co-construction of knowledge (Crook, 1994). Students working in pair dyads must verbalize their existing conceptions as they attempt to make sense and incorporate new and discrepant information. This requires that students summarize their existing ideas in order to share. The act of verbalization may also serve as a catalyst to recognize erroneous ideas and perhaps modify concepts. Students who work alone do not have a peer to sound new ideas and are not challenged to explain existing conceptions. As a result, students who worked individually may not have as much opportunity to recognize inadequate conceptions or to give up alternative concepts.

A second conclusion is that computer simulations enhance students' enjoyment of the laboratory. Regardless of whether students worked individually or collaboratively, students felt cognitively engaged in doing the simulation and felt as though they had learned a substantial amount of the theory and practice of working with alkyl lithium reagents. This finding is corroborated by numerous other studies (Escalada & Zollman, 1997; Kulik, 1994; Strauss & Kinzie, 1994; Zirkel & Zirkel, 1997). Students felt that they learned more efficiently from the computer simulation and felt confident that they had learned the techniques well.

Most students indicated that they prefer computer simulations to hands-on laboratory work. This may be due to the novelty effect of doing computer simulations and the perception of computer simulations as requiring less time than performing a real experiment. However, other six other attributes of the computer simulation contribute to their preference for computer simulation over traditional wet laboratory experiments: (a) Students aren't limited to safe, inexpensive, and available chemicals, but can do a wide range of reactions, illustrating and supporting concepts learned in lecture. (b) Students can repeat an experiment as many times as necessary to understand the concepts, mechanism, or procedural attributes of the experiment. (c) Students can gain experience using expensive equipment or complex spectroscopic techniques. (d) Students can practice a technique before they have to do it in lab, thereby improving their confidence in doing lab work. (e) Students can make mistakes without risking time, money, or safety. (f) Students can get rapid, almost instant, feedback, thereby improving learning. In addition to these cognitive benefits, the Virtual Organic Laboratory simulations offer another practical benefit: Students can do the lab any time of the day, from anywhere in the world.

While computer simulations will never replace traditional laboratory experiments, laboratory simulations may be the answer to the increasing need to deliver a pedagogically sound laboratory experience in distance science courses. Regardless of whether students are at a distance or face to face, computer simulations can enhance learning, particularly if students are allowed to collaborate, either at the computer or in cyberspace.

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# What and How Do Designers Design? A Theory of Design Structure

Andrew S. Gibbons  
Utah State University

## Abstract

*A question I always ask my Instructional Technology students at Utah State University is, "What do instructional designers design?" We have had interesting discussions on this question, and I try to revisit the question at several points throughout all of my classes. I find that the students' perceptions of what instructional designers design changes over time. This is no doubt a product of the faculty's teaching, but it also represents a personal commitment that the student makes. What the student commits to is what I would like to talk about. My thesis will be that it is a commitment to a particular layer of the evolving instructional design. I will talk about the layering of instructional designs and the implications for both teaching and practicing instructional design.*

## "The Centrisms"

Here are some of the phases I see students evolving through as they mature in their theoretic and practical knowledge:

**Media-centrism.** Media-centric designs place great emphasis on the constructs related to the instructional medium. The technology itself holds great attraction for new designers. They often construct their designs in the vocabulary of the medium rather than seeing the medium as a plastic and preferably invisible channel for learning interaction (See Norman, 1988; 1999). We are currently experiencing a wave of new media-centric designers due to the accessibility of powerful multimedia tools and large numbers of designers "assigned into" computer-based and Web-based training design. Most of these designers speak in terms of the medium's constructs (the "page," the "hyperlink," the "site," etc.) as the major design building blocks. Many struggle as they attempt to apply inadequate thought tools to complex design problems.

**Message-centrism.** Realizing that media design building blocks do not automatically lead to effective designs, most designers begin to concentrate on "telling the message better" in order to "get the idea across" or "make it stick." This is a phase I call message-centrism. Message-centric design places primary importance on message-related constructs and employs media constructs—main idea, explanation, line of argument, dramatization, etc.—secondarily, according to the demands of the message. The media constructs are used, but they are used to serve the needs of better messaging. Better message "telling" means different things to different designers: providing better illustrations, using animations, wording the message differently, using analogies, or focusing learner attention using attention-focusing questions, emphasis marks, repetition, or increased "interactivity."

**Strategy-centrism.** Message-centrism is normally followed by a recognition of underlying structural similarities within messages and interactions that cross subject-matter boundaries and that have important instructional implications. This leads to a new viewpoint I call strategy-centric design thinking. Strategy-centrism considers the structured plan of messaging and interaction as a main source of instructional effectiveness. Therefore, the designer's first attention is to strategic constructs that are appropriate to instruction in categorized varieties of learning. Strategy-centric design can be viewed as the use of rules to governing the delivery of compartmentalized information and interaction elements (Gagne, 1985; Merrill, 1994). This can be a very useful conception for both the designer and the learner, and structured strategy is an important key to logic templating and design automation.

**Model-centrism.** Whereas strategy centrism permits the use of instructional experts (Zhang, Gibbons, & Merrill, 1997), it does not lead the designer to design interactive micro-worlds in which instruction can take place through problem solving. This realization leads to model-centered design thinking. Model centering encourages the designer to think first in terms of the system and model constructs that lie at the base of subject-matter knowledge. The designer therefore gives first consideration to identifying, capturing, and representing in interactive form the substance these constructs. Then to this base of design is added strategy, message, and media constructs. Model-centrism is the common thread running through virtually all new-paradigm instructional approaches (for a review, see Gibbons & Fairweather, 2000). Many current researchers consider learning to be a problem-solving activity (Anderson, 1993; Brown & Palincsar, 1989; Schank, 1994; VanLehn, 1993). If this view is correct, then the designer

must also give first preference to decisions about the problems the learner will be asked to solve. A model-centered view prescribes instructional augmentations that support problem solving in the form of coaching and feedback systems, representation systems, control systems, scope dynamics, and embedded didactics (see Gibbons, Fairweather, Anderson, & Merrill, 1997).

These phases in the maturation of design thinking tend to be encountered by new designers in the same order, and one could make the argument that these phases describe the history of research interests in the field of instructional technology as a whole. A good place to see this trend in cross-section is the articles in *the Annual Review of Psychology* beginning with the review by Lumsdaine and May (1965) and progressing through subsequent chapters by Anderson (1967); Gagne & Rohwer (1969); Glaser & Resnick (1972); McKeachie (1974); Wittrock & Lumsdaine (1977); Resnick (1981); Gagne & Dick (1983); Pintrich, Cross, Kozma & McKeachie (1986); Snow & Swanson (1992); Voss, Wiley & Carretero (1995); Sandoval (1995); VanLehn (1996); Carroll (1997); Palincsar (1998); and Medin, Lynch & Solomon (2000).

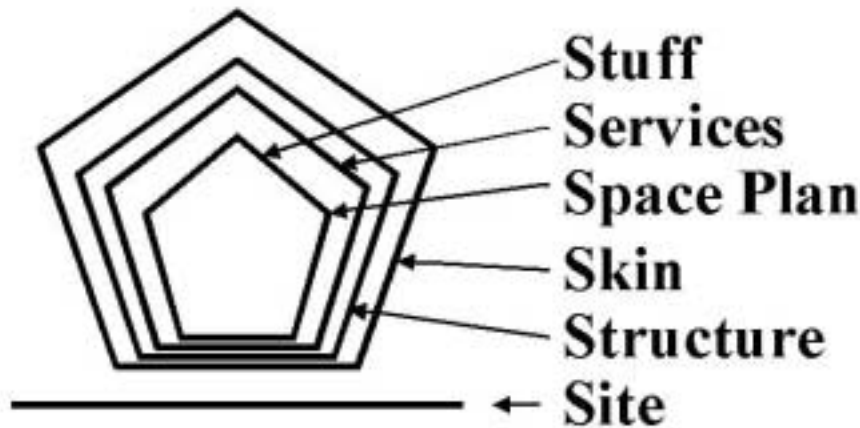
## Roots of the “Centrisms”

I am interested in this paper in exploring the roots of this progression. Important clues can be found in design areas outside of *instructional* design. A provocative statement on design structure is given by Brand (1994) in a description of how buildings are seen by architects and structural engineers. Brand begins by stating that architects see a building as a system of layers rather than as a unitary designed entity. He names six general layers, illustrated in Figure 1 and described below in his own words:

- SITE – This is the geographical setting, the urban location, and the legally defined lot, whose boundaries and context outlast generations of ephemeral buildings. “Site is eternal,” Duffy agrees.
- STRUCTURE – The foundation and load-bearing elements are perilous and expensive to change, so people don’t. These **are** the building. Structural life ranges from 30 to 300 years (but few buildings make it past 60, for other reasons).

*Figure 1. Layers of building design.*

- SKIN – Exterior surfaces now change every 20 years or so, to keep with fashion and technology, or for wholesale repair. Recent focus on energy costs has led to reengineered Skins that are air-tight and better insulated.
- SERVICES – These are the working guts of a building: communications wiring, electrical wiring, plumbing, sprinkler system, HVAC (heating, ventilating, air conditioning), and moving parts like elevators and escalators. They wear out or obsolesce every 7 to 15 years. Many buildings are demolished early if their outdated systems are too deeply embedded to replace easily.
- SPACE PLAN – The interior layout—where walls, ceilings, floors, and doors go. Turbulent commercial space can change every 3 years or so; exceptionally quiet homes might wait 30 years.
- STUFF – Chairs, desks, phones, pictures, kitchen appliances, lamps, hair brushes; all the things that twitch around daily to monthly. Furniture is called **mobilia** in Italian for good reason. (p. 13)



Brand points out some important implications of the layered view of design:

1. That layers of a design age at different rates
2. That layers must be replaced or modified on different time schedules
3. That the layers must be articulated with each other somehow
4. That designs should provide for articulation in such a way that change to one layer entails minimum disruption to the others.

In work for the Center for Human-Systems Simulation, my colleagues Jon Nelson and Bob Richards and I have applied Brand's ideas to instructional design (Gibbons, Nelson & Richards, 2000). We have found that instructional designs can indeed be conceived of as multiple layers of decision making with respect to different sets of design constructs, and we find a rough correspondence between the layers and the phases of designer thinking already described. Gibbons, Lawless, Anderson and Duffin (in press) show how layers of a design are compressed at a "convergence zone" with tool constructs that give them real existence and embody them in a product.

Tables 1 through 7 at the end of this paper summarize what we think are the important layers of an instructional design: model/content, strategy, control, message, representation, media-logic, and management. Each layer is characterized in the tables by the following:

- A set of design goals unique to the layer
- A set of design constructs unique to the layer
- A set of theoretic principles for the selection and use of design constructs
- A set of design and development tools
- A set of specialized design processes

In addition, a layer often corresponds with a set of specialized design skills with its own lore, design heuristics, technical data, measurements, algorithms, and practical considerations. The boundaries of these skills over time tend to harden into lines of labor division, especially as technical sophistication of tools and techniques increases.

More detailed principles of design layering are outlined in Gibbons, Nelson, and Richards (2000). The purpose of the present paper is to show how design layering influences the designer's thinking and allows it to change over time into entirely new ways of approaching the design task. The media-, message-, strategy-, and model-centric phases designers experience can be explained as the necessary focus of the designer first and foremost on a particular layer of the design. That is, the designer enters the design at the layer most important to the design or with which the designer is most familiar and comfortable.

Media-centric designers do not ignore decisions related to other layers, but because they may not yet be fully acquainted with the principles of design at other layers, they naturally think in terms of the structures they do

know or can acquire most rapidly—media structures. As designers become aware of principles at other layers through experience and the evaluation of their own designs, focus can shift to the constructs of the different layers: message structurings, strategy structurings, and model and content structurings. Each step of the progression in turn gives the designer a new set of constructs and structuring principles to which to give the most attention, with other layers of the design being determined secondarily, but not ignored.

Is there a “right” layer priority in designs? Should designers always be counseled to enter the design task with a particular layer in mind? It is not possible to say that, because design tasks most often come with constraints attached, and one of those constraints may predetermine a primary focus on a layer. An assignment to create a set of videotapes will lead the designer to pay first and last attention to the media-logic and representation layers, and other layers are forced to comply with the constraint within the limits of the designer’s ingenuity.

## Conclusion

The design layering concept has many implications. In this paper I have explored one of them that explains the maturation in designer thinking over time. In order to move to a new perspective of design it is not necessary to leave older views behind. The new principles added as the designer becomes knowledgeable about each new layer adds to the designer’s range and to the sophistication of the designs that are possible. Further consideration of the layering concept will expand our ability to communicate designs in richer detail, achieve more sophisticated designs, and add to our understanding of the design process itself.

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**Attachment A.**  
**Design Layering Principle:**  
**Application to Instructional Design**  
**From Gibbons, Nelson & Richards (2000)**

*Table 1: Model/Content Layer Description*

<i>Layer Design Goals</i>	<i>Common Layer Design Constructs</i>
To define the units of content segmentation To define the method of content capture To gather content elements To articulate content structures: With the Strategy layer With the Control layer With the Message layer With the Representation layer With the Logic layer With the Management layer	(Incomplete sample list) Model Relation Production rule Working Memory Element Proposition Fact Concept Rule Principle Task Task grouping Theme Topic Main idea Semantic relationship Chapter
<b>Design Processes:</b> Task Analysis, Cognitive Task Analysis, Rule Analysis, Content Analysis, Concept Mapping	
<b>Design/Production Tools:</b> Data base software, Analysis software	

*Table 2: Strategy/Event Layer Description*

<i>Layer Design Goals</i>	<i>Common Layer Design Constructs</i>
To define event structures (time structures) To define event hierarchies To define rules for event generation To articulate strategy structures: With the Content layer With the Control layer With the Message layer With the Representation layer With the Logic layer With the Management layer	(Incomplete sample list) Problem Information event Interaction event Exercise Instructional period Discovery challenge Unit Lesson Strategy component Argument Argument support
<b>Design Processes:</b> Strategy planning, Problem planning, Challenge formation, Activity planning, Exercise design	
<b>Design/Production Tools:</b> Data base software	

*Table 3: Control Layer Description*

<b>Layer Design Goals</b>	<b>Common Layer Design Constructs</b>
To define the set of possible user actions To define the rules of control availability To define the rules for control action To define the rules/processes for response recognition, parsing, and judging To articulate control structures: With the Content layer With the Strategy layer With the Message layer With the Representation layer With the Logic layer With the Management layer	(Incomplete sample list) Menu item Administrative control Strategy control Message control Representation control Logic control Content control Forward, Back Play, FF, FR, Stop, Pause Exit, Quit
<b>Design Processes:</b> Flow planning, Control walk-through, Diagramming	
<b>Design/Production Tools:</b> Flowcharting, GUI-logic construction authoring systems	

*Table 4: Message Layer Description*

<b>Layer Design Goals</b>	<b>Common Layer Design Constructs</b>
To define message types To define message composition by type To define rules for message generation To articulate message structures: With the Content layer With the Strategy layer With the Control layer With the Representation layer With the Logic layer With the Management layer	(Incomplete sample list) Main idea Example Non-Example Discussion block Commentary Advance organizer Primitive message element Spatial relationship Temporal relationship Causal relationship Hierarchical relationship Explanation Stem Distractor Response request Transition message Goal statement Directions "Resource" Database entry Coaching message Feedback message Hint
<b>Design Processes:</b> Message design, Strongly related to Strategy design	
<b>Design/Production Tools:</b> Timeline-building tools, Flow diagrams	



*Table 5: Representation Layer Description*

Layer Design Goals	Common Layer Design Constructs
To select media To define media channels To define channel synchronizations To define representation structures by type To select representation production tools To match production tool structures To define rules display structure To define rules for display generation To define rules for structure generation To define rules for display management To articulate representation structures: With the Content layer With the Strategy layer With the Control layer With the message layer With the Logic layer With the Management layer	(Incomplete sample list) Background Resource file (audio, video) Resource file (BMP, JPG, GIF, MPG) Headline, Body Placeholder 3-D object Rendering Animation Tag parameter Sprite Control icon Layer (e.g., Photoshop, Dreamweaver)
<b>Design Processes:</b> Display design, Formatting, Display event sequencing, Media channel synchronization, Media channel assignment	
<b>Design/Production Tools:</b> All content/resource production tools for all media, All layout or formatting tools for all media, Display managers	

*Table 6: Logic Layer Description*

Layer Design Goals	Common Layer Design Constructs
To define media-logic structures by type To define rules to apply logic structures To select logic construction tools To define segmentation/packaging plan To define logic distribution plan (time) To articulate logic structures: With the Content layer With the Strategy layer With the Control layer With the Message layer With the Representation layer With the Management layer	(Incomplete sample list) Display Branch Program Command Procedure Program object Applet Application Book, object Movie, stage, actor Object, Method, Data Site, Page
<b>Design Processes:</b> Program design, Program construction	
<b>Design/Production Tools:</b> All logic production tools, Modeling languages (e.g., UML)	

*Table 7: Management Layer Description*

<i>Layer Design Goals</i>	<i>Common Layer Design Constructs</i>
To define session control rules/procedures To define the rules for initiative sharing To define transition between events To define record keeping and recording To define variable-keeping and use To define outside communications: Host, Peer, Net, Libraries, Databases To define data reporting: Learner, Instructor, System To plan security/privacy policy/provisions To plan evaluation activities To plan implementation activities To plan management activities To articulate management structures: With the Content layer With the Strategy layer With the Control layer With the Message layer With the Representation layer With the Logic layer	(Incomplete sample list) Menu Record Variable Database entry
<b>Design Processes:</b> Management planning, Implementation planning, Evaluation planning	
<b>Design/Production Tools:</b> Data base software	

# Teaching and Learning Strategies for Complex Thinking Skills

Lucy A. Goodson  
Florida State University

## Abstract

*This paper proposes a model for teaching and learning complex thinking skills developed from a synthesis of theories and research. The model functions like a concept map or a graphic organizer with five major components: (1) presence of complex authentic life situations within a context; (2) activation and execution of complex thinking skills; (3) development of interactive prerequisites of content, simple thinking skills, and dispositions and habits; (4) inclusion of connecting networks and operations (linkages, schemata, and scaffolding) to bridge complex thinking skills with interactive prerequisites; and (5) targeted teaching and learning strategies. Terms associated with thinking and learning guided the manual and electronic search through the Internet and on-line library files.*

## Background

There are known instructional strategies to support the learning of different types of knowledge and skills (Merrill, Drake, Lacy, Pratt, & the ID2 Research Group, 1996), and for the most part, these were identified by observing the conditions of learning across six decades of study. Classifications of learning outcomes tend to progress from simple to complex (Bloom, 1956; Briggs & Wager, 1981; Bruner, 1990; Clarke, 1990; Dewey, 1933; Gagné, 1985, 1989; Gagné & Briggs, 1974; Gagné, Briggs, & Wager, 1988; Costa, 1990; Cotton, 1997; Glaser, 1941; Guilford cited in Crowl et al, 1997; Haladyna, 1997; Jonassen, n.d.; Marzano, 1993, 1994; Marzano, et al, 1992; Marzano, et al, 1988; Merrill, 1987; Merrill et al, 1996; McREL, 1997; Piaget cited in Crowl et al, 1997; Sternberg, 1998; Sternberg & Davidson, 1995; Sugrue, 1995; Vygotsky cited in Crowl et al, 1997).

Many publications cite the distinction between lower order and higher order thinking skills (Arter & Salmon, 1987; Carnine, 1993; Clarke, 1990; Ennis, 1989; Fogarty & McTighe, 1993; Crowl et al, 1997; Kauchak & Eggen, 1998; Kirby & Kuykendall, 1991; Lewis & Smith, 1993; McDavitt, 1993; McGregor, 1993; Paul & Nosich, 1992; Weisberg, 1995; Young, 1997). Some refer to tasks requiring *increased levels of processing* (cognitive: classifications, rule or procedural executions) and others to tasks demanding *high levels of processing* (constructive: heuristic problem solving, personal selection and monitoring of cognitive strategies) (Ertmer & Newby, 1993).

Yet, the definition of complex thinking skills has been referred to as a *conceptual swamp* (Cuban cited in Lewis & Smith, 1993, p. 1) and ...a *century old problem* for which *there is no well-established taxonomy or typology* (Haladyna, 1997, p. 32). What is unknown also has been described as follows.

*...While advanced knowledge, higher order thinking, problem solving, and transfer of learning evoke common associations and expectations in most of us, there remains an operational inexactitude in these constructs..these learning outcomes can best be operationalized and predicted by assessing and understanding learners' mental models of the problem or content domain being learned....*

Jonassen, n.d., p. 1

## A Model for Teaching and Learning Strategies

Figure 1 represents a synthesis from theories of learning and research associated with complex thinking skills. This model functions like a concept map or graphic organizer (Ausubel, 1968; Clarke, 1990; Kealy, 2000; Jonassen, 1996; NCREL, 1988; Novak, 1990; Plotnick, 1997). It shows components, linkages, relationships, and interactions for teaching and learning complex thinking skills. The narrative further explains the relationships among the five components: (1) presence of complex authentic life situations within a context; (2) activation and execution of complex thinking skills; (3) development of interactive prerequisites of content, simple thinking skills, and dispositions and habits; (4) inclusion of connecting networks and operations (linkages, schemata, and scaffolding) to bridge complex thinking skills with interactive prerequisites; and (5) targeted teaching and learning strategies.

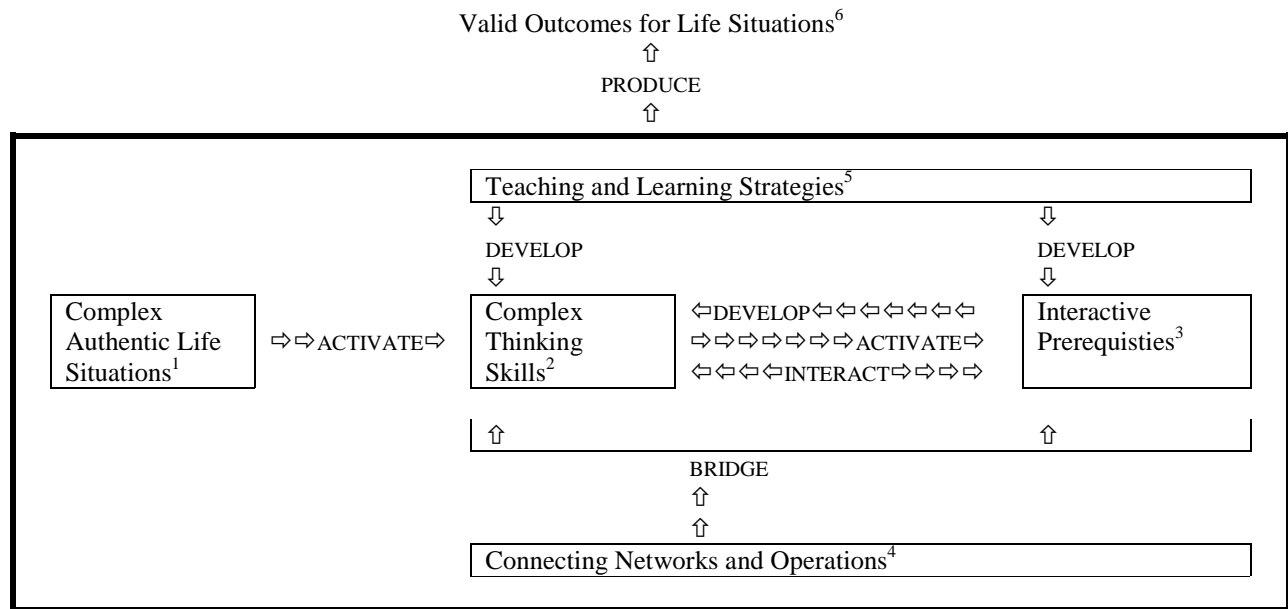


Figure 1. A Model for Teaching and Learning Complex Thinking Skills

<sup>1</sup>**Authentic Life Situations.** Situations of multiple categories for which the student has not learned answers, preferably real-life context. Examples: ambiguities, challenges, confusions, dilemmas, discrepancies, doubt, obstacles, paradoxes, problems, puzzles, questions, uncertainties.

<sup>2</sup>**Complex Thinking Skills.** Multidimensional skills using more than one rule to manage a life situation or transforming known concepts and rules to fit the situation. Examples: complex analysis, creative thinking, critical thinking, decision making, evaluation, logical thinking, metacognitive thinking, problem solving, reflective thinking, scientific experimentation, scientific inquiry, synthesis, systems analysis.

<sup>3</sup>**Interactive Prerequisites.** Content, simple thinking skills, and learner dispositions and habits.

Content. Content includes subject area content (vocabulary, structure, concept definitions, procedural knowledge, reasoning patterns) and thinking content (thinking terms, structures, strategies, heuristics, and processes).

Simple thinking skills. Simple thinking skills include cognitive strategies, comprehension, concept classification, discriminations, routine rule using, simple analysis, and simple application.

Dispositions and habits. Dispositions and habits include attitudes, adaptiveness, tolerance for risk, flexibility, openness; cognitive styles (such as field dependence, locus of control, response rates); habits of mind (persistence, self-monitoring, self-reflection); multiple intelligences (linguistic-verbal, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal, and intrapersonal).

<sup>4</sup>**Connecting Networks and Operations.** Bridges between interactive prerequisites and complex thinking skills related to the life situations by means of linkages, schemata, and scaffolding.

Linkages. Linkages involve the extension of prior learning to the new context and higher order skills. They may require mastery or automatization of prior learning. It is important to link new knowledge and skills with prerequisites.

Schemata. Schemata may be a network, organization, representation, or architecture for organizing new learning so that it makes sense to the learner.

Scaffolding. Scaffolding includes the guidance, structure, visual and verbal representations, and modeling of complex thinking skills.

<sup>5</sup>**Teaching and Learning Strategies.** Teaching and learning strategies for the interactive prerequisites and complex thinking skills provided in a learning environment that is considered safe, motivating, and supportive. Learning progresses in levels, each elaborating on previous levels, and connecting previously learned knowledge and skills to the next higher level.

<sup>6</sup>**Valid Outcomes for Life Situations.** Outcomes will be valid for life situations when they are managed or resolved within their context, including conditions, resources, constraints, and criteria.

Complex thinking skills will develop more fully when teachers and instructional programs align learning activities with authentic life situations and provide scaffolding to help learners move from simple through progressively more complex content, processes, and outcomes. In life situations, individuals must be able to select, organize, and sequence knowledge, thinking skills, and dispositions relevant to the life situations that they encounter. They must be able to apply content knowledge and thinking models or strategies to productively manage various life situations.

In order to develop the cognitive structure that is most consistent with complex thinking skills, learners must have opportunities to achieve increased generality and complexity in thinking applications, with practice beginning within the lower-order levels of content and learning outcomes. The importance of developing this cognitive structure and the role of guidance and practice has been well established (Merrill, 1987). The benefit for progressive movement from simple to increasing complexity also has been well established (Ausubel, 1968; Clarke, 1990; Crowl et al, 1997; Kauchak & Eggen, 1998; Marzano et al, 1988; McREL, 1997; Wilson & Cole, 1992).

### **Authentic Life Situations**

Knowledge develops within each individual through learning events in education and everyday life (Bruner, 1990; Dewey, 1933; Jonassen, 1999). Most problem situations are multicategorical and not domain-specific (McPeck, 1990). An action-based learning environment depends on immersion with real-world or authentic problems (Ausubel, 1968; Dewey, 1933; Glaser, 1941; Huot, 1998; Jacobs, 1995; Jonassen, 1999; Jonassen, Merrill, Reigeluth, and Rowland, 2000; Marzano et al 1988; McREL, 1997; Vygotsky, 1978). Yet, life engages people in many situations that may require complex thinking, not just problems to be solved.

In addition to problem solving, other purposes achieved through complex thinking skills include finding problems, incompleteness, anomalies, troubles, inequities, and contradictions; developing methods of inquiry; making decisions; making choices, creating new ideas or objects, and making predictions (Cotton, 1997; Gagné, Briggs & Wager, 1988; Kahneman, Slovic & Tversky, 1982; Lewis & Smith, 1993; McREL, 1998; Tversky & Kahneman cited in Ohio State University, n.d.; Wilson & Cole, 1992).

### **Complex Thinking Skills**

Complex thinking skills encompass the higher level skills defined in Bloom's Taxonomy of Educational Objectives (Bloom, 1956); the problem-solving level of skills in the hierarchy of learning capabilities described by Briggs and Wager (1981), Gagné (1985), and Gagné, Briggs, and Wager (1988); the critical thinking skills identified in Gubbins' *Matrix of Critical Thinking Skills* (cited in Legg, 1990); and the kinds of critical thinking, problem solving, decision making, and creative thinking skills described by Lewis and Smith (1993).

Terms used to describe complex thinking skills have been diverse, including active inquiry and discovery, creative thinking, critical thinking, decision-making, evaluation, higher order thinking, inquiry, insight, logical thinking, metacognition, problem solving, scientific reasoning, rational thinking, reflective thinking, synthesis, and systems analysis (Bloom, 1956; Bruner cited in Crowl et al, 1997; Cotton, 1997; Crowl et al, 1997; Csikszentmihalyi & Sawyer, 1995; Dewey, 1933; Ennis, 1989, 1993; Facione, 1998; Fogarty & McTighe, 1993; Gagné, Briggs & Wager, 1988; Gick & Lockhart, 1995; Glaser, 1941; Gruber, 1995; Haladyna, 1997; Kahneman, Slovic & Tversky, 1982; Kauchak & Eggen, 1998; Legg, 1990; Lewis & Smith, n.d., McREL, 1998; Piaget cited in Crowl et al, 1997; Pogrow, 1999; Pogrow & Buchanan, 1985; Siowick-Lee, 1995; Sternberg & Davidson, 1995; Tversky & Kahneman cited in Ohio State University, n.d.; Utah State Office of Education, 1997).

For the purpose of focusing the model presented in this paper, a complex thinking skill is one that involves the application of at least two rules or principles to a situation with multiple factors. It is *productive* rather than only *reproductive* thinking (Maier cited in Lewis & Smith, n.d., p. 6). It requires going beyond applying routine rules, beyond the routine application of previously learned knowledge (Newman cited in Lewis & Smith, n.d., pp. 7-8). It may involve the *putting together of certain rules that may not have been applied to previous similar situations* (Gagné, Briggs & Wager, 1988, pp. 65-66). In this process, concepts and rules must be *synthesized into new complex forms for the learner to cope with new problem situations* (Gagné, Briggs & Wager, 1988, pp. 65-66).

In Gagné's framework, intellectual skills begin with discriminations as a prerequisite for concrete and defined concepts, simple rules, and then more complex higher order rules and problem solving. The application of at least two rules defines the problem solving level of learning (Briggs & Wager, 1981; Gagné, 1985; Gagné, Briggs & Wager, 1988).

Though focused on process or biological development or stages of development, other learning theories also express levels of increasing complexity. For example, in Bloom's taxonomy, lower levels of learning provide a base for higher levels of analysis, synthesis, and evaluation. Piaget and Bruner focus on different processes for acquiring skills, but both include the importance of linking previously learned concepts and information to new

learning (Crowl et al, 1997; Hummel 1997). Bruner's spiral curriculum has long served as a model for developing higher levels of complexity over periods of time (Bruner cited in Crowl et al, 1997). Vygotsky observed that cognitive development progresses as children learn and that internalizing knowledge facilitates higher mental functions (Crowl et al, 1997). Finally Marzano and McREL have focused on developing dimensions of thinking and learning in which core thinking skills and more complex thinking processes interact with types of knowledge (Marzano et al, 1988; McREL 1997).

It is most important that individuals make *acquaintance with the particular facts that create a need for definition and generalization* in order to see *the correct difficulty to be overcome* not with *definitions, rules, general principles, classifications, and the like* (Dewey, 1933, p. 186). Perceiving the correct difficulty is particularly important because the way a problem is *apprehended or defined limits the kind of answers that will occur to the thinker* (Glaser, 1941, p. 25). Individuals must be able to reformulate issues and steer the thinking process in the right direction.

Individuals must be able to combine new with familiar information and skills creatively within limits set by the material or context (Bloom, 1956; Bloom cited in McDavitt, 1993). The interplay of multiple intelligences, insight, and creativity also fits within the concept of complex thinking skills.

Intelligence, no longer limited to the idea of a single ability or global capacity to learn, is characterized by multiple dimensions of mental processes, types of information, and types of outcomes involving convergent and divergent thinking (Crowl et al, 1997). These different abilities contribute to success with different types of subject matter content, approaches to thinking strategies, and ways of coping with new and unfamiliar life situations (Guilford cited in Crowl et al, 1997; Thurstone cited in Crowl et al, 1997; McPeck, 1990; Gardner, 1983; Gardner cited in Crowl et al, 1997; Sternberg, 1998; Sternberg & Lubart, 1995; Sternberg cited in Crowl et al, 1997).

Insight, a concept often associated with creativity, manifests itself in the sudden unexpected solution to a problem (Schooler, Fallshore, & Fiore, 1996). Non-insight problems require routine application of rules, while insight problems require problem solving and cognitive strategies or analysis, synthesis, and evaluation (Gagné, Briggs & Wager, 1988; Bloom, 1956). Insight may be a product of the prepared mind because *only a trained mind can make connections between unrelated events, and recognize meaning in a serendipitous even*, and produce a solution which is both novel and suitable (Pasteur cited in Crowl et al, 1997, pp. 192-193). Insight has been characterized as involving the access of appropriate problem elements, the search for a new problem representation, the finding of alternative approaches, the habit of persevering, the taking of risks, the application of broad knowledge, and the recognition and use of analogies (Schooler, Fallshore & Fiore, 1995).

Creativity, often characterized by fluency, originality, and elaboration, requires going beyond previously learned concepts and rules to generate rather than merely reproduce something (Crowl et al, 1997). Creative problem solving involves finding problems, working to find fresh ways to view them, evaluating shortcomings and weaknesses, selecting relevant aspects for attention while ignoring the irrelevant, and putting the pieces together in a coherent system that integrates the new information with what an individual already knows (Barron & Harrington cited in Crowl et al, 1997; Hebb, Perkins, & Smith cited in Sternberg & Davidson, 1995; Sternberg & Davidson, 1982, 1983; Davidson & Sternberg cited in Crowl et al, 1997). Examples of products resulting from the creative process include Benjamin Franklin's application of conservation and equilibrium (Crowl et al, 1997); Picasso's *Guernica* resulting from sketches and modifications of previous work (Weisberg, 1995); Coleridge's *Kubla Khan*, a product of numerous revisions (Crowl et al, 1997); Watson and Crick's discovery of the DNA double helix structure (Weisberg, 1995; Crowl et al, 1997; Edison's invention of an electric lighting system (Weisberg, 1995; Crowl, 1997).

In this model, metacognitive strategies have been classified as complex thinking with the focus on their executive control function—evaluating, planning, and regulating thinking processes. Some metacognitive strategies might be considered simple thinking skills, while others would be complex. Metacognitive strategies include problem finding and the linkage of problem finding and creativity through activities of planning, self-monitoring of progress, and self-adjustments to thinking strategies (Gagné, Briggs & Wager, 1988; Sternberg & Lubart, 1995; McREL, 1998; Young, 1997).

The cognitive development involved in complex thinking also leads to more efficient learning of both facts and skills (DeVries & Kohlberg, 1987; McDavitt, 1993; Schwartz & Reisberg cited in Crowl et al, 1997; Son & VanSickle, 1993).

## **Interactive Prerequisites**

Content is a building block for thinking skills. The recall of content is verbal information. Whether or not thinking can be learned without content is only a theoretical point because education and life engage both. Individuals take current knowledge and interrelate or rearrange it together with new information, using thinking

skills, which then function to extend and refine knowledge (Huot, 1998; Marzano et al, 1988; McREL, 1997). As learners build relationships among concepts, they broaden their knowledge of the world and begin to form rules to use in problem situations (Gagné, Briggs & Wager, 1988).

*Content begins in relatively simple forms and grows towards complexity and the nature of thinking adapts to increasing challenge* (Clarke, 1990, p. 24). Mastery of content and simple thinking skills are particularly important prerequisites because *any lesser degree of learning...will result in puzzlement, delay, inefficient trial and error at best, and in failure, frustration, or termination of effort toward further learning at the worst* (Gagné, Briggs & Wager, 1988; cf. Bloom cited in McDavitt, 1993).

Examples of objectives that express the need for complex thinking skills in particular subject matter areas include the ones listed below (Florida DOE, 1996).

- Math: *uses and justifies different estimation strategies in a real-world problem situation and determines the reasonableness of results of calculations in a given problem situation.*
- Language Arts: *selects and uses strategies to understand words and text, and to make and confirm inferences from what is read, including interpreting diagrams, graphs, and statistical information.*

Dispositions and habits contribute to the success of thinking in developing valid outcomes for life situations. They include an individual's tendencies and behaviors to seek accuracy and clarity, restrain impulsivity, take a position or direction, exercise self-regulation, think critically and creatively, set goals, make and execute strategic plans, seek and evaluate reasons and justifications, analyze and monitor one's own thinking processes, sustain intellectual curiosity, organizing information and ideas, persisting when answers are not apparent, and remain open-minded in exploring alternative views and generating multiple options (Dewey, 1933; Fogarty & McTighe, 1993; Huot, 1998; Marzano, 1993; McREL, 1997).

In this model, cognitive strategies have been classified as simple thinking strategies. They *often intrinsically possess a simple structure* such as underlining main ideas, outlining, and paraphrasing (Gagné, Briggs & Wager, 1988, p. 70).

## Connecting Networks and Operations

Bridges between interactive prerequisites and complex thinking skills related to life situations are formed by means of linkages, schemata, and scaffolding. They interweave the levels of thinking with content through *elaborating the given material, making inferences beyond what is explicitly presented, building adequate representations, analyzing and constructing relationships* (Lewis & Smith, 1993, p. 133).

Different processes may create the connecting networks and operations to relate new conceptual meaning to previously established ones, to integrate new information into existing schemata, to restructure schemata, or to restructure experience (Ausubel, 1978; Dewey, 1933; Jonassen, 1996). Linkages from the connecting networks are critical because *in very simple terms, we remember those things for which we have made many linkages* (Marzano, 1993, p. 156).

Teaching strategies make a difference in learning outcomes (Underbakke, Borg & Peterson, 1993; Kauchak & Eggen, 1998; Merrill, Drake, Lacy, Pratt, & the ID2 Research Group, 1996). Methods of teaching also influence the type of learning outcomes. For example, a Socratic method, or the use of stories or case studies, or class discussions may produce different kinds of learning (Wilson, 1997, p. 11).

Teachers who provide ready-made rules and generalizations for students to memorize are following practices that interfere with the development of thinking skills (Glaser, 1941). Novelty and usefulness to real life, and tasks that are neither too easy nor too difficult, hold more promise for making goals meaningful than isolated, rote learning tasks. The synchronous development of thinking skills with a deepening of the knowledge base promotes higher levels of thinking (Cotton, 1997; Crowl et al, 1997; Weisberg, 1995). Cognitive development through layers of instruction, each elaborating on the previous levels, progressively moves the learner from simple to complex concepts and thinking processes (Reigeluth, 1987; Reigeluth cited in Wilson & Cole, 1992).

Thinking skills instruction produces gains on measures of learning and intelligence (28 studies cited in Cotton, 1997). This instruction includes multidimensional strategies, wait time after presenting questions or problems, and a variety of examples with think-aloud explanations. It may include cycles of analysis and a period of incubation or reflection (Crowl et al, 1997; Facione, Sanchez, Facione & Gainene, 1995; Pogrow, 1990; Pogrow & Buchanan, 1985). Practical methods for infusing thinking into curriculum and instruction include the ones listed below (APA, 1997; Dewey, 1933; Glaser, 1941; Huot, 1998; Kauchak & Eggen, 1998; Marzano et al, 1988; McREL, 1997).

- Encourage positive attitudes, perceptions, and motivation about learning in a supportive and safe learning environment with respectful and caring relationships.
- Emphasize acquisition of meaningful knowledge, especially procedural knowledge as a base for applied thinking.
- Link, extend, and deepen knowledge through thinking skills applied to relevant, authentic, real-life learning tasks.
- Use knowledge and skills in meaningful authentic tasks over a period of time.
- Develop dispositions, habits of mind, or habits of reflection for organizing information and thinking and learning processes, including creative and critical thinking.

In addition, it is important to provide the following.

- Alignment in content and complexity of tasks, assessment activities, and objectives (Kauchak & Eggen, 1998).
- Deliberate design of activities and programs to teach specific thinking and learning strategies along with self-monitoring, self-reflection, and evaluation (Cotton, 1997; Darmer, 1995, abstract; Easterwood, 1996, abstract; Glaser, 1941; Kauchak & Eggen, 1998; Perkins & Salomon, 1989).
- Directions on use of cognitive strategies such as methods of rehearsal, elaboration, organization, reflection, and paraphrasing to improve one's own learning (Cotton, 1997; Crowl et al, 1997).
- Novel problems and questions to evoke thinking (Dewey, 1933; Kauchak & Eggen, 1998).
- Emphasis of broad problem solving strategies, algorithms, or heuristics (Crowl et al, 1997; Kauchak & Eggen, 1998).
- Clarity of instructions and assignments, e.g., explain the nature of the thinking task (Kauchak & Eggen, 1998).
- Organized activities and structure for processes (Kauchak & Eggen, 1998).
- Choices among assignments (Kauchak & Eggen, 1998; Crowl et al, 1997).
- Emphasis on transfer of skills to everyday life situations by including conditions of real-life in practice opportunities (Kasonen & Winne, 1995; Perkins & Salomon, 1989).
- Scaffolding of just enough support to guide students until they can perform skills independently (organizing frameworks, hints, questions, examples with explanations, modeling, corrective and specific feedback ) (Kauchak & Eggen, 1998; Slavin, 1995; Vygotsky in Crowl et al, 1997; McREL, 1997).
- Explanation and modeling of habits of thinking and dispositions such as persistence (Crowl et al, 1997; Kauchak & Eggen, 1998).
- Activities that use various types of intelligences and encourage intellectual diversity (Gardner in Crowl, 1997; Gardner cited in Kauchak & Eggen, 1998; Kauchak & Eggen, 1998; Merrill, 2000).
- Open-ended tasks involving several ways to resolve difficulties or solve problems and that give opportunities for small groups to contribute to outcomes (Kauchak & Eggen, 1998).
- Visual and verbal representations and explanations (drawings, graphs, maps, tales, hierarchies, lists of steps) (Clarke, 1990; Crowl et al, 1997; Glaser, 1941; Kauchak & Eggen, 1998).
- Practice in making inferences, in deciding how and when to apply different types of thinking skills, and in producing outcomes for a variety of life situations (Crowl et al, 1997; Howe & Warren, 1989; Kauchak & Eggen, 1998).
- Frequent, short assignments to include learning of prerequisite knowledge and skills and drill and practice using verbal analogies, logical reasoning, inductive and deductive thinking, and discrete steps and linkages involved in complex thinking processes (Kauchak & Eggen, 1998).
- Varieties of structured peer tutoring, cooperative learning, collaborative small group work, team assisted individualization with individual responsibilities and group products (Kauchak & Eggen, 1998; Kewley, 1996, abstract). [Social interaction is one of the vehicles by which learners share information (Vygotsky cited in Crowl et al, 1997)].
- Small group discussions only after assuring presence of prerequisite content knowledge and thinking skills (Kauchak & Eggen, 1998).
- Limited direct teaching, and if used, focus on mini-lectures combined with activities such as guided practice, demonstrations, debates, student questions, reviews and summaries (Patrick, 1986; Crowl et al, 1997; Kauchak & Eggen, 1998).
- Questioning strategies to stimulate curiosity of all learners, beginning with lower-order questions and progressively leading up to more complex questions (Crowl et al, 1997; Kauchak & Eggen, 1998).
- Monitoring, feedback, redirection, and correction of inefficient or incorrect strategies and pursuit of dead-end or simplistic answers (Cotton, 1997; Crowl et al, 1997).



- Feedback in the form of informal checks, immediate, with positive emotional tones, specific and non judgmental, simple correction of errors without overexplaining (Crowl et al, 1997; Kauchak & Eggen, 1998).
- Reinforcement and encouragement of targeted thinking skills and progress of learners to develop their confidence and a greater sense of locus of control (Cotton, 1997; Crowl, 1997).
- Adaptations for diverse learner needs (Kauchak & Eggen, 1998).
- Mastery skills development and test management for subskills and prerequisite knowledge (Kauchak & Eggen, 1998).

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# Social Desirability Responding on World Wide Web and Paper-Administered Surveys

Dawson R. Hancock

Claudia P. Flowers

University of North Carolina at Charlotte

## Abstract

*Social desirability responding (SDR) on surveys administered on the World Wide Web (WWW) and on paper was examined using 178 graduate and undergraduate students randomly assigned to a 2 (survey's administration mode: WWW and paper)  $\times$  2 (participants' identifiability level: anonymous and non-anonymous) true experimental design. The findings reveal no differences in SDR between the WWW and the paper-administered survey conditions, and no differences in SDR between the anonymous and non-anonymous conditions. These findings and potential explanations are examined for consideration by anyone interested in using the WWW to obtain accurate information from survey participants.*

## Introduction

*Response bias* (i.e., the systematic tendency to respond to surveys, questionnaires, standardized tests, and other self-report measures on some basis other than the specific item content) continues to confound research findings. People's reports of their own traits, attitudes, and behaviors often involve systematic bias that obscures measurement of content variables (Calsyn, 1999; Paulhus, 1991). For example, early research suggested that standard self-report methodologies distorted the reporting of racist attitudes (Sigall & Page, 1971), abnormal sexual attitudes (Knudson, Pope, & Irish, 1967), desirable behaviors (Phillips & Clancey, 1972), deviant behaviors (Clark & Tiffet, 1966), and abortion (Wiseman, 1972). More recent studies have revealed a tendency among individuals to conceal truth when reporting unverifiable information (Lautenschlager & Flaherty, 1990), seeking employment (Calsyn & Klinkenberg, 1995), reporting information designed to impress others (Rosenfeld, Giacalone, & Riordan, 1995), and when a respondent's anonymity is violated (Sproull & Kiesler, 1991).

Among the most common forms of response bias reported in the literature are deviant responding (Berg, 1967), careless responding (Meehl & Hathaway, 1946), consistent responding (Dillehay & Jernigan, 1970), item omission (Cronbach, 1946), acquiescence (Ray, 1983), and extremity bias (Hamilton, 1968; Peabody, 1962). However, perhaps the most frequently studied response bias is *social desirability responding (SDR)* (i.e., the tendency to provide answers which cause the respondent to look good) (Rosenfeld, Booth-Kewley, Edwards, & Thomas, 1996). As early as the 1930s, Bernreuter (1933) reported that psychometricians had already noted the problem of SDR effects on the validity of questionnaires. Years later, Meehl and Hathaway (1946) were able to cite eight measures specifically designed to index SDR in self-report measures. Since that time, SDR has been a major concern in measuring personality, psychopathology, attitudes, and self-reports of various forms of sensitive behavior (Paulhus, 1991).

Recently, the proliferation of web-based and other computer-assisted means of acquiring information from individuals has raised concerns regarding how responses obtained through computers compare with responses obtained on paper instruments. Several published studies (see Booth-Kewley, Rosenfeld, & Edwards, 1993; Moorman & Podsakoff, 1992, for reviews) have reported that computer responses are more candid, less biased, and less influenced by social desirability than responses given on paper. However, very few studies have examined people's responses on the World Wide Web (WWW). Furthermore, several research efforts have failed to replicate the findings of previous studies regarding SDR. For example, studies in the 1980s investigating the feasibility of a U.S. Navy computer-based survey system failed to demonstrate that computer-administered surveys were superior at reducing SDR (Doherty & Thomas, 1986; Rosenfeld, Doherty, Vicino, Kantor, & Greaves, 1989; Vicino, 1989). In addition, Lautenschlager and Flaherty (1990) found that undergraduates responding to a computerized survey had higher scores on a self-deception scale than did their counterparts who used a paper survey. Extending this research, Booth-Kewley et al. (1993) had subjects complete surveys using computer or paper administration modes under anonymous or identified conditions. Consistent with Lautenschlager and Flaherty's (1990) results, Booth-Kewley and her colleagues found that identified respondents gave more socially desirable responses than did their

anonymous counterparts. However, Booth-Kewley et al. (1993) failed to replicate Lautenschlager and Flaherty's (1990) finding of greater levels of SDR among participants who completed the survey by computer.

The lack of consistent findings regarding the extent to which people demonstrate SDR on computer versus paper-administered instruments, combined with the scarcity of research in this area on people who respond to surveys and questionnaires administered through the WWW, was the purpose for conducting the current study. Based on previous research suggesting that computer-administered surveys yield more candid responses than do paper surveys, this study hypothesized that adult students taking a survey on the WWW would demonstrate significantly less SDR than would students taking the same survey on paper. Furthermore, based on previous research suggesting that participants would be more inclined to respond to survey items under conditions of anonymity, this study hypothesized that adult students taking the survey anonymously would demonstrate significantly less SDR than would respondents who were asked to identify themselves.

## **The Study**

### **Participants**

178 undergraduate and graduate students at a large university in the southeastern United States, enrolled in introductory research and technology courses, participated in this study. 69% of the participants were female. The average age of participants was 34.2 years.

### **Instrument**

To assess the extent to which participants would demonstrate SDR, this study used the Balanced Inventory of Desirable Responding (BIDR) (Paulhus, 1993). The BIDR consists of 40 items stated as propositions. Respondents rate their agreement with each statement on a seven-point scale. The scoring key is balanced. After reversing the negatively keyed items, one point is added for each extreme response (six or seven). This method of scoring ensures that high scores are attained only by subjects who give exaggeratedly desirable responses. The 40 items are then summed to yield an individual's overall level of SDR.

Several studies have established the reliability and validity of the BIDR. With respect to internal validity, values of coefficient alpha have ranged from .68 to .80 and from .75 to .86 (Mellor, Conroy, & Masteller, 1986; Paulhus, 1984, 1993; Quinn, 1989). Demonstrating concurrent validity as a measure of SDR, the sum of the 40 items on the BIDR correlated .71 with the Marlowe-Crowne Social Desirability scale (Crowne & Marlowe, 1960) and .80 with the Multidimensional Social Desirability Inventory of Jacobson, Kellogg, Cauce, and Slavin (1977). Supporting the construct validity of the BIDR, Paulhus (1991) discovered that high deception subjects were more likely than lows to show a self-serving bias after a failure experience. High self-deception subjects also showed more illusion of control, belief that they were safe drivers, and proneness to love (Paulhus & Reid, 1991) and to intrinsic religiosity (Leak & Fish, 1989).

### **Procedures**

Using a true experimental design, this study examined the impact of two independent variables -- the participants' identifiability level (i.e., anonymous and non-anonymous) and the survey's administration mode (i.e., WWW-administered and paper-administered) -- on one dependent variable -- the participants' social desirability response levels measured by the BIDR. Using a random number table, 283 potential participants were assigned randomly to one of four conditions: (a) anonymous/WWW-administered survey (n=75); (b) non-anonymous/WWW-administered survey (n=78); (c) anonymous/paper-administered survey (n=63); and (d) non-anonymous/paper-administered survey (n=67).

Prior to their departure from the classroom during an initial session in the course, participants in all four conditions were provided a manila envelope by their professor, who was instructed to say, "*Prior to our next class attendance, please follow the instructions contained in your envelope. Those instructions will require you to individually complete a very short survey that we will use later in this course when we discuss data collection techniques. Remember, please follow the instructions contained in your envelope by our next class attendance. Thank you.*"

For the participants in the paper-administered survey groups, the manila envelopes contained a copy of the Balanced Inventory of Desirable Responding (BIDR). One-half of the BIDRs in those envelopes (i.e., the non-anonymous/paper-administered survey group) were preceded by the written instructions, "*Please complete the following survey and mail it in the self-addressed envelope prior to our next class attendance. The survey contains 40 items and takes approximately 10 minutes to complete. Using the scale below as a guide, write a number in each blank to indicate your agreement with the statement. For the purpose of accountability, please be certain that you*

*print your name legibly in the blank provided. The results of this survey will be completely confidential. The results will be reported only in the aggregate; therefore, at no time will you be identified individually."*

The other one-half of the BIDs in those envelopes (i.e., the anonymous/paper-administered survey group) were preceded by the same written instructions, with one exception -- the phrase, "*For the purpose of accountability, please be certain that you print your name legibly in the blank provided,*" was replaced with the phrase, "*To maintain anonymity, please do not indicate your name anywhere on the survey.*"

For the participants in the WWW-administered survey groups, one-half of the manila envelopes (i.e., the non-anonymous/WWW-administered survey group) contained a sheet of paper with the written instructions, "*Please complete the survey that you will find on the World Wide Web at <http://education.uncc.edu/survey1.htm> prior to the next class attendance. The results of this survey will be completely confidential. The results will be reported only in the aggregate; therefore, at no time will you be identified individually.*" For participants in this condition, the BIDR at the prescribed web site address included the following additional instructions, "*This survey contains 40 items and takes approximately 10 minutes to complete. Using the scale below as a guide, type a number in each blank to indicate your agreement with the statement. For the purpose of accountability, please be certain that you type your name in the blank provided.*"

The other one-half of these manila envelopes (i.e., the anonymous/WWW-administered survey group) contained a sheet of paper with the same written instructions, with two exceptions -- the WWW address for accessing the survey for participants in this condition was changed from "[education.uncc.edu/survey1.htm](http://education.uncc.edu/survey1.htm)" to "[education.uncc.edu/respond1.htm](http://education.uncc.edu/respond1.htm)," and the phrase, "*For the purpose of accountability, please be certain that you type your name in the blank provided,*" was replaced with the phrase, "*To maintain anonymity, please do not indicate your name anywhere on the survey.*"

Of the 283 potential participants in this study, 181 students completed a survey (i.e., a 64% response rate). However, three students' survey responses were excluded from the data analysis because these students incorrectly completed the survey. Of the remaining 178 surveys, 44 surveys were in the anonymous/World Wide Web-administered condition (i.e., a 59% response rate), 50 surveys were in the non-anonymous/World Wide Web-administered condition (i.e., a 64% response rate), 44 surveys were in the anonymous/paper-administered condition (i.e., a 70% response rate), and 40 surveys were in the non-anonymous/paper-administered condition (i.e., a 60% response rate).

A 2x2 analysis of variance (ANOVA) was conducted with the survey's administration mode (i.e., WWW-administered and paper-administered) and the participants' identifiability level (i.e., anonymous and non-anonymous) as the independent variables and the participants' SDR levels measured by the BIDR as the dependent variable.

## Findings

Means, standard deviations, and sample sizes for the social desirability levels by condition are presented in Table 1. The results of the ANOVA are presented in Table 2. The main effect for survey administration mode was not statistically significant ( $F(1,174)=.071, p>.05$ ). Students taking the survey on the WWW ( $M=15.33, sd=6.23$ ) did not demonstrate significantly less SDR than did adult students taking the same survey on paper ( $M=15.07, sd=5.50$ ). Furthermore, the main effect for participants' identifiability level was not statistically significant ( $F(1,174)=.150, p>.05$ ). Students taking the survey anonymously ( $M=15.03, sd=5.47$ ) did not demonstrate significantly less SDR than did survey-takers who were asked to identify themselves ( $M=15.39, sd=6.29$ ). Finally, there was no statistically significant interaction ( $F(1,174)=.027, p>.05$ ), suggesting that no differential effect on SDR was noted with the combination of independent variables.

## Conclusions

The hypotheses of this study were based on previous research; therefore, it is important to examine possible reasons for the non-statistically significant findings. One explanation may be that, unlike the current study, most previous studies linking lower anonymity with higher levels of SDR administered their surveys within the context of the experimental setting. For example, Lautenschlager and Flaherty (1990) asked college students to complete the BIDR in a small office on the site of the study. Similarly, Rosenfeld, Booth-Kewley, Edwards, and Thomas (1996) administered the BIDR to Navy recruits in a large testing room immediately after the sailors received instructions about the study. However, in the current study, after the professor distributed the manila folders, students were allowed to depart the classroom with the expectation that they would complete the survey on the WWW or paper prior to the next lesson. Undoubtedly, students completed the survey in many different locations -- at home, at work, at school, in a computer lab, and so forth. As a result, even those students in the non-anonymous WWW and paper-administered survey conditions whose instructions included a directive to type or print their names on the

survey may have felt a sense of anonymity as they completed the BIDR. This pervasive sense of anonymity experienced by the participants may have mitigated the effects of self-identification created in the study, thereby contributing to the lack of a statistically significant main effect for participants' identifiability level.

Another potential contributor to this study's findings may have been the written instructions provided to the participants. In all experimental conditions, the written instructions included the sentences, "*The results of this survey will be completely confidential. The results will be reported only in the aggregate; therefore, at no time will you be identified individually.*" Although these sentences were inserted to ensure compliance with the 1974 Buckley Amendment, their inclusion may have lessened the extent to which participants in the non-anonymous conditions perceived that they could be identified. In effect, these sentences may have caused all participants to believe that their identity was completely protected, thereby mollifying the impact of anonymity on participants' demonstration of SDR.

Furthermore, research has suggested that a survey-taker's perception of the verifiability of her or his survey responses may impact the extent to which the survey-taker stretches the truth in an effort to make a good impression (Lautenschlager & Flaherty, 1990). Specifically, when respondents believe that their answers cannot be validated, they tend to exhibit higher levels of SDR than when they think that their responses are verifiable. In the current study, however, participants were told that the results of the survey would be used in an upcoming discussion of data collection techniques. As a result, participants may have believed that the survey responses were being verified, thereby negating any SDR effects prompted by the method of survey administration (i.e., WWW or paper).

In the past, one factor often associated with lower levels of SDR in computer-administered survey responses than in paper-administered survey responses has been the standardization that computer administration affords (Feuer, 1986). In computer-administered surveys, SDR may be reduced by controlling the respondent's ability to preview, skip, review items, and change responses. In other words, the greater structure imposed by the computer mode of survey administration may limit respondents' ability to reveal themselves in the best possible light. However, in the current study, the survey's presentation on the WWW was designed to maximize participants' freedom to negotiate the instrument. Students who accessed the BIDR through the WWW had complete latitude to preview, skip, change, and review their responses to the items prior to submitting their surveys electronically. As a result, the restrictions often inherent in computer survey administration which lead to lower levels of SDR were not evident in this study, perhaps contributing to the non-statistically significant main effect for survey administration mode.

Finally, although early research revealed that computer-administered survey settings seemed to reduce SDR because those settings offered greater anonymity and were perceived as impersonal and nonjudgmental, recent studies have discovered a growing concern among many survey-takers that computers are becoming overly intrusive (Rosenfeld, Booth-Kewley, Edwards, & Thomas, 1996). This concern, sometimes labeled the 'big brother syndrome' (Martin & Nagao, 1989), suggests that people are becoming more aware that computer communications can be monitored and shared. Computer-users who suspect "big brother monitoring" have reported increased anxiety, fatigue, stress, and reduced job satisfaction (Eisman, 1991; Iadipalo, 1992). In the current study, students in the computer-administered survey condition may have felt that their responses, even in the anonymous condition, could and perhaps would be traced to them through the WWW. As a result, participants may have felt less inclined to present themselves in a truthful manner.

The growing popularity of computers throughout much of the world suggests that computer administration of surveys will continue to increase in the future. Therefore, it is important to know how survey responses obtained through computers compare with responses obtained on paper instruments. Although some research has reported that computer responses are more candid, less biased, and less influenced by social desirability than responses provided on paper, the current study using the WWW as the means by which to administer computer-based surveys did not support these findings. Students taking a survey on the WWW did not demonstrate significantly less SDR than did students taking the same survey on paper, and students taking a survey anonymously did not demonstrate significantly less SDR than did survey-takers who are asked to identify themselves. Unlike traditional computer-based modes of survey administration in which people demonstrate less SDR than people taking a survey by paper, this study suggests that people who take surveys on the WWW demonstrate SDR at levels comparable to those who take paper surveys. Although increased objectivity and cost effectiveness have often been associated with computer administration of surveys relative to paper administration of surveys, this study's findings should be considered carefully by all professions interested in using the WWW to obtain truthful and accurate information from survey-takers.

Table 1

*Means, Standard Deviations, and Sample Sizes of Social Desirability Responding Level by Participants' Identifiability Level and Survey's Administration Mode*

	Administration Mode								
	World Wide Web-Administered			Paper-Administered			Overall		
	<u>M</u>	<u>SD</u>	<u>n</u>	<u>M</u>	<u>SD</u>	<u>n</u>	<u>M</u>	<u>SD</u>	<u>n</u>
Participants' Identifiability									
Anonymous	15.07	5.73	44	14.98	5.25	44	15.03	5.47	88
Non-anonymous	15.56	6.69	50	15.18	5.83	40	15.39	6.29	90
Overall	15.33	6.23	94	15.07	5.50	84	15.21	5.88	178

Table 2

*2x2 ANOVA of Effects of Participants' Identifiability Level and Survey's Administration Mode on Social Desirability Responding Level*

	SS	df	MS	<u>F</u>	Sig
Participants' Identifiability Level (PIL)	5.256	1	5.256	.150	.699
Survey's Administration Mode (SAM)	2.504	1	2.504	.071	.790
PIL x SAM	.956	1	.956	.027	.869
Residual	6115.868	174	35.149		

Note:  $p > .05$

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# **Student Perceptions: Printing Activities' Influence On Satisfaction with Web-Based Instruction**

Karen Kaminski  
Colorado State University

Landra L. Rezabek  
University of Wyoming

## **Abstract**

*The use of Web-based and Web-enhanced instruction is growing rapidly. There is much information and discussion surrounding the layout of content on the screen and facilitating communication yet little information is available regarding the students perception and use of online instruction. Everyone knows that students print information available on the Web but not why nor how this affects their satisfaction with the course. This study was designed to identify factors that influence students to print course information delivered online, to ascertain if these printing activities are related to reducing barriers, and to determine if these printing activities influence students' satisfaction for learning via the Web. Implications for the design and development of Web-based instruction are discussed.*

Designers and developers of Web-based instruction, specifically Web-enhanced instruction, assume that students use the information in the format it was designed that is, online. In fact, many learners actually transfer this information to paper by printing it. This study was designed to identify factors that influence students to print course information delivered online, to ascertain if these printing activities were related to reducing barriers, and to determine if these printing activities influence students' satisfaction for learning via the Web. These possibilities have implications for the design of Web-based instruction.

As interest in Web-based instruction (WBI) has grown, much of the discussion in professional circles has revolved around the mechanics of which software to use (McCollum, 1997); how and when to incorporate visuals (Bixler & Spotts, 1998; Dana, 1998; Milheim & Rezabek, 1997); and how to manage e-mail, listserv and threaded discussions (Friedlander & Kerns, 1998). In addition to spending time on the mechanics of Web page development, a considerable amount of the WBI designer's time is devoted to the design and layout of the screen or interface (Bixler & Spotts, 1999; Carr & Peters, 1998; Horton & Lynch, 1998; Ipek, 1999; Kahn, 1999; McCormack & Jones, 1998; Montgomery, 1998). Finally, current research has focused on online communication issues such as email, bulletin boards, and threaded discussions (Jiang, 1998; McCabe, 1997; Nasseh, 1996). These discussions do not address the aspects of evaluating learning opportunities via the Web, nor do they address concerns arising when students transfer information from the computer screen to the printed page.

The systematic approach to the design of instruction (Dick & Carey, 1990; Gagne, Briggs & Wager, 1992; Reigeluth, 1999; Seels & Glasgow, 1997; Smith & Ragan, 1993) suggests that the analysis of student characteristics is critical to the design of effective instruction. There is little research available which tells the instructional designer, course developer, or instructor, how students are actually using online course materials. Ward (1998) found that many articles have been published on instructional design issues, technical considerations, and accreditation issues of distance education courses but little has been published regarding the online distance learner's experience in his or her own words. Determining the form in which students prefer to use information, and what their learning needs are is a crucial design component for designers of WBI.

## **Instructional Design and the Web-based Instructor**

The design of effective instructional materials is a complex task. The designer asks what is the message being delivered to the learner and what is the best way to deliver that message. With the advent of Web-based instruction, an entire new set of concerns is presented to the instructional developer. These include questions such as how to break the information up into usable pieces and how to guide the student through the now nonlinear information. At first, screen layout and design were based on well-established theories of layout for the printed page.

From the beginning of their educational experience, students learn to learn from the printed page. Researchers have had years of opportunity to study this method of information delivery. As Houle (1996) notes for print based information, much is known about such matters as readability, the display of exhibited material, the way

to arrange items of content so that they are maximally educative, and the best use of various resource categories. Reiser & Gagne (1983) state that when such conditions prevail, the learning of verbal information from text is probably several times as rapid as with the use of any other medium. Fleming and Levie (1993) acknowledge that when using print-based information a student can readily see how extensive the printed piece is by noting the thickness, the size of the type, the number of pages, the table of contents, and other visual clues. On the other hand Pantel (1997) indicates the fact that the Web is a nonlinear information space and that the size of the information space is unknown to end-users can be problematic. Users may experience disorientation and become frustrated. When students view a Web page that cannot fit on the computer screen at the same time, they must use the scroll bar (or the arrow keys) to move up and down the page. Using this method, it is easy for students to lose their place in the text. Forsyth (1998) advises the developer to keep scrolling to a minimum, to display the important content on one screen, and to limit a printed page to the size of the screen.

If it is difficult to navigate through online course information and locate information, then students may print the information to return it to a format that they are comfortable with and which, traditionally has been easy for them to use. When Web pages are printed, links are no longer active and do not indicate where they link. Color schemes are no longer visible unless a color printer is used. If information is placed into small chunks and linked together, clues that tell students which pieces fit together are essential.

To resolve the issue of layout for screen verses printing, McCormack and Jones (1998) suggest that it is much easier to print a longer page than a series of hyperlinked pages and therefore developers should perhaps provide two versions of any material that the students may need to print. One version would be intended to be viewed online and the other version would be a collection of the hyperlinked pages combined into one document.

### **Readability, Comprehension, and WBI**

When designing instruction, one of the designer's basic concerns is the student's ability to comprehend the materials. All the other aspects are related to aiding this comprehension. Smith (1994) indicates that while reading for comprehension, the brain must always move ahead quickly to avoid becoming bogged down in visual detail of the text. Lack of familiarity with the layout and flow of the text has a great affect on a student's ability to read information off of the screen (Smith, 1994). Although Web developers advise instructors to break their information into chunks and to include links and graphics, each of these can interrupt the flow of the eye and the pace of reading and therefore affect comprehension of the information (Smith, 1994; Veen, 1998).

In his research on typography, Wheildon (1995) found that readers were annoyed by jumps in online content and the interruption in their reading when they had to jump several pages. This may be due to the fact that sensory and short-term memory have very small capacities and brief storage times (1/2 minute) while long-term memory lasts a lifetime (Merriam & Caffarella, 1991). The jumps may interrupt the natural process of determining what should move into long-term memory.

The recommendations for designing online instruction for the screen to break the information up into small chunks and to link these chunks together makes the student responsible for deciding when to follow a link and when to finish the information on a page and then return to a link. This can interrupt the process of moving information from short-term to long-term memory as well as disrupt the process of bringing in prior knowledge. When asked to think about decisions of navigation, the student's thoughts are directed away from the intended content toward mechanical tasks and unrelated decision making.

Careful analysis of the materials and the delivery will improve the quality of the teaching and learning experience. Quality of instruction is based on many concepts including the selection of the medium used to deliver the content, the design of the content to be delivered, and the learners needs. Druin & Solomon (1996) indicate that it is important to keep in mind that not all educational experiences necessitate online technologies. Designers should consider if the learning experience is improved if offered through the use of online environments. Volker and Simonson (1995) agree with Druin and Solomon, indicating that when deciding to use the computer in instruction, the designer needs to ask a fundamental question: "What can the computer do that can not be accomplished by other media" (p. 115). Computers do not offer the complete answer to any instructional problem and in some cases may be less desirable. Studies have illustrated that using technology to deliver course information does not in and of itself enhance learning (Russell, 1999). It is how the technology is used to enhance the learning experience that makes a difference.

Effective design of online instruction takes advantage of the Web's greatest assets, interactivity. Unfortunately, the easiest way to develop online course content is to take existing materials, place them on the Web, and call them interactive. At best this results in electronic page turning or much scrolling (Forsyth, 1998; McCormack & Jones, 1998). Instead, Veen (1998) recommends use of principles and alternatives that may provide optimum usability of the Web for the learners. The most successful Web sites are ones that seamlessly blend the

spatial, physical, and temporal, creating a complete picture of what is available behind the 'front door' (Veen, 1998). Veen believes that successful Web design takes control of content and boils its presentation down to the essential elements in a subtle visual context. Achieving this says much more than could ever be said through long explanations of content on the pages.

If instructors choose to enhance their course with the use of online instruction, there should be a very good reason why these instructors require their students to visit a Web site. This may be to provide visuals, additional interaction, records of discussions, online evaluation or a number of other reasons. If the learner feels they are wasting their time or have to work hard to make sense of the information, they may reject it as inappropriate for the learning experience. Are instructors willing to rethink their role as educators and be freed from the traditional, mechanical ways of handling the same material. Are they ready to change their role to a designer of learning resources, a facilitator of information, an interest stimulator, a motivator, a diagnostician of learning needs, or a dialogue initiator (White, 1984).

An understanding of who the learners are will provide insight to understanding how to develop quality instruction for online learners. Design decisions may affect printing behaviors of the students in these online courses and this printing activity may affect student attitude and satisfaction for learning via this method.

### **Factors that Influence Participation**

The bulk of learning theory indicates that instructors need to provide quality instruction which is easy to use, easy to understand, and which is applicable to the learning situation (Cross, 1979; Knowles, 1980; Knox, 1980; Rogers, 1969). This supports the notion that developers of WBI need to address the learners needs and learning styles and then provide alternative learning experiences that meet these. There are many factors that influence participation in a learning activity. When these factors make it difficult to participate, they are considered barriers to participation. The most common barriers for adults to involve themselves in learning activities include time, costs, and quality (Darkenwald & Knox, 1984; Houle, 1996; Knowles, 1980; Merriam & Caffarella, 1991). Today's learners require flexibility and mobility in their learning experiences (Holmberg, 1981; Kaye & Rumble, 1981; Neil, 1981). One primary reason students choose to study at a distance is the freedom of time and space (Kaye & Rumble, 1981; Holmberg, 1981; Neil, 1983). They are free to participate in learning activities when it is convenient for them.

Today's students have two needs. The first is to learn the content presented in the course. The second is to become familiar with using the technology. The second need should not be a deterrent to meeting the first. These students may have little if any experience using a computer much less learning via the Web. Although they may be learning to use a computer at work or at home they may not have ready access to a computer and the Internet on a regular basis. If course content is placed on the Web, learners may be faced with difficulties of computer access and lack of experience using this learning medium. Providing alternative learning experiences and the ability to receive the information in a familiar, easier to comprehend, print format can provide these learners with the ability to easily access the information in a comfortable medium. Also providing the information in an online format which is easy to access and easy to use can begin to help students become familiar with this medium of delivery.

### **Subjects**

The students included in this study were a sample of convenience selected by contacting faculty who taught Web-enhanced courses. The sample consisted of students enrolled in four undergraduate level courses at Colorado State University. Of the 289 students who received the survey, 205 students completed it for a response rate of 70.93%. Of these participants, 202 were undergraduate students and three reported "other". These three responses were retained in the study since they were students enrolled in undergraduate courses and did not report themselves to be graduate students. Sixty-four percent or 131 of the respondents were female. The majority of the students who responded were between 20-24 years of age with a mean age of 22 and a standard deviation of 4.29. The majority of the participants,  $n=177$  (86.34%) were white, non-Hispanic, and 28 (13.66%) of the participants fell into other categories.

### **Data Collection and Analysis**

The instructors forwarded an electronic mail message to their students which briefly described the study, provided a link to the Web site, and asked the subjects to participate in the survey. WebCT, the data collection instrument, allows multiple participants to respond to the survey at the same time. Once the survey questions were answered, the responses were automatically transferred to an electronic database housed within WebCT. Follow-up was implemented by sending out a second electronic message. True anonymity was maintained forfeiting the

potential for further follow-up as there was no way to determine which students in a class had not responded and to then contact them individually.

As responses were submitted by the participants the multiple-choice questions were tallied automatically by the WebCT program. The researcher compiled the short answer and paragraph responses for further analysis. The qualitative questions were coded based on similar and related themes of response.

### **Underlying Assumption**

The assumption was made that students do print the information made available on a course Web site. One hundred seventy-five participants (85.37%) reported they printed pages from the course Web site. This number substantiates the assumption. Eighty-two participants (40%) reported they printed 50 or more pages from the course Web site. The average number of pages printed was approximately 30 (mean = 4.79, SD = 2.30).

### **Factors that Influence Students to Print**

The primary research question determined factors that influenced students to print online course information.

#### **Computer Access**

Requiring students to access a computer to obtain course materials or participate in discussion forced them to be in a particular location, at the computer. The majority of participants used a computer at home (n = 148, 72.20%) or a computer in a lab on campus (n = 143, 69.76%). Twenty-two of the participants (10.73%) indicated they used a computer at work and 42 of the participants (20.49%) indicated they used a computer in other locations. Eighty of the participants (39.24%) used a computer both in a lab on campus and at home. It is important to note that analysis of the data in this study indicated that the actual location of the computer, for example at home or in a computer lab, did not affect student satisfaction with the course, students' perception that printing affected satisfaction with the course, or the number of pages printed.

#### **Reasons for not Printing**

The primary reason for not printing, reported by 12 participants (5.80%), was to save paper. The next most frequently reported reason, reported by 8 participants (3.90%), was that there were too many pages to print and it took too long. Although 19 participants who did not print provided reasons related to cost, (too many pages, to save paper, and don't own a printer) cost did not appear to be a major factor in this study.

#### **Reasons for Printing**

The data indicate that course information on the Web was not accessible during class, was not transportable, was not easy to reference, and was not tangible. The most common reason for printing, (n=71, 40.57%) was that participants printed the information to study. This was followed by; to be able to take the information with them to other locations (n=46, 26.29%), for easy reference to the materials (n=43, 24.57%), to be able to take notes on the pages, highlight them, and use them during lecture (n=36, 20.56%), and it is hard to read on the computer (n=18, 10.29%).

Each of these reasons for printing could be interpreted as a more specific indication of using the materials to study. They each support the literature indicating that location is a barrier. These reported reasons for printing also support the literature that students return the information to a format in which they are familiar (Pantel, 1997; Ruben, 1996) that is: to be able to carry the information with them as they do text books, handouts and notes; to be able to access the information in class, between class, and in multiple locations; and to be able to write on the information.

#### **Learner Investment in Time on Course and Printing**

The average time students invested in the course was 4.67 hours (SD = 3.96). The average time students invested in printing was 20 minutes (SD = 25.94). The average time students spent printing was 4% of the average total time they reported spending on the course. In addition, only three participants indicated the time it took to print as a reason not to print. Therefore the time it takes to print out online class information did not appear to be a major factor in this study.

### **Prior Experience**

It could be expected that the more prior online course experience, the fewer pages printed. It does not appear that prior experience in learning via WBI or Web-enhanced instruction has an affect on the printing activities of students that participated in the study. Ninety-nine participants (48%) reported that this was the first course they had taken that had a Web component (mean = 1.96, SD = 1.09). Thirty-nine participants (19.02%) reported they had taken one prior course with a Web component and the same number reported two prior courses. Twenty-five participants (12.20%) indicated they had completed three or more courses with Web components.

Based on the number of pages printed by the students, further analysis was needed to determine if this printing activity was related to lack of experience with learning online. Using Spearman's Rho indicated that there is a low, positive relationship between number of prior courses and the number of pages printed ( $r = .130$ ). This result indicated students with more prior experience in courses with a Web component printed as much as or slightly more than students with little or no prior experience. Therefore designers of WBI can not assume that students will get use to using course materials online and will not want or need to print them.

### **Influence on Satisfaction**

The second research question determined if students' printing activity affected their satisfaction with the course.

#### **Difficulty Using the Information on the Course Web Site and in Print**

The majority of the participants (84.88%) indicated that it was moderately easy or very easy to use the information on the Web site (mean = 3.26, SD = .803). Of those who did print from the Web site, 90.62% reported it was moderately or very easy to use the information they printed (mean = 3.20, SD = 1.01). When asked what difficulties student has with printed information, fifty-one of the participants did not respond to this question, 44 participants stated that they did not have difficulties, and 18 reported that the question was not applicable. The reported difficulties were related to the format of the information to be printed. Examples included graphics that would not print or were not legible if they did print and that the format of the information printed was ruined making it difficult to find information.

#### **Satisfaction with the Overall Course**

Of the students who participated in this study 82 or 40% reported they were mildly satisfied with the course and 41 or 20% reported they were very satisfied with the course (mean = 2.60, SD = 1.04). Thirty-five percent of the participants indicated that their printing activity mildly increased their satisfaction with the course and 19% indicated that their printing activity greatly increased their satisfaction with the course (mean 3.63, SD = .996).

#### **Printing and Its Affect on Satisfaction**

Spearman's Rho was used to determine the relationship between overall satisfaction with the course and students' perception that printing affected satisfaction with the course ( $r = .334$ ). This moderately positive relationship suggests that the more students believed that printing increased their satisfaction with the course, the more they perceived that they were satisfied with the overall course. To further examine how students' printing was related to course satisfaction, Spearman's Rho was used to determine the relationship between the number of pages printed and perception that printing affected satisfaction for the course ( $r = .304$ ). The results indicated that the number of pages printed has a low, positive relationship to the affect that printing had on student satisfaction for the course. Namely, the more pages participants printed, the more they reported an increase in satisfaction in the course. The increase in satisfaction based on printing may have been due to the students' ability to use the information they printed in the same fashion that they would use traditional class materials.

Finally, analysis of the data showed that satisfaction for the course and students' perception that printing activities influence satisfaction were not related to where students reported they had access to a computer for the course. In addition, the number of pages printed was not related to location of a computer. In other words whether a student used a computer at home or in a campus lab for course work did not affect their perception of course satisfaction, printing activity, or the number of pages they printed.

#### **Preference for Receiving Learning Materials**

This finding was also reflected in the participants' response to their preference for receiving the materials. Fifty-nine participants (28.78%) reported that they would prefer the option to purchase a preprinted packet. Forty-nine participants (23.90%) reported that they would prefer to have a version online that is formatted for print. Fifty-

two participants (25.27%) reported they preferred to print from the screen. Thirty-three of the participants (16.10%) reported that they preferred to use the information online.

### **Suggestions for Designers and Developers of WBI**

The recommendations reported followed three themes. The first theme was to support the students in their printing activities. This theme included recommendations such as formatting the information for print, breaking the information up into printable chunks, and providing printing options without graphics and color. The second theme was related to the actual instruction. This theme included recommendations such as instructors still needed to show enthusiasm for teaching and enhancing communication. The third theme was related to the design of the course Web site. This theme included recommendations such as providing a study guide for the Web, making the Web site more interactive, and ensuring the information on the Web was accurate.

Some of the student responses did not apply to the Web-based aspects of courses but did provide information about the attitudes and beliefs of the learners who participated in the study. Several students commented that WBI was a positive approach to learning. "Online courses have been a blessing and are absolutely a great way to take a class." "After I got used to using the web site I really enjoyed having the freedom of when to get my work done." Others expressed a very different attitude: "Taking quizzes online is fine, but learning online is not." "Please stop making Internet classes, they are just another fabrication of this increasingly impersonal world and is seemingly a waste of time." "I think that having the entire class online really took away from my learning experience and I am upset for having to pay for such a format." "Personally, I prefer to obtain written notes in a classroom format because I think that the instructor and students interaction is very important to really learn the material."

The Web is an efficient way to distribute information to students quickly and is inexpensive for the faculty/institution. Instructors and designers need to be aware of the students' perceptions of learning online and take students' concerns into consideration when developing WBI.

### **Implications for Design and Development of WBI**

The information obtained in the study presents a number of implications for the design of WBI. These implications support the instructional design principles presented in the literature of knowing the audience and designing effective instructional materials to meet the learners' needs and preferences (Dick & Carey, 1990; Gagne, Briggs & Wager, 1992; Reigeluth, 1999; Seels & Glasgow, 1997; Smith and Ragan, 1993).

First, instructional design models indicate it is important to do as complete an analysis as possible of the audience that will be using the course Web site. This can be done by surveying students in a traditional offering of the class or in a class that is similar to or a prerequisite for the class being designed for the Web. If the students are going to print the information on the Web site to facilitate their learning, then content should be provided in a printable format. As a number of students indicated in their recommendations, they want to be able to print the information without color or graphics.

Secondly, designers should look more closely at the information they are putting online. During the phase of media selection, designers need to determine if the information simply replaces another medium or if it supplements information presented in another form. Not all educational experiences are appropriate for online technologies (Druin & Solomon, 1996; Volker & Simonson, 1995). Questions for the designer to investigate include: Is the information interactive, providing feedback for the learner? Does the information present some form of visual communication or motion that can not be presented on a black and white sheet of paper? Can the students easily access the information they need to complete assignments and study? Answers to these questions influence decisions to place course information online, to offer it in a printable version or to offer it in another form.

Thirdly, the designer needs to consider all the instructional resources available. Students did not express dissatisfaction with printing information from the course Web site. If the textual information is to be printed, then both course designers and students can save much time and energy if resources are not used to format for the screen and make text information look appealing on a computer. Instead, designers can spend valuable time and resources developing instructional activities that use the interactive and visual features of the Web. Course information that is typically printed can easily be placed on the course Web site in a printable format. This activity supports Knox's (1980) belief that alternative materials that differ in emphasis and complexity result in program flexibility and responsiveness to learners. This allows participants the option to select materials that are relevant and challenging to them, set their own pace, and maintain interest through variety. Students can use this information to enhance their learning.



Finally, the designer of WBI needs to provide information on how the Web site should be used. Pantel (1997) suggests that when the size of the nonlinear information space is unknown it can be problematic. He recommends including a site map that provides guidance for the user. Although this information was not solicited, five students made the recommendation to provide instructions for printing and three students recommended providing a study guide for the course Web site.

## Recommendations for Future Studies

Many institutions of higher education believe that delivering course content on the Web is one way they will remain competitive in the educational market. Much pressure is being placed on faculty to incorporate the Web into their teaching and learning. More research is needed to determine optimum design standards for developing Web courses that enhance student learning.

This study provides support for the anecdotal evidence indicating that students print information available on a course Web site. It also suggests reasons why the students are printing. Additional research is needed to gain more specific information regarding how students use the information they print from the Web site. The primary reason reported for printing was 'to study'. This raises the question of what it means when a student says 'to study'. An investigation of the literature on how students study is warranted.

Additional research is also needed to determine if satisfaction with online learning is affected differently when the course Web site is used in combination with other course materials as in a Web-enhanced course versus a completely Web delivered course.

Finally, additional research is needed to determine if courses with Web sites which are designed to be highly interactive provide different results than those courses with Web sites which simply provide content in the form of text and graphics. Specifically, does the increased online interaction affect students' satisfaction with the course and is this affect based on the interaction or on the fact that increased online interaction would require the students to spend more time at a computer to participate in class.

## Summary

Pantel (1997) states it simply when he says that one significant advantage of the Web is that it causes us to expand the notion of a document by enabling multimedia documents. Whereas print is better at presenting text, photography better at presenting images, radio better at presenting sound, and television better at presenting video, the Web's advantage is that it combines all of these media reasonably well into a single package.

When students reach post-secondary education, they have spent most of their lives devising and hopefully perfecting an effective way to learn the material presented in their classes. When faculty place their course material on the Web, they are presenting the students with a new challenge in learning. Students can learn the mechanics of accessing a Web site and navigating through it. However, it takes time to develop new study habits.

"Learning as a process (rather than an end product) focuses on what happens when the learning takes place" (Merriam & Caffarella, p. 124). If the information is to remain online, then students will need to gain new tools in how to use the information effectively while it remains online. This requires a change in students study habits. They will need new techniques to replace taking notes on the printed pages and highlighting the important information. Until new study habits are developed, or students have the ability to take notes on the Web, to highlight online, and to access the Web remotely with pocket size computers the implication for the design and development of WBI include formatting the information in a way that facilitates learning. Students' printing activity is an important consideration for the design and development of Web-based instruction.

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#### The questions.

1. What is the name of your course? \_\_\_\_\_
2. What is your birth date? \_\_\_\_\_
3. Please indicate your gender.  
☐ male  
☐ female
4. Please indicate your ethnic origin.  
☐ Asian  
☐ Black, non-Hispanic  
☐ Hispanic  
☐ American Indian  
☐ White, non-Hispanic
5. Where do you have access to a computer to access the course materials? Select all that apply.  
☐ I use a computer with Internet access at home.  
☐ I use a computer with Internet access at work.  
☐ I use a computer with Internet access in a lab on campus.  
☐ Other: public library, friend, etc.
6. Are you an undergraduate or graduate student?  
☐ undergraduate  
☐ graduate  
☐ other
7. In addition to participating in class through the class Web site do you meet face-to-face with your instructor in a classroom setting.  
☐ yes  
☐ no
8. Do you print out pages from the course Web site?  
☐ yes  
☐ no
9. If you do not print out pages from the Web site, what are the reasons why?
10. How many pages did/do you print out from the course Web site?  
☐ 0-5  
☐ 6-10  
☐ 11-20  
☐ 21-30  
☐ 31-40  
☐ 41-50  
☐ more than 50
11. What type of information was available on the course Web site? Check all that apply.  
☐ Syllabus  
☐ Course schedule or calendar  
☐ Online discussion content  
☐ Assignments  
☐ Content

12. What other type of information was available on the course Web site?
13. What type of information was on the pages you printed? Check all that apply.
- ☐ Syllabus
  - ☐ Course schedule or calendar
  - ☐ Online discussion content
  - ☐ Assignments
  - ☐ Content
14. What other information available on the course Web site did you print?
15. Why did you print the information on the course Web site?
16. On average, how much time do you spend working on this course each week?
17. On average, how much of the time that you spend working on this course is spent printing from the Web site?
18. Do you find it easy or difficult to use the course information on the course Web site?
- ☐ Very difficult
  - ☐ Moderately difficult
  - ☐ Moderately easy
  - ☐ Very easy
19. Do you find it easy or difficult to use the course information you print from the Web site?
- ☐ Very difficult
  - ☐ Moderately difficult
  - ☐ Moderately easy
  - ☐ Very easy
20. If you do have difficulties using the information you printed, what are they?
21. Indicate your overall satisfaction with this course.
- ☐ very unsatisfied
  - ☐ mildly unsatisfied
  - ☐ mildly satisfied
  - ☐ very satisfied
22. Does printing the Web pages increase or decrease your satisfaction for the course?
- ☐ greatly decrease
  - ☐ mildly decrease
  - ☐ no affect
  - ☐ mildly increase
  - ☐ greatly increase
23. Indicate the number of courses, that require you to access a course Web site, you have completed prior to taking your current course.
- ☐ 0
  - ☐ 1
  - ☐ 2
  - ☐ 3 or more
24. Given the following options, which would your prefer:
- ☐ To purchase a printed packet of course information from a bookstore or similar location?
  - ☐ To print a version of the information formatted for the printed page.
  - ☐ To print the screens as they appear on the Web site.
  - ☐ To use the information online and not print.
25. Do you have recommendations for designers and instructors of online course information regarding your experiences

# **The Relationship Between the Types of Resources Used in Science Classrooms and Middle School Students' Interests in Science Careers: An Exploratory Analysis**

Tiffany A. Koszalka  
Pennsylvania State University

## **Abstract**

*The U.S. is investing millions of dollars each year on developing new resources to inspire students to pursue science careers, yet there are no data to support the premise that specific types of resources are associated with student interest in science careers. The results of this thesis demonstrated that using resources high in sociableness and high in webnicity positively and significantly related to higher levels of interest in pursuing science careers.*

## **Introduction**

Implications for future applications of technology are many ... a mature profession recognizes its needs and seeks to utilize all of the resources – human and nonhuman – that it can muster to attain its goals and objectives ... (Hayden & Torkelson 1973, p. 34).

The U.S. invests millions of dollars each year on securing and developing new resources to inspire students to pursue science. Since middle school is a time when students begin to explore careers - and select and de-select career domains to pursue (Gottfredson, 1981) - it is important to understand the relationships among the types of resources used during middle school science and the level of student interest in science careers.

There are indications from previous research that different sources of information may influence a student's choice to pursue science (Charron, 1991, Jovanovic & Steinbach King, 1998; Lederman & Druger, 1985). However, many questions remain unanswered in regard to the use of different types resources in the classroom. Is using information from outside the classroom – through human and web resources – during science more predictive of students' interest in science careers than students in classrooms that do not regularly employ these types of resources? Is using human or web resources during science class predictive of boys' science career interest ... of girls'? To find answers to these questions data was collected on the different types of resources used in the classroom as well as gender, a factor that has been empirically shown to be related to the development of career interests (Hill et al., 1990; Hyde, 1993).

## **Learning and Information Resources**

Career interests are *learned* characteristics (Super, 1984). Instructional designers and educators have an obligation to create environments that facilitate learning. A key step in the instructional design process is developing or integrating existing resources that will provide students with the information necessary to advance their learning process. Not much is really known about the relationship between learners and the use of different types of information resources employed in the classroom. Decisions about resources are rarely made based on understanding the relationships between learner-level and classroom-level factors, but often are based on best guesses, experience, the types of resources that are available, or the latest and greatest resource.

## **Dimensions of Informational Resources**

In this study the types of supporting classroom resources were classified along two dimensions - "sociableness" and "webnicity" of information. On the first dimension, "sociableness," a resource is defined on its measure of providing information through interactions with people (Sundar, 1994). High sociableness occurs when people, human resources, are actively and socially involved in sharing information with others in the learning environment. Books, models, pictures, posters, or other objects are considered resources low in sociableness. Guests, experts, and others who participate with students during science instruction are high in sociableness. On the second dimension, "webnicity" (Grabowski, personal conversation on October 19, 1999) is a measure of a resource's interconnectedness of information to other supporting information on a continuum regardless of delivery methods or reference to the form of information. For this study, on one extreme, high webnicity refers to resources providing

vast and easily accessible supportive information as only available on the Internet. On the other extreme, low webnicity refers to resources that provide limited supporting information that is not easily accessed in time, often classroom-bound, i.e., requiring students to leave the classroom to get additional information, such as books, posters, and non-networked computers. Thus, different types of resources provide different types of information to students. Much of the literature indicates that exposure to both social and non-social information is important in developing career interests.

### **Why is Studying Student Interest in Science Careers Important?**

Since the 1950's, following the Russian orbiting of Sputnik, the need for advances in science education has been a concern of educators, parents, employers, government agencies, and the American society at large. The government undertook actions to increase the scientific literacy and interest of America's students by developing new science and math curricula, educational resources, and more recently expending enormous capital to supply all classrooms with computer and Internet technology. This movement spawned many research efforts to measure the effects of these actions on students' pursuit of science and engineering majors. While the importance of well-prepared curricula to help educate students for these future needs is recognized by many, previous studies have not investigated whether the characteristics of the classroom, classroom resources, or of the students themselves were related more strongly to the development of interest in pursuing science-related careers.

Discovering the relationships among classroom-level and student-level characteristics and science career interests may help instructional designers and educators design educational environments using resources that empirically have been shown to be predictive of the development of student interests in pursuing science-related careers. These designs would then, in turn, support the efforts to increase student interest in science careers in the United States.

### **Development of Interest: Interactions and Relationship Building**

Interest, an acquired attention or enthusiasm for a particular field, is a *learned* characteristic and has been shown to be the key factor in making career choices (Super, 1984). Developing interest in a specific career domain, such as science, is a consequence of many learning interactions with the people, information, and objects of the practice. Lave & Wenger (1991) describe learning, such as developing an interest in pursuing science, not as a matter of a person's internalizing knowledge but as a matter of a person's transforming his/her participation in a social community. Learning, therefore, is based on building relationships between people and their places in the community and associations with the information and objects of the practice. Thus, becoming a member of a community of scientific practice requires that newcomers interact with the information, artifacts, and people that make up and define the scientific community.

The development of career interests is a complex phenomenon. Much of the research provides evidence that there are specific background variables a person's life that also influence the development of specific career interests. When children enter into the early stages of adolescence and begin to explore relationships and activities outside the family they begin to develop independent career interests. Interactions with reference or peers groups, personality characteristics, societal expectations, perceived abilities, achievement levels, and acquaintances with role models outside the classroom all have been found to have some effect on the career aspirations of adolescents (Hill, Pettus, & Hedin, 1990).

### **Development of career interest and classroom variables**

When children enter into adolescence and begin to develop their own career interests, people and activities outside the home and specifically in the classroom, influence them. Over the last two decades, much research has focused on investigating the relationship between rich learning environments and developing interest in science careers, especially for girls and minorities (Hill, Pettus, & Hedin, 1990; Kahle, Matyas, & Cho, 1985; Mason & Kahle, 1988). However, the research in this area has clearly focused on the results of sensitizing teachers to the needs of minorities and training teachers in the use of sound instructional strategies. No published literature could be found that reported on investigations of the relationships between the use of classroom resources and student science career interests in typical science classrooms as opposed to classrooms participating in science intensive programs.

Most theoretical perspectives also acknowledged the interactive effects of multiple variables, such as resources, instructional strategies, and gender, on student learning. However, a majority of the educational research neglects to take into account the influence of these variables on developing middle school students' interest in pursuing science. Nor could published research be found that specifically examined the predictive relationship

between the use of different types of informational resources in science classrooms and student interest in pursuing science-related careers.

### **Social Environment of the Classroom**

A body of empirical research describing the relationship between psychological-social aspects of the classroom and students' interest in science is growing. Evidence exists to support the claim that, on average, students in classrooms with strong social environmental characteristics, such as high involvement, peer affiliation, and competition, do manifest more positive attitudes toward science than do students in classroom with low measures of these social characteristics (Fouts & Myers, 1992; Gallagher, 1994; Kahle, Matyas, & Cho, 1985; Talton & Simpson, 1987; Yager & Yager, 1985). However, Roth (1996) found that the diffusion of the various forms of knowledge occurred at different rates and in different forms in early adolescent student groups. Roth suggested that availability of specific resources and social networking that occurred during the classroom activities influenced student learning. It was unclear if learning was related more strongly to the webnicity or the sociableness of the supporting resources.

### **Why would Sociableness of Resources make a Difference?**

Lent et al. (1994) argued that over the course of adolescence, being exposed to social interactions differentially reinforced the individual for pursuing certain activities from among those that were possible, thus gave rise to interests in specific career domains. Short-term social interactions and relationships with resources high in sociableness such as adults outside the family have the potential to cause changes in an adolescent's interests. These types of relationships do not generally yield emotionally laden feedback, as one would expect from family or close peers, but the feedback is perceived more as providing a valid evaluation of the adolescent's behavior (Darling, Hamilton, & Niego, 1994). Thus, an adolescent's self image can be influenced by resources high in sociableness such as a significant other outside the family because the adolescent believes that the other is a credible source of information about his/her behaviors. Exposing early adolescents to a variety of human resources during science class could be most beneficial in fostering curiosity and exploratory behaviors that promote career interests (Super, 1984).

### **Why would Webnicity of Resources make a Difference?**

The interconnected nature of the Internet is making access to more information and more people much easier in the classroom. The types and numbers of resources that can be used in the classroom are increasing as schools become wired and access to the Internet expands. Studies have found that when web resources were introduced into the classroom, students interacted in more complex tasks, developed greater technical skills, and used more outside information (Hardin & Ziebarth, 1995; Owston, 1997; Rice, McBride, & John, 1998) than before the Internet was available. Thus, resources high in webnicity provided access to additional information resources and promoted the use of additional resources.

Web resources also provide connections to people outside the classroom. Research in this area reports that collaborative instructional strategies employing web resources high in sociableness and encouraging group sharing and knowledge development increased student achievement, perceptions, and self-esteem (Conlon, 1997; Federman & Edwards, 1997; Karayan & Crowe, 1997; Papert, 1997). Central to those studies were the instructional strategies used to encourage interactions among students and others outside the classroom. It is not known whether the access to resources high in sociableness or the instructional strategy itself was related to increases in the learning outcomes.

What is not currently understood is whether there is a significant relationship between developing career interests in science and the use of resources with different combinations of sociableness and webnicity. Thus, if students' interests in science are promoted when they are actively involved with information and people (Super, 1984) and they access more supporting information when using web technology than when not, then unpacking the relationships between the types of supporting information resources used in the classroom and student interests may help to determine which types of resources could be used in science classrooms to inspire students to pursue of science careers.

### **Research Methodology**

A one-time cross-sectional observational method was used to collect data from more than 600 middle school students at the end of the school year (Koszalka, 1999). Student data were collected using a modified version of the Self-Directed Search Career Explorer for Middle School students (Holland & Powell, 1994) and teacher questions drawn from research on integrating technology resources into the classroom (Grabowski & Koszalka, 1998).

A snowball sampling procedure was used to identify middle school science teachers who would be willing to participate in this study. Teachers were not, however, required to have completed any special teaching certification programs or be regularly using any specified procedures, materials, or technologies. All classrooms were required to have school access to Internet technology resources, although there were no requirements that teachers had to regularly use these resources. The students who participated in the study were intact groups from the science classrooms taught by the participating teachers.

The dependent variable for this study was *Science Career Interest*. The science career interest measurement scale was continuous (interval/ratio) with possible scores ranging from 0 to 36. The higher the score, the more interest the student had in pursuing science-related careers.

The student-level independent variable for this study was gender that has been shown to be related to an adolescent's interest in science careers (Boone & Butler Kahle, 1998; Hill et al., 1990).

Teachers were asked to provide information on the types of resources used regularly in the classroom. Classrooms were classified into resource use types based on an indication of whether the resources had been used regularly during science class, i.e., 5 or more times during the school year (Becker, 1998). Classrooms were coded into only one of four resource types:

1. Low sociableness and low webnicity—use neither human or web resources 5 or more time per year,
2. High sociableness and low webnicity—use human resources 5 or more times per year and web resources less than 5 times per year,
3. Low sociableness and high webnicity—use human resources less than 5 times per year and web resources 5 or more times per year,
4. High sociableness and high webnicity—use human and web resources 5 or more times per year.

At the beginning of a typical science class, teachers provided students, who had received parental consent, with a paper and pencil survey of their career interests. The teacher collected the completed surveys and signed consent forms and returned them with completed teacher surveys in a provided mailer.

All data used for analysis were first summarized to provide a description of the participating classrooms and students. All descriptive data were computed using SPSS version 8.0. The complex nature of the multilevel environment of the classroom, where students are nested in classrooms and classrooms are nested in schools, can produce inaccurate measures of relationships unless the characteristics of both the individual student and the groups of students are taken into account (Arnold, 1992). Thus, hierarchical linear models (HLM) were used to examine the associations among classroom-level factors, student-level factors, and science career interest using two-level hierarchical linear models. All estimates were calculated at a .05 alpha-level. Pair-wise deletion was used when missing data was encountered.

## Results

A total of 658 surveys, from 23 teachers in 9 schools were administered and returned. Fifty-eight surveys were either returned without signed parental consent forms or with incomplete data and were removed from the sample. The remaining 619 surveys, 94% of the returned surveys, were included in the data analysis that included 51% girls (n=304) and 49% boys (n=297). Eighteen students in the sample did not identify their gender.

This sample of students had a fairly high level of interest in pursuing science careers ( $M=23.47$ ,  $SD=5.37$ ). The scores spanned 34 points ranging from a minimum score of 2 to maximum score of 36. The distribution of scores had a slightly negative skew,  $-.437$  indicating a slightly higher frequency of scores above the mean than below. The schools represented East and West Coast middle class suburban/rural middle schools.

The mean science career interest for students in classrooms that used resources low in sociableness and low in webnicity was 17.46, for boys it was 18.10 and for girls it was 16.46. The mean score for students in classrooms that used resources low in sociableness and high in webnicity was 21.95, for boys the mean score was 20.12 and for girls it was 24.19. Students in classrooms that used resources high in sociableness and low in webnicity had a mean science career interest score of 20.68, for boys the mean score was 21.83 and for girls it was 21.52. For classrooms that used resources both high in sociableness and high in webnicity the mean science career interest score was 28.33, for boys it was 23.44 and for girls it was 29.31. (See Table 1.)



*Table 1. Science Career Interest and Combinations of Sociableness and Webnicity*

Resource Types	All Students			Boys			Girls		
	M	SD	N	M	SD	N	M	SD	n
Low Sociableness and Low Webnicity	17.46	6.05	68	18.10	7.55	30	16.46	4.44	37
Low Sociableness and High Webnicity	21.95	4.67	105	20.12	5.26	53	24.19	3.69	48
High Sociableness and Low Webnicity	20.68	5.74	88	21.83	5.55	46	21.52	6.01	42
High Sociableness and High Webnicity	28.33	4.66	358	23.44	4.88	168	29.31	4.50	177

Notes: Possible range for science career interest scores is 0 – 36 points; All students: n=619, mean score 23.47; Boys: n = 297, mean score 23.71; Girls: n = 304, mean score 23.12

An HLM baseline analysis of the data revealed that the average mean science career interest score across all classrooms was 23.63. The reliability measure for this data was .871, indicating that the sample means tend to be quite reliable as indicators of the true classroom means. The analysis resulted in a chi square of 196.581 with 22 degrees of freedom and a  $p < .000$ , indicating that there was evidence of significant difference in science career interest across U.S. middle school classrooms, thus a null hypothesis of no differences in science career interest was rejected.

When classrooms used web resources during science lessons students had, on average, a 3.86 point higher score in science career interest than students in classrooms that did not employ web resources ( $t=3.615$ ,  $p<.002$ ). Similarly, there was a significantly higher score, on average, of 2.68 points in student science career interest in classrooms that used human resources as compared to science classrooms that did not use human resources ( $t=2.959$ ,  $p<.008$ ). (See Table 2.)

The interaction of gender and human resources resulted in a positive estimated coefficient ( $t = 1.788$ ,  $p < .088$ ) indicating that human resources were potentially important predictors of science career interest for boys. The interaction of gender and web resources resulted in a negative estimated coefficient ( $t = -1.947$ ,  $p < .055$ ). Since boys were coded as “1” and girls as “0,” the negative coefficient indicated that the use of web resources was potentially a more important predictor of science career interest for girls. Further analysis was required to determine whether the use of human and web resources were indeed significant predictors of science career interest for boys and/or girls.

*Table 2. Classroom-Level Resources and Gender*

Fixed Effects	Estimated Coefficient	Standard Error	T-Ratio	P-Value
<b>Science Career Interest Mean</b>	23.53	.43	54.260	0.000
Use of Human Resources	2.68	.91	2.959	0.008
Use of Web Resources	3.86	1.06	3.615	0.002
<b>Gender slope</b>	0.21	.42	0.499	0.623
Gen X Hum Resources	1.58	.88	1.788	0.088
Gen X Web Resources	-2.87	.91	-1.947	0.055

Note: N = 619, Model 1 Intercept Reliability Estimate = .732

Data were split by gender to investigate the relationships further. The mean science career interest score for boys was 23.69. The use of human resources was a significant predictor of science career interest for boys. When human resources were used in the science classroom, boys, on average, scored 2.68 points higher than boys in classrooms that did not use human resources ( $t=2.187$ ,  $p<.048$ ). Using web resources ( $t=1.139$ ,  $p< .269$ ) did not significantly predict science career interest for boys. The use of both human and web resources ( $t=.495$ ,  $p<.626$ ) also did not significantly predict science career interest for boys. (See Table 3 and Figure 1.)

Table 3. Classroom-Level Resource Effects for Boys and Girls

Fixed Effects	Estimated Coefficient	Standard Error	T-Ratio	P-Value
<b>BOYS*</b>				
Science Career Interest Mean	23.69	.54	44.017	0.000
Use of Human Resources	2.68	2.26	2.187	0.048
Use of Web Resources	2.14	1.88	1.139	0.269
Human x Web Resources	1.29	2.61	0.495	0.626
<b>GIRLS**</b>				
Science Career Interest Mean	23.34	.42	55.207	0.000
Use of Human Resources	4.54	1.78	2.555	0.020
Use of Web Resources	7.06	1.43	4.941	0.000
Human x Web Resources	4.63	2.06	2.252	0.036

Note: \* Boys: N = 297, Model 2 Intercept Reliability Estimate = .597

\*\* Girls: N = 304, Model 2 Intercept Reliability Estimate = .514

When human resources were used in science class girls, on average, scored 4.5 points higher ( $t=2.555$ ,  $p<.020$ ) in science career interest than girls in classrooms that did not use human resources. In addition, girls scored, on average, 7.1 points higher ( $t=4.941$ ,  $p<.000$ ) in science career interest when web resources were used in the classroom than girls in classrooms that did not use web resources. When both web and human resources were used in science class, the interaction effect of both produced, on average, an increase of 16.2 points ( $t=2.252$ ,  $p<.036$ ) in science career interest for girls -- interaction effect:  $4.5*1 + 7.1*1 + 4.6*1*1 = 16.2$ .

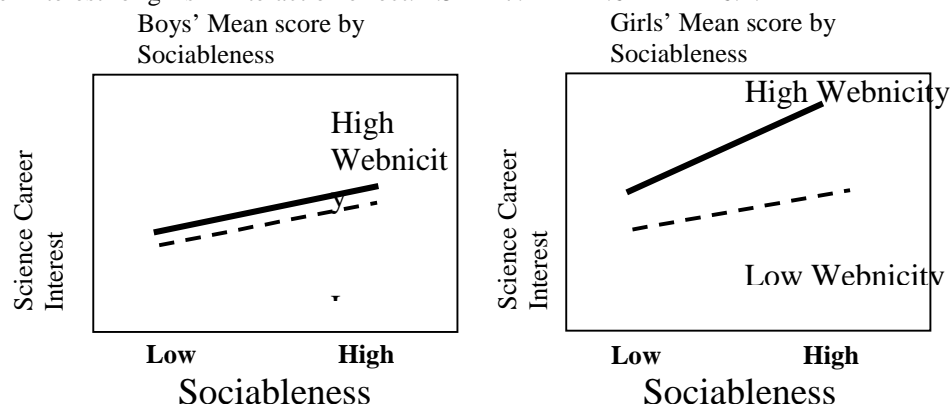


Figure 1. Science Career Interest Scores for Boys and Girls in Science Classrooms High and Low in Webnicity, by Sociableness

## Discussion, Practical Implications, and Future Research

Developing interest in specific career domains is a consequence of many learning interactions with the people, information, and objects of the practice (Lave & Wenger 1991). Conceptually, previous research provided indications that working with science practitioners and exploring science information was important in developing interests in science careers (Vondracek, 1993; Helwig, 1998; Hill et al., 1990). The use of *human* and *web* resources during science can provide adolescents with opportunities for exploring science by providing access to additional social and supportive information. Thus, the significant relationships found support a conceptual hypothesis that increasing the richness of information through human and web resources during science class was related to higher levels of science career interest. (See Figure 2)

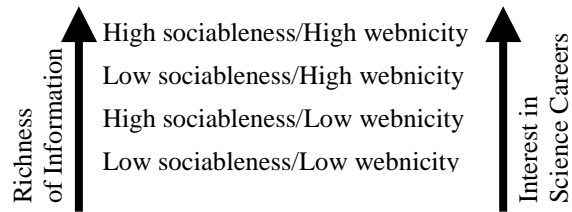


Figure 2. *Level of Information Richness*

Science career interest was predicted differently for boys and girls given the types of resources used regularly in science class. It was hypothesized that using web resources would support boys' needs to manipulate and explore information using inanimate resources, yet not be significantly related to girls' science career interest because girls were thought to prefer social and cooperative learning environments (Schram, 1996). Thus, web resources were expected to be predictive of boys' and human resources were expected to be predictive of girls' science career interest. Contrary to the expectations of this study and the literature on gender differences, the use of resources high in sociableness was predictive of higher science career interest for both girls and boys. The use of resources high in webnicity had a significant predictive relationship for girls' interest in science careers, but did not predict boys' interests. The literature on gender differences in educational environments theorizes that girls learn better in socially active settings. As young children, girls were inducted into relational modes in which they were encouraged to be conscious of others' needs and be more cooperative, whereas boys were encouraged to be autonomous and to achieve a sense of identity on their own (Boaler, 1997; Head, 1996).

Hyde (1993) cited environmental factors such as cooperative teaching strategies and significant people in the learning locale as influencing girls. Classrooms that encouraged independent, hands-on experimental activities influenced boys. Girls were more interested in animate objects high in sociableness, especially people, than inanimate objects and boys were found to be more interested in inanimate objects, low in sociableness, more than in people. Why then, did boys who were exposed to resources high in sociableness in the science classroom have higher science career interests than boys who were not? And, why would using web resources, e.g., inanimate manipulatives, not be predictive of boys' interest in science careers and be a significant predictor for girls'?

Significant others, such as visitors to the science classroom, influence adolescents both through the interactions with them and through their ability to serve as role models (Darling et al., 1994). A visitor to the science classroom may provide boys with a solid understanding of a complex scientific concept about which the teacher lacks expertise or engage them in challenging discussions about scientific phenomena to increase their investigative skills. Boys may identify with the visitor, especially if the visitor is a male and fits the boys' perceptions of being a scientist (Mason, Kahle, & Gardner, 1991), thus his science career interest could be significantly influenced by the addition of the human resource (Young, Reynolds, & Walberg, 1996). Since details about human resources, e.g. gender, strategies used with students, etc., were not gathered research is needed to confirm these explanations.

It was also surprising to find that using web resources in science class was highly predictive of girls' science career interests and not predictive of boys'. The use of human resources in the science classroom predicted higher science career interest in girls; however, the use web resources predicted girls' science career interest scores seven points higher, on average, as compared to girls who did not have access to web resources. The use of both web and human resources was related to dramatically higher scores in the girls' science career interest. Why were girls' interests in science career predicted by the use of web resources and boys' not?

Girls are generally thought to learn better in social environments and are expected to have strong associations with resources high in sociableness. Girls are theorized to benefit more from social learning activities. Much of the research illustrated that science programs focusing on girls and incorporating cooperative instructional strategies, science equipment, and other science materials influenced girls' interest in science (Mason & Kahle, 1988; Schram, 1996). However, it was not clear whether the influence was from the social nature of the activities, use of equipment, or exposure to new information. Girls could potentially be intrigued by the use of web resources to investigate areas they have not been encouraged to explore previously.

The use of the web may also provide another mechanism for encouraging social interaction in science class on several different levels. First, the low number of computers generally found in classrooms may make it more effective to have students work in cooperative groups while completing science projects using web resources. This type of strategy enhances the social nature of using web resources, thus could explain the relationship to girls' science career interests. Secondly, the use of web resources in the classroom may predict girls' science career interest because girls reportedly do not interact with computer technology outside the classroom as much as boys

(Rocheleau, 1995). The use of web resources may have provided girls in this study with a novel experience thus increasing their opportunities and interest in exploring science content and conversing with science experts virtually.

Boys, on the other hand, have generally been shown to be the heavier users of computer technology outside of the science classroom (Rocheleau, 1995). Because boys are thought to be the heavier users of computer technology, they are most likely to be more knowledgeable of the web and the resources it has to offer. Boys with interests in science are therefore more likely to use the web to explore science-related sites outside of class. Using web-based science resources inside the classroom thus may not be unique to boys thereby, reducing the potential relationship between the use of web resources in the science classroom and their interest in science careers. Additionally, if students are mainly assigned to cooperative activities when using web resources, boys, who prefer to learn autonomously (Boaler, 1997; Head, 1996), may not be benefiting from the use of web resources in the science classroom or be more apt to explore sites not related to science assignments.

Further research is required to understand the circumstances of use that demonstrated significant relationships between different types of web resources and science career interest among girls and boys. Does increasing the amount of time on-line relate to higher levels of science career interest? What types of web resources promote science career interest? What types of interactions with web resources promote science career interest? Is it more beneficial to work in a group or individually during activities that employ web resources?

Understanding the relationships between the use of different types of resources during class and students' science career interests can provide a basis for developing and securing resources that have been empirically shown to be related to higher interest in science careers. If these results hold up in replication studies, there are significant practical implications that may drive educational policy decisions. Given the goal of inspiring students to pursue science careers and the relationship between interest in science careers and use of human and web resources, policy makers should provide financial commitments to enhance computer equipment, facilitate access to science information, and develop communication and working opportunities with scientists and experts in science communities. In addition, commitments should be made to adequately support teachers in their efforts to integrate these resources into their teaching and learning environments. Teachers should be given release time to prepare lessons that incorporate human and web resources and in-service training that focuses on developing strategies and skills to enhance existing lessons with web resources. These efforts would help to increase student access to human and information resources conducive to exploring science.

These findings shed new light on understanding the complex relationships between the use of resources in the classroom and multiple factors that affect the development of science career interest. Without an understanding of the relationships between the types of resources used in the educational environment and student science career interest there is a risk that large investments in educational resources will go unmatched in student outcomes. The results of this study demonstrated that using resources high in sociableness and high in webnicity during science was positively and significantly related to higher levels of student interest in pursuing science careers.

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# Action Research on Training Students to Be Independent Learners

Amy S. C. Leh  
California State University San Bernardino

## Abstract

*Technology advancement is shifting our education paradigm. The role of the instructor is changing from an information-giver to a facilitator. Students no longer passively receive information. Given opportunities, students may become instructional resource providers and self-learners. This article reports how the author encouraged students to be resource providers and trained them to be self-learners and self-trainers in an educational multimedia course. Class observations and students' feedback revealed that the teaching methods and new role of the instructor had positive impact on students' learning.*

What is a teacher? Who is the teacher? Answers to these questions have been changing in the past few years due to technology advancement. Years ago, teacher was the main information giver and center of a classroom. Lately modern technology has been shifting the education paradigm and providing students with information from a variety of resources via various channels. Consequently the teacher is no longer the center of the classroom. According to the report released by the National Council of Accreditation of Teacher Education (NCATE) in September of 1997, teachers should develop a new understanding, new attitude, new approach, and new role (NCATE, 1997). Tom Carroll, director of Preparing Tomorrow's Teachers to Use Technology (PT3) grants of the US Department of Education, vividly described the changing role of teachers at the annual convention of Society for Information Technology and Teacher Education (SITE) 2000.

Carroll (2000) advocated that a teacher should take the role of a learner. A teacher is an expert learner while a student is a novice learner. Novice learners may become expert learners as time progresses. As an expert learner, the teacher should facilitate learning for novice learners and let them become instructional resource providers. Creating a learning community that consists of expert learners, novice learners, parents, and members who may foster the learning process, a teacher's responsibility is to facilitate interaction and learning within the learning community and to further expand the community by involving members of other communities. Hence learning no longer refers to learning from a teacher. A student may learn from other students or any member of the community. A student who does not know one area may be expert in another area. Thus a student may be a receiver at one time while he (she) may be a provider another time. A student may also self-learn from available resources, for example, the Internet. Learning becomes multifaceted and dynamic, and resources become essential in the learning process.

In addition to Carroll, Oliver (2000), an invited speaker at World Conference of Educational Multimedia, Hypermedia, and Telecommunications (EDMEDIA), also supported the idea of using students as instructional resource providers. In his speech, he further explained how he treated his students as resource providers and how his students contributed to the teaching materials. Similar ideas were echoed at two presentations at the convention, Leh (2000) and Santema & Genang (2000). The author of the paper was one of the presenters and was pleasantly surprised to see the idea simultaneously spring up on three different continents, North America (USA, Leh), Europe (Netherlands, Santema & Genang), and Australia (Oliver). This notion might be an indicator of a current global educational trend.

In this paper, the author will share her experience why the role of instructors in Instructional Technology has to change. She then will describe how she played the role of a facilitator and encouraged her students as educational resource providers in an Instructional Technology course. She will also report her students' opinions towards their learning in the course.

## The Need for the Changing Role

The author is a university professor who teaches technology credential and graduate courses in Instructional Technology at the College of Education of a public university in the USA. The students of the course were K12 schoolteachers working on their master's degree at the university. Due to state mandate, her students had to integrate technology into their classroom. In addition, because they were master's students in Instructional Technology, they were also expected to help their colleagues in their schools to employ technology. These two forces generated their need to study the use of technology, especially a variety of computer-based software applications and existing technology resources.

How could the author successfully and effectively help her students? She realized that technology advancement had changed how people learned and altered the role of the instructor. She could no longer be an information giver but had to become a learner learning with her students. For example, while the author was a student, she learned HyperCard, a commonly used multimedia authoring program during that time. When she became an instructor, HyperCard was considered to be an out-of-date program and most people no longer used the program. Similarly, while she was a student, only professionals developed webpages. Now webpage development has become common knowledge and a necessary skill for many people. She could not depend on what she learned in school but had to keep learning new technology by herself. Likewise, her students would face the same challenges. They had to become self-learners of technology.

Technology integration requires people's knowledge and expertise of subject areas. The author might be an expert of integrating technology into one subject area, like second language learning, but might not know how to effectively integrate technology into another subject area, for example, science. As a result, the author had to learn with her students who were experts of their subject areas.

Due to the two facts mentioned above, the author changed her role to be a facilitator and hoped to set a good teaching example for her students. She encouraged her students to be instructional resource providers and trained them to be self-learners. She prepared a learning environment in which students could learn by themselves and from each other. The computer applications they learned in her classes might be obsolete one day; however, the learning skills, she hoped, might be transferred and applied to new learning experiences. Illustrated below are her experiences with teaching one of the graduate courses, "Advanced Computer Applications in Education".

### **Students: Resource Providers and Self-Learners**

The goal of the course "Advanced Computer Applications in Education" was to familiarize students with a variety of authoring multimedia software programs. Since this was the only course directly dealing with such applications in the academic program, the author structured the course as a multimedia survey course in which students studied a variety of applications rather than focused on a specific computer program.

She assessed students' skills at the beginning of the course. On a survey, students identified their skills of using the following seven computer-based application software: Webpage development tool, HyperStudio, PowerPoint, PhotoShop, Premier, Authorware, and Director. The students circled one of the following—"don't know", "good", "very good", and "excellent"—which best described their skill level.

The author reported the survey results in class. She intended to help the students use the information to complete their course assignments: developing a HyperStudio project, creating a webpage, integrating PowerPoint in instruction, and offering a technology training session. Course assignments emphasized integrating technology into content areas, independent learning, and learning from each other. Described below is how the students learned from each other in the "Technology Training" assignment.

For the assignment, the students selected their team members (no more than three members in a team). Each team chose and learned one of the software applications mentioned above. Overview of software and step-by-step instruction of using some of the software were illustrated in a course textbook.

After selecting the software program, the students constructed a training plan for a 60 to 90 minute training session. In the training session, they were supposed to teach their classmates the use of the application software they selected. The training plan had to contain (1) assessment, (2) time length, (3) content outline, (4) evaluation, and (5) training materials like handouts or evaluation sheet if applicable. They met with the author to discuss their training. They had to be prepared to answer questions like what prerequisite skills their trainees had, what they would cover in the training, which criteria they used to decide on the content in the training, and how they would evaluate the success of their training session. The students were aware that they could ask for help from the instructor (the author) at any point of time.

Finally they delivered the training to the entire class. The author observed the class and recorded classroom interaction. She also took notes how the trainers could make the training better. After the training, the author first asked the trainers to self-evaluate their training. She then asked the trainees to critique the training session by providing good points and suggestions for improvement. She asked the trainees to provide oral input in class so that the trainers could receive instant feedback and response. She conducted the discussion and concluded with her own critiques. The trainers also received written feedback afterwards from the trainees and the instructor.

## Evaluation and Opinions of Students

During the quarter, the author observed the class and interviewed students about their learning experiences in the course. At the end of the quarter, the author interviewed the students and also had them fill in a survey expressing their opinions about the course. The responses were analyzed and categorized. The results revealed that the teaching methods used in the course were deemed to be successful.

The teaching methods highly motivated the students. The students were enthusiastic about choosing a training topic and being actively involved in the learning process. Some of them chose software they were familiar with but more than half of them selected software that they knew little about. When asked why they selected the software foreign to them, the students answered that this would be a good opportunity for them to learn new skills. One said, "I wanted to learn this software for a while. Selecting this topic may push me to learn it." They learned beyond the textbook. Two of them rented a videotape on Macromedia Director. Three of them bought a book and together studied Adobe PhotoShop. They mentioned that they enjoyed learning with their partners. They also expressed their frustration when they explored software, for example, the learning curve of studying a sophisticated software application. Despite the frustration, they cherished the learning experience and thought that they learned a lot from their peers and other resources, not only from the instructor.

The teaching methods generated students' meaningful, active, and constructive learning. For the training plan, the students constructed their own instrument to assess the trainee's skills, decided on training content, and determined how to evaluate their training. They mentioned that instructional design models, for example Dick and Carey's model, made much more sense when they went through the process. They expressed that they spent much time on the course, much more than what they spent on a regular course. However, they liked the experience. They felt that they were the masters of their learning and felt sense of ownership. They mentioned that this learning experience would influence how they learn and how they teach in the future. They would search for resources that could foster their learning, and the instructor would only be one of the resources. They would also try to play the role of a facilitator rather than an information giver in their classrooms when appropriate.

The author required the students to critique their classmates' training sessions. She noticed that the students could easily say, "You did a great job!" Nevertheless, they had difficulty in addressing points of improving a training session. By requiring the students to specify good points and provide recommendations for improvement, they practiced to think critically. At the end of the quarter, the author noticed the improvement that the students made on critique.

The teaching methods increased the students' self-confidence. Before taking the course, the students often complained that they did not know how to use certain software, for example, webpage development tool, because the instructors did not teach them. The students seemed to count on the instructors and did not feel comfortable of learning by themselves. At the end of the course, the students expressed that the course increased their confidence in learning technology on their own. They mentioned that, if they could learn software with their partners and successfully provide training to their classmates in this course, they should be able to do the same elsewhere. They became comfortable of being self-learners.

The students also benefited from one of the textbooks used in the multimedia course. Many instructors could not include advanced multimedia software in their courses because institutions could not afford the expensive software. The textbook offered a possible solution to the problem that educators and students often encountered. The book included a CD of recent multimedia software—MacroMedia Authorware, MacroMedia Director, MacroMedia SoundEdit 16, Adobe PhotoShop, and Adobe Premiere—and step-by-step instruction on the use of the software. The advantage of such a book was that users could explore and learn the software at low cost, approximately \$40 US dollars. They could also independently practice the software. The disadvantage was that saving of files was restricted. Several companies published books similar to the book mentioned above. Because of the opportunity of exploring a variety of advanced multimedia software at low cost, the author highly recommends using such a book to make students learning possible.

## Conclusion

Technology advancement is shifting our education paradigm. The role of the instructor is changing from an information-giver to a facilitator. Students no longer passively receive information but may be instructional resources in class. Given opportunities, they may be self-learners and self-trainers.

In a multimedia course, the instructor employed teaching methods allowing her to be a facilitator and her students to be self-learners. It was found that the course motivated students, fostered students' active, meaningful, and constructive learning, encouraged students' critical thinking skills, and increased students' confidence. Class



observations and students' feedback revealed that the new teaching methods and role of an instructor had positive impact on students' learning.

As a university professor in Instructional Technology, the author might have experienced the education paradigm shift and its impact on the role of an instructor earlier or faster than instructors of other subject areas might. However, the changing role is a strong, perhaps inevitable, trend. Every instructor should be open to the idea and explore the possibility and experiment with the opportunity.

As NCATE stated in 1997, teachers need to develop a new understanding, new attitude, new approach, and new role. Every instructor should be open to the changes and further create a learning community in which instructors, students, and community members may contribute, benefit, and generate meaningful learning experiences. One can only look forward to participating in the dynamic learning and expect its positive impact on our society.

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# Gender Differences in Learning Strategies within Asynchronous, Open, Text-based and Learning Task-Oriented Cyberspace

In-Sook Lee  
Sejong University

## Abstract

*It is a very recent phenomenon for gender differences to receive attention, even though research on CMC goes back to the 1970s, to an earlier stage in computer technology. The current research reports survey results on gender differences in cyber learning strategies with respect to expression, information processing, self-control, and use of human resources; and suggests instructional interventions to guarantee a gender-free cyber learning environment.*

## Introduction

Distance education is moving toward a new generation, which is the Internet-based cyber education. Today, functions and advantages of the Internet will be further capitalized for education, especially learner-centered learning. The Gartner Group (1998) estimates that 60% of higher education students will access content electronically by 2003.

Computer mediated communication in which historically males continued to dominate (Herring, 1994) but increasing numbers of female populations are getting benefits from this new technology. Recent reports and studies indicate that females' access to the Internet is substantially improving (Refer to ALMANAC, 1990; Media Metrix, 1999). However, it is still difficult to conclude that females are participating equally with males in the cyberspace. Although especially the Internet among various technologies has been expanding in the educational community worldwide, it is not clear whether all and every learner will benefit equivalently from this new learning technology. It is a very recent phenomenon for gender differences to receive attention, even though research on CMC has been back to the 1970s, to an earlier stage in computer technology (Herring, 1994).

Learner issues are the core elements for success in cyber education (Bonk & Dennen, 1999) and learning strategies among those issues are especially significant factors. Cyberspace is a highly learner-centered place, where learners should take more responsibility for their own learning. This is primarily due to the nature of cyberspace, which is represented by time and space independence, openness, constructiveness, and webbness. Therefore, learner issues are the core element for success in cyber education; and learning strategies, through which learners themselves regulate their own learning process, are taking a more critical part than instructional strategies. Nonetheless, the existing literature on learning strategies in cyber space is limited and none of it focuses on gender differences. The current research reports survey results on gender differences in cyber learning strategies as follows:

- (1) How do genders differ in 'expression' in cyberspace?
- (2) How do genders differ in 'information processing' in cyberspace?
- (3) How do genders differ in 'self-control' in cyberspace?
- (4) How do genders differ in 'the use of human resources' in cyberspace?

## Literature review

### Learner characteristics

A great deal of distance education literature supports the claim that learner characteristics are very critical factors for achievement and satisfaction levels in distance education (e.g. Willis, 1994; Smaldino, 1999; Simonson, 1999). Willis (1994) suggests adult distance learners' success factors including tolerance for ambiguity, a need for autonomy, and an ability to be flexible; and failure factors including preference of a great deal of structure, face-to-face lectures and the opportunity to interact with instructors.

The goal of planning cyber education programs is to provide learning experiences and environments based on the each learner's needs so to 'makes the sum of each learner equivalent' (Simonson, 1999) by incorporating the proper design elements and instructional strategies.

### Cyberspace and learning strategies

Substantial numbers of literature lead us to the conclusion that learning strategies take the important roles for learning performance (Dansereau, 1978; Weinstein, 1978). Ignoring learning strategies is basically discouraging

learners from developing and exploring their own new learning strategies. Nonetheless, relatively insufficient attention to learning strategies is found in the current cyber education literature. Burge and Eastmond found that learners in online context transfer many of learning-to-learn approaches from traditional learning contexts to online setting. At the same time, however, they identified that online environment requests learners idiosyncratic learning strategies. Burge (1993) found learners using learning strategies with respect to making choices, expression, group interaction, and the organization of information.

Eastmond (1993) found that learners in computer conferencing based online courses employ strategies to deal with multiple discussions, information overload, synchronicity, textual ambiguity, and processing online information and determining what contributions to make. Conferencing systems, basically with a hypertext structure and led by learner participation, demand of learners a high level of self-regulation and meta-cognitive abilities in the learning process.

Lyman (1998) suggests that cyber learners need to develop learning strategies called 'information literacy' in order to take benefits from the Internet. The abilities especially required in a resource-based learning environment through the Internet include the followings:

1. know when there is a need for information
2. identify information needed to address a given problem or issue
3. locate the needed information
4. evaluate the information
5. organize the information
6. use the information effectively to address the problem or issue

Cyber learning space is typically structured with hypertext and is heavily expected to be the one that is strongly learner control oriented. Learner-oriented environment demands learners to make decisions by themselves throughout the learning process and, therefore, requires a high level of self-regulation and metacognitive abilities. It is important for learners and in particular for novices in a cyber-hypertext environment to acquire learning strategies. Learners who cannot use effectively the complexity of cyber communication environment, therefore, need explicit modeling and scaffolding support as well as more experiences in hypertext-based, open, flexible technologies for constructive learning.

### **Gender issues in cyberspace**

Issues of relationship between technology and gender in education have been increasingly explored in recent years (Kerr, 1996). Probably due to the short history of cyberspace within educational sectors, however, little attention has been paid to the issues of gender difference in and even less regarding the issues of learning strategies. Most frequently appearing research issues are the ones regarding styles or purposes of social interactions and dynamics, attitudes; and styles and frequencies of expression, discussion, and feedback.

## **Methods**

The subjects were 156 undergraduate students, 35 males and 121 females, from a medium size university in Seoul, Korea. As a reference, Korea is one of the countries most aggressively experimenting to maximize educational benefits of the Internet. Recent statistics indicated that Korea was the 10<sup>th</sup> in the Internet users as of the end of 1999.

These students were varied in terms of their academic backgrounds and years in their programs. All of the courses were integrated with a web-based instruction tool, UniverCampus. Cyber learning and instruction in this research is basically asynchronous, text-based, open, and learning task oriented features; and was operated with combined with face-to-face class. Instruction/learning room (figure 1) and discussion room (figure 2) were used as two main learning spaces. Instruction and learning room provided learning materials, simple discussion issues, and quiz activities. In the discussion room, typically the professor posted discussion topics and specified the timeline; and learners were expected to discuss about it within the timeline.



Figure 1. Instruction/Learning Room Sample Screen



Figure 2. Discussion Room Sample Screen

Cyberspace in this research was typically used to facilitate learner-learner interaction, more specifically peer discussion, idea-sharing, critique, feedback, and review. Further, it intended to facilitate learner-instructor interaction, including assignment posting and submission, and question-and-answer session. In addition, it supported to provide additional learning materials, as learner-material interaction. Throughout the semester, learners were encouraged to contact assistants and the professor as they need help. At the outset of the semester, one-hour orientation covering how to use the online tool was offered.

A 28-item questionnaire survey was conducted during the final week of the semester. The questionnaires were organized into four categories: expression, information processing, self-control, and the use of human resources. Each item was designed with 7-point Likert type scales, using values of 1 for “strongly agree” and 7 for “strongly disagree”. Post-hoc, internal consistency reliability of the survey was measured to be Cronbach  $\alpha = .86$ . T test was computed for the questionnaires and 7-point Likert like items with negative descriptions were reversed for convenient interpretation.

## Results and discussion

### Expression

Responses, in general, indicate that males appear to use more proactive and aggressive expressions than females and feel less mental pressure. More males perceived themselves actively presenting opinions ( $p < 0.05$ ) and felt fewer difficulties in expressing ideas in a written form within the cyberspace ( $p < 0.05$ ). Moreover, more males are positive toward cyber discussion (means = 3.86); on the contrary, females are more likely to be negative toward it (means=4.35) ( $p < 0.05$ ). Those results can be discussed in terms of core nature in this research cyberspace of text-based, open, formal, and task-oriented. The cyberspace of the present study is text-based and open space, where participants were expected to conduct open discussion within specific learning purposes, not for personal and social and information dialogues: Therefore this implies very much male superior and male dominating features (Ebben, 1994; Fishman, 1997; Hatton, 1995; Herring, 1993; Herring, 1994; Herring, Johnson, & Dibenedetto, 1992; Kramarae & Taylor, 1991; McDowell & Schuelke, 1998; Selfe & Meyer, 1991; Spender, 1995; Tannen, 1991). In this context, female students tend to have relatively higher appreciation to communication than males; motivationally or behaviorally discouraged eventually in posting own opinions or providing feedback to others. These apprehension and dispirit can function against full or appropriate use of learning strategies required to be successful in the cyber communication system.

In addition, females showed stronger appreciation about expressing ideas in a written form in the “real” space ( $p < 0.05$ ). Those findings, as a whole, confirm various existing research that learner characteristics in real space are highly transferred into cyberspace (McDowell, E. E. & Schuelke, L. D., 1998; Fishman, 1997).

### Processing of information

12 questionnaires were asked with respect to information overload, information decoding, and mental pressure of asynchronous interaction. Males appear to outperform females in perceptual and behavioral strategies as well. If overloaded, more females tended to skip reading others’ postings than males ( $p < 0.05$ ). In addition, when messages were overloaded, females (mean score = 4.33) tended to feel more difficulties in selecting and appreciating them than males (mean score=3.8) ( $t = -1.917$ ,  $p = .057$ ). ). These results imply that more females may lack skills and strategies for managing information overload in cyber space and, as a result, experience more obstacles in cyber learning process than males.

In spite of no significant differences in the degree of “reading” messages posted by other learners, the degree of “dislike” of reading them was significantly different between genders ( $p < 0.05$ ). This result may indicate that cyberspace which is time consuming due to its text ambiguity (Mason, 1994) still put more mental stress on males, comparing to males.

On the contrary and interestingly, females outperformed males in submitting assignments or learning activities corresponding to instructors’ statement ( $p < 0.01$ ). There was no statistical difference with respect to motivational strategy needed for asynchronous communication ( $p = .066$ ). Considering mean scores, however, males tended to be more positive (means=3.83) toward asynchronous communication; on the contrary, females were more likely negative (means=4.27).

### Self-control

Since cyber learning environment strongly requires learner control (I-S Lee, 1999b; J-K, Lee, 1999; J-H, Lim, 1999; M-H, Jo, 1999; I-S, Jung, 1999; O, Cho, 1999; Keegan, 1990; Mason, 1994; Bonk & Dennen, 1999), learners need self-control strategies for a successful cyber learning. Therefore, this research tried to determine gender differences in self-control through the questionnaires employing the items of time management, diligence, and persistence. The analysis, in general, revealed no statistically significant differences between genders except the following. Females are more likely to outperform males in submitting assignments or participating in activities within due date ( $p < 0.05$ ).

### Use of human resources

Two items were employed to determine whether any differences existed between gender with respect to use of instructors, assistants, or colleagues in order to solve any instruction or supportive problems during the cyber learning process. The analysis revealed no statistically significant differences.

## Conclusions

This research reveals significant gender differences in the categories of expression strategy and information processing strategy, in which males showed stronger abilities and positive attitudes without exception. The findings are not entirely surprising, since they replicate many of the existing findings from the areas of communication, linguistics, and sociology and more.

Currently dominant modes of cyber courses demonstrate structures and functions in favor of males. However, it should not be taken for granted; we have to move toward a gender-equal cyber learning environment. This can be achieved by including instructional design and implementation, which might more likely respond to learning strategies in favor of females. Of greatest potential leading to gender inequality in a cyber learning environment is its text-based, public, and information overload natures. I suggest the following instructional interventions to overcome potential negative impacts of those natures on female learners.

First, considering that females tend to experience difficulties in thinking and expressing in a written form, there is a need for providing additional interaction modes, which might support rather a dialogue-like interaction. Real time chatting is one of the exemplars of instructional intervention. In addition, sound materials and interaction through voice messages should be used more substantially.

Second, considering that females tend to experience difficulties in public postings and arguments, there is a need for learning opportunities through rather informal and social interactions. Among others, I suggest designing learning spaces for small group discussion and reading materials for individualized learning. Individual learning activities, rather than too much focusing on learner-learner interactions, might be instructional interventions useful for females who demonstrate rather high apprehension in public interaction.

Third, considering that females rather tend to experience difficulties in reading others' messages, when especially overloaded, there is a need for interface design which might help individual learners to search, organize and present information in their own convenient way. Concurrently, it is equally useful for mediators to regularly provide summary notes of shared information and ideas among learners.

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# **Fostering Design Culture Through Cultivating the User-Designers' Design Thinking and Systems Thinking**

Li, Ming-fen  
National Taiwan Normal University

## **Cultivating design thinking and systems thinking for building a design culture**

Since Cross (1990) claimed that design is a unique mode of culture, like science culture and humanities culture, the cultural aspect of design has received more and more attention in the design community. Banathy (1996) is probably the most well-known scholar who profoundly interprets Cross' thinking about design culture. He states that it is important to build a design culture through cultivating the general public's design competence and design literacy. However, I contend that we need to focus on ways of cultivating design thinking and systems thinking if we want to foster a design culture in the learning society. Because our thinking is constantly interacting with our action, which becomes the essence of our daily experience, and gradually shapes the forms and content of our culture.

Indeed, the significance of design thinking and systems thinking to design has gained much recognition in recent years. Tripp (1991), Rowland (1994), Akin (1994), Nelson (1994), Banathy (1996) have expended much efforts in analyzing and synthesizing design thinking and systems thinking since 1990. Compared to design thinking, scholarly discussion about systems thinking has a much longer history and includes more multiple and divergent perspectives. Some major systems theories have been successfully applied in organizational change, such as Senge's systems thinking, Checkland's soft systems methodology, Ackoff's design of idealized systems, and Nadler's planning and design approach. However, in this paper, I would focus on Banathy's and Senge's systems thinking. Meanwhile, I would propose an enlightening design approach, the DESIGN-WITHIN approach. This approach aims at enhancing both learners' inner revolution and societal learning revolution. Through design-within, we could engage learners and the learning community in envisioning their learning, and in systemically designing their own learning. Indeed, design thinking, as well as contemporary systems thinking are two wings to make us fly in the spacious learning world. The design-within approach is an alternative approach which synthesizes the truly systemic spirit of systems thinking and the enlightening spirit of transformative design.

## **The emergence of design thinking and its multiple perspectives**

Design thinking is a historically well-developed discipline across many fields. However, in the field of instructional design, it has long been confined within strategic or systematic mode of thinking. Its rich essence is yet to be discovered. However, the following contemporary perspectives on design thinking have pointed out a much spacious world for instructional designers to explore.

### **Creativity and design**

While clarifying the essence of instructional design and development, Davies (1981, 1994) attempts to uncover the multiple facets of it. The way he frames design in the craft, science, and art facets is very illuminating. He pinpoints the kinds of design and development possibilities from the "process" perspectives, and proposes a "process design" approach for corporate training. Rowland and Wilson (1994) look into the creative processes of design by exploring the essence of Csikszentmihalyi's flow psychology. They contend that to situate the designers in liminal states is critical to nurture their creative thinking. They enumerate several contexts that could trigger the designers' mental occurrence of liminal states. Most important, they depict design as the designerly ways of knowing, which is resonant with Banathy's interpreting design as a mode of inquiry. Meanwhile, Rowland (1993) investigates the design process of expert designers across many different design disciplines. By synthesizing the commonalities underpinning many design-related fields, he enriches our thinking about and understanding of the "design process".

Comparatively speaking, the way Nelson (1994) approaches design is quite unique. He contends that design as learning is quite different from the traditional understanding of learning. He uses the concept of feedback for further explanation. He argues that "feedback in learning process is typically presented as positive or negative. Design learning involves another less known system's process that can best be characterized as feedforward; inquiry pulled by volition and purpose. It is not about discovering correct or incorrect predictions neither about describing reality in terms of truth. It is discovering knowledge at the edge between chaos and order; between the unknown and the known. Design learning is also pragmatic in the discovery and mastery of skills needed to bring about



abstract concepts into lived reality (p.52).” Nelson (1994) advocates that we should have more patience to live with fuzziness of design and to undisciplined design. He also claims that design includes, but goes beyond, the theory of a science of the artificial in that it deals with the social organizations, patterns of human interactions, and functional social-technical structures that serve human purposes. Design is a synthesis of creativity (imagining new things) and innovation (bringing those new things into existence) within this multi-dimensional domain. It is both process and artifact. Compared to Davies and Rowland, Nelson seems to hold a more moderate stance.

### **Design as problem-solving vs problem-restructuring vs dialogical process**

As an architecture design researcher, Akin has very different perspectives on problem solving and problem restructuring from many other researchers. He affirms that problem-restructuring is by no means a newly discovered phenomenon, but has a rather long history in design research and even historical discover on reasoning. We need to be aware that here Akin focuses much on “problem restructuring”, rather than on problem-solving or problem framing. It is such problem-restructuring process that underlies design, and represents design as a unique profound discipline. We can say that the way Rowland situates designers in the liminal states for generating creative design is very similar to the way Akin emphasizes on engaging designers in the problem- restructuring process. Beyond our common-sense knowledge of problem-solving, Akin holds the views that the less understood a problem domain, the more the degrees of freedom the designer has and less reliance on standard solutions can be expected. Like Rowland (1994) and Banathy (1994) who believe that to design is to leap out from the present to the possible future, Akin thinks the process of creative design is to leap out of the framework to explore other possibilities or expand the boundary of the problem domain. Although Schon’s research on professional practice is not limited to design-related fields, his thinking about problem solving has great implication on design. In fact, Schon (1985) is more pragmatic in terms that he values both problem-solving and problem-restructuring process. He regards problem solving and problem restructuring as the indispensable dual process, which provide us with the moderate way of knowing and action about design.

From these discussions, we could find that design thinking encompasses multiple perspectives. Instead of listing the various definitions of design, I would first synthesize Tripp’s (1991) and Rowland’s (1993) discussions about the design process and design nature, and then summarize Banathy’s discussion about design nature and design culture in the following section. Tripp (1991) reviews numerous empirical studies of design across the general design field, such as engineering, architecture, software design. In probing the nature of design, Tripp tries to clarify if a theory of design can be constructed. Thus, he synthesized many divergent views of design into two general theories of design. According to Tripp, there are two different theories of design, namely design as optimization and design as dialogue. The former is in the same vein of Simon’s perspectives (1981) whereas the latter is in aligning with Schon’s (1987) reflection-in-action. They have various focuses. Design as optimization usually takes logical, rational, systematic processes. Yet, design as dialogue takes intuitive, creative, artistic processes. In terms of problem-solving in the design process, optimized design places emphasis on complete understanding prior to solution attempts in order to finding the best description of the problem. However, dialogical design takes early attempts at solution. Therefore, it is not like optimization design that treats design as an instance of problem solving. Instead, design is treated as a reflection-in- action process, and a social process of negotiation, hermeneutic in nature. In contrasting to optimization design’s focus on formal representation of problem-heuristics activities, dialogical design usually embeds uncertainty, uniqueness and conflict.

From the above discussion, we could find that design has been inquired from various perspectives, which indeed range from design product (artifact), to design skills and strategies, to design process, and to design thinking. Rowland traces the process of design by finding out the converging arena of instructional design with design. He studies the relationships between design and instructional design from the 4 facets: the purposes or goal of design, relationships to other processes, factors that influence the design process, and the nature of design process. In addition to exploring the designers’ creativity, and the design expertise, Rowland extends much of his scholarly discussion to the issue of nurturing the dialogical culture within the design community. This is very different from simply embedding the dialogical strategy to the design process. Indeed, Rowland and Wilson’s conceptions of designerly ways of knowing and Rowland’s discussions about design “culture” make design thinking the indispensable knowledge base of instructional design.

### **Design culture**

While clarifying the nature of design, Banathy (1996) enumerates the various definitions of design from various design-related disciplines. He found that the various definitions of design convey the notion that design is practiced by many professions, in many different ways, and is applied in various contexts. When extending Cross’ design as a mode of culture, he advocates that we should not leave design decisions affecting our society to the so-

called design experts. Instead, we should include a broad-based participation of the users in the design of their systems. We should build design cultures that include the general public in order to complement the expert culture of professional designers. However, if we want to include the general public in the design process, we need to cultivate the public's literacy in design. He affirmatively states that our era can surely be called the age of design. He suggests that in the age of design, the building of a design culture is an inescapable necessity. Because, if we take away design, we strip the world of most of its enabling mechanism. He urges the public to make choice for themselves, not simply relying on the experts' design thinking and decisions. Because we can either live with the poor design by the so-called experts, or we can empower ourselves by acquiring design literacy and design competence so that we can assume responsibility for the design of systems in which we live and to which we are connected.

Indeed, we should not be engaged in design simply to fix or complement certain aspects of the whole learning environment. What we need is to create a new image which is more encompassing than the original one through reflective, critical and enlightened thinking. We also need to cultivate the designers', user-designers' or the design community's critical awareness of their beliefs and values that underlying their design thinking and action. Like the way Senge clarifies unwhished vision and wanted vision, Banathy makes clear difference between improvement and restructuring. Through such clarification and distinguishment, we could better understand that design is a unique mode of thinking, not an add-on to any other disciplines. In particular, Page's (1966) "design as an imaginative jump from present facts to future possibilities" seems to provide a clear direction for designers to strive for. But, here emerge some fundamental questions:

- How could we transform the current reality by design?
- Do we need any other disciplines than design to attain such transformation?
- While trying to generate the design image of the new reality, how should we cope with our own habitual design thinking and action, which is so deeply ingrained in our mental models?
- How would users and designers interact in the design culture?

### **Link between design thinking and systems thinking**

Although design thinking and systems thinking seem to be literally different, they are two interrelated concepts when applied in learning or instructional design. When dealing with design issues, instructional designers inevitably face the complicated learning or educational systems. Indeed, design is a powerful bridge to integrate systems thinking into learning or instructional practice. This is why Banathy (1996) highlights systems thinking as the conceptual environment or parent of design thinking. He regards that design is one of several disciplined inquiry domains of social systems in which systems thinking is manifested.

#### **Banathy's intellectual technology—"designing" social "systems"**

Indeed, Banathy has been engaging himself in the design inquiry since the 1960s. While he is well known as an enthusiast for systemic design of educational systems, his efforts in advocating design literacy and culture is less well known. Part of the reason may be because of the complexity and profundity of his design thinking. In "Designing social systems in a changing world", Banathy (1996) endeavors in historical and extensive scholarly discussion on design. He compares design and other modes of inquiry, and treats design as one of the three cultures, science, humanities and design. Furthermore, he tries to envision the new social systems by regenerating design, trying to bring design to the social system, the educational contexts, and everyone's life. His design thinking is closely linked to his systems thinking. In another words, his design thinking is to be realized and carried out in the open social systems. We can say that he has depicted a spacious and magnificent landscape for the designers to travel.

Banathy advocates that we need creative and proactive design visions to transform the social, educational reality. He not only defines design and social systems, but also comprehensively compares design and other modes of inquiry, and approaches design from the cultural visions. He defines design as a multidimensional inquiry by synthesizing systems thinking, design thinking and other multiple perspectives. He also tackles the ethics of social system design and the design of the ideal system. In essence, he integrates a wide range of knowledge in approaching his inquiry of design. His contribution to design inquiry is that he elegantly and profoundly synthesizes design thinking and systems thinking.

#### **Nelson's designers as symbolic synthesizers**

While Banathy conceptualizes social systems design as intellectual technology, and integrate systems thinking in his social systems design inquiry, Nelson cautiously probes the reasons for engaging in systems design. He claims that we need to know about why systems design is in need for the new age, and contemplates that system

designers as symbolic “synthesists”, whose role is inclusive of what a symbolic analyst does, is an emerging significant role for a complex world, working in environments of complexity.

He asserts that new times need new designs. Therefore, learning systems design should involve the synthesis of two very important intellectual traditions which are gaining prominence with the establishment of the information age: systems thinking and design action. He further explains that systems thinking provides a framework for describing or conceptualizing the complexity, interconnectedness, and nonlinear dynamics of institutional and organizational systems, while design provides the action framework for how to visualize and bring into existence, in functional form, telelogic systems (i.e., serving human purpose). Of the two, systems thinking is the most developed theoretically. Design is the most developed pragmatically but is in need of the most development conceptually in order to more fully enhance the synergistic potential in combination with existing systems thinking.

Nelson’s (1994) thinking about design is special in three aspects: First, he argues that problem solving and design are entirely two different phenomena. Design is a special way of thinking-different from scientific thinking-that is performed “out of control”, with a deliberate break from restrictions on imagination. Second, in defining design, he distinguishes between self-expression of the arts and other expression of design. He describes the relationship between designer (self) and the client (other) as synergistic, as becoming more capable of more than the client or designer separately. Third, like Banathy, he links systems thinking to design thinking, and argues that we need to move away from thinking in separate disciplines of expertise. He offers the integration of systems and design as a powerful perspective for meeting current organizational challenges.

### **Systems thinking as another wing to take us to the spacious learning world**

Systems thinking has played a critical role in the historical development of educational technology since 1970s. The instructional design models which adopt systems thinking were once widely recognized in many educational and training contexts. Despite the positive recognition of its value to education and training, the essence systems thinking is narrowed down to “systematic” view, distorted its true spirit greatly. While constructive learning and situated learning gain more and more attention in the area of instructional design, the way systems thinking has been interpreted and applied is also challenged. Although some scholars turn to systemic views to broaden their perspectives on systems thinking, its essence has yet been thoroughly studied. I believe that deeper understanding and discussion about various modes of systems thinking is essential for uncovering the potential significance of systems thinking in terms of fostering design culture. At the fundamental level, cultivating user-designers’ systems thinking for design is more important than developing more systematic or systemic models for them to use.

Therefore, in addition to reviewing, analyzing and comparing the design thinking mentioned above, I would focus on Banathy’s and Senge’s systems thinking. Because Banathy not only synthesizes and critically reviews many system philosophers’ systems thinking, but also integrates successfully systems thinking into his design inquiry. He integrates a wide range of knowledge of design thinking and systems thinking when undertaking his design inquiry to transform the social systems. His contribution to design inquiry is that he elegantly and profoundly synthesizes design thinking and systems thinking by pointing out the route to transforming the existing educational systems into the ideal creative system. Senge’s systems thinking, as he refers to as the fifth discipline, is embodied in and interacting with other disciplines (i.e. personal mastery, shared vision, team learning & mental model) to help a team or organization to cultivate their learning culture. His systems thinking and other disciplines to be practiced with systems thinking has been widely recognized in restructuring organizational learning culture. In the past two years, he and several other researchers and practitioners also develop organizational learning through the five disciplines in the educational contexts. Therefore, his systems thinking as well as other disciplines has great implications on fostering an organization’s learning culture.

### **Systems thinking and open educational systems design**

Banathy’s visions of systems thinking underwent great change in the 1970s. Earlier than that, he regarded instructional systems as close systems to be well thought and designed like many instructional technologists. In the book “Instructional Systems”, he was still confined within closed systems engineering type of thinking to construct the instructional systems. Even so, the instructional systems he proposed is much more systemic compared to many instructional design and development models in the 1970s and 1980s. Yet he believes that as long as the instructional systems are closed, they are useless in the domain of social systems, and even counter the spirit of learning and education. Therefore, he proposes an open-systems view to deal with the educational problems, and published “Developing a systems view of education: A systems models approach in 1973. In the past 2 decades, he has been advocating his design thinking and systems thinking to designing social systems. He attempts to diffuse systems thinking and the dynamism of it to the educational community. In 1996, he finished his system design

theory, which encompasses 3 models for redesign the educational system, i.e. a system-environment model, a functions/structure model and a process model. The three models are to be applied in two aspects: First, they are to depict the systems concepts and the systemic level of the way we understand the educational structure of the existing systems, and the way we evaluate the educational environment. Second, they are used to design the new educational systems by comparing the gap between the ideal conceptual systems and the existing systems. He not only designed the 3 models but also provide many activates to guide the users to apply his models, through which users might gradually cultivate their systems thinking and systems application capabilities. In terms of this, Banathy seems to be much closer to Senge, both of whom do not intend to merely invent models and theories for users and learners to apply, but engage them in the thinking process and problem-solving processes. Unlike many instructional technologist who make much efforts on constructing design models and theories, Banathy claims that more efforts should be expended to cultivate the instructional technologists systems thinking, and their literacy of systems theories and systems methodology, which he has been persistently working on.

In referring to Stafford Beer's vision that human beings are prisoned by their own thinking, Banathy tries to construct his systems models to expand our cognitive power, and enhance our capabilities to deal with complexity. He found that traditional science defines complexity by examining the multiple components within a system, whereas systems science defines complexity by the interaction between the system and its environment, and by the relationship among the components within the system. What makes a difference is that the former is a close, static system, but the latter is an open, dynamic system. It is essential to recognize that Banathy's systems thinking is to be applied in the open social systems, and closely linked to the concepts of synthesis and expansion, rather than analysis, which underlies most traditional instructional design and development models. He argues that through synthesis and expansion we can better understand the systems and its relationship with the larger systems or environments. Meanwhile, we should shift from anticipating, predicting and controlling the human world to understanding the uncertainty and complexity of the environment.

However, while applying Banathy's systems models to designing educational systems, we need to reflect upon how our habitual thinking, acting and problem-solving patterns might counter the new design thinking or systems thinking. Because no matter how sounding the systems methodology or models are, human thinking and acting tend to follow their habitual routes, rather than new, less traveled routes. Especially when the user-designers are engaged in team work, such reflection on the gap between their old and new thinking is even more important. Because everyone's understanding and acting upon the system methodology and models may diverge at different levels and dimensions. Therefore, how to cultivate all design participants to use design language or system language at a more communicable platform becomes a fundamental, significant issue. If users or learners do not have full understanding and communication of the visions of the ideal systems, or could not form a design team, they might add another dimension of complexity to the system itself. Indeed, the human factors which interfere with or even fail many restructuring tasks in education are not uncommon at all.

From Banathy's systems thinking, we have a much broader view of what systems are and how systems thinking might be applied to solve the existing problems or design new educational systems. Such systemic perspectives do help expand our cognitive power about systems and reconceptualize our rigid understanding of instructional or educational systems. However, as mentioned earlier, the user-designers or learners should be provided with ample opportunities to reflect upon their habitual thinking and acting which might have interfered with their engagement in systems thinking or even prevented them from understanding the new mode of thinking. Because transforming one's inner habitual thinking, acting and ways of design may be more difficult than redefining and clarifying the system problems, or generating strategies to create the ideal systems. To overcome this, we could gain much insights from Senge's systems thinking.

If we could undertake the task of design from alternative perspectives, we might be able to shift design focus from designing learning product and environments to cultivating their thinking and actions about design. Below, I will analyze and critique Senge's systems thinking, and its practice with other disciplines for regenerating a learning organization.

### **The essence of Senge's systems thinking: Philosophical roots in both western and eastern culture**

Senge's systems thinking has profound philosophical roots in both western and eastern cultural traditions. While developing his systems thinking, he converges much ancient Chinese wisdom with traditional western philosophies, and, furthermore, integrates them into the theory of systems dynamics. If we interpret Senge's systems thinking without recognizing its profound philosophical roots, we may not be able to capture the wholeness of his systems thinking. Through critically reviewing the essence of Senge's systems thinking, I found that his systems thinking is framed from views of learning, time and space, cause and effect, universe, structure, and working ethics. He argues that "learning" has lost its central meaning in contemporary usage, because learning has come to be synonymous with "taking in information." Yet, taking in information is only distantly related to real

learning. Learning should involve a fundamental shift or movement of mind. Real learning gets to the heart of what it means to be human. It is through such learning that we re-create ourselves. In other words, true learning should be transformation of spirit and mind, not merely accumulation of information or knowledge. Furthermore, he proposes that we need to transform the technical mode of working into the spiritual pursuit of working ethics.

Senge also thinks that our distorted views of time and space often destroy our patience because we can easily encounter a current problem, which is indeed resulted from yesterday's solution. The relationship between cause and effect is not closely related in time and space as we always imagine and expect. Very often our impatience and intolerance with the effect makes us rush into erroneous judgment or decision-making, which is even worse than no judgment or decision at all. His perspectives on universe distinguishes him from other systems thinkers greatly. He does not define the components of systems or categorize the types of systems, but emphasizes that the line between inside and outside, parts and wholes is indeed very arbitrary. Because we tend to treat problems as if we are outsiders, rather than treating the problems and ourselves as oneness, we often unconsciously complicate the nature of the problems. Based on these philosophical thinking and perspectives, he develops several laws of systems thinking, such as "Today's problems come from yesterday's solutions.", "The harder you push, the harder the system pushes back.", "The cure can be worse than the disease."

### **Systems thinking as a thinking language to be cultivated**

Like many other systems thinkers, such as Banathy and Checkland, Senge's systems thinking is also a discipline for seeing wholes, a framework for seeing interrelationships rather than things. But, his systems thinking is not only characterized by seeing wholeness and interrelatedness of systems, but also, by seeing patterns of change. He regards systems thinking as a discipline for seeing the "structure" that underlie complex situations, and for discerning high from low leverage change. Because he thinks structure influences behavior, and structure in human systems is subtle. The reason that structural explanations are so important is that only they address the underlying causes of behavior at a level that patterns of behavior can be changes. Therefore, he claims that we need to look into the underlying structure of many organizational behaviors, not being confined within the incidents or patterns of behaviors. It is only when we see the systemic structure could we be collectively engaged in generative organizational learning, not responsive or reactive learning.

Another unique aspect of Senge's systems thinking is that Senge constructs systems thinking as a thinking language to be learned, practiced and cultivated. It is used to capture the structures underlying the individuals' or organizations' behavior structure. He develops 3 primary thinking tools for cultivating systems thinking: (1) feedback loop 1--reinforcing loops: when small changes become big changes, (2) feedback loop 2--balancing loops: pushing stability, resistance, and limits, and (3) delays: when things happen....eventually. In order to guide us to learn these thinking tools, he develops four toolboxes. They are (1) learning how to draw systems maps, including the interaction between cause and effect, its dynamic loop, system feedback perspectives, anti-agnosticism, and sharing systems problems, (2) learning how to describe reinforcing loops, (3) learning how to describe balancing loops, and (4) learn how to describe delays. Senge identifies the limitation of our written and spoken language, and thus tries to demonstrate to us how systems thinking can be represented through drawing systems maps, systems loops, nodes and time delay. He translates his long-term observation of and experience with recurrent organizational learning development and problems into "systems archetypes." Such systems archetypes are used to frame structural, and rooted problems of certain organizational behaviors or phenomenon. They are found in many organizations, include limits to growth, shifting the burden, eroding goals, escalation, success to the successful, tragedy of the commons, fixes that fail, and growth and underinvestment. In addition, he regards systems thinking as the fifth discipline which is the conceptual cornerstone underlying all of the five learning disciplines, team learning, shared vision, mental model, personal mastery and systems thinking itself. According to Senge, all of the five disciplines "are concerned with a shift of mind from seeing parts to seeing wholes, from seeing people as helpless reactors to seeing them as active participants in shaping their reality, from reacting to the present to creating the future. (p.69)." We should identify the fact that systems thinking has been successfully integrated to the teaching of many school subjects and many organizational learning-training programs. Its potential and value to education really needs further exploration.

### **Comparison of Banathy's and Senge's systems thinking**

Generally speaking, Senge's systems thinking not only has Banathy's systemic view, but also has its unique features. From his profound systemic views, self and others are inseparable oneness. Therefore, the purpose of applying systems thinking is not to depict the details of the component systems, and the relationships among the major and minor systems. It is to frame and reframe our own problems by situating ourselves within the systems which we intend to understand and interpret. Meanwhile, his systems language translates complexity of reality into simplicity of wisdom, with which we could better identify the structural and rooted problems embedded in our own thinking and action. Systems archetypes become powerful tools for converting complicated problems or systems

into simple communicable language. In addition, Senge's systems thinking is intended to be practiced with other disciplines, personal mastery, mental models, team learning, and shared visions. All of the five disciplines cannot be cultivated in isolation. Through the mutual cultivation of the five disciplines, each discipline can exert its greatest learning impact on the team or organization. The five disciplines have been widely recognized and successfully practiced in many organizations. It is time for us to think about its value to education.

In the past decades, educational technologists' visions of systems thinking have been narrowed down to systematic ways of design. We should expand our thinking and discussion about the true nature of systems thinking, and allow more multiple perspectives on systems thinking to enrich our visions. We have focused too much on defining the outer educational systems, ignoring the inner systems within which most of us are prisoned. We may need to start thinking about how to bridge our inner thinking systems with the outer systems through Senge's cultivation of shared visions, team learning and reconstruction of mental models. It is significant to situate all learners, teachers and designers in the boundless circle of the educational systems. We should also learn to live with the fuzziness of system boundaries, which might have seriously distorted our perspectives of systems. If more and more designers could integrate the systems thinking proposed by Banathy and Senge into their practice, design will no longer be treated as models or theories to be applied. When the design community becomes more concerned about ways of expanding design visions and cultivating design thinking, design culture could be possibly fostered. Below is the comparison and synthesis of Senge's and Banathy's systems thinking.

*Table 1: Comparison of Banathy's and Senge's systems thinking*

<b>The 1<sup>st</sup> generation Designer</b>	<ul style="list-style-type: none"> <li>* enters a system as an outside expert</li> <li>* creates an image of the future system</li> <li>* hands it over to the clients for implementation</li> </ul>
<b>The 2<sup>nd</sup> generation designer</b>	<ul style="list-style-type: none"> <li>* has slightly more interaction with clients</li> <li>* asks clients for feedback on the final draft before turning it over to them for implementation</li> </ul>
<b>The 3<sup>rd</sup> generation designer</b>	<ul style="list-style-type: none"> <li>* enters an organization as outside expert</li> <li>* draws up plans for the design or redesign of a system with even more interaction with clients.</li> <li>* invites input and feedback from the clients throughout the design process and may even assist them with the implementation.</li> </ul>
<b>The 4<sup>th</sup> generation designer</b>	<ul style="list-style-type: none"> <li>* takes a radically different role in the design process</li> <li>* functions primarily as a learning facilitator to help clients learn to design for themselves</li> <li>* shifts primary responsibility for learning and designing to the clients</li> <li>* shoulders responsibility for fostering participants' design competence</li> <li>* "does with" the clients, instead of "does to" or "does for" the clients</li> </ul>

## **Lookforward—the design-within approach**

Indeed, no matter whether design is a problem-solving, problem-reframing, or dialogical process, we need to be aware if we are doing design in the mode of “reflection in action” or in our original habitual thinking, acting and ways of design. We also need to cultivate our critical awareness and understanding of the essence of design thinking and systems thinking. Especially when design in a team or organization, we need more space to allow one another to navigate so that design visions can be shared, and one’s beliefs, values and mental models can be transformed through team learning. It is through the cultivation of design thinking and systems thinking in a learning team and organization that design culture could gradually be fostered. After reviewing and critiquing the essence of design thinking and systems thinking in the previous passages, I would like to propose a new approach of design—design WITHIN to elaborate on the possibilities of fostering a design culture. By taking the design-within approach, the user-designers could be engaged in the design process through which their thinking about design and systems are undergoing inner revolution. Such inner revolution will be dynamically interacting with the outer learning, instructional and educational transformation.

### **A design philosophy arises from inner revolution**

To cultivate our inner revolution, we should hold a truly holistic, systemic view of their inner system and relate our inner systems with outer systems, and furthermore, resolving the boundary existing in between. Such systems thinking aims not at depicting individuals’ and organizations’ recurrent behavioral structure, but at integrating one’s inner systems and outer learning and educational systems. Such systems thinking is to be cultivated through nurturing our inner systems which encompasses awareness, insights and visions. To nurture the growth of such inner system, we could take efforts through the following 3 tasks:

#### **1. Arousing our AWARENESS of**

- our design thinking & action patterns/structures
- personal and collective design thinking & action patterns/structures
- the embedded causal links in our design thinking & action,

#### **2. Deepening our INSIGHTS of**

- the multiple relationships of self, others, world and universe
- the multiple relationships of cause and effect
- complexity and uncertainties of human world

#### **3. Cultivating our VISIONS of**

- integrating self with others through mutual growth
- transcending personal limitation, & vicious causal links
- tracing the pattern and structure of problems

When engaged in building a design-within culture, the user-designers will not first define their design product or determine their design strategies. Instead, they will look inwardly through individual and collective reflection to nurture their systemic visions, insights, will and awareness of design. By doing so, uncovering one’s design belief, value and philosophy would become the priority of design action. The design goals will shift from enhancing effectiveness and efficient to deepening design participants’ visions, insights, will and awareness. In other words, the design-within approach identifies problems as those arising from one’s inner systems which are intertwined with and inseparable from the problems we point outwardly to. The design-within approach is concerned with how our design might be influenced by our inner systems, and how we might reconceptualize our views of self and others, designers and users. When we view self and others, designers and users as oneness, we could approach design-within from a truly systemic spirit. Such systemic spirit would better engage us in crystallizing our ingrained design beliefs, values and philosophies. Through such crystallization, we could leap out from our habitual design thinking and action patterns.

### **Interconnectedness of inner and outer systems dynamics**

Indeed, design-within is humanistic-based oriented toward one’s inner realization, rather than product-based or goal-based. Design-within is an approach which extends from inner systems to outer learning systems, and arrows from the outer learning systems back to our inner systems. It focuses on the ongoing system dynamics among our inner systems, outer systems and inter-systems. It is through such inner-outer-inter systems dynamics that users and designers, or the so-called user-designers, might cultivate truly systemic thinking, and integrate with one another as an interconnected design community. If designers and users could collaborate with one another beyond the level of information and knowledge sharing, and engage themselves in such inner revolution and systems dynamics, transforming our design mindsets and the reality might be possible. While engaged in the design-within

process, users and designers probe their philosophy and values of design in reflective dialogue, and gradually cultivate their design-within thinking. Through such thought engagement, an interactive process from outward to inward, from inward to outward will be integrated. This might foster our design thinking and action with truly systemic spirit so as to take the responsibility for caring the whole, rather than improving parts of the system.

It is very likely that user-designers could leap out from the existing systems if their inner growth is taken into serious consideration. Because the design-within approach aims at collective and dialogical engagement of all participant's inner revolution. It focuses not on methods, tools, or models to create products, but on methods, tools and models to engage all participants in the systemic thinking process and in the inner revolution process. Its ultimate goal is to transform the existing inner and outer systems. I contend that when our design thinking is no longer locked in product-oriented design, we might foresee the magnificence of design art. The design-within approach is to explore the alternative design possibilities for transforming both inner and outer world. It is feedward from and feedback to the inner systems which are integrated with any outer systems we attempt to design.

#### **The roles of designers in the design-within approach**

Before elaborating on what roles the designers in the "WITHIN" approach might play, it is helpful to understand how Banathy compare the roles designers might play in different modes of design. The following table is a brief summary of Banathy's comparison of the evolutionary roles of designers.

<b>The 1<sup>st</sup> generation Designer</b>	<ul style="list-style-type: none"> <li>* enters a system as an outside expert</li> <li>* creates an image of the future system</li> <li>* hands it over to the clients for implementation</li> </ul>
<b>The 2<sup>nd</sup> generation designer</b>	<ul style="list-style-type: none"> <li>* has slightly more interaction with clients</li> <li>* asks clients for feedback on the final draft before turning it over to them for implementation</li> </ul>
<b>The 3<sup>rd</sup> generation designer</b>	<ul style="list-style-type: none"> <li>* enters an organization as outside expert</li> <li>* draws up plans for the design or redesign of a system with even more interaction with clients.</li> <li>* invites input and feedback from the clients throughout the design process and may even assist them with the implementation.</li> </ul>
<b>The 4<sup>th</sup> generation designer</b>	<ul style="list-style-type: none"> <li>* takes a radically different role in the design process</li> <li>* functions primarily as a learning facilitator to help clients learn to design for themselves</li> <li>* shifts primary responsibility for learning and designing to the clients</li> <li>* shoulders responsibility for fostering participants' design competence</li> <li>* "does with" the clients, instead of "does to" or "does for" the clients</li> </ul>



## **New roles of designers--Visioning designers**

Compared to the four generations of design which focus on “design to”, “design by”, “design for”, and “design with” respectively, the design-within approach places emphasis on all design participants’ engagement in design “WITHIN”. It is a thought-engagement and action-engagement process undertaken either individually or collectively. Its systemic spirit builds on the integration of our inner systems into the outer systems, and the inter-systems. It is such holistic system dynamics that designers, users and all design participants are engaged in the design process as “visioning” teams or design communities, rather than “visible” teams or design communities. Through such visioning design teams or community, both inner revolution and societal revolution could be fostered. Designers of this approach share some similarities with the 4<sup>th</sup> generation designers. They also play as learning facilitators to help clients learn to design for themselves. While the responsibility they need to take is fostering participants’ design competence, the responsibility for learning and designing is shifted to the clients. Despite these similarities, they would play other significant roles which the 4<sup>th</sup> generation designers may even be unaware of. Below are the different roles they would play:

- enters the design systems by treating themselves, other design participants and the social systems as “systemic oneness”
- cultivates all design participants’ inner growth and mutual growth
- engages all design participants in reflective and critical thinking of their habitual thinking and action about design
- functions as learning enablers by transforming design into an inner and societal learning process
- shifts design focus from design product to design process to “design mind”, a truly humanistic-based design

In one word, the design-within approach focuses on cultivating one’s mind for design. It is truly systemic design in which learning and design comes to be oneness, everyone is working toward oneness of the whole system. Oneness becomes the philosophical foundation for constructing an integrated design team or community. Through such integration, design product and process can be greatly enriched and all participants’ awareness, vision, insights and will of transforming reality by design can be nurtured and cultivated.

## **Conclusion**

The knowledge base of instructional design models and theories encompasses behaviorism, neo-behaviorism, cognitivism, constructivism, situated theory, and even thinking from critical theory and postmodernism. It also integrates various views and concepts of learning, knowledge and systems thinking. Along with the evolution of design’s knowledge base, the roles instructional designers play also change. When instructional designers work as an outside consultant, their role is to design for the users, working at best as the partners of subject matter experts, or the design experts of instructional materials or activities. When constructivism and situated learning gain more attention, instructional designers are expected to design with more comprehensive and timely understanding of the users’ needs and feedback. They are also expected to create rich environments and situations for the users’ learning, reflection and action (Streible, 1991). When embracing the critical paradigm of thinking, instructional designers’ responsibility is to empower the learners’ critical awareness of their own thinking and action so that learners are enabled to design their own learning (Li, 1993). In reviewing the evolutionary trend of instructional design, I found that different orientations of instructional design imply different design philosophies of and approaches to design. Although the previous research efforts have consolidated the knowledge base of instructional design to a certain degree, the essence of instructional design is yet to be fully explored. It is not until the early 1990s that the nature of design thinking and systems thinking receives more attention in the field of instructional technology; and more scholars share with the vision of transforming reality by design. As instructional designers, we need to leap out from our technical mode of thinking and acting. We need systemic change in the way we think and act about learning so as to foster our inner and social revolution. Most important of all, we need to cultivate strong willingness to redefine our roles as teachers, learners or designers. We should learn to be more responsible for our own learning, and resume the responsibility to design our own learning in the forthcoming learning world.

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# **Rapid Application Development of a Self-Paced Pre-Service Teacher Technology Course**

Linda Lohr  
Manisha Javeri  
Chris Mahoney  
Dawn Strongin  
James Gall  
University of Northern Colorado

## **Abstract**

*This research examines the feasibility of rapid application development (RAD) in the design of two undergraduate pre-service teacher technology courses. The study was conducted over a three-semester period during which a needs assessment was conducted; eleven units of instruction were prototyped, tested, modified, retested; and the course was fully implemented. The total number of participants included 570 students, six instructional designers/teaching assistants, one lead designer, and four lab assistants. Results of the study showed significant differences in usability scores between the second and third semester. Both positive and negative experiences with RAD are discussed.*

## **Introduction**

With technology changing rapidly, instruction on its use must change rapidly as well. Instructional designers are thus increasingly dependent on the use of rapid application development (RAD) procedures for producing timely instruction related to technology use. In recent years, the use of self-paced instruction in the educational environment has been gaining popularity for teaching technology skills. A growing number of self-paced instructional formats are now readily available including books, tutorials, and video series, to name a few. The benefits of self-paced instruction reach an increasingly larger audience as more people take part in distance learning environments, which may in whole or in part employ self-paced features. Despite the benefits, research shows that there remains a stigma surrounding teaching a course via a 'distance' format (Betts, 1998). Further investigation shows that much of this reticence comes from the initial, up-front time investment and the work involved by the person(s) designing and teaching the course (Wollcott & Betts, 1999, p. 35-6).

In these diverse, fast-paced, and quickly changing educational settings, the use of RAD procedures in creating highly usable self-paced instruction is advantageous. How then do we implement RAD for self-paced instruction, and how do we make the self-paced instruction effective, efficient, and appealing, and how do we do that in short order? This study addresses these overarching questions.

## **Review of the Literature**

In the 1960s, the personalized system of instruction (PSI) method of self-paced instruction was developed by Fred Keller [Keller & Sherman, (1982)]. PSI was designed and tested to address researchers' concerns that teaching was primarily focused on the teachers both actively, and passively presenting information to a passive, and at times somnolent, student. According to Sherman (1992), this type of teaching tends to neglect what and how the student learns. It also assumes that the student, as a passive learner, will one way or another receive and understand the information simply because the information has been presented. Teaching styles during that time also encouraged negative reinforcement as behavior/learning modification. Sherman goes on to state that, "if a high frequency of behavior is to be encouraged so that progress can be selectively rewarded, punishing errors is the wrong way to go about it" (p.59). Both PSI and self-paced instruction address these concerns.

According to Kemp, Morrison, & Ross (1998), PSI is also often referred to as "the Keller Plan" and is often used when planning and implementing a whole course of instruction. At the time of its inception, this method was based on the use of a textbook, with assigned readings, followed by questions and problem solving. With the advent of microcomputers and especially when these are connected to the Internet, the Keller Plan can be more creatively applied—often with dramatically positive results.

Self-paced instruction has long been used to teach computer applications such as word processing, spreadsheets, MS Power Point, etc. Technology, however, is changing so rapidly that it often requires frequent

updates to training materials. Unfortunately, self-paced materials are time consuming to produce and thus present a developmental challenge in a dynamic technological world. Even though the designing of self-paced instruction brings with it several unique challenges, there are several advantages to self-paced instruction that make it worth of the time expended in development (Hannifin & Peck, 1987). Most importantly, self-paced formats allow individuals to progress through the material at their own rate. In the classroom environment frees the teacher to help those students who need augmented and/or more ancillary instruction. In both the classroom, and the distance-learning environments, self-paced instruction allows the learners to access the material at times that fit their individual schedules.

It is common practice for software development environments to follow RAD models in creating their software products (Galitz, 1997). Although research has been conducted on self-paced instruction, there is little specific research on the development of self-paced instruction using RAD procedures in academic environments.

Rapid application development is a term used to describe production of software and training products in a series of development cycles that move quickly from initial prototypes to a fully developed product. In these scenarios a prototype of the software is quickly created, tested for usability, and then revised. This cycle is repeated until the final product has been developed. Reigeluth & Nelson (1997) describe a RAD approach in an emerging paradigm of instructional systems design (ISD) they call ASEC (Analysis, Synthesis, Evaluation, and Change). Design and development phases move through an "iterative series of ASEC cycles for progressive sets of instructional decisions" (Reigeluth & Nelson, 1997, p. 31).

The ASEC process allows a designer/developer to focus on how a learner or user responds to instruction as it is being developed. The Evaluation Step in the ASEC process allows for this type of learner/user feedback, (important to learning more about the usability or learner-friendliness of the product). "User-friendly" is a term that describes how technically easy a product is. "Learner-friendly" describes how easy an instructional product is for a learner to use (Lohr, 2000). The International Standards Organization (ISO) defines usability with the descriptors effectiveness, efficiency, and satisfaction. Lohr (2000) defines usability and learner-friendliness with effectiveness, efficiency, and appeal, based on similar definitions by other design researchers (Flagg, 1990; Nielson, 1993; Shackel, 1991; Tessmer, 1993).

## **Research Questions**

This study focuses on the development of self-paced pre-service teacher technology training using a RAD approach. Research questions include:

1. How usable was the instruction from student, instructional designer/Teaching Assistant (ID/TA), lead designer, and lab assistant perspectives?
2. Did usability perceptions change during the RAD process?
3. What are the advantages and disadvantages of using a RAD process in an academic setting?

## **Methodology**

### **Participants**

This research was conducted at a medium-sized Western university and involved 570 pre-service teachers enrolled in two levels of technology-integration courses. Other participants in the study included six instructional designers/teaching assistants (IDs/TAs), a lead instructional designer, and four lab assistants. Out of 657 total students enrolled in both 200-level, and 300-level levels during the two semesters, a total of 570 students participated in the study. Of the 570 students who filled out the surveys, 316 students were from the 200-level classes and 254 students from 300-level classes (described later in this paper). At the end of each semester, four students from each class were randomly selected to be interviewed (a total of 118).

### **Course Description**

Two one-hour pre-service teacher technology courses were developed for this study, referred to as the 200-level and 300-level courses. The 200-level course was an introduction to technology for freshmen or sophomores. The 300-level course was a more advanced course for juniors and seniors. In both courses combined, there were a total of 11 units of instructions to be created. The topics included, email, uses of the World Wide Web (WWW), and word processing.

All sections were taught in three formats: workshops, open-labs, and via self-paced instruction. The three formats broke down as follows: The workshops consisted of instruction, both verbal and visual, where each project was completed in front of the students. In this format many of the students could follow along step by step. The open

labs were set up so that any student could get individual instruction. For the aspects of each project where a number of students were struggling over the same component, this was noted so that it could be addressed in a redesign between semesters. The lab assistants were also present during open labs to help students one-on-one with their individual difficulties. The self-paced instruction was taught via the web sites set up for each of the two courses. Every student was required to have an e-mail account and access to the Internet. The students could access the 200-level and 300-level web sites where all the 11 units of instruction were hosted. To view these units of instruction, visit these Web sites; [www.edtech.unco.edu/et34x/](http://www.edtech.unco.edu/et34x/) and [www.edtech.unco.edu/et24x/](http://www.edtech.unco.edu/et24x/).

## **Procedures**

The study was conducted over three semesters (Spring of 1999, Fall of 1999 and Spring of 2000). The topic covered as well as the formats of instruction were gleaned from a pre-service teacher needs assessment conducted in the spring semester of 1999. Three students (pre-service teachers), three graduate-level teaching assistants, and one faculty member were interviewed about the effectiveness, efficiency, and appeal of the undergraduate pre-service teacher technology courses at that time. These interviews revealed the following: a) there existed a lack of instructional consistency in courses (different instructors teaching different topic in different ways); b) the instructional materials were outdated; c) students came to the class with different proficiency levels ranging from computer illiterate to highly skilled computer users, but all students were expected to learn at the same pace; d) students were required to attend all classes even if they knew, and were proficient with, the software being taught; e) many students had scheduling conflicts that could have been prevented with the implementation of a self-paced format.

The needs assessment team identified self-paced instruction as a possible solution to these issues, since SPI not only allows for learners to progress at their own pace, but allows for greater standardization of the instructional content as well.

Beginning with the fall semester of 1999, a team of three teaching assistants (TA's) and a lead instructional designer (ID) planned the development and implementation of RAD to the instructional material needed for the courses. The team met weekly intervals to plan and review their work, discuss problems, concerns, and progress. The team also kept a record of their observations. The actual RAD course development was performed throughout the first semester, but a revising process (implementing feedback from the first semesters' participants) continued between the semesters as well. Each of the teaching assistants developed approximately one-third of the total units of instruction.

Every week each of the developed units of instruction would be presented to the team members who would collectively review what each TA had designed, test the instruction, and make suggestions. At this time the lead ID would also make suggestions. After this open-forum-type of critiquing was finished, the TA in charge of each unit of instruction would make the necessary revisions, test it, and then re-present it to the group the following week where the rest of the team members would again review the TA's work, usability test the unit of instruction, and give their final suggestions. The TA would then make any necessary final revisions, transfer the finalized unit of instruction to the course web site for those who were doing the course via self-paced instruction, and the instructor would also present it to the class as an in-class instruction module. This process of designing, developing, open-forum critiquing, revising, and usability testing was followed for each of the 11 units of instructions. Thus, every two weeks and within a two-week span, the RAD model was used with two individual units of instruction.

## **Instruments**

Quantitative and qualitative data were collected from the following sources: students participating in the course; teaching assistants, all of whom not only taught the course, but also monitored the lab sessions, and some of whom (instructional designers) also helped design the course; the lead instructional designer who managed the design and development process, and the lab assistants who interacted with the students while the students participated in the instruction. Both the lead instructional designer and the IDs/TAs kept journals for a 12-week period. Lab assistants were informally interviewed. Qualitative student data was obtained using 16 open-ended questions included in an end-of-the-semester questionnaire, from 120 student observations, and from 118 student interviews.

All qualitative data were transcribed, and thoroughly read and re-read. Different colored markers were used to highlight words and statements which fell into the three main research categories: effectiveness, efficiency, and appeal. An overall theme and sub- were then identified for each category.

Quantitative data were collected using 43 Likert-type items included in an end-of-the-semester questionnaire. The five-point Likert scale ranged from "strongly disagree" to "strongly agree." The items were created for each of the three main domain areas: effectiveness, efficiency, and appeal. Factor analysis was used to

verify the structure of the above mentioned survey questionnaire. A structure matrix of a three-factor oblique rotation ( $Kappa = 4$ ) of a principle-components solution was found. The factors were learning and educational value (effectiveness), resources (efficiency), and self-paced instruction (appeal). Problematic items i.e., loaded on two factors or demonstrated a factor loading under .30 on any factor, were not used as part of the composite scores. Item analysis within each factor demonstrated strong reliability, and hence stability of the survey as a whole. Reliability coefficients for the 200-level courses were found to be  $\alpha_{\text{effective}} = 0.9301$ ,  $\alpha_{\text{efficiency}} = 0.8071$  and  $\alpha_{\text{appeal}} = 0.8070$  respectively. Reliability coefficients for the 300-level courses were found to be  $\alpha_{\text{effective}} = 0.9121$ ,  $\alpha_{\text{efficiency}} = 0.7270$  and  $\alpha_{\text{appeal}} = 0.8775$  respectively. The final composition of the domains suggest a degree of validity.

## Results

### Students perceptions of usability

#### Effectiveness

Qualitative analysis of the randomly selected interviews and open-ended questions found a strong majority of positive responses from students related to the effectiveness of the course. Students mentioned liking the course for a variety of reasons that were categorized as educational and learning value. Data were coded into the following sub-themes: content learned was applicable to the classroom; knowledge was gained; portfolios were developed; topics could be freely chosen; projects were relevant; the overall format was convenient; the experience was isolating and often not challenging enough. Most of the positive comments from both levels were associated with how precise the instruction was and how useful it would be in a classroom. Most of the negative comments were associated with dislike for specific topics that were considered repetitive (ASSURE), too difficult (Photoshop), or too easy (email). The most common statements used by students were as follows: "I learned a lot in this class."; "I gained more knowledge, new ideas, and ways to use technology."; and, "I feel comfortable with technology." All of the students randomly selected to perform a task representing the semester's work performed satisfactorily. All of these same students felt the textbooks were a "waste of time".

Quantitative data for effectiveness was calculated by averaging the percentage of agree and strongly agree scores for fall and spring semester for each course level on specific questions. Quantitative results were similar to qualitative results with a strong majority of students (86% of fall and spring 200-level and 72% of the fall and spring 300-level) agreeing or strongly agreeing that the course was educationally valuable. Eighty nine percent of the 200-level and 72% of the 300-level agreed or strongly agreed that skills learned were important. Fewer students indicated they learned a lot (61% of the 200-level, 69% of the 300-level). As indicated by the qualitative data as well, both levels felt that the instruction, given both in-class and on-line, was precise and clear. These students indicated that they would use the technological skills learned during this course both in their future classrooms for instructional delivery, and for their own personal classroom management use and gains. They stated that this usage would include programs like PowerPoint (200-level) and Web design (300-level), also suggested as a way to gain employment) and incorporate the design and graphics knowledge they had learned. These students indicated that the course helped them not only learn skills with which they were previously unfamiliar, but also to learn how to integrate technology into their classrooms. At the end of the course, a majority of students felt very comfortable with technology

#### Efficiency

In the Qualitative analysis the *Value of resources in terms of access and ease of use* emerged as the key theme or descriptor for questions related to efficiency. Data were coded, then grouped into these sub-themes: online materials, open labs, workshops, instructors and lab-consultants. Two-hundred-level and 300-level students were most positive about having a choice of learning format (workshop, open-lab, or self-paced), and most negative about specific projects and isolation. The 300-level group felt strongly that they had too much work to do for a one-credit course. Of those who were interviewed that did not like the course, two main reasons were given. Some mentioned they did not like the self-paced format because of isolation and problems with self-discipline. Others mentioned they didn't believe the technology would be available to them in the classroom. All students felt the textbooks were not helpful. Half of the students in the first semester wanted more project examples when interviewed at the end of the fall semester. Surprisingly just a little under a half of the students interviewed in the spring still indicated the need for more examples (despite the development of examples and non-examples for each unit of instruction that took place during the spring semester).

Typical comments during student interviews included: “The on-line materials were precise and easy to understand because of the step by step instructions”; “The rubrics/or grading criteria were too easy”; “I would like to see more examples of finished projects” ;“PhotoShop was too confusing”; “In open-labs I could get personal attention and help to complete my projects”;“ Workshops were very helpful for difficult projects like PhotoShop, Web design and PowerPoint”; “The instructors were very approachable, accessible and always available to help me”; “The instructors were knowledgeable.”;“The lab consultants were there to help me when I got stuck.”

Quantitative data for efficiency was calculated by averaging the percentage of agree and strongly agree scores for fall and spring semester for each course level on specific questions. Quantitative data was similar to qualitative with a higher percentage of neutral responses and a lower percentage of responses in the agree and strongly agree categories. Approximately 60% of the 200-level responses were positive about both the instructors and the self-paced instruction. Approximately 75% of the 300-level responses were positive about the instructors and the self-paced instruction. Open labs and workshops received lower scores, with less than half of the 200-level students positive about either format. The data was similar for the 300-level who had a slightly higher percentage of agree or strongly agree responses (59% for workshops and 55% for open-labs.) Of particular interest is that only 58% of the 200-level and 59% of the 300-level felt they had enough self-discipline for the self-paced format.

### **Appeal**

Of the three usability variables, appeal had the most positive student responses. Quantitative data related to appeal was more positive than the qualitative data regarding overall course appeal. From the qualitative data, a strong majority of students interviewed mentioned liking the self-paced nature of the course. Not surprisingly, the key theme that emerged from the questions was a positive regard for the self-paced format. Self-paced thus emerged as a key descriptor for appeal based on data that was coded then grouped into following sub-themes: freedom, self-discipline, convenience, isolation, and not challenging. Both levels of students mentioned the self-paced format gave them the freedom and flexibility to go at their own rate and, hence, made them feel less pressured and felt they had a lower stress level than if they had taken the course via a traditional in-class format. The self-paced format was particularly helpful for the students who already knew most of the tools. The self-paced format also required students to apply better time-management skills. Again, some students did not like the self-paced because they felt the format lacked student/teacher interaction as well as class-related communication with fellow classmates. Typical comments included: “I liked the option to attend workshops open labs or follow self-paced for projects that I was comfortable with”; “It was nice to know that help was available whenever required”; “I learned to manage time effectively”; “I sometimes tended to procrastinate my work”; “I liked the convenience of working at my own time and pace”; “I liked the fact that I did not have to come to the class if I knew the project”; “The fact that I did not meet officially made me feel isolated”; “Projects like word, e-mail, WWW were too simple and basic”; “I knew most of the software and hence was hard to stay motivated.”

Quantitative data for appeal was calculated by averaging the percentage of agree and strongly agree scores for fall and spring semester for each course level for specific questions. Results related to appeal were quite high for both the 200 and 300 level students. Approximately 90 % of the students agreed or strongly agreed to statements regarding the overall usefulness of self-paced instruction. For example 97% of 200-level students and 89% of 300 level students indicated liking self-paced instruction. Ninety five percent of the 200-level students and 89% of the 300-level students indicated the self-paced instruction was helpful.

### **Teaching Assistants/Instructional Designers**

The instructional designer/teaching assistants were asked to keep a journal during the fall semester to record two types of information: 1) student behaviors and attitudes, and 2) issues relating to the format and accuracy of instruction. Perceived effectiveness, efficiency, and appeal data were categorized and grouped. Observations related to the effectiveness of the course included noticing that students were often copying the assignment example instead of generating their own solutions, and were not checking the Web site bulletin board. Observations related to the efficiency included the lack of student attendance at workshops. For example, students would elect the self-paced format, wait until the last minute, and then discover they could not do the assignment without help. Observations related to appeal included reports that many students were unhappy with scheduling issues. These students said the classes did not meet during convenient times.

Several actions were taken immediately prior to the next semester to address these issues: 1) the free-for-all schedule was eliminated requiring students to sign up for a class at a specified time; 2) students were required to attend workshops unless they had turned in the self-paced instruction; and 3) class listserves were used as a communication vehicle in addition to the message board. During the following semester these problems were not

mentioned by the students. One issue however that remained a problem was the need for the Web site to provide more and varied project examples since students continued to turn in assignments very similar to the examples used.

### **Lab Assistants**

The lab assistant interviews indicated mostly problems with efficiency and effectiveness. Lab assistants described themselves as being bombarded the day an assignment was due. These students felt that they had to teach students how to do their projects. The interviews revealed that over half of the lab assistants did not know about the self-paced materials or where they could be located. Those who did know indicated that most of the students did not have the web-site address easily accessible. Lab assistants addressed this problem by writing the class website on lab whiteboard. The one problem identified in the Spring semester interviews with lab assistants was the difficulty students were still experiencing with the Web site URL. Therefore in the third semester of the project, the web site was given a new and simpler URL, and desktop Web site icons were created to allow students to access the site by clicking the icon instead of typing in a lengthy url (<http://www.edtech.unco.edu/et34x/def34x.html>).

### **The Lead Instructional Designer**

The Analysis, Synthesis, Evaluation, and Change interpretation of RAD was documented and evaluated on a weekly basis by the lead designer to determine overall effectiveness of the RAD approach. Time spent, management issues, technical issues, and student behaviors were noted for all eleven cycles of development during the fall semester. Of each of the steps, the lead designer was most disappointed in the inability to implement learner testing in the Evaluation step. Lack of time prevented the IDs to involve students in the development of the instruction. Therefore the learner-testing phase was actually a design-team testing phase. The process however seemed adequately effective even without student involvement in the two-week testing phase. The units of instruction were delivered on time with few errors.

The efficiency of the RAD process was assessed in part by recording time-spent on specific activities. The lead designer was not prepared for the amount of time it took to set up the course templates and create master schedules for open labs and workshops to accommodate student schedules. Three full days were spent working on the schedule alone. These cycles included a brief analysis step (identification of a specific task and content needed), development of instruction (seven hours), testing by the team (1 - 2 hours), revision and Web posting by the designer (8 hours), team re-testing and revision, changes (3 hours), and implementation. The lead designer also regretted her decision to use Microsoft Word as the Web-site authoring tool because it was less stable on the server than were other Web authoring programs. Microsoft Word was chosen because most IDs/TAs were not proficient with Web authoring and needed a very simple tool. Unfortunately this backfired with numerous server problems that took up an additional four hours per week to address.

The more interesting aspect of the appeal data relate to the RAD process came from the lead designer's observations of ID's/TA's gradual acceptance of both the format of instruction and the RAD process. Early in the first semester students were highly frustrated with the process of rapid development. They were unfamiliar with the precision self-paced instruction required as well as the demand for user-friendly writing. Combined with low workshop and open lab attendance during the first few weeks of the semester, these TA/IDs were openly frustrated. By the middle of the semester they voiced extreme dissatisfaction with the process and structure. During the second half of the semester they gradually gained more acceptance of the format and showed interest in making improvements. Also noted was their improved ability to write learner-friendly instruction.

### **Change In Usability Between Semesters**

Lead designer, TAs/IDs, and lab assistants all noticed improvement in the course during the Spring semester. These observations are in part supported by multivariate analysis of variance (MANOVA) results. A MANOVA was used to investigate differences between the fall 1999 and spring 2000 semesters with respect to the factors: effectiveness, efficiency and appeal. Significant MANOVA results were followed by discriminate analysis. A significant difference was found in the ET 200-level data between the fall of 1999 and the spring of 2000 semesters ( $F(3,301) = 8.356, p < 0.00, \text{Wilks' } \lambda = 0.923$ ). A stepwise discriminate analysis was used to determine if there was a specific variable contributing the strongest influence to this difference. It was found that only the resources factor -- efficiency -- (e.g., workshops, open labs, and self-paced instruction) that contributed most to a change between semesters ( $F(1,303) = 22.11, p < 0.00$ ).

In comparing the fall and spring ET 300-level courses, significant differences in all three factors ( $F(3,240) = 19.702, p < 0.00, \text{Wilks' } \lambda = 0.802$ ) were found. A stepwise discriminate analysis was used to determine if there was a specific factor contributing the strongest influence to this difference. This analysis indicated that all the three dependent variables were equally responsible for the differences between fall of 1999 and the spring of 2000



semesters. The stepwise discriminate analysis showed that Appeal made the biggest difference among semesters ( $F=45.568$ , Wilks' Lambda=.955). Appeal was followed by Effectiveness ( $F=41.426$ , Wilks' Lambda = .941). Efficiency made the smallest difference among semesters ( $F = 8.18$ , Wilks' Lambda = .831).

## Discussion

That significant differences were found in usability perceptions between the second and third semesters might suggest that RAD played a role in improving instruction. Changes to instruction were made based on data gathered during the semester. For example clarifications in assignments, additional examples, the correction of errors, all improved the quality of the experience. Many of the concerns and complaints expressed by TAs and students alike during the first semester were not voiced during the second semester.

There are however, many possible reasons for the significant differences that took place between the second and third semester that may not be attributable to RAD. A more positive or motivated group of students may have been enrolled in the second semester. TAs may have conveyed more confidence, thereby influencing the attitudes of the students for a variety of reasons. Most obvious would be that the materials were already developed and error-free, therefore TAs had more time to devote to individual students, and were also more confident that fewer mistakes would cause student confusion. The simple change in required scheduling had perhaps the biggest impact as many students were dissatisfied with the open schedule format of the first semester. This schedule change was not a function of RAD.

The key benefits of RAD in this study appears to be improved instruction that lasts for a longer period of time. There has been much cited in the research about the low return on investment of self-paced instruction (Wolcott & Betts, 1999). Initially, in this study, that was the case as well; however, because the course content has remained fairly stable over the past year and a half, the time expenditure has been amortized very effectively. As this article is being written (halfway through the third semester after the RAD took place) the researchers have found that the time expended for evaluation and revision have been substantially less than if the courses were being taught via a more traditional format. For the spring 2000 semester, approximately a week was spent in completing a cursory analysis of the data from the previous semester's surveys; in reevaluating the course philosophies and content in light of the surveys; and in revising the Websites, syllabi, rubrics, and schedules. In the summer semester, there were no changes made other than changing the dates and times on both the syllabi and the course schedule, which took approximately two hours for both courses. In the fall 2000 semester, a total of approximately two days was spent in the review, analysis, and revision process. All told, for two different courses that serve so many students, this time expenditure is quite modest.

The key drawback of RAD in this study was the need to act quickly. In this study hasty decisions had long-lasting ramifications. When the study began, the lead ID drew up the original course outline and even created the initial Website shell for the courses using a very simple authoring tool, Microsoft Word. This was done because the TA/IDs had little experience with developing Web based instruction and would need a familiar and easy development tool. Because the Lead ID did not want application specific ramp-up time to impede the IDs progress, it was decided that templates could be created and used. Because Microsoft Word is a fairly basic web-authoring tool the software became a limiting factor once the demands of the site require more complexity. The team recommends beginning with a more robust web-authoring software capable of accommodating a broader range of Web site maintenance tasks, such as frequent revisions to instruction and use of different browsers and Web editors.

Also of interest to future RAD projects in academic environments is the effect the approach has on novice instructional designers. Because rapid application development is just that, rapid, it brings with it a set of dynamics with which most academic settings are not usually confronted. In this study, the lead ID had been through this type of development numerous times and, as a result, was mentally prepared for the frustration that is typically a part of the designing, developing, open-forum critiquing, revising, and usability testing process. Individual and team frustration is so inherent in the RAD model that it can almost be mapped out and defined as part of the cycle. In this study's cycle, the TA/IDs became quite frustrated with the intensity and seeming lack of progress early on. However, as the process continued and the fresh, never-tried-before units of instruction were introduced to the students they seamlessly learned the material and skills and produced the hoped-for and required results. The TA/IDs then began to more clearly understand how RAD works, and as a result, became much more enthusiastic about its application and results.

## Conclusion

Overall, quantitative and qualitative data collected from students, TAs/IDs, the lead ID, and lab assistants suggest that the course was learner-friendly. The data identified areas for improvement as well as areas where students were highly satisfied with the quality of instruction in both the 200-level and 300-level courses. The

importance of providing instruction that is neither too easy or too difficult was identified, as both were mentioned as negative aspects of the course. The need to help students think creatively and find ways to use the tool for their unique instructional purposes must be improved, perhaps through many and varied examples and non-examples. Scheduling problems and difficult Web site access negatively influenced student's perceptions of efficiency and appeal. The self-paced format, however, was considered highly appealing. Though many students considered themselves self-disciplined, the data suggested the need to implement a structure for students that imposed due dates, designated class times, and the requirement to have self-paced instruction completed prior to a workshop.

Although RAD has found an almost hallowed place in fast-paced corporate settings, we were reticent about its usefulness in an academic setting. The results of this study, however, have shown that RAD can be applied quite effectively. The results have shown that in the right application, time-dependant course material can be delivered efficiently, effectively, and in an appealing manner using RAD. The caveat is that all aspects of the process should be well thought out, critiqued, revised, and usability tested.

Several areas of future research related to this topic should be explored. For one, the importance of instructional graphics needs to be examined. Because instructional graphics are so time-consuming to develop, an important consideration is the optimal amount of graphics to include as well as the type of graphics for RAD of self-paced instruction. For example, should graphics show an entire computer screen, or should they display just a button or pull down menu? Additionally, what are the most learner-friendly writing conventions? Is "select Save As from the File pull down menu" as effective as File > Save As? Another more challenging question asks how pre-service teachers can be taught to think creatively when applying technology to their unique instructional management or development goals. The excuse of not needing to learn about technology because one already knows how to use a particular tool isn't valid when the focus is on learning to use the tool to enhance instruction. These questions and many more will provide more insight into learner-friendly development of pre-service teacher technology courses.

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# **In Support of Constructivism: Utilizing Rational, Moral and Communicative Frameworks to Address Frequently Posited Criticisms**

Rocci Luppicini  
Heidi Schnackenberg  
Concordia University

## **Abstract**

*The goal of this paper is to demonstrate how Constructivism in education has failed to address criticisms by re-directing or misdirecting the focus of the debate over whether or not Constructivism is able to give support to a viable theory of instruction. In response, support is given to Constructivism by drawing on rational, moral, and communicative frameworks to clarify the main Constructivist tenets and to address levied criticisms. From this, the recommendation is made that, depending on how they are used, objective standards of learning and evaluation are not problematic for Constructivist instruction.*

## **Constructivism**

Constructivism in Education originates with the basic assumption that reality (or its experience) is not separate from but includes participants (regardless of the nature of that participant) in its observations. The same constructs and mutual meaning are construed as a gradual process of accommodation that achieves a relative fit of meaning constructions.

Constructivism concentrates on contextually meaningful experience with the goal of fostering the development of autonomy and social reciprocity. Generally, Constructivism is considered to be a theory of knowledge and learning that concerns itself with what one knows and how it is that one comes to know. This theory derives its views on knowledge from multiple sources (i.e., philosophy, psychology, anthropology, sociology, etc) and considers knowledge to be internally constructed and socially mediated. Learning is viewed as a self-regulatory process involving individual meaning construction and processes of social negotiation through social activity, discourse, and debate (Twoney & Fosnot, 1996).

According to Constructivists, how one constructs knowledge is a function of the prior experiences, mental structures, and beliefs that one uses to interpret objects and events. Constructivism does not preclude the existence of external reality, it merely claims that each of us constructs our own reality of the external world. Thinking is grounded in perception of physical and social experiences, which can only be comprehended by the mind (Jonassen, 1991).

There have been many branches of Constructivist theories put forth. In contemporary Constructivist theory, the strongest individualistic theory of Constructivism comes from von Glaserfeld (von Glaserfeld, 1995; 1996). Von Glaserfeld's "Radical Constructivism" rejects the Objectivist notion that knowledge can be treated as an accurate representation of external things. In contrast the author emphasizes that knowledge be treated as an individual 'mapping of actions and conceptual operations that had proven viable in the knowing subject's experience' (von Glaserfeld, 1996). Under this view, no two people produce the same constructs and mutual meaning is construed as a gradual process of accommodation that achieves a relative fit of meaning constructions.

Spiro, R., Feltovitch, P., Jacobson, M., & Coulson, R. (1991b) offer a very selective version of individualistic Constructivist instruction drawing from their Cognitive Flexibility Theory (Spiro et al., 1987, 1988). This theory attempted to explain learning in ill-structured domains, highlighting the centrality of multiple knowledge representations:

"Our Constructivist position, as it applies to complex and ill-structured domains, rejects any view that says either that there is no objective reality, or that there is an objective reality that can be captured in any single and absolute way. Rather, one of our principle tenets is that the phenomenon of ill-structured are best thought of as evincing multiple truths: single perspectives are not false, they are inadequate. That is why multiple knowledge representations are so central to Cognitive Flexibility Theory."

Spiro et al. (1992) refer to their general approach as 'Cognitive Flexibility Theory,' taking it to be an integrated theory of learning, mental representation, and instruction that focuses on the acquisition of knowledge in ill-structured domains. This approach can be characterized as being critical (addressing deficiencies in learning) and involving multiple perspectives or representations of knowledge (multiple juxtapositions of instructional content).

A second branch of contemporary Constructivism concentrates on the socially and culturally situated nature of learning activity, drawing much of its theoretical basis from Vygotsky (1970; 1979), social activity theorists (Bordieu, 1976; Garrison, 1998; Lave, 1998), Mead, and pragmatism (Rorty, 1978; Putnam, 1987). Garrisons (1996), Meadean approach to Constructivist epistemology emphasizes individual's self-realization being derived from actions in the social world. This view of Constructivism is largely embedded in a social context characterized by argument, discussion and debate. This is described by Cunningham (1991):

"At the heart of Constructivism is the notion that knowledge is constructed, which in the present instance means that our theoretical views are personal creations, embedded in a social context, within a social community that accepts the assumptions underlying the perspective. There is no right or wrong here in any absolute sense. Holding a theoretical perspective means, making a personal commitment to it, while recognizing the potential validity of other positions."

There are also approaches that attempt to combine both individualistic and social approaches to Constructivism. CTGV (1991) view of Constructivism can be described as combining elements of a individual and social learning perspective in an emphasis on the social nature of cognition. Under this view, the individual is free to build his or her own interpretations of the world, so long as the interpretation is coherent with the general zeitgeist. Knowledge is taken to be a dialectic process the essence of which is that individuals have opportunities to test their constructed ideas on others, persuade others of the virtues of their thinking and be persuaded, (CTGV, 1991).

Regardless of the Constructivist theory supported, there are certain fundamental characteristics of Constructivism that can be enumerated. First, there is a general agreement on Constructivists' rejection of the Objectivist framework, which assumes that there are established standards of teaching and evaluation that are known and can be imposed to control learning and assess learning performance. Constructivists oppose objectivity on two main points: (1) they oppose the external control of learning that is imposed independent of learning, and (2) they oppose Objectivists' justification of objective standards of evaluation based on claims of having objective knowledge of the real world. However, this does not mean that all forms of objectivity or objective standards of evaluation have to be rejected (as will be shown).

Second, there is a perceived necessary link between Constructivist instructional theory and practice. In, "Continuing the dialogue", Duffy and Jonassen (1991) hold that behind every good instructional design model there is a theory drawn from experience. They state that, "The models derived from those experiences do not simply reflect instructional strategies and methods--simple behavioral activities. They also reflect an underlying conceptualization of what it means to learn and to understand." What this does is establish a criterion that prevents any external control of learning, while at the same time not exclude theoretical concerns needed for there to be an instructional theory at all.

Many Constructivist authors believe that theories of learning and prescriptions for practice go hand in hand. Duffy and Jonassen (1991) state, "While instructional designers typically may not have the time or support to explicitly apply a theory of learning during a design or development task, the theory is nonetheless an integral part of the instruction that is produced." Thus, learning cannot be assessed on the basis of immediate task performance. Some aspects of learning are not required until much later. It is largely for this reason that there is an emphasis on higher-order learning.

It is also for this reason that there is an emphasis that learning environments should have real-world relevance and that students should be equipped with appropriate levels of complexity (authentic tasks). Learners should actively engage in building complex knowledge structures and this requires higher-order thinking (knowledge construction). Evaluations need to be able to assess higher order thinking well (Gagne, 1987; Merrill 1983). It is seen as more important to evaluate how learners construct knowledge (knowledge acquisition), rather than to evaluate the product (process oriented).

Third, there is a strong prescriptive component that marks a defining feature of the Constructivist approach (Bednar, Duffy, Cunningham, & Jonassen, 1991). This is reflected in how learning and learning assessments are considered to be a continuous, ongoing process, rather than being tied to a specific task performance (Jonassen, 1991, 1992, 1995). Also, Constructivist instruction is directed towards the cultivation and assessment of higher-level learning (Spiro, Feltovitch, Jacobson, & Coulson, 1991, 1992). The prescriptive aspect of Constructivist instruction is valuable because it includes within its approach the assumption that learning and instruction are evolving processes. This is highly supported by those educational scholars who believe in the importance of educational ideals (Searle, 1995; Steffe, 1995).

### **Objectivist and Constructivist responses to paradigmatic criticism**

One pivotal methodological issue for Constructivist theory surrounds the question of how objective knowledge is to be treated. Given that, terms like "objectivist" and "objectivity" have been used in a multiplicity of ways, it must be clarified how these terms are been employed in the present work.

The present discussion utilizes the general notion of objectivity as the objective view of knowledge derived from general philosophy. The objective view of knowledge asserts that there is a real and structured world for which one can possess reliable knowledge (Putnam, 1994; Reigeluth, 1991). Knowledge obtained from the world is taken as stable and reliable because properties of objects in the world from which knowledge is obtained are assumed to be relatively unchanging. Because knowledge is objective, the meaningfulness of knowledge is external to individuals and therefore can be analyzed and standardized.

The first criticism from Objectivists opposes Constructivist's failure to take pre-existing skills and individual performance outcomes into consideration, based on their evaluation of success being represented by the completion of the learning task (Dick, 1991). Jonassen (1995) discusses the implications of Constructivism for learning and instruction:

"The principles by which those learning environments may be built focus on four general system attributes: context, construction, collaboration, and conversation. Constructivist environments engage learners in knowledge construction through collaborative activities that embed learning in a meaningful context and through reflection on what has been conversation with other learners."

Many of the fundamental attributes considered by Constructivist instruction do not start in learning that begins in the discrete learning situation to be considered. Rather, they have been built from previous experience (Dick, 1991; Reigeluth, 1991). According to Objectivists, such attributes as pre-existing knowledge cannot be dismissed. They are a part of, and presupposed by, any Constructivist instruction. There exists some standards due to previous experience, without which, new learning would be inconceivable (Searle, 1981, 1992). Such standards are brought into new learning situations in the form of previous knowledge and skills that have been built through past experience. In the Objectivist view, ignoring this is a serious oversight that plagues Constructivism in education.

A second criticism from Objectivists concerns the Constructivist challenge of assessing learning. If Constructivists do not use performance as an assessment of learning, then how does one know if learning has taken place? Some Constructivists posit that learning is an emergent property, invoking both instructors and participants, that "falls out" of the learning process (Bednar, Cunningham, Duffy, & Perry, 1991; Cobb, 1994; Cobb & Yackel, 1996; Jonassen, 1991). Cobb (1996) argues that researchers have to be included as well due to their interpretive role and perspective in the educational context. Cobb further states that it is social reality that should dictate the theoretical perspective. The author draws on previous classroom research (Cobb & Yackel, 1994) that utilized ongoing student-instructor interactions in conjunction with an inquiry-based instruction and that yielded positive support for learning mathematics. Emergent learning explanations, similar in nature to Cobb's (1996) are becoming increasingly popular as well (Bereiter, 1994; Martin & Sugarman, 1996; Perkins, 1993; Prawat, 1996).

For some, these types of learning explanations are not sufficient. Reigeluth (1991) supports there being a need for some sort of objectivity in contextual performative evaluation. He accounts for the fundamental difference in approach to learning assessment by the fact that these other authors chose to connect instructional theory with learning theory, whereas he treats them as different and maintains the need for there to be a separation.

Unfortunately, the Constructivists' responses do not sufficiently address the above levied criticisms. Most responses do not acknowledge the specific questions, but merely attempt to oppose the Objectivist framework (Bednar, Cunningham, Duffy, & Perry, 1991, Jonassen, 1991, 1994, 1997). Jonassen, Hennon, Ondrusek, Samouilova, and Spaulding (1997) provide opposition to the Objectivist approach to science by utilizing work from hermeneutics (knowledge building through interpretation), fuzzy logic (evaluating from multiple sources and perspectives based on probabilistic and non-linear nature of information), and chaos theory (emphasizing non-predictable nature inherent in systems). Stronger Constructivist responses seek to reject completely the criticisms levied, but more moderate Constructivist responses seek to assimilate other perspectives into their own framework (Cunningham, 1991, 1992). Within this view, objectivity becomes translated into another perspective that can be subsumed and exercised without contradicting other perspectives. This multiple perspectives approach emphasizes the importance of integrating all views in the evaluation process (Jonassen, 1991). By not acknowledging specific questions and by redirecting the focus of existing criticisms made, Constructivist explanations do not address the issues, but merely evade them.

## **Towards an alternative view of Constructivism**

For the most part, Constructivist explanations share a common theoretical grounding in Postmodernist philosophy (Phillips, 1995, 1996; Prawat, 1996). Postmodernist philosophy can be characterized by the breaking of all ties with existing foundational modes of thought and replacing this structure with a relativistic philosophy that embraces multiple frameworks of meaning found in particularistic accounts, (Guba & Lincoln, 1985; Howe, 1988;

Rorty, 1986). Guba and Lincoln (1985) believe there to be no possibility of accommodation between the foundational scientific and Postmodernist paradigms because the basic assumptions of the two are in conflict.

Adherence to a Postmodernist framework is an implicit assumption that runs through numerous Constructivist theories, such as von Glaserfeld's (1990) "radical Constructivism" and the majority of social Constructivist work (Cunningham, 1991, 1992; von Glaserfeld, 1990). Radical Constructivism (1990) holds that there is no objective reality that can be uniformly interpreted by all, while Cunningham's (1991) Social Constructivism calls for the integration of multiple perspective taking to accommodate individuals' differing interpretations. Much of the criticism of Constructivism (Reigeluth, 1991; Dick, 1991) is directed at the lack of objective standards and means of rational legitimization entailed by adopting Postmodernist philosophy.

There are alternatives to Postmodernist philosophy that allow for multiple frameworks of meaning, which characterize Constructivist explanations. Putnam (1990) argues for the possibility of appealing to objective rational standards by demonstrating the need for particular communities and practices to rely on some level of underlying conditions required for evaluative judgements to be made in the Constructivist domain or any other domain. This demonstrates the potential of Constructivism to overcome certain limitations that have been pointed out (Dick, 1991; Reigeluth, 1991).

A more comprehensive view of Constructivist instruction can be obtained by examining the cognitive tools available (Kommers, Jonassen, & Mayes, 1992) within a non-Postmodernist perspective (Putnam, 1990; Siegel, 1996). Attempting to theoretically ground cognitive and non-cognitive tools relevant to the Constructivist position will provide a more extensive view essential to providing any serious support to the Constructivist position.

### **Addressing criticisms to Constructivism by drawing on multiple frameworks**

This section deals with criticisms to Constructivism by presenting evidence from areas outside the literature. The literatures drawn from provide innovative ways to defend Constructivism, referred to as tools. These tools are divided in cognitive and non-cognitive types. Cognitive tools refer to individual psychological processes, whereas, non-cognitive tools refer to broader normative acts such as discourse practices.

#### **Theoretically grounding cognitive tools in support of Constructivism**

In *Rationality Redeemed?*, Siegel (1996) introduces his theory as a continuation of longstanding efforts to demonstrate that rationality possesses an "educational cognate" in critical thinking (Barnes, 1992), which represents an educational ideal. This work stems partly from an effort to address anti-Enlightenment tenets present in philosophy of education. It acts as both a response to existing arguments and as a further development of the Siegel's rationalist thesis.

The main tenet of the thesis is that the ideal of education is to promote rationality and critical thinking. This rationality is broad, involving both epistemological and moral dimensions. Siegel (1996) defends the critical thinker as someone who possesses specific characteristics:

"A critical thinker must have, then both a solid understanding of the principles of reason assessment, and significant ability to utilize that understanding in order to evaluate properly beliefs, actions, judgements, and the reason which are thought to support them. This dimension of critical thinking may be called the reason assessment component of critical thinking."

Following this, Siegel outlines two principles of reason assessment: general (applicable to many domains) and subject-specific (domain specific). Grasping these principles is considered to be an important part of critical thinking. Ultimately, Siegel supports that critical thinking is an educational ideal characterized by the following attributes: respect for students as persons, self-sufficiency and preparation for adulthood, initiation into the rational tradition, and democratic living. This educational ideal is, therefore, also a moral ideal. Thus, although critical thinking links directly with epistemology, it involves other dimensions as well when it is considered an educational ideal. It is also for this reason that Siegel believes it is important for philosophy and philosophy of education to engage in discourse.

This broad notion of rationality has not only an epistemological dimension, but also a moral dimension. For this reason, a large range of cognitive tools can be congruent with Constructivism's prescriptive component, concerned with learning activity that includes individuals' attitudes (moral).

Another important cognitive tool for Constructivist instruction is the imagination. Imagination is a cognitive tool that represents Constructivist instruction as a higher order learning skill. Egan (1992) provides a very useful aid in shedding light on a powerful cognitive tool that contributes greatly to learning. This is important to the present discussion on Constructivism as a means of pointing to cognitive capacity often overlooked by instructional theories but essential to Constructivist instruction. Egan incorporates the cognitive tool of imagination into educational practices.

Egan (1992) argues for the necessity of imagination to be incorporated in education. He attempts to carry his concept of 'imagination' into discussions of conventional thinking, emphasizing the need for freedom of mental activity:

"Imagination is what enables this transcendence, and is consequently necessary to education. It is important because transcending the conventional is necessary to constructing one's sense of any area of knowledge: accepting conventional representations is to fail to make knowledge one's own. It is to keep it inert rather than incorporate it in one's life."

Egan remarks on the tension that exists between conventions and imagination, marking it as a problem that has to be worked out. Also, Egan distinguishes the way in which humans learn from the ways computers operate in order to demonstrate that learning is not simply a question of recording symbols for later retrieval:

"If we allow our technologies to determine how we think about our intellectual processes, then one effect, which has been pervasive and very damaging to education, is to think of learning as a process analogous to recording symbols in the mind for later retrieval."

Here, Egan is attempting to draw attention to the fact that the meaningfulness of learning requires a more flexible approach. He (1992) states, "The more flexibly we can think of things as possibly being so, the richer, and more unusual and effective can be the meaning we compose." Thus, memorization of knowledge only is simply not enough. However, the memory is considered to be important to the imagination, since it is that which is contained in one's memories that the imagination draws on with which to construct.

The above discussion on imagination builds on the discussion of cognitive elements, giving attention to a cognitive tool that has been neglected in the literature. In addition, the discussion on imagination makes an appeal to non-relativistic standards that extend beyond the practical instruction, transcending conventions. This gives a prescriptive element into educational practices that Constructivist instruction encourages.

#### **Theoretically grounding non-cognitive tools in support of Constructivism**

Recent innovative Constructivist research in the area of moral and cooperative learning has contributed to extending what is understood to represent Constructivism's theoretical grounding (DeVries, Reese-Learned, & Morgan, 1991; DeVries & Zan, 1996). This work has demonstrated that Epistemology is an element of the whole of Constructivist philosophy, which is dynamic, including not only descriptive but prescriptive elements. That is, it is not only about what is but also what could be. This is an important attribute of Constructivism that has been largely neglected.

The presence of broad treatments, such as Larochelle and Bednarz's (1998), suggests that the foundation of Constructivism cannot be exhausted by epistemological legitimization. There are also needs for cooperation and discourse, which have moral as well as epistemological conditions. Sensitivity to these non-cognitive tools is required for Constructivist instruction be initiated (Jonassen, 1994).

The moral dimension of Constructivism has received little attention in the contemporary Constructivist literature. However the need to consider moral dimensions of Constructivism is a pressing task (Piaget, 1965; 1981). Piaget (1965) argued against the Objectivist approach to education where instructors controlled all aspects of student learning. In drawing from his own work, he observed that such a control over learning resulted in mindless moral and intellectual conformity, leading to self-doubt, lack of curiosity, uncritical thinking, and problems in cooperative interactions. DeVries and Zan (1996) support a sociomoral theory of Constructivism aimed at encouraging cooperative sociomoral development. The authors believe that such considerations are necessary in order to prevent the loss of individual knowledge constructions and self-regulatory learning.

Attention is directed at promoting multiple perspective taking and moral reasoning among children to encourage greater interpersonal understandings. This perspective draws on previous research (DeVries, Reese-Learned, & Morgan, 1991), which found that children subjected to a Constructivist classroom setting invested greater effort to resolve interpersonal conflicts compared to children subjected to eclectic or didactic oriented kindergarten classroom settings. From this work, DeVries & Zan (1996) support that rule and decision making should be directed, promoting feelings of necessity and fairness in rule making, a sense of commitment and ownership in decision making, and a sense of shared responsibility in how the group gets along. The result of this is believed by the authors to encourage mutual respect among learning. From this they conclude that a moral classroom contributes general conditions for intellectual development.

How can broadening Constructivism to include moral attributes aid in dealing with posited criticisms? First, on a theoretical level, it contributes to the understanding of Constructivist Instruction as not only descriptive but prescriptive as well. This builds on the discussion of cognitive tools by tying the prescriptive value of Constructivism to actual Constructivist research. On a practical level, it extends knowledge of Constructivism's

breadth with respect to learning content. It demonstrates that Constructivism is not only limited to epistemological constructions but also includes moral constructions. More importantly, this work brings to the surface an important aspect of Constructivism that has never been actually pursued but only speculated on by Bednar, Cunningham, Duffy, and Perry (1991):

"Optimally, we would tie our prescriptions for learning to a specific theoretical position--the prescriptions would be a realization of a particular understanding of how people learn. Minimally, we must be aware of the epistemological underpinnings of our instructional design and we must be aware of the consequences of that epistemology on our goals for instruction, our design of instruction, and on the very process of design."

In addition, there is something extremely important to recognize when assuming a theoretical-practical connection that has not been addressed in the Constructivist literature. This is perhaps one of the most powerful Constructivist tools that has yet to be discovered. Given that there is an assumed theoretical-practical connection at the heart of all Constructivist inquiry (Bednar, 1991; Cunningham, 1991; Jonassen, 1991), any extension of Constructivist practices (e.g., moral and cooperative learning) also assumes a theoretical connection beyond other knowledge constructions acquired in experience. In this way, the theory of Constructivism is itself a meta-construction or meta-cognition. This is similar to Siegal's (1996) argument against Postmodernism.

One way to bind these cooperative and communicative practices to a theoretical grounding that supports both morality and rationality has been posed by Habermas (1990; 1993). Habermas advocates a communicative theory of meaning where claims of validity and truth are decided by resolving normative rightness, which can be determined through discursive argumentation. He summarizes the generalized moral imperative that corresponds to his theory of argumentative discourse. He states that, "All affected can accept the consequences and the side effects its general observance can be anticipated to have for the satisfaction of everyone's interests (and these consequences are preferred to those of known alternative possibilities for regulation)."

Habermas makes a concerted effort to bridge the gap between appeals for the communal shaping of values/practices with the autonomous role of the rational individual. For Habermas, moral practices are social matters to be decided by discourse interactions of individually deliberating subjects. Thus, both individual will and community practices are taken into consideration by Habermas' (1990) universal theory of argumentative discourse.

The importance this has for Constructivism is threefold: (1) it provides a means of making a theoretical-practical bridging generally assumed within the Constructivist domain, (2) it provides a connection between rationality and morality, and (3) it provides a means of connecting the individual and collective group.

Habermas' work could be used to support the Constructivist Theory of Learning and Instruction against Objectivist criticisms. Much of the criticisms surrounding Constructivism are directed at the inability to have any objective standards (Reigeluth, 1991). However, the theoretical grounding provided above with Habermas' Kantian project (1990) offers certain objective standards. Kant (1787) believed that the only genuine morality is one that would be objectively and universally binding. It would apply to all people and be the same for all. The basis of this morality that applied to all resided in rational nature. For Kant, it was rational nature that provided the binding force in which to ground morality. In his "Critique of Practical Reason" (1787), Kant defines "practical principles" and discusses their moral implications. Kant also states that, "Practical principles are propositions which contain a general determination of the will, having under it several practical rules. They are subjective, or practical laws, when the condition is recognized as objective, i.e., as valid for the will of every rational being."

This notion of objectivity is not the same as that to which Constructivism is opposed. The brand of objectivity that Constructivism opposes claims that knowledge representations correspond to the external world and that externally imposed standards based on this knowledge can be used to control teaching. This brand of objectivity controls the learner and prevents learning to be constructed. This is very different from the brand of objectivity discussed by Kant (1781), which does not claim objective knowledge of the external world at all.

Instead it assumes only objectivity that corresponds to the individuals' shared rational nature. It is not an externally imposed standard to control learning, but rather, represents an integral characteristic of each individual to be constructed in practical experience with others. What makes this limited brand of objectivity so attractive is that it allows for objective standards to be pursued as an essential part Constructivist Instruction. At the same time, it does not enforce any objective standards that would control learning. This is overcome by viewing objective standards as prescriptive standards to be progressed toward but never fully obtained. This form of objectivity as a rational standard is substantiated by the efforts throughout the paper to demonstrate the prescriptive components of Constructivist Instruction entailed by Constructivism's theoretical-practical assumption.

How does this contribute to the problem of learning assessments? How does an objective rational grounding address standards of evaluation required for effective instruction? The contribution made lies in how it is that standardized evaluative measures essential to instruction are treated. Under this view, problems of



evaluation are resolved by Constructivist instructions' prescriptive function. First, evaluations would not simply be administered but would be integrated as part of the learning process. This could be accomplished by making clear who is responsible for creating the evaluative standards and when. This way students can feel they are not merely subjected to some imposed standard, but rather are participating in the standard evaluation. This is done so that students can learn to understand the standard as a first step in being able to participate in the evaluation and selection of future standards. This can be taken to be a type of cognitive apprenticeship (Clancy, 1992; Cobb, 1996; Collins, 1991).

Second, learners are participating in standard evaluations administered not with the understanding that the standard is objectively true but rather, is a logical possibility, objectively true for all learning participants and to be worked towards in a cooperative manner (Habermas, 1995; Kagan, 1990). This captures the essence of what Constructivism should encourage when attempting to provide instruction in an educational setting.

## Conclusion

The previous discussion yields positive support for the possibility of supporting a Constructivist Theory of Learning and Instruction without adopting a Postmodernist stance. The following conclusions are drawn: (1) a close theoretical-practical connection assumed to be a defining element of Constructivist Theory and can be given support independent of a Postmodernist framework by appealing to a broader notion of rationality that is objectively grounded and co-extensive with the prescriptive idealization of education, and (2) a theoretical exploration of practical cognitive and non-cognitive tools reveals a connection between these tools with prescriptive elements valuable to Constructivism and evolving education.

The issue of objective standards within Constructivism is found not to be a problem as many critics purport. While Constructivist Instruction does not base itself on the thesis of objective realism, incorporating objective standards within Constructivist instruction without opposing its fundamental tenets is a challenge. Concentrating on the necessity of rationality and the prescriptive component of Constructivist Instruction have revealed promising objective standards in which to imbed Constructivism. This adds an important element to the existing Constructivist paradigm.

Supporting the necessity of rationality and the prescriptive component of education has revealed promising objective standards in which to imbed Constructivist Instruction. Future work should be concerned with determining the extent to which such objective standards are effective for Constructivist instruction.

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# **An Instructional Design Model for Online Problem Based Learning (PBL) Environments: The Learning to Teach With Technology Studio**

Larissa Malopinsky  
Jamie Kirkley  
Richard Stein  
Indiana University

Tom Duffy  
Unext.com

## **Abstract**

*This paper provides a discussion of the theoretical and methodological implications of designing a problem-based professional development system on the Web as well as describes an instructional design model using problem based learning (PBL) principles. The purpose of the paper is to help instructional designers understand the methods used by the LTTS team in developing and structuring PBL on the Web.*

## **Background**

Telecommunication networks are changing the nature of teaching and learning. In the past decade, Web-based learning has experienced rapid growth in various educational arenas. From corporate training to K-12 and higher education, many educational providers are now providing online courses and learning modules so learners can gain access to education anytime and anywhere there is an Internet connection.

Currently, more than 50,000 university courses are taught online, and 1,000 universities developing and offering these online courses (Carnavale, 2000; National Center for Education Statistics, 1999). Nearly all of Fortune 100 companies already offer some form of online computer-based training (Herther, 1997), and this will continue to increase as the demand for stand up training decreases rapidly (ASTD, 2000).

A need for periodic professional development has contributed to the demand for more flexible access to higher education. Organizations and institutions are increasingly offering online professional development opportunities to educators (Mather, 2000, Schrum, 1999). In current times, continual reskilling is a fact of life (Bonk and Wisher, 2000), especially for teachers who must keep up with new teaching strategies, the latest professional standards, and constantly changing technologies. Coincidentally, new technologies promise to facilitate access to learning at times and places chosen by the learner (Albion and Gibson, 1998). These web-based environments have the potential to transform teacher professional development through the use of new models of teaching and learning. Online environments also have the potential to facilitate a sustained culture of sharing, collaboration, mentoring, and support for K-12 teachers.

With the rapid rate of expansion of online education, there has also been a call for a renewed focus on understanding and improving online teaching and learning. As a result, institutions are designing and implementing new models of distance learning environments (Institute for Higher Education, 1999). The goal of these learning environments is to promote learner engagement using inquiry and problem solving. One such methodology being implemented online is problem-based learning. Problem-based learning (PBL) is often promoted in response to the current need to offer authentic and effective professional education. Jonassen (1991) argues that "the most effective learning contexts are those which are problem or case based and activity oriented, that immerse the learner in the situation requiring him or her to acquire skills or knowledge in order to solve the problem or manipulate the solution" (p. 36).

Problem-based learning is a curriculum development and instructional system that simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem solvers confronted with an ill-structured problem that mirrors real-world problems (Finkle and Torp, 1995). Traditionally, PBL is used in face-to-face environments, with a facilitator guiding collaborative teams of students in solving a problem. PBL was initially developed at McMaster University in the late 1960s. It is used in a wide variety of educational environments including medical education (Barrows, 1985), business administration (Stinson and Milter, 1996), schools of education (Bridges and Hallinger, 1992), undergraduate education (White, 1996), and K-12 schools (Barrows and Myers, 1993). Problem based learning environments are often reported to increase student

motivation, to help develop critical thinking skills, to increase use of outside learning resources, and to increase understanding of content knowledge in context of its use (Albanese and Mitchell, 1993, Torp and Sage, 1997).

As traditional PBL has naturally expanded to many curricular areas, it has also expanded to the online educational arena (Stinson and Milter, 1996; Oliver and Omari, 1999; Pankratz, 1998; Naidu and Oliver, 1996). Yet online learning environments are new, and principles for the design of instruction in this environment are just emerging [Duffy, Dueber, and Hawley, 1999; Bonk et al, in press]. This means that instructional designers are the first who face the challenge of incorporating PBL approaches into the Web structure.

Heath (1997) recognizes a trend in instructional design towards replacing traditional behaviorist approaches with constructivist orientations emphasizing the use of emerging technologies. Therefore, understanding how to design and support the online problem based learning process is critical to the effectiveness of such online learning systems. Since few instructional designers have experience in developing problem based instruction for a Web based learning environment, it is critical that we provide instructional models focusing on the design of online problem based learning systems.

In this paper, we provide an instructional design model for designing a problem-based professional development system on the Web, called the Learning to Teach with Technology Studio. This model will help instructional designers better understand the theory and methodology of online problem based learning and enable them to adapt it as needed for their own online learning environments. This model will also help support new models of professional development for K-12 teachers. Understanding how to design online professional development systems for in-service teachers is important given recent recommendations from the professional development literature. The design of these online learning environments presents unique opportunities for transforming current models of preK-12 professional development. "Rather than having information delivered to them, teachers need to examine their beliefs about subject matter, student learning and instruction in the light of innovation" (Marx, Blumenfeld, Krajcik, and Soloway, 1998, p. 33). These models build on continuous inquiry, integration of new ideas with colleagues, and reflective practice, which are critical elements of successful professional development (Shanker, 1990).

### **Theoretical Framework**

Before we discuss the instructional model used in the design of the Learning to Teach with Technology Studio, it is important to address the theoretical framework that was used as the basis for its development. Constructivism served as the guiding theoretical framework for the development of this instructional model. Constructivist theories of learning posit that knowledge evolves through social negotiation and through the viability of individual understandings, that understanding come from our interactions with the environment, and that cognitive conflict or puzzlement is the stimulus for learning and determined the nature of what is learned (Duffy and Cunningham, 1996; Savery and Duffy, 1996).

During the past several decades, there has been an important shift in the way we view knowledge as well as the process of learning. Knowledge was once viewed as a known set of discrete *facts* to be *acquired* during the learning process via a simple process of *inputting information* into a learner 's head. Within a Constructivist framework, the focus is on the role of the learner. Rather than simply acquiring existing knowledge, the learner constructs knowledge through a complex set of interactions with the environment, culture, negotiations with other people, and tools (technological and otherwise) used in the process of learning. As learners engage in the social construction of knowledge, meaning, practice, and context are inextricably woven together (Lave and Wenger, 1991; Naidu and Oliver, 1996). Savery and Duffy (1996) link the theoretical principles of constructivism with the methodology of problem based learning as follows:

- Learning should be relevant
- Instructional goals should be consistent with the learner's goals.
- Cognitive demands and tasks in the learning environment should be consistent with cognitive demands and tasks for the environment for which the learner is being prepared.
- Teachers' role is to challenge the students' thinking.
- Students' ideas should be tested against alternate views through social negotiation and collaborative learning groups.
- Encourage reflection on the learning process (p.137).

By using Constructivist theories of learning as the basis for the development of this instructional model, we considered the role of the learner, the knowledge construction process, and the learning environment. By using the principles of Constructivism to guide the development of an online problem based learning instructional model, we

can design educational environments that further develop learners' critical thinking and problem solving abilities, content knowledge, skills, strategies, and learning processes.

### **The Learning to Teach with Technology Studio**

In order to understand this instructional model, it is first necessary to understand the context in which this instructional model was created. In 1999, Indiana University's Center for Research on Learning and Technology received a grant from the Department of Education to develop the Learning to Teach with Technology Studio (LTTS). The LTTS is a web-based professional development system to help K-12 teachers learn to use technology to support student inquiry and problem solving. (See <http://ltts.org> for more information). The LTTS is being developed to address needs of K-12 inservice teachers who lack skills and confidence in integrating technology into their teaching. While the technology infrastructure grows — 51% of classrooms are wired for Internet access, and there is one computer for every 5-7 students (National Center for Education Statistics, 1999; President's Panel, 1997) — the ability to use it lags. The Milken Exchange (Solmon, 1998) found that teachers do not model the use of IT skills in their teaching. Eighty percent of teachers report that they do not feel well prepared to integrate technology with their teaching (National Center for Education Statistics, 1999). Little seems to have changed since the 1995 OTA report concluded, "Overall, teacher education programs in the U.S. do not prepare graduates to use technology as a teaching tool" (Office of Technology Assessment, 1995, p. 184).

The challenges of this were to design an online learning environment based on the following criteria:

- To meet the needs of K-12 teachers in helping them learn about technology integration issues
- To create a learning anytime and anywhere which is open entry and open exit
- To design a learning environment that could be used by teachers' current technology levels as well as technological resources, which are all extremely varied
- To design a learning environment that emphasizes the individual but promotes community
- To design a learning environment that integrates the latest research and pedagogical innovations into daily classroom practice
- To provide high quality resources for learning
- To enable teachers to enhance their knowledge for using technology in their subject area while addressing professional standards

The current emphasis on technology is to ensure that it is used effectively to create new opportunities for learning and to promote student achievement. Educational technology requires the assistance of educators who integrate technology into the curriculum, align it with student learning goals, and use it for engaged learning projects" (NCREL, 2000) "Teacher quality is the factor that matters most for student learning," note Darling-Hammond and Berry (1998). Therefore, professional development for teachers becomes the key issue in using technology to improve the quality of learning in the classroom.

To address this need, the LTTS is being developed to provide learning modules that help teachers learn to integrate technology to support student inquiry and problem solving. These learning modules are self-contained, problem-based learning packages where a learner is presented with a problem scenarios based on significant technology integration issues that they face today, such as learning how to choose Internet-based projects, design WebQuests, and evaluate information found on the Internet. The goal for solving the problem is related to the teachers' own classroom context. So the teacher may develop an Internet-based teaching unit for her own class, choose an appropriate technology for her own students' collaboration, or learn how to teach Internet search models to her students.

Considering the meaning of professional development in the technological age, Grant states:

"Professional development goes beyond the term 'training' with its implications of learning skills, and encompasses a definition that includes formal and informal means of helping teachers not only learn new skills but also develop new insights into pedagogy and their own practice, and explore new or advanced understandings of content and resources. [This] definition of professional development includes support for teachers as they encounter the challenges that come with putting into practice their evolving understandings about the use of technology to support inquiry-based learning" (NCREL, 2000).

Additionally, the U.S. Department of Education (1995) set forth several related principles that professional development should meet, including:

- It should reflect the best available research and practice in teaching, learning, and leadership.

- It should enable teachers to develop further expertise in subject content, teaching strategies, uses of technologies, and other essential elements in teaching to high standards.
- It should promote continuous inquiry and improvement embedded in the daily life of schools.

In developing the LTTS, these professional development principles were considered as part of the design. Problem based learning was chosen as the methodology because of the strengths and advantages it offers for supporting teachers' professional development and learning. First, PBL builds on the use of teachers' research and practice in teaching and learning. Because the learner must address real classroom problems and issues using the latest research and other resources, they are connecting research to classroom teaching and practice.

Third, PBL provides a model of inquiry and investigation for teachers to learn not only for themselves but to apply to their own classroom practice. The PBL process requires that teachers address questions, make hypotheses, research and investigate issues, and develop a project that addresses the problem or issue.

In conclusion, the context for which this online PBL instructional design model was developed is critical to understanding the model itself. Other designers will perhaps need to adapt this model for their own particular contexts, but this will provide a starting place for their efforts.

### **Adapting PBL for a Web-Based Learning Anytime, Anywhere Environment**

Since the LTTS is a web-based learning anytime anywhere environment, using problem based learning as a design framework required that we adapt PBL to work with this environment. This resulted in the development of a new instructional model. In making this adaptation, we considered the characteristics of web-based learning environment, the needs and characteristics of our learners, and their goal for using the LTTS.

First, several distance learning principles guided the development of this model. Since our learners are from diverse backgrounds, we cannot make common assumptions about them with regard to prior knowledge of technology integration and usage, knowledge of terms or current issues, or knowledge of inquiry based learning. So we designed a very structured PBL experience with built in scaffolding activities that help support the learner in solving the problem.

Second, finding high quality resources on the Web is a challenge for novices who do not know the research or current issues. Therefore, we provide some high quality resources to assist the learner in solving the problem. These resources are provided within activities as well as separately in a resources section. Also, learners are encouraged to find other high quality resources to use in solving the problem and contribute those to the system for others to use.

Third, the navigation of the Web can inhibit learning if it is too complex or difficult to use. If learners have to focus efforts on finding information or figuring out where to go next rather than learning, they can become quite frustrated. So we designed a navigational system that illuminates our PBL instructional model and process. In fact, in a usability test conducted with six teachers (Kirkley et. al., 2000), we found that teachers understood the PBL flowchart style navigation and liked its consistency.

With regard to adapting PBL for a learning anytime anywhere environment, several adaptations were made. First, a traditional PBL model typically includes collaborative group work and tutor and a facilitator who models higher order thinking and challenges the thinking of learners. In designing PBL for a Web-based format where learners are separated from each other and from the facilitator by time and space, there is a challenge for the instructional designers who want to apply PBL principles in developing online learning environment. This realization forced our design team to consider the ways in which learners and facilitators would want and need to communicate with each other.

In order to implement PBL on the Web, we explored the role that collaboration plays in the overall experience of PBL but within the framework of a learning anytime, anywhere environment. Within a face-to-face PBL framework, learners have active, group-based roles at some stage of the process for the purpose of determining solutions and synthesizing knowledge. In outlining PBL, Boud (1985) and Bridges and Hallinger (1992) emphasize the importance of a group role when learning stems from collaborative analysis of the problem and is largely learner-directed. Yet within a learning anytime, anywhere environment, it is difficult to set up a collaborative group experience. With open entry/open exit structure, learners are completing modules at their own pace. While learners can participate and discuss issues with other learners, collaboration would be extremely difficult.

The role of the facilitator in LTTS is flexible since the type of facilitator and location of the facilitator will depend on the learner's goals for completing a module. For example, if a learner is completing a module for graduate credit, he may work with a facilitator at that university in which credit is being obtained. If a learner is completing a module to receive continuing education credits, he may work with his state monitor who acts as facilitator. If a learner is completing a module to improve technology integration skills, he may work with his

district staff developer. With this design, facilitators will have difference backgrounds, goals, and expectations, so instruction and assessment must be well designed.

Studies of the cognitive and metacognitive processes of students during the initial problem analysis phase of PBL support the view that the role of group interactions in PBL is to facilitate activation and elaboration of students' existing knowledge and so encourage conceptual change through cognitive dissonance (De Grave, Boshuizen, and Schmidt, 1996). If this is the function of group interaction in PBL, then, provided that an alternative mechanism with an equivalent effect is introduced, it should be possible to design effective PBL for individual use.

Exploring the value of PBL experiences for individual rather than collaborative use may be justified by the fact that professional practice is situated in a variety of contexts including individual study as well as collaborative and competitive teams. Successful professional practice frequently depends upon individual's capacity to solve problems. Logically, educational experiences which develop that capacity should be valued. Individual PBL experiences may help to address the increasing interest in distance and flexible access to professional education and the increasingly successful technology integration (Albion and Gibson, 1998).

Thus, not diminishing the value of collaboration and facilitation, we have developed instructional design model for individual web-based PBL, using appropriate alternatives which will assist learners through the problem solving process. Gibson and Gibson (1995) describe an alternative approach in which a learner is engaged with a problem individually and prepares a written analysis of the problem in preparation for group interaction. Within LTTS, this is done through module navigation and visual format, the use of scaffolding approaches, such as breaking the larger problem into sub-problems, the inclusion of the heuristic aids, the integration of metacognitive self-assessment tools as well as various mechanisms for supporting cooperative work on the problem at a distance. All these elements are intended to assist the learner in the individual PBL web-environment.

#### **Web-Based PBL Instructional Model**

According to our PBL model, which is very similar to traditional PBL models (Barrows and Myers, 1993), the LTTS learner goes through the series of phases in order to finally generate a problem solution. The problem scenario begins with identification of key concepts from the content domain and a typical context in which the concepts might be used. This *Presentation Phase* is intended to situate the learner in the problem context and to begin the process of activating relevant prior knowledge. Additionally, it is in this phase that learners have the option of beginning to customize their interpretation of the problem to make the context as specific as possible.

The *Exploration Phase* provides opportunity for recall and reconfiguration of prior knowledge relevant to the specific problem and exploration of additional, content specific knowledge and 'experience' gained during problem solution. Learners have access to a collection of resources relevant to the concepts encapsulated in the problem. We want them to identify possible solutions and resources needed for understanding the problem.

The *Integration Phase* emphasizes relevant knowledge transfer, analysis, integration, synthesis and evaluation of selected, content specific knowledge and problem based 'experience'. The problem in each module is divided into a series of tasks/sub-problems to facilitate scaffolding by considering the types of artifacts, typically documents of various kinds, which might be produced by the learner in association with a stepwise solution to the problem situation. Because PBL is intended to increase the capacity of learners to solve real problems and because identifying critical elements may be counter-productive, the learners are required judgment in selection from what is provided and initiative in employing material from alternative sources in order to be able to solve the problem. But we need to note that resource collection and analysis to some extent is embedded into each phase of the process.

The *Solution Phase* encourages learners to further integrate knowledge, 'experience' and artefacts gathered through the problem solving process into their cognitive structures as though products of real experience.

During the *Reflection Phase* learners are encouraged to conduct self-assessment of their artifacts assessing the content and organization of the learning modules according to the particular domain of technology integration.

Each learning module in the LTTS system is a self-contained, problem-based learning package, which presents a scenario, which includes a problem, resources, activities, solution, and assessment. The problem may ask the student to develop, design, or critique something such as an effective use of technology to meet a need, the resolution of an ethical dilemma, or the critique of a web interface. Students are asked to produce a product such as a report, or the development of an instructional plan or materials to address the problem. In all cases, the problem is flexible and enables learners to approach solving it from their own perspective and context. For example, rather than being given artificial scenarios, the learner solves the problem using the context of his or her own classroom. Each problem is authentic because it is related to a significant issue in the classroom today.

The module navigation scheme visually represents the problem solving process, and helps the learner organize working process.





The *Problem* section is intended to provide a situation description, a concrete and authentic context out of which arises a problem to be resolved or a project to be completed. It contains background information that helps establish the importance and broad relevance of the problem to the teaching and learning environment. The problem presentation contains enough information to make the problem intriguing, yet general enough to allow the learner freedom in determining the shape of the solution or product. The problem presentation includes a specific description of the role learner will adopt while working on the module. The problem needs to be important and containing motivating factors such as mystery, puzzlement, novelty, originality, and high relevance.

The purpose of the *Resources* section is to provide the learner with core materials that are of high quality and relevant to the problem. Our goal is for the learner to understand the resources as reflected in the learner's ability to apply them to the problem, which contrasts to the traditional learning environment that measures understanding by performance on a test rather than in the ability to apply concepts and principles. Module resources are primarily links to authentic materials (online research publications, projects web sites, online interviews, etc.) serving as a support to problem solving process. Resources may also include references to off-line materials such as books, magazines and videos. While we provide learners with a list of resources, we do not discourage them to use other materials they see as relevant and useful in the process of solving the problem.

*Activities* in problem-based LTTS module serve as scaffolded instruction that prepare the learner to develop problem-solving strategies. Due to the challenges of online environment, and considering the lack of instructor or facilitator, we divide problem into sub-problems or tasks that scaffold, model and coach the learner in his/her thinking and learning. Each activity is built around the issue relevant to the overall problem and includes links to resources presenting this issue. The learner is expected to complete a written analysis of some aspects of the problem for the purposes of synthesizing knowledge and determining solutions. All submitted works are stored in the system database and the learner has an access to them at the later stages while preparing the final product. The learner has an opportunity to modify and resubmit his/her work and retrieve his/her works in the *Solution* section in order to support the final product.

When the learner has completed the tasks specified in module *Activities* he/she is expected to prepare a final product, *Solution* for the problem. The solution can be prepared in the format of a paper, project, job-aid or instructional materials addressing the problem. The final product must address the major decisions that were made and should be based on or cite research, theory, or practice that grounds the decision making in the literature. In *Solution* section the learner has an opportunity to review his/her earlier work from *Activities* and create a final product.

The purpose of the *Assessment* section is to encourage and help structure the learner's reflection on his/her performance through a series of reflection questions. We recognize the importance of reflective questions for understanding the learners' thinking and assisting them move through the experience. In our design, we adopted the portion of Naidu and Oliver's PBL model (1996) that deals with reflection at multiple points in the process. We included two types of reflective questions that proved to be most important: check-up questions, and stepping back questions (Hmelo and Ferrari, 1997). Check-up questions are the ones that help students think about they goals as they work. In LTTS module these questions take the form of self-checks integrated into each activity. The second set of questions, stepping back, take the form of final reflection questions that ask the learners to reflect on the whole process of solving the problem. Reflection is considered a critical tool for synthesis as well as for facilitating students' forward motion in the problem environment (Orrill, 2000).

#### **Reflection on the Instructional Model**

Admittedly, the structure we used for web-based problem solving process is much more rigid than traditional face-to-face PBL environment. However, Abrami and Bures (1996) recognize that setting the agenda for students learning at a distance may be problematic since learners structure to help in planning and managing projects. This is

why we structured the problem solving process by dividing the problem into a set of sub problems, or activities. Wegner, Holloway, and Grader (1997) also confirm the need for structured support in their online PBL experience. Their issues focus on the development of particular content knowledge. They use some imposed structures such as process-oriented questions and lists of key terms and concepts in order to help their students move through the PBL experience and reach the desired outcomes. While this may have prevented the students from arriving at the “knowledge abstraction” phase of PBL (Barrows, 1985), it likely helps them stay on track to finishing the problem.

Compromising certain aspects of the problem-solving experience, we are also scaffolding learners to help them work in web-based environment. However, while providing more rigid structuring strategies we do not eliminate the most of the critical elements of PBL. A community of peers and a facilitator provide ongoing support to learners working on the problems individually. Corrent-Agostinho, Hedberg, and Lefoe (1998) emphasize that the most successful learning experiences are those in which the environment both structured and well facilitated.

The role of the facilitator is not to inform but to model higher order thinking and to challenge the thinking of learners (Boud, 1985; Savery and Duffy, 1995). Studies of student interaction with peers in the PBL environment (De Grave, Boshuizen, and Schmidt, 1996) suggest that exposure to different ideas in the group leads to conceptual change. The group interactions serve to encourage activation and elaboration of existing knowledge and integration of alternative views. Providing the style of support which the learner typically receives from the facilitator and peers in the face-to-face PBL environment presents an obvious challenge to the web-based PBL design. In our design, we are considering several options to satisfy the learners’ need for group interaction and facilitation of their activities. The LTTS design team is developing various mechanisms (discussion forums, chat rooms) to support the process of building a community of learners interested in the similar problematic issues, discussing authentic experience, creating mentor-type relationships and teams to work together on the same problem. Another strategy, which would compliment the group interactions, is incorporating a feedback mechanism through which after completing a task the student will obtain access to a collection of responses containing varying interpretations of a problem. It is anticipated that exposure to a collection of responses in this way will have effects similar to interactions among a group of learners with differing vision of a problem and its solution. We hope to develop such an environment where the learner utilizing the individualized PBL model in a web-based learning environment will be able to receive both human and technology support.

At each stage of the design process, we used rapid prototyping techniques to ensure that the overall scenario was plausible and the problem process flowed naturally according to learners’ perspective (Tripp and Bichelmeyer, 1990). This was done through having inservice teachers examine the modules in depth and make suggestions. Also, usability testing was conducted with six teachers, who are the real audience for LTTS.

## Conclusion

This is a new instructional model for Web-based PBL. Obviously, it is not the same as traditional face-to-face PBL, and it is not our purpose to duplicate the traditional face to face PBL, which has the strengths of group collaboration. Our goal is to take the best of PBL learning and develop a new instructional model that would work within a Web-based learning anytime, anywhere environment. In doing this, we have to consider both the strengths and constraints of web-based instruction, learner characteristics, and the purpose of the LTTS, which is professional development. We need to understand the strengths and limitations of the online environment and learn how to operate within these. We also have to understand what aspects of PBL will work in these environments and will enhance professional development as well as how PBL needs to be adapted to fit the learning environment in which it occurs.

This instructional model is just one of many possible implementations of PBL on the Web. As communication technologies advance, there will be future instructional design models of PBL that are even more innovative. McLoughlin and Oliver (1999) argue that we need to develop online tools to support parallel problem solving, simulating course material, information exchange, database creation, and case-based projects. As new tools are created, instructional designers will need to develop enhanced instructional models that facilitate and support the inquiry and problem solving processes within the context of the areas being studied.

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# Distance Education: Looking Beyond the No significant Difference

Nancy J. Maushak  
Hui-Hui Chen  
Laura Martin  
Benny C. Shaw, Jr.  
David Unfred  
Texas Tech University

## Abstract

*A review of research in distance education indicates that results are consistent in that there is no significant difference in achievement attributable to the delivery system. And it is this 'no significant difference' that seems to be quoted most frequently. This perspective represents a very narrow vision of what research is actually occurring in the field of distance education. This paper attempts to look beyond or behind this no significant difference in achievement by examining research related to three other factors: learner interaction and control, two different approaches to multiple learning styles and, utilizing intelligent agents to facilitate interaction and collaboration. The approach has been taken to not simply review what has been studied but to examine areas for future study that will make significant contributions to the field.*

## Introduction

Research in distance education has tended to follow the same trends as research with other new technologies. The first factor that is explored is related to learner outcomes. The temptation is there to try to prove that the use of new delivery systems result in higher student achievement. The multitude of media comparison studies conducted in the area of distance education have shown repeatedly that distance education is at least as effective as traditional education in regards to learner outcomes (Hanson, et. al, 1996, Russell, 1999, Saba, 2000). In fact, several studies have produced results that indicated distance education students had a higher achievement than those in traditional settings. However, a review of the literature supports a perspective of research in distance education that is examining this phenomenon from multiple approaches. This paper presents an examination of the research in distance education examining factors beyond achievement including emerging technologies, learning styles and interaction.

The first section will look at using CAI to support K-12 distance education. While CAI appears to be decreasing, it offers intriguing possibilities when explored for its distance education potential particularly in the K-12 setting. Learning styles appear frequently in the distance education literature. However, the utilization of multiple models and instruments makes interpreting and generalizing the results difficult. The second section explores a classification system for learning styles that would prove useful to help interpret the research related to learning styles in distance education. The third section explores learning styles in one specific setting. The use of Web-based instruction continues to increase but little has been studied in regards to learning styles and designing web-based instruction that supports multiple learning styles. The fourth and final section, examines the emerging technology of intelligent agents and what impact this might have on changing the paradigm of distance education.

## Using CAI to Facilitate Distance Education in K-12

Since 1985, distance education has been growing as a means of teaching and learning. Distance education enables bringing knowledge to students regardless of the limitation of time and geographical location. It has been typically defined both as a synchronous mode and as an asynchronous mode. Contemporaneously, Computer-Assisted Instruction (CAI) has been evolved since 1960s. CAI is an effective intervention for improving students' achievement in different subject areas (Christmann, Badgett, & Lucking, 1997). Researchers have dedicated many efforts and money to study and improve the instructional design of CAI. However, with the rapid development of distance education, the use of CAI seems to be decreasing in popularity. It is no longer the spotlight compared to the foci on other delivery methods within distance education. Nevertheless, CAI has another chance to gain the attention of instructors and instructional designers again with the increasing use of distance education within the context of K-12.

## **Instructional Forms**

Lauzon & Moore (1989) thought that a successful application is dependent upon understanding how the technologies can be used to enhance distance learning. Hence, it is necessary to review instructional forms prior to adopting a specific instructional design for distance education. Kowitz and Smith cited in Lauzon & Moore (1989) mentioned the three forms of instruction represent positions on two dimensions: the density of content to be learned and the styles of human interaction. Different instructional forms require different styles of learner/instructor interaction.

The first form represents learning the basics. It is characterized by instructor control of the development, design, and evaluation. The second form assumes students an active role in their education. The instructor acts as an expert and becomes more consultative with students. It is characterized by instructor control as well as learner control of field study. The third instructional form is characterized by experts seeking to improve and master their existing knowledge and performance. It is more toward learner control.

## **Factors Influencing Learning, Interactions, and Control in Distance Education**

Vrasidas and McIsaac (1999) concluded the structure of the online transaction, class size, feedback provided to students, and students' prior experiences were the major factors to influence interactions. Baynton (1992) indicated that the factors of "control" in distance education are competence, independence, support, time flexibility, value orientation, and access to resources.

By comparing aspects of studies, we can make an assumption that we are comparing students' expectations (Vrasidas & McIsaac, 1999; Baynton, 1992) and teaching behaviors (Mckenzine et al., 1998). Students' expectations are more in terms of self preferences, while teaching behaviors are more in terms of management and instructional concerns. Nevertheless, requiring and providing support and feedback are congruent.

## **Distance Education in K-12**

Currently, most of the attention given distance learning programs in K-12 schools is focused on synchronous modes of instruction (Barker & Dickson, 1996). Schools are using distance education technologies to help them offer both elective and required courses for which a certified teacher is not available or in situations where low student enrollments do not qualify a full-time teacher being hired. Barker and Dickson (1996) indicated that the most common technologies used in distance education programs in K-12 have been satellite-delivered instruction, cable television, and computer audiographics. Even so, Barker and Dickson also indicated that the use of the Internet and the Web to assist distance education has been emerging.

## **Characteristics of CAI**

It is essential that CAI applications be examined in order to seek consistency with instructional forms as well as interaction styles and controls mentioned above. Thesaurus of ERIC descriptors cited in Fourie (1999) defines that CAI stands for an interactive instructional technique in which a computer is used to present instructional material. CAI can monitor learning as well as present corresponding instructional material to what individual learner needs. Lockard, Abrams, and Many (1997) described the nature of CAI as the following:

Computer-assisted instruction (CAI) is the most common term for the interaction of a learner with a computer in a direct instructional role. CAI software provides instruction in some particular content in any of a variety of formats, with or even without any involvement of a human teacher. (p. 190)

The major characteristics of CAI are interaction, flexibility, and meeting student needs (Lockard, Abrams, & Many, 1997). CAI engages learners interacting directly and continually with computers. Learners take active roles instead of passive roles in their learning processes. It provides feedback to learners as well. Its flexibility allows teachers involving in teaching both higher-order problem-solving and simple cognitive learning. Furthermore, it can response to different needs due to different levels of competencies that learners hold. The advantages and disadvantages of CAI in terms of distance education are discussed in the following.

*Advantages.* The advantages of CAI are (Fourie, 1999; Lockard, Abrams, & Many, 1997; Luzon & Moore, 1989; Daniel, 1999):

1. Interaction: CAI engages learners interacting directly and continually with computers.
2. Immediate feedback: CAI is capable of providing immediate feedback to learners.
3. Self-pacing: Learners can learn at their own paces with CAI.
4. Visualized effects and sound: Integrated effects can impress learners to keep their retention and extend the duration of their learning.
5. Branching for different interests or difficulties: Learners can go through the order depending on their own learning styles and entry levels.

6. Providing sufficient drill, practice, simulations, and games: CAI provides plenty of opportunities to learners to do drill, practice skills, simulate problems, and have fun while learning.
7. Independent tutorial: Learners can go through the tutorial when they need.
8. Allowing a large number of learners: CAI applications can be duplicated and distributed easily.
9. Time flexibility: Learners can use CAI at their own convenience.

*Disadvantages.* The disadvantages of CAI includes ((Fourie, 1999; Lockard, Abrams, & Many, 1997; Luzon & Moore, 1989; Joseph, 1999):

1. Cost to develop: It is expensive to develop a new CAI application and takes much time and many efforts of people involved.
2. Computer platforms: If CAI only used for distance education by distributed learning, different computer platforms that learners have should be considered and can be a problem.
3. No standards to apply applications: There is no standard for what CAI application to apply for courses.
4. Requiring computer skills: Certain computer skills are needed while working within an CAI application.
5. Lack of synchronic oral communication.
6. Eyestrain: It is easy to get eyestrain after a long period of watching the computer screens.

However, Olcott (1997) argued that distance education does not necessarily save money in the short term if we view distance education from a value-added perspective.

## Discussion and Conclusion

Olcott (1997) stated the shift to competency-based assessment models that certify learning through mastery of specified skill competencies rather than learning based on credit hours and seat time has impacted K-12 school restructuring initiatives. The shift may use CAI applications to achieve its goals since CAI applications can provide students with what individual needs and enhance learning. CAI can work for K-12 students in the diverse subject areas and further in the distance education context.

CAI is well known for its ability to address the independence of learners. This aspect relates well to how distance education works for most participants. Through distance education, K-12 schools can obtain collaborative and cooperative teaching and learning. CAI has the potential to enrich and facilitate distance education for K-12 schools. With the help of CAI, the use of distance education in K-12 could be extended to every single possible geographical and content area.

CAI is congruent with how distance education works. Traditional distance education programs of the past 10 years operate mostly in the synchronous mode; however, increasingly, programs are being offered in the asynchronous mode especially because of the rapid development of the Internet and the World Wide Web (Baker & Dickson, 1996). Garrison's opinion (1986) cited in Lauzon and Moore's observation (1989) indicated that the new generation of delivery system for distance education should be capable of both asynchronous group and individualized instruction and integrate the communications network with computer-based instruction. In other words, CAI combining with the Internet and the World Wide Web is the ideal application for distance education. It is evidenced that Web browsers are powerful programs which can integrate various types of media. Web browsers provide an inexpensive and widely available application that can combine text, graphics, audio, video, data, and programming within the same software program (Daneil, 1999). Consequently, CAI on the Web does not need to address the problem caused by the different platforms of computers

It is easy to update or upgrade CAI applications via the Internet so as to save cost and time from publishing and distribution. While learning with CAI, learners will have easy access and jump to different resources due to the connections with the Internet and the context of the World Wide Web. Learners also can acquire immediate use of e-mail, chat-room, and even Internet phone to have online communications with others. Developing CAI for the Web also facilitate collaboration by geographically dispersed institutions (Daneil, 1999). This will increase collaboration and cooperation between schools.

In sum, CAI applications for distance education for K-12 students should integrate with the Internet and the Web. The Internet provides synchronous settings as well as asynchronous. The implements and potentials of CAI on the Web in distance education for K-12 need to be studied by researchers, instructors, and designers much farther in the future.

## **The Influence of Learning Styles in Distance Education**

Research studies in distance education have measured learning styles using different instruments and have classified these styles according to various schema. Most of these studies used subjects that were either not representative of the population or were samplings of convenience. These conditions complicate the comparisons of the resulting data. In order to compare learning styles across these research studies, the learning style instruments and classifications need to be related to general models. Claxton & Murrell (1987) have classified learning style instruments into three broad learning style models: 1) instructional preference, 2) social interaction, and 3) information processing.

Instructional preference models address motivation and persistence of the learner. Social interaction models are learning style models that address the learner's need for an interchange of ideas or knowledge with one or more people concerning the learning material. Information processing model address the influence of the structure of the instruction, an individual's self-concept as a learner, distinct personal goals, and expectations of success or failure on the amount of information learned. Learning styles are the combination of the developmental, cognitive, and affective factors that influence the way in which we process and perceive information.

### **Instructional Preference Models**

Instructional preference models are learning style models that are associated with environmental and emotional preferences. Emotional preferences that address motivation, persistence, and structure have been extensively studied in distance education. Research has shown that knowledge acquired through activities that motivate the individual is learned more deeply than rote memorization (Cognition and Technology Group at Vanderbilt, 1993). Persistence, which is a function of motivation, is the extent to which an individual continues to do an activity.

In distance education, many research studies have investigated the persistence of learners either within a course or within a program. These studies have examined previous educational level, age, gender (Coggins, 1988; Powell, Conway, & Ross, 1994; and Richards & Ridley, 1997), employment, illness, family problems (Coggins, 1988; Gibson, 1996; and Powell et.al, 1994), support programs, tutors, and quality of instructional material (Powell et. al., 1994). Many different schemes have been used to provide an explanation or prediction of attrition, but the single point of agreement is that attrition is multivariate in nature (Gibson & Graff, 1992). When examining how learning styles affect persistence, we must look at emotional elements that relate to motivation. Motivation, whether intrinsic or extrinsic, helps to drive the student to learn a particular piece of information. With intrinsic motivation, a learner is driven internally by interest and curiosity and learning that piece of information is important to the learner himself. A learner that is extrinsically motivated is driven to learn a particular piece of information by a requirement imposed by some outside force. The importance of that requirement to the learner will determine that amount of drive to learn the information.

Another factor that is common in a number of distance education persistence studies pertains to the learner's perception of his ability to succeed in the educational setting (Gibson, 1996; and Powell et. al., 1994). A learner's academic self-concept is important as a predisposing characteristic in the learner's ability to complete a distance education program (Coggins, 1988). The confidence a learner has in his ability to succeed in a course could affect the learner's motivation

Coggins also stated that major motivational factors influencing a learner's persistence in a distance education course are goal-clarity and course relevance. These motivational factors can be intrinsic or extrinsic factors and are significant influences on distance education persistence. The students who intend to earn a degree and/or who were taking a distance course that was relevant to their degree program were more likely to complete the distance education course or program (Coggins, 1988; and Powell et. al., 1994).

### **Social Interaction Models**

Social interaction has been shown to be a significant factor in determining distance education success. Individuals who prefer a collaborative learning style, where interaction with other learners is important, are less likely to succeed in a distance education environment (Dial & Cartnal, 1999).

A recent study examined the implementation of groupware into an asynchronous learning environment and found that groupware facilitated the group learning process (Becker & Dwyer, 1998). This study also investigated visual/verbal learning preferences of the students. A comparison of visual/verbal learning styles to independent/dependent learning styles has not, to my knowledge, been conducted with respect to distance education. However, accepting the fact that dependent learners learn best when interacting with other students or teachers, a preference for verbal learning would include dependent learners. Interestingly, Becker and Dwyer found that students who were categorized as more visual learners perceived an added benefit from utilizing groupware and considered the groupware to be valuable in the group learning process.



### **Information Processing Models**

The amount of information processed and the amount of information learned are influenced by an individual's self-concept as a learner, distinct personal goals, expectations of success or failure, and preference, or lack of preference, for structured learning activities (Gibson, 1996; Wagner and McCombs, 1995; Dunn, Griggs, Olson, Gorman, & Beasley, 1995). Research studies in distance education have linked field dependence/independence with academic achievement (Ching, 1998; and Powell et. al., 1994;). Learners who prefer a more structured learning environment are learners who prefer a dependent learning style (field dependent). These learners are less likely to succeed in a distance education environment (Powell.et.al., 1994; ). As the degree of learner control of the distance education environment increases (or structure is decreased), dependent learners reported that they "got lost" when studying or were unsure of the instructor's expectations (Ching, 1998; and Gibson, 1996).

In a study examining the amount of learner control in a hypermedia environment, active (independent) learners performed best with high levels of learner control, and reflective (dependent) learners performed best with low levels of learner control (Rasmussen & Davidson-Shivers, 1998). In a study of forty-eight sixth-graders, a structured presentation of material facilitated learning better than an unstructured presentation of material when using computer based instruction (Yang & Chin, 1996).

In a distance education nursing program, a study demonstrated that a field dependent learning style is a good predictor of poorer academic performance (Ching, 1998). This study also demonstrated that development of field independence could be influenced by the curriculum and teaching approach. Ching compared the field independence of students beginning distance education study to their field independence at the end of one year of study and found that field independence increased in these students. Ching attributed this increase to the distance education environment on the basis that this distance education course was taught to isolated students that had no formal means of student-to-student interaction. However, many students did indicate that they created their own student study groups that would foster the field dependent students' learning.

### **Conclusion and Future Studies**

Learning styles are a preference in how a learner interprets and processes information. Most of the learning style instruments measure learning styles in terms of binomial opposites (i.e., dependent/independent and verbal/visual). However, learning styles are not absolute opposites; they are measurements of a continuum between these binomial opposites. Learners prefer a certain mode of learning, and are not locked into one mode of learning. In the study of Chinese nursing students, it was demonstrated that a student's learning style could change over time (Ching, 1998).

One consistent finding in the research on learning styles in distance education was the outlook for the dependent learner. The independent learner was more likely to succeed in a distance education course or program than a dependent learner. The dependent learner may be a good predictor of poorer academic performance. To date in distance education research, most of the studies in learning styles have used samplings of convenience.

Also most of these studies were conducted on students who chose to take the distance education course over a traditional course offered at the same institution. In general, independent students usually self-select to the distance education course while dependent student self-select to the face-to-face courses. With the use of distance education in universities to deliver courses throughout a system where students are distributed among campuses in different cities, the choice of taking a traditional face-to-face course may not exist. Therefore, future studies should examine the dynamics of learning styles when the student has no choice but a distance education course or program.

### **Addressing Multiple Learning Styles in Web-based Instruction**

The purpose of this literature review is to report current research addressing how Web-based instruction and the technological capabilities of the World Wide Web have been used to meet the individual learning styles of students. This review will look at research in the areas of learning styles and World Wide Web technology.

The area of Learning Styles has been researched extensively throughout the past fifty years. Much of this research has been conducted in the traditional classroom setting. The majority of research supports matching the individual's learning style with a complementary mode of instruction. Researchers agree that learning styles represent the ways in which individuals interpret, process, understand, and integrate information. Learning styles are defined in many different categories and inventories, none of which are standardized across the research. This makes it difficult to apply general conclusions across the research findings. Since much of the research on learning styles supports teaching students to their individual learning styles, for greater academic achievement, and shows support for the need to address multiple learning styles in every instructional lesson, this literature review is not limited to any specific learning styles categories or inventories.

The research in the combined areas of learning styles and Web-based instruction is very limited. The research that has been reported used mainly undergraduate college students as samples. Little is known or has been reported about addressing learning styles in Web-based instruction, for K-12 students. This appears to be an area requiring further research.

### **Learning Styles**

Extensive research has been conducted in the area of learning styles in the traditional classroom setting. A great majority of this research has supported the fact that each individual differs in the way they interpret, process, understand, and integrate information. Research shows that people exhibit significant individual differences in the cognitive processing styles that they adopt in problem solving and other similar decision making processes (Robertson, 1985). Individual differences in student learning are categorized into learning styles. Learning styles are the ways in which the brain interprets processes, understands, and integrates information. Dunn, Dunn, and Price (1989), state that classrooms need to concentrate more upon individual learning styles because students tend to learn and remember better and enjoy learning more when they are taught in a way that takes into account for their learning style preferences. When developing instruction to accommodate learning styles, the instructional developer must know what delivery mode best suits each learning style type. When applying learning styles to the curriculum, Dunn & Dunn (1978) state that students should be taught to their dominant learning style and then followed with their second strongest learning style. Auditory learners learn best when they listen, read, and then take notes. Visual learners learn best when they read, look at visual aids, took notes, and then listened to a lecture on the material. Tactile learners require manipulative materials in which they can use to construct and then read, write, and listen to the material. Kinesthetic learners prefer exposure to the real world, such as field trips, followed by reading, writing, and listening to the material. A case study, by Hodges (1982), shows how putting these learning styles strategies into action can increase student achievement. The study was conducted with Junior High school students, from extremely low socioeconomic backgrounds, who were not responding to conventional strategies for learning. Each student was given a Learning Style Inventory test and an individual curriculum was matched with the student's dominant learning style. Results indicate that eighty-five percent of the students substantially increased their achievement levels in reading and math compared with their previous performance in a typical school setting. The data revealed that, when learners are taught through methods that complement their learning style preferences, learners become more motivated and have higher academic achievement.

Robotham (1995) questions the practice of placing students into pre-specified learning style categories. The author believes that this causes students to become stagnant in their ability to understand how they learn. The author believes that forcing students to learn, using different learning styles, can help them grow. Snider (1990) also states that it is good practice to recognize and accommodate individual differences and to present information in a variety of modalities. This research shows support for providing instruction that addresses multiple learning styles, within one lesson. With the advanced technological capabilities of the World Wide Web, it is possible for students to have exposure to a variety of instructional delivery methods that can accommodate multiple learning styles.

### **World Wide Web Technology**

Some current capabilities of Web development software and World Wide Web technology have allowed teachers to expand upon traditional text and lecture based classes by creating individualized lessons that are aligned with teachers' lesson plans and individual students' competencies and abilities. Some current Web development software tools include, Microsoft Front Page, Macromedia Flash, Hyper Studio, Claris Home Page, and Power Point. This Web development software also allows each student to meet his or her individual needs, by selecting a unique course of instruction, through non-linear, branching structures. Students can direct their own learning by pursuing their interests and organizing and synthesizing data and constructing projects that are meaningful and can be applied to real life situations. Ayersman and Minden (1995) state that hypermedia has the ability to deliver information in contextually meaningful sequences, at a variable pace controlled by the learner, through multiple sensory modalities. Summerville (1997) states that hypermedia holds great promise for the accommodation of individual differences. Hypermedia has the ability to be flexible or structured, provide varied feedback, and allow the user to access other resources.

Some of the current features in multimedia Web development include the use of audio, video, virtual reality, animation, and simulation. RealAudio provides music, news, and talk shows over the World Wide Web. Java is a programming language that lets Web page developers add software applications, games, animation, and other features to Web pages. Shockwave enables the playback of high-impact multimedia on the Web and Virtual Reality Modeling Language (VRML) describes how three-dimensional scenes are delivered across the World Wide Web (Serim & Koch, 1996).

The World Wide Web can be used to accommodate students with diverse styles in processing sensory information, such as visual, auditory, and kinesthetic learners (Ross, & Schulz, 1999). Visual students can benefit

from World Wide Web instruction that includes course animations, hypertext, or clickable diagrams and video clips. These images can clarify concepts that static textbooks cannot. Learners who have difficulty processing auditory information in a lecture could benefit from having the professor's lecture notes, slide presentations, or overhead slides online. Auditory learners can benefit from Web-based instruction by having professors record their lectures, record class summaries, or create archived sound resources and place them online (Ross, 1998). Kinesthetic learners can benefit from Web-based instruction by providing them with Java based puzzles, games and simulations. Providing a course listserv, bulletin board, discussion thread, or chat room can also accommodate collaborative learners (Ross & Schultz, 1999).

Lin and Davidson (1996) found that when using hypertext instruction, structure and cognitive style had a significant effect on student performance. Research has shown that learner control is an important factor when creating Web-instruction for diverse learning styles. Learner control is the amount of personal responsibility an individual can have in an instructional lesson. Learner control in Web-based instruction can be exhibited through sequencing, pacing, advisement level, practice, and amount of material (Rasmussen & Davidson-Shivers, 1998). In a study conducted by Rasmussen and Davidson-Shivers (1998), the influences of the individual differences in learning styles and the concept of learner control to assist instructors and developers in designing effective instruction for all learners were investigated. They hypothesized that learning styles can be used in conjunction with learner control to facilitate and enhance student performance in hypermedia learning environments. The study found that learning styles significantly influenced performance in hypermedia learning environments. Individuals who had a learning style preference towards active learning preferred low levels of learner control and performed best in the hierarchy structures. The hierarchical structures allowed students to quickly accomplish tasks, which fits the style of the active learner who prefers to complete tasks as quickly as possible. Individuals who were reflective in their learning style preference performed highest with moderate structure. The results show that reflective learners must have some structure but must also be provided with the ability to explore other related material. In addition, all learners performed well in an environment that provided moderate structure. This research suggests that environments with high levels of learner control may be counterproductive to all learning style types.

### **World Wide Web and Learning Styles**

World Wide Web technology has the capability of meeting the individual needs of a variety of learner types within each Web-based lesson. Much of the instruction taught in schools benefits the auditory and visual learners. Other learning style types are often not focused on in the classroom. Although research on Web-based multimedia instruction and learning styles is extremely limited, the following examples have been found that support the use of Web-based multimedia instruction for meeting the diverse needs of learners. For example, tactile learners gain and attain information when they are given hands-on activities (Dunn & Dunn, 1978). These students can respond well to game-like activities that are naturally motivating and self-correcting. Students can use the self-correcting features to discover correct answers through inductive and deductive learning (Bruno, 1982). An example of a game activity that can be beneficial to a tactile learner is the microworld. A microworld is an exploratory learning environment, discovery space, and constrained simulation of real-world phenomena in which learners can navigate, manipulate or create objects, and test their effects on one another (Jonassen, 1996). A study conducted by Stoney & Oliver (1999), explored the notion that students who learn in an applied setting, such as a microworld, will experience cognitive engagement and motivation through the relevance of the material to the student's real world. University students were selected and their activities, communication, and interactions were observed. Results found that the use of well-designed interactive microworlds leads to learner cognitive engagement and will drive learners towards greater levels of higher order thinking. The microworld game also provided motivation and engagement with the program content because it provided real life experience. The game helped learners to judge and assess the credibility of potentially conflicting information and to develop strategies to think critically, resolve conflicts, and solve current and potential problems.

The California State University Biology Labs On-Line Project (Bell, 1999) is a project that seeks to use technology for improving biology education. This project provides Web-based simulations for different Biology labs in which learners can access anywhere and anytime. Initial tests on the Biology project have suggested that the programs can be very useful learning tools. Students liked the way the simulations made them think, solve problems, and understand the breadth of the material better. The one disadvantage noted was that novice computer users require assistance to get the most out of the simulations.

An additional case study involving a college Engineering Graphics class, at the University of Texas, has used the World Wide Web to publish a comprehensive multimedia instructional CD-ROM Web page (Crown, 1999). The CD-ROM Web page consists of an integrated web site with links to hours of tutorial movies, lecture presentations, web-based games that reinforce course topics, and interactive web-based quizzes. The CD-ROM Web page was designed to make more efficient use of faculty time and to provide students with additional individualized

help. This project had many positive results on both faculty and students. Professors benefited by having their course lecture time reduced by eighty percent. Students who require extra help or need to make up work were able to catch up and perform well in the course. The visualization tools, provided in the games, offered students the opportunity to view objects repeatedly, which would be difficult to teach using other methods. Two noted drawbacks to the CD-ROM Web page include the high initial cost in time to develop the project and the fact that this environment has less student-to-student interactivity and is more impersonal than traditional classroom lab settings. The most notable changes in student performance were by those students that fell outside the average range. The advanced students were stimulated and motivated by the self-paced nature of the course and the students who found the material challenging were able to work at a slower pace and finish a course that they normally would drop.

### Conclusion

Little Research has been done on addressing multiple learning styles in Web-based instruction. The literature shows strong support for matching learning activities with students' preferred learning styles. Web-based instruction allows for the development of instruction that can meet a variety of learning styles. It can address multiple learning styles within the same instructional lesson. Therefore, it is hypothesized that students will perform better and learn more from properly designed Web-based instruction that meets the many individual learning styles of students, than Web-based instruction that is linear and text based. Since World Wide Web technology and multimedia software is capable of supporting instruction that appeals to a variety of learning styles, and research suggests that students must also be exposed to other non-dominant learning styles, a Web-based instructional lesson that accommodates multiple learning styles should be ideal for enhancing student achievement. When addressing the no significant difference phenomena, the research presented in this literature review supports that there are significant differences in student achievement, in a Web-based environment, when instruction is developed using theories on the way students learn. In order to look beyond the no significant difference phenomena, Web instruction must go beyond the technology and look into how the technology can be used to deliver instruction to all students, each unique in their experiences and in the ways they learn. Integrating learning styles research into Web-based instruction is one way that may show a significant difference in achievement in Web-based instruction.

### Application of Intelligent Agents in Web-based Learning Systems

How will the Intelligent Agents (IAs) and World Wide Web (WWW) architecture impact education in the future? Perhaps learning will resemble this imaginary encounter:

The twelve-year-old girl enters a room containing a wall display and an electronic unit about the size of the obsolete desktop PCs of a decade ago. Her "learning center" is a voice activated intelligent appliance linked directly to a database via the new Information Superhighway.

"Computer on," she commands.

The computer synthesized voice responds, *Good morning Genevieve. School was to begin 27 minutes ago. Are you ready?*

"Yes," she replies rather unenthusiastically.

*I recommend beginning with Statistics. You are now one week behind your agreed schedule,* the course management agent continues.

"Great!," the girl responds with even less enthusiasm than before.

*I'm sorry. Is that an affirmative Genevieve?*

"Yes"

The display screen next shows the animated face of a dog wearing glasses (the girl's creation). *Genevieve, good to see you. Your reflective time is over. Are you ready to review your last exam?*, the animated persona smiles with lolling tongue awaiting the girl's voice response.

"Not really, but OKAY Topper" (The girl's name for her animated tutor). She smiles as she emphasized the command word "okay."

*You completed 30 of 50 questions correctly,* Topper continues.

"I figured as much"

The animated persona looks quizzical and responds, *Yes. Well, it appears that you are having difficulty relating the concept of the normal distribution to the concepts of standard deviation and confidence intervals. Do you want to review the material or try a new approach.*

"I'll try the new approach." And the lesson begins.

At what point in the future will technology and software combine to produce the scene above? As prototypes and experimental models, this future is already here.

### **Alan Turing and Moore's Law**

In a 1950 article, *Computing Machinery and Intelligence*, mathematician Alan Turing posited the question, "Can a Machine Think?" (Hodges, 2000). To Turing the question was: "If a computer could think, how could we tell?" He considered that if the computer's responses were indistinguishable from that of a human, could the computer be said to be thinking. Turing set a standard for determining intelligence or thinking by making a prediction. He postulated that within fifty years (i.e., the year 2000) an average person would not have more than a 70 percent chance of distinguishing between a computer or human responding to five minutes of questioning. Turing's imitation game has now become known as the Turing Test. In 1990 philanthropist Hugh Loebner agreed to underwrite a contest to implement the Turing Test. The contest is conducted each year by The Cambridge Center for Behavioral Studies ( <http://www.loebner.net/Prize/loebner~prize.html>). A grand prize of \$100,000 and a Gold Medal will be awarded to the first person constructing a computer that passes the Turing Test. Although this prize has yet to be claimed, each year an prize of \$2000 and a bronze medal is awarded to the individual constructing a computer program offering the most "human" responses.

In addition to software advances required to pass the Turing Test technology must also progress. Moore's Law is based on the observation that the logic density of silicon integrated circuits follows a mathematical curve. According to its author Gordon Moore (who co-founded Intel) the amount of information storable on a given amount of silicon has roughly doubled every year since the technology was invented. In the 1970s the rate of doubling slowed to 18 months, and Moore predicted that natural limitations would invalidate the "Law," but not until 2017 (Kanellos, 1997).

In a broader view both the Turing Test and Moore's Law are illustrative of the first steps toward an ideal where economical intelligent machines serve the needs of the individual. This paper will examine the development of intelligent agents and forecast applications for education deliverable on the World Wide Web (WWW).

### **Intelligent Agents**

'Intelligent agent' as a concept has been around for about 25 years. An agent is a software entity that has some degree of autonomy, carries out operations on the behalf of a user or another program, and represents or has knowledge of the user's goals and wishes. Definitions approach intelligent agents based on how the term "intelligent" is defined. Science fiction genres tend to associate intelligent software with human-like emotional and mental processes such as knowledge, belief, intention, and obligation (Coen 1994). Utilitarian definitions of intelligent agents focus on a particular software's ability to function in some complex dynamic environment, and to sense and react autonomously to achieve a set of behaviors. Intelligent agents can also simulate worlds and operate in those simulated worlds interacting with the users and other agents. Information agent software searches multiple databases to retrieve, collate, filter, and organize information to answer queries from users (Shoham, 1993). A list of attributes of agents, not all of which need to be present in an agent, are:

- Autonomy – ability to operate without the direct intervention of humans;
- Social ability – can interact with other agents or humans by providing assistance to users dealing with another agent;
- Reactivity - have perception of their environment which allows timely response to changes that occur in it;
- Proactivity - exhibit goal-directed behavior (initiative);
- Mobility - can move to other environments;
- Reusability - agent algorithms run continuously;
- Adaptivity – will automatically adapt to changes in their environment; and
- Synergism - higher level of interoperability is made possible through the interaction of agents and humans as a system (Shoham, 1993).

There are many categories that research on intelligent agent systems and similar software applications have been subdivided. For example, adaptive learning systems, artificial intelligence, artificial life, biocybernetics, cognitive and neural modeling, evolutionary computation, fuzzy systems, genetic algorithms, knowledge-based systems, multi agent systems, neural networks, parallel and distributed computing, self-organizing systems are terms associated with the above attributes for intelligent agents. Furthermore, each of these categories is being researched for applicability to learning on the WWW.

### **Intelligent Agents and Tutoring Systems on the WWW**

With the World Wide Web becoming an increasingly important platform for the delivery of educational content, instructional designers and researchers in artificial intelligence are reconsidering architectures that were

developed for stand-alone computer or local network applications (Ritter, 1997). Intelligent agents are being developed for many of the new applications (Johnson & Shaw, 1997). Areas of intelligent agent research that show promise for educational applications deliverable through the WWW are briefly described in this paper.

### **Intelligent Agents Used for Database Management and Information Retrieval**

The WWW can be viewed as an extremely large database. This database is composed of heterogeneous documents that are accessed via a wide-area network (WAN) and a client-server protocol. These documents (nodes) are connected by hyperlinks. To retrieve information hyperlinks must be navigated and navigation becomes extremely difficult in the three-dimensional structure of the WWW (De Bra & Post, 1994).

Intelligent agents have the potential to search the vast volume of information on the Web in ways that are only now being explored. Agents have advantages of (1) robustness – available 24 hours a day, seven days a week, (2) speed – transmit information within seconds, and (3) value adding – the more sophisticated the agent in terms of design for ability to discover relevant information the more tangible the benefit from the information (Etzioni, 1999). Etzioni and colleagues at the University of Washington are researching and designing Internet Softbots (intelligent agent software) that will enable a user to specify personalized *wants*. The Softbot is designed to calculate the *how* and *where* to satisfy the request. Etzioni uses the metaphor of a food chain or pyramid to visually describe the role that a discriminating information agent would play in this new information “ecosystem” of the WWW. Developmental work is also being done by Etzioni’s group on adaptive Web sites that automatically reconfigure their layout and presentation by analyzing user access patterns recorded in their server logs (Perkowitz & Etzioni, 1997).

### **Intelligent Agents and User-Friendly Interfaces for Databases**

The use of an animated persona to communicate information has recently caught the interest of the news media. The highly publicized virtual newscaster Ananova (Hopper, 2000) is an example. Using streaming video Ananova provides the latest headline news. Facial expressions are cued by XML (eXtensible Markup Language) tags that are added to the script. Digital Animations Online (<http://www.digital-animations.co.uk/>) is the creator of Ananova.

*Customizable animated intelligent agents.* Customizable animated intelligent agents are available to Web developers to enhance the commercial value of a Web site. These virtual personalities can assist a visitor to the site in identifying products, guiding the visitor through product features and benefits, or even making the “sales pitch” and closing the sale. The animated persona can interact with the user by answering queries including the display of facial features ascribed to various human emotions. Animated personas are proposed by their developers as adaptable for use by educators.

### **Intelligent Agents Facilitating Collaboration in Online Courses**

A significant problem experienced by students (as well as causing concern for instructional designers of online courses) is how to facilitate collaboration in a largely asynchronous environment. Typical problems expressed by students working as groups in a face-to-face environment are “lack of time, lack of skills and members not contributing” (Whatley, Staniford, Beer & Scown, 1999). These problems are made more manifest in collaborating groups separated geographically (Johnson, Aragon, Shaik, & Palma-Rivas, 2000). In order to facilitate collaboration intelligent agents are able to support planning through task allocation, progress monitoring, and problem flagging (with communication with the individual student as well as with the agents of other students).

O’Riordan and Griffith describe a multi-agent system design where several intelligent agents that the authors believe will overcome specific web-based education shortcomings in the areas of peer-peer learning, static content, and personalized learning (O’Riordan & Griffith, 1999). Their system design focuses on a User Modeling Agent that maintains the student profile. The profile consists of material covered and how fast it was covered, quiz score, frequency of links visited, and use of an FAQ section. Collaborative groups are based on multiple profiles.

*Intelligent tutoring systems.* An Intelligent Tutoring System (ITS) is designed to simulate what occurs between a student and teacher one-to-one. ITSs typically have four components: (1) an intelligent interface (communication), (2) a knowledge domain, (3) an instructional module, and (4) a student model (representing the student’s current state of knowledge). Student modeling has been the most difficult due to the learner uniqueness and individual learning styles (Stern, 1997).

Most models of student behavior commonly used with intelligent tutoring systems (ITSs) or not designed to deal with such human inputs as inconsistency, incompleteness, and ambiguity. Often this “fuzziness” of human input results in an inability of the ITSs to correctly evaluate student answers. Huang approached this problem by developing a model that incorporates fuzzy set theories and two-dimensional (Hasse) diagrams to provide more accurate feedback to incomplete student answers (Huang, 1999). The learning agent captures inconsistent behaviors of the student. A student’s inconsistent response, for example, triggers the learning agent procedure that uses an inconsistency identifier. The inconsistency identifier is based on a heuristic, such as on the same or similar question

the student's answer is now incorrect. The feedback from the learning agent then displays features of the inconsistencies and provides suggested strategies to prevent the behavior from happening again.

*Animated pedagogical agents.* Animated pedagogical agents are designed to facilitate learning in computer-based instruction, and also have been applied to Web-based intelligent tutoring systems (Rickel & Johnson, 1997). Typically, animated agents have personas that can exhibit emotive-kinesthetic behaviors responding to user input within the program (Lester, Stone & Stelling, 1999). Pedagogical agents are built upon ITS research, but have the added requirements of coordinating the agents behavior with personality cues that relate to student input (Lester, Towns & FitzGerald, 1999). Animated agents can provide real-time advice that supports a learners' problem solving activity, but can also exhibit contextually appropriate emotive behaviors such as facial expressions and gestures. Lester, *et al* identify two key problems with representing emotive behaviors are conversational believability and emotive believability, and have developed a dialogue mapping framework to achieve conversational believability and full-body emotive behaviors in response to learner problem solving activities to achieve increased emotive believability.

An example of a prototypical animated intelligent agent is was developed by Andre, Rist, & Muller (1997). Their agent did not involve speech, but with animated gestures and text interacted with the user. One unique feature of their animated agent was that the presentation scripts and navigation structures were not storied, but generated just-in-time from pre-authored document fragments.

Adele (Agent for Distance Education) is an example of a more sophisticated animated pedagogical agent developed by researchers at the Center for Advanced Research in Technology for Education (Shaw, Johnson & Ganeshan, 1999). Adele was specifically designed to support online students in problem-solving exercises with a simulated patient in a clinical setting. Students are able to ask questions regarding the simulated patient's medical history, perform a physical examination, order diagnostic tests, and make diagnoses. Adele also provides the student feedback relative to the actions chosen by the student in the form of suggested correct actions, or hints and rationales for particular actions with reference to relevant background material. In this autonomous agent design, Adele consists of two sub-components: the animated persona (a Java applet) and the reasoning engine. The reasoning engine performs all monitoring and decision making activities. Decisions are based on a student model, the case design, and the initial state of the case. All this information downloaded from a server when as the student selects the case. Initial student evaluations of Adele concluded that the hints and rationales provided by the animated agent were helpful, but not complete. However, this appeared to be a function of the students not interacting with the persona, for example, asking "Why?" The agent was capable of accessing more authored knowledge. This problem was remediated by allowing the agent to provide more of an explanation.

## **Conclusion**

The significance of intelligent agent systems on the WWW will probably eventually be best understood in the context of a paradigm shift. The combination of technology in terms of software and hardware, and the delivery and accessibility afforded by the WWW, is creating an environment of change. The impact of change on institutional or traditional education is in the infancy of exploration.

Web-based educational systems represent an area that growing exponentially with educational technology research and software development leading the way. Pedagogical aspects such as instructional design theories and models have lagged behind (Tergan, 1997). In many respects the situation facing educators is similar to the company that designs a product and goes out to find a market for it. The technology is driving the process and instructional theory and design are attempting to "find the market."

This situation may be due to the fact that much of the developmental research work on Web-based IA software being done for commercial objectives. Major efforts in IA research and design are directed toward e-commerce applications on the WWW. Software agent technologies are being investigated to expedite the electronic commerce revolution. E-commerce development issues, such as distributed component-based marketplaces, protocols for locating and defining goods and services, value-based product comparisons, buying decision aids, visualization of marketplace data and activities, have pedagogical counter-parts in education.

Intelligent agent systems that support student collaboration, support problem solving, and explain errors will certainly be a first step. How will Web-based distance education benefit from this development? The development of quality databases on the WWW coupled with the development of intelligent agent software that can retrieve personalized information. Will a student having greater access to knowledge be a better learner? What instructional designs will be necessary? Are animated personas described in this paper, that guide a student through a lesson or topic, an advantage to learning or a distraction? Opportunities abound for the researcher in both the design and in the development of instructional models that incorporate intelligent agents and the WWW.

## Summary

The four approaches presented here support the need for continued exploration of distance education from new perspectives. The use of CAI is not new. However, the use of CAI as the technology of choice for distance education in the K-12 setting has potential. CAI's capabilities of individualizing instruction and providing asynchronous instruction combined with the richness of the World Wide Web need further exploration as an effective and cost efficient means of providing access to educational opportunities for K-12 students.

More studies into learning styles of distance learners are needed that control for the problems identified in the current literature in this area. Sampling needs to be moved from simply relying on convenience sampling. In addition, standardized instruments need to be developed to examine this learner attribute. Designer's of distance education need to address the needs of the dependent learner and student support services developed to assist these learners in having success in the distance education environment. When reviewing learning styles and web-based instruction, there appears to have been little research. From a design perspective can and should web-based instruction be designed in such a way to accommodate all learning styles?

New technologies are constantly emerging. How will the use of intelligent agents impact the learning environment particularly distance education? Instructional technology has a tendency to lag behind technology advancements. Exploring the utilization of intelligent agents to support student collaboration, problem solving and provide assistance in the distance learning environment would be one step toward closing the gap.

Certainly, thinking of distance education research only in terms of the no significant difference does not represent the wealth of research that is occurring in the field. However, as researchers we can do more by looking beyond the conventional, looking at new uses for current technologies, and exploring the potential of emerging and future technologies.

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# Identification and Analysis of the Leading Journals in the Field of Educational Technology: A Guide for Reading and Writing about Educational Technology

Nancy J. Maushak  
Robert Price  
Hsi-Chi Wang  
Texas Tech University

## Abstract

*This article reports on a study conducted to identify and analyze the content of the five leading journals to assist those reading, teaching and publishing in the field of educational technology. Email was used to contact professionals in the field. They were asked to identify the top five journals in educational technology. Results were summarized then the leading journals were reviewed for content and number of articles. ETR&D was identified as the leading journal in the field. The content and type varied from journal to journal based on the overall goals and intended audience of the journal. Suggestions for writing and publishing are included.*

## Introduction

Research, teaching and service continue to be the three pillars supporting recognition, promotion and tenure in the academic world. For many, the greatest contribution is research. Research, theory and changing paradigms must be communicated to the field in order to make a positive contribution. This is as true for educational technology as it is for other academic areas. Publication therefore becomes a primary role for the novice as well as the experienced professor and for the graduate students they mentor.

The process of publication seems at times almost mystical. Young professionals tend to be intimidated by the whole idea, especially the prospect of rejection. They view successful scholars as possessing great wisdom and intellect when in reality they could be more accurately characterized as persistent, systematic and, sometimes, just plain lucky!

This article provides a background of the literature in educational technology related to publication and presents results of an informal study which identified and analyzed the top ranked journals in the field. This information should be of use to both novice and experienced scholars and as they share their research, knowledge and expertise in the field of educational technology.

## Background

Publication has always been and continues to be of great interest for scholars, researchers, and graduate students because it is the road to making a contribution to the field and contributing to their personal goals of professional advancement. A review of the literature related to publishing in the educational technology field yielded some interesting findings.

Ninety percent of the articles identified discussed general publishing principles. Thompson (1995) compiled a what-to-do list, and Newren (1992) contributed a list of major causes of rejection for writers to consider before and after they send in their manuscripts to a journal publisher. Abelson (1990), the editor of the journal *Science*, talked about his experiences in evaluating submitted manuscripts. He believed in the value of peer review, and tried to caution writers to beware of any unethical behaviors such as plagiarism.

Newren (1992), Thompson (1995), Clemente, Shapiro, Miheim, and Bohlin (1990) each summarized vital information of the many different journals in the educational technology field. Types of information presented included contact information, acceptance rate, readership, decision time, publication time, etc. These summaries are useful for prospective authors to help them familiarize themselves with different journals in order to more effectively select a journal for manuscript submission. Yet, not one of these articles examined the types or topics of the articles actually published in the journals. Thompson (1995) suggest that all perspective writers should look into the matter of finding the types and topics patterns in addition to identifying the guidelines for authors of the journal they have selected to send their manuscript. This step is vital to the process of getting a manuscript accepted by the specific journal.

The review of previous articles related to scholarly publication in the field of educational technology identified a need for a study that identified information about types and topics of articles in the top ranked

educational technology journals to assist scholars in selecting the best match for their manuscript and to help them recognize the current trends and future direction in educational technology. This study attempts to fill that need.

## Methodology

An email survey was used to identify the top five journals being read by educational technologists. Websites of nine schools with nationally recognized programs in educational technology were used to identify faculty in the field. An email message was sent to 85 faculty members asking them to list in rank order the top five journals. In addition, they were asked to respond with one piece of advice for those just starting to write for publication.

An analysis of the 1998-1999 issues of the top journals was conducted to identify the average number of articles per publication, general types of articles, and topic categories of articles. Four categories for classification of journal articles were identified by Klein (1997) in a review of *Educational Technology Research and Development*. These categories included case study, description, empirical research, and literature review. For this study, these categories were revised to include descriptive, research, book review and editorial articles.

Topic categories of articles emerged from the analysis conducted by two researchers. Categories were not exclusive but topics were placed under the theme that best reflected the intent of the article. Four broad themes emerged from the review: design, environment, student, and teacher. A fifth category (other) was used for additional topics that either encompassed several categories or seemed to fit none of the emergent themes.

Where possible, actual copies of the journal were used for review purposes. The use of on-line databases including ERIC and Education Abstracts facilitated the review process.

## Results

A total of 30 responses were received to the email survey with each school represented by at least one faculty member. Five of the responses simply indicated the individual was no longer in the field or had moved to another institution. Responses from the remaining 25 (31% response rate) were summarized to identify the top five journals. A total of 31 different journals were identified. *Educational Technology Research and Development (ETR&D)* was ranked first or second by 18 of those responding.

### The Big Five

To identify the top five journals, responses were assigned values based on rank. The number one journal listed by an individual received a score of five with others in descending order. Scores across all responses were summed and journals with the highest values were identified. The top five journals in order with their scores were:

<i>Educational Technology Research and Development</i>	91
<i>Performance Improvement Quarterly</i>	35
<i>Educational Technology</i>	31
<i>Journal of Educational Computing Research</i>	29
<i>Instructional Science</i>	28

### **Types and Topics**

An understanding of the number of issues and number of articles published on a yearly basis can be one factor in selecting a journal for publication (Table 1). Three of the five top journals are published quarterly. In the subscription information, *Instructional Science* indicates it is published six times a year. A review of the actual citations and abstract seems to indicate that while six numbers are used for each volume, only four actual publications could be located. Numbers 1 and 2, and numbers 3 and 4 for both 1998 and 1999 were found to be combined into one issue.

All articles including introductions to special issues and book reviews were counted. The average number of articles per year per journal varied from a low of 25 to a high of 62 (Table 1). Similarly, the average number of articles per issue varied from just under six for *Journal of Educational Computing Research* to almost 10 for *Educational Technology*.

Table 1: Summary of Average Number of Articles per Issue of the Top Five Journals.

Journal	Number of issues per year	1998 articles	1999 articles	Average per issue
<i>Educational Technology Research and Development</i>	4	36	40	9.5
<i>Performance Improvement Quarterly</i>	4	37	40	9.6
<i>Educational Technology</i>	6	57	62	9.9
<i>Journal of Educational Computing Research</i>	8	49	43	5.8
<i>Instructional Science</i>	4 (6)*	25	31	7

\*Publisher indicates six issues are published yearly, however issues 1-2 are combined as are 3-4 resulting in only 4 publications a year

Simply knowing the numbers of articles per publication is not enough to select a journal for publication. It is also important to know what types of articles are generally published. Four general categories (Descriptive, research, editorial, and book review) were used to review all five journals. Descriptive articles had the greatest diversity and included description of theory, practice, models, curriculum, etc. Research encompassed articles reporting empirical research (both quantitative and qualitative) and evaluation. Introductions and conclusions to special issues were included in editorial articles.

Our review indicated that descriptive articles were in the majority and articles reporting results of research were second (Table 2). Three of the top five appear to have a good balance between research and description though all three publish more descriptive articles than research articles. *Educational Technology* focuses almost exclusively on descriptive articles and the *Journal of Educational Computing Research* leans heavily toward publishing more research articles.

Table 2: Summary of Types of Articles

Journal	Descriptive	Research	Editorial	Book Review
<i>Educational Technology Research and Development</i>	40	27	7	4
<i>Performance Improvement Quarterly</i>	43	22	8	2
<i>Educational Technology</i>	109	9	1	0
<i>Journal of Educational Computing Research</i>	15	63	1	13
<i>Instructional Science</i>	33	20	6	0

The third factor we looked at when reviewing the top five publications related to topics. A constant comparative method was used to identify themes of article topics. The four emergent themes were design issues, environment issues, student attributes, and teacher concerns and attributes. The following section presents a summary of article topics organized by journal. An overview of each journal presenting mission and goals, and subscription information is also included.

#### *Educational Technology Research and Development (ETR&D)*

ETR&D is a scholarly journal published quarterly by the Association for Educational Communication and Technology (AECT). Each issue includes two sections: one devoted to research, both practical and applied, and one to design and development issues. Issues frequently include book and international reviews as well as research abstracts ([http://www.aect.org/Pubs/etrdweb/etr\\_d.html](http://www.aect.org/Pubs/etrdweb/etr_d.html), July 12, 2000). *Cabell's Directory of Publishing Opportunities in Education*, 5<sup>th</sup> Edition (1998) indicated ETR&D had a circulation of close to 5,000 and an acceptance rate of 11-20%.

Volumes 46 and 47 of ETR&D, a total of eight issues, were reviewed for this study. The large number in the design category are representative of the development section of the journal. Several sub-theories of design emerged including:

- Theory and models (systems theory, ARCS model, constructivism, activity theory);
- Media and attributes (authoring systems, multimedia, ILS, digital manipulatives);
- Design principles (needs assessment, evaluation); and
- Learning and cognition (knowledge management, user-design, cases, cognitive approach, design experts).

The primary topic under environment issues was interaction. Interaction related topics included learning communities, cooperation, and electronic classrooms. Other environment topics were accessibility, support and organizational complexity. Student attribute topics included achievement, recall and transfer, preferences, and reflection. Topics related to teacher focused heavily on teacher preparation but also looked at planning, methods, management, and support issues.

Because of ETR&D's focus on research, the prime category that did not seem to fit any of the themes were topics related to research issues. These topics related to changing paradigms and theories, and research methodologies.

#### *Performance Improvement Quarterly* (PIQ)

Bob Mager on the PIQ website (<http://www.fsu.edu/~lsi/piqweb/>, July 12, 2000) provides insight into the focus of PIQ with the following quote:

Serious researchers in various corners of performance technology will find PIQ a scholarly source of current research by some of their more notable colleagues. Practitioners will find thought-provoking reports about leading-edge ideas and techniques that may influence their practice. If you're serious about performance technology, you should be reading *Performance Improvement Quarterly*.

PIQ is a quarterly publication of the Learning Systems Institute of Florida State University in cooperation with the International Society of Performance Improvement.

Volumes 11 and 12, numbers 1-4 of *Performance Improvement Quarterly*, a total of eight issues were reviewed for this study. There were three special issues during this time: global distance learning, diversity, and action learning. These topics also appeared in the regular issues.

It was more difficult to fit the topics in *Performance Improvement Quarterly* into themes. The focus of these articles was on the corporate/business environment. Articles related to instructional design were featured in almost every issue. A variety of ID models were described and research results related to emerging models of design were presented. Environment related issues also appeared prominently. The distance learning environment was featured frequently and included topics related to international distance learning, delivery systems, history and definitions. Student issues included performance/achievement, transfer, perceptions, and lifelong learning. Little coverage was given to teacher topics. Cost benefit and analysis appeared frequently as did topics related to diversity.

#### *Educational Technology*

*Educational Technology* is a bi-monthly publication with a readership of 3000-4000. Manuscripts are reviewed in-house with an acceptance rate of 21-30% (Cabells, 1999). This journal does not focus on research articles but has a more general slant. "The editors are looking generally for articles which *interpret* research and/or practical applications of scientific knowledge in education and training environments" (<http://www.lbcovote.com/resource/pub/edutech.html>). A big plus with this journal for authors is the turn around time. Notification of acceptance is usually only a couple of weeks versus the months of waiting that accompany submission to other journals.

Volumes 38 and 39 were reviewed for this study. One special issue "Integrating cognition and affective domains of learning" was identified; and two special sections: "Return on investment in educational technology" and "Intelligence tutoring and learning environments". The articles included in *Educational Technology* have a more conversational tone than the articles found in the other journals reviewed for this study. Articles also tended to be shorter and included a greater variety of topics and viewpoints.

Design and environment themes tended to dominate. Design sub-categories were similar to those found in ETR&D, however the topics included in the sub-categories were more varied. Examples include:

- Theory and models (systems model, social systems, interactive model, conversational paradigm, alternative paradigms, postmodernism)
- Media and attributes (PowerPoint, multimedia, simulations, expert systems, ILS, games, WWW, screen design)
- Design principles (usability, feedback, planning); and
- Learning and cognition (independent learners, affective domain, discovery learning).

Environment interaction issues focused on the virtual classroom, virtual events, online education, community of practice, and international collaboration. Other environment topics included educational reform and specific environments of distance learning and Internet.

Student themes fell into two categories: learning and achievement including future skills and information literacy skills; and characteristics such as gender differences, mental models, and self-regulation. Few article topics

seemed to address teacher issues or characteristics. Other topics included in *Educational Technology* were systemic change, diversity, federal policy, and future visions.

#### *Journal of Educational Computing Research*

Baywood Publishing publishes this journal eight times a year. Articles include both practice and theory with an emphasis in four broad areas: 1) outcome effects of educational computing applications, 2) design and development, 3) research, and 4) foundations in educational technology (both theory and historical).

The Journal's editors view the term "education" in its broadest sense. The use of computer-based technologies at all levels of the formal education system, business and industry, home-schooling, lifelong learning and unintentional learning environments, are examined.

(<http://www.baywood.com/site/new2/viewbook.cfm?id=100133&c=>, July 12, 2000)

According to Cabell's (1998), the *Journal of Educational Computing Research* has a readership of approximately 1000 with an acceptance rate of 11-20%.

The primary theme that emerged from a review of the topics in volumes 18-21 of *Journal of Educational Computing Research* was student attributes. Three sub-categories were identified:

- Student learning (achievement, prerequisite skills, critical thinking and problem solving);
- Learning and cognitive styles; and
- Characteristics (attitudes, perceptions, anxiety, self-efficacy, gender differences).

While student themes dominated, the other three themes were well represented. Design topics focused on theory and models and media attributes. Interaction and cooperation were the leading topics related to environmental issues. Teacher attribute topics included perseverance/confidence, learning styles, and beliefs.

Additional topics included culture and social/ethics issues. Both culture from a technology environment viewpoint and an international viewpoint appeared in many issues. Social/ethic issues included equity, access and copyright issues.

#### *Instructional Science*

Unlike the previous journals, the focus of this journal is not on technology but on learning. *Instructional Science* is an international journal of learning and cognition published six times a year by Kluwer Academic Publishers. "The primary aim of *Instructional Science* is to promote a deeper understanding of the nature, theory and practice of the instructional process and of the learning to which it gives rise." (<http://www.wkap.nl/journalhome.htm/0020-4277>, July 12, 2000).

We reviewed eight issues of *Instructional Science*, Volume 26 Number 1-6 and Volume 27 Number 1-6. The numbering system used is misleading. Number 1 and 2 were included in one publication as were numbers 3 and 4. In the two-year time period there were four special issues: generic tutoring environment (GTE), metacognition, use-system interaction, and didactics. Each special issue included at least one editorial as an introduction to the special issue and some also included concluding comments.

Topics reviewed student issues/attributes and design issues. Student topics included:

- Achievement including performance and vicarious learning;
- Characteristics (self-regulation, motivation, reactions, attitudes, cognitive styles); and
- Processing (metacognition, knowledge construction, cognitive processing).

Tools to assist in the design process, such as authoring tools and newly developed design software, were included in design issues. Also included in this theme were specific media and media attributes such as user-interface. Environment issues and teacher issues received limited attention.

#### **Summary of Journals**

ETR&D received overwhelming support as the leading journal in the field of educational technology. The average number of articles included in each issue was 8.5. The types of articles and topics covered varied greatly from journal to journal and appear to be dependent on both the mission of the journal and the intended audience. Authors should carefully review journals to identify those that most closely match the content of their article and the audience they are trying to reach. Journals should also be reviewed to identify the dominant writing style and take that into consideration when selecting a journal for publication.

#### **Advice for Authors**

The second part of the email survey focused on the process of writing for publication. A review of previous articles on writing for publication in the field of educational technology seemed to focus on identifying and targeting a journal and the submission process. Newren (1992) contacted editors and summarized the many causes for rejection. Both Clemente, et.al. (1990) and Thompson (1995) emphasized the need to concentrate on writing style, targeting a journal and following submission guidelines.



This survey was interested in more personal suggestions. Frequently the most difficult part of writing is the process. While not all individuals responded to the call for suggestions for those beginning a publication career, the suggestions that were received focused more on the process of writing rather than the submission. Twenty individuals responded to “What one suggestion would you give a doctoral student or faculty member just beginning his or her writing for publication career?”.

Three themes seem to emerge with analyses of the responses: work with a mentor, believe in yourself and what you are researching, and write frequently. Several suggested that the individual just getting started work with a mentor or collaborates with a faculty member.

*“Apprentice under/collaborate with a faculty member who has established an understanding of the processes, strategies and priorities of publishing scholarly research.”*

*“Find a mentor willing to read your papers and provide you with constructive criticism prior to submitting them for publication.”*

Others felt it was important to not only believe in what you are researching but to believe in yourself.

*“Believe in yourself and believe that your ideas and your information are good. People just starting out tend to think that everyone else in doing great things but that their own work is trivial...that’s a shame because so many people are doing great, interesting things but they never share it with anyone because they are embarrassed or they don’t think it’s good.”*

Still others felt that it was important to concentrate on one or two projects at a time and to write every day.

*“Write every day. Work on thins slowly and steadily over time, reserving the most creative and productive time of day for writing time.”*

Certainly paying attention to detail and selecting an appropriate journal for submission are important. However, there is more of a personal side to the writing process and this was emphasized by those responding. Attitude and persistence are important. Making time for writing, not simply “finding” time, and collaborating with others are instrumental in becoming a successful writer. Perhaps, most important of all is belief in yourself and what you are writing. With the fast changing world of technology, exciting research is going on and all have something important to contribute to the discussion.

## **Conclusion and Recommendations**

The purpose of this study was to identify and analyze the leading journals in the field of educational technology. While the top five journals all examine technology, they represent disparate views in the field and address a wide audience. The journals are all unique in their goals and mission, writing styles, and intended audience. Certainly, anyone in the field of educational technology would benefit from reading any of these journals but would gain a much broader and more balanced sense of research, theories, and visions from reading several. Collectively they provide a wealth of information to assist the researchers in identifying problems and areas of study needed to make a contribution to the growth of the field of educational technology.

In some cases, the topics presented in the articles are very similar. However, an article on distance education, for example, would need to be written quite differently to submit to *ETR&D* than to submit to *Educational Technology*. The general summaries presented here serve only to provide a concise look at the myriad of possibilities for publication in the field of educational technology. It is imperative that those preparing manuscripts actually review the journal they have selected for submission

It should also be noted that research articles do not constitute the majority of published articles. Frequently, novice writers make the false assumption that only results of empirical research will be published. There are many opportunities for publication of articles describing projects, special instructional methods, new models and paradigms, and future visions. Topics are only limited by the experiences, imagination, creativity and interest of the writer.

Practice in writing, as with all things worth doing, is important. The experts represented in this study as well as colleagues we have visited with indicate the importance of writing on a regular basis. Frequently, in the day to day workday, other activities take precedence over writing. Time should be blocked out for writing as a scheduled activity and care should be taken to guard and use that time to polish the skills needed for successful writing.

In summary, while the response rate to the email survey was lower than hoped for, the responses did represent what practitioners in the field of educational technology are reading and which journals were most respected by a broad group of leading professionals in the field. *ETR&D* was emphatically identified as the leading journal in the field of educational technology. Broad categories of topics emerged from a review of the top five journals. These categories (with some examples) include:

- design issues (models, theory, principles, media, and media attributes);
- student issues/attributes (achievement, learning styles, attitudes, perceptions);
- environment issues (interaction, collaboration, international); and
- teacher issues (pre-service teacher, confidence, attitudes, methodology).

Dissemination of research in educational technology is the responsibility of all professionals in the field. Publication in recognized journals contributes to the growth and recognition of educational technology. The information discussed in this article provides a base for selecting a journal for publication. It is up to each individual author to provide the personal side of creativity, dedication, and perseverance.

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# **Preparing Teachers for the Inclusive Classroom: A Preliminary Study of Attitudes and Knowledge of Assistive Technology**

Nancy J. Maushak  
Pat Kelley  
Teresa Blodgett  
Texas Tech University

## **Abstract**

*The purpose of this study was to examine current attitudes and knowledge of pre-service teachers towards assistive technology and to develop, implement, and evaluate a mini-workshop on assistive technology to better prepare regular classroom teachers for the inclusive classroom. A pre-post survey design was used. Data from the pre-survey provided demographic information as well as documenting current attitudes and knowledge. Participants were 168 students enrolled in a computer applications course for elementary teachers. A mini-workshop on assistive technology was presented by experts in the field. Data was analyzed to determine impact of the mini-workshop on attitude and knowledge and to detect differences based on completion of a diversity course, having a disabled family member and having a disabled friend. Results indicated a continued need to include assistive technology under the broader umbrella of technology in teacher preparation programs.*

## **Introduction**

During the past decade, the demand for technology literate teachers has increased dramatically. Both the government and the public support the need for excellence and equity in technology integration, though, funding opportunities to support technology related professional development have focused on the in-service teacher. Technology experiences for pre-service teachers have centered around one basic class, usually computer based, and limited modeling by a few innovative methods instructors. The content of the basic course, too frequently, focused heavily on computer skills and minimally on integration of technology. Little if any reference was made to assistive technology and appropriate application in the regular classroom.

This paper presents the results of a preliminary study to evaluate the use of a mini-workshop on assistive technology presented by special education experts intended to assist pre-service teachers in developing an awareness of the variety of assistive technologies available and the teacher's role in using these devices or equipment in the regular classroom.

## **Background and Purpose**

Mention the word technology to someone today and the first thing that comes to mind is computers and the World Wide Web. However, when it comes to education, that is too narrow of definition. In teacher preparation programs, students used to be required to take a media class that addressed a variety of technologies from 16mm films to overhead projectors to computers. Because of the technological advances in the past ten years, these classes have evolved to where the primary focus is currently on computer use and curriculum integration. Students have little exposure to other effective and appropriate technologies that can be used in the regular classroom to promote and enhance teaching and learning. One major category of technologies has been virtually ignored, assistive technology.

First, it would seem appropriate to provide a definition of assistive technology or AT. The following definition appeared in the Technology-related Assistance for Individuals with Disabilities Act of 1988 or the Tech Act (P.L.100-407) and has been adopted in the Individuals with Disabilities Education Act (IDEA, 1990). Assistive technology is "any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities." [20 U.S.C. Chapter 33, Section 1401 (25)]. As you can see, this definition is broad and can encompass a range of devices from low technology to high technology items as well as software. It certainly expands the interpretation of technology beyond the computer to include even simple tools that can be used to enhance learning for all individuals.

The 1997 reauthorization of the Individuals with Disabilities Education Act (IDEA) mandated that students with disabilities learn and be evaluated with their peers (Goldberg, 1999; Derer, Lewis, & Rieth, 1996; Lewis, 1998). With this mandate, more school districts are implementing inclusion of students with disabilities into the

regular classroom. This in turn has created greater need for awareness of instructional methods and assistive devices to help these students become a productive member of the classroom with a minimum amount of disruption.

Previous research in the area of assistive technology and teacher preparation appears to be very limited (Derer, Polsgrove & Rieth, 1996). There was discussion of the needs in this area and some suggestions as to how to address this need, however, very few of the articles reflected an actual implementation of in-service and pre-service training in assistive technology for administrators, teacher and other school personnel. For example Bryant, Erin, Lock, Allan and Resta (1998) discussed the need for higher education faculty responsible for special education teacher preparation programs to explore ways to better prepare teachers to work with students using assistive technology devices but did not address this same need for “regular” classroom teachers.

In the inclusive classroom, assistive technology can provide support for both students and teachers (Mebler, Hadaian & Ulman, 1999). However, in order for this to happen both the student and the teacher must understand and know how to use the devices. Planning and policy at all levels, (classroom, school and district) are essential to achieve this.

It appears that regular classroom teachers are not currently receiving knowledge and skills related to assistive technology. One way to address this need is at the pre-service or teacher preparation level. The International Society for Technology in Education (ISTE) is the professional education organization responsible for recommending guidelines for accreditation to National Council for Accreditation of Teacher Education (NCATE) for programs in educational computing and technology teacher preparation. Included in the recommended foundations in technology for all teachers are two standards that point to the need for assistive technologies to be included in the teacher preparation program. First, beginning teachers should be able to “plan and participate in activities that encourage lifelong learning and promote equitable, ethical, and legal use of computer/technology resources” (ISTE, I.B). In addition, they should be able to “demonstrate awareness of resources for adaptive assistive devices for student with special needs” (ISTE, I.B.5).

The ISTE foundation standards guide the activities and instruction in the Applications of Technology in Elementary Education Course. This is an undergraduate teacher preparation class that engages the student in the use of technology as an educational tool. Opportunity is provided for students to explore and utilize technology applications that enhance the teaching and learning process. Emphasis is placed on the design, development and delivery of effective communication and learning activities. Until fall, 1999, the standard related to assistive technology was not addressed. This study looks at an effort to assist pre-service teachers in achieving an awareness of assistive technology, the appropriate application of AT in the regular classroom, and the role of the classroom teacher in using assistive technology to enhance teaching and learning for all students.

#### Purpose

Very little supporting research for the incorporation of assistive technologies into the teacher preparation program for regular classroom teachers was found in a review of the literature. Therefore, a decision was made to conduct a preliminary study to determine the students’ knowledge of and attitudes toward assistive technology.

The purpose of this study was three-fold. First, researchers were interested in identifying pre-service teachers current knowledge of and attitude toward assistive technology. If the ISTE standard related to assistive technology is to be achieved, than a knowledge of current status related to this standard must be assessed to establish baseline data. Second, it was important to assess the impact of a mini-workshop on both knowledge and attitudes. Similar to the majority of pre-service method classes, time restraints and current curricula needs in the Computer Application class restricted the amount of time that could be allotted to this topic. There was a need to discover if the mini-workshop approach would be an effective means to assist students in achieving the minimum standard related to assistive technology. Last, instruments and procedures needed to be evaluated for their potential use in future studies. The inclusion of assistive technology into the pre-service teacher education program was a much-neglected area of study. Both instruments and procedures that are valid and reliable needed to be developed to further this field of study.

### **Methodology**

A pre-post test design was used for this study. The class instructor conducted survey administration. At the beginning of the class period, participants were asked to complete the pre-survey. After surveys were collected, two experts in the field conducted a mini-workshop on assistive technology. A diverse sampling of assistive technologies were presented and discussed. Students had the opportunity to interact with the technologies shown and to ask questions of the two experts. The entire time allotment for both the pre-survey data collection and the mini-workshop was approximately 80 minutes. Within two weeks during another class period, students were asked to complete the post-survey.

### **Mini-workshop**

The mini-workshop began with a review of the definitions of assistive technology and the Tech Act. Various low and high tech devices were shown, demonstrated when applicable, and applications for specific disabilities were identified. The students then had the opportunity to handle and explore the various devices. Other options for assistive technology were briefly reviewed. Emphasis was placed on the role and responsibility of classroom teachers to make their classroom accessible. Assistive technology can provide the means for accessibility for some children with disabilities. Students had the opportunity to ask questions throughout the workshop and were encouraged to talk with the presenters individually and examine the technology in more detail at the conclusion of the workshop.

### **Instrument**

The instrument used for this study was adapted from an instrument with known validity and reliability previously used by one of the researchers. While the original instrument was not appropriate for use in these circumstances, it did provide guidance in the selection of items to include that addressed attitude and knowledge related to assistive technology. Using this instrument as a guide, a special education professional and an educational technology professional worked together to develop a 20-question survey for this study. A total of 20 questions were designed to measure students' knowledge of and attitudes toward assistive technology and students with disabilities. A six-item Likert scale from strongly disagree to strongly agree was used as a response set. In addition to the 20 Likert scale items, the survey included demographic items to describe the population. Three additional variables were also investigated. They were:

1. Completion of a required course on diversity,
2. Having a family member who is disabled,
3. Having a close friend who is disabled.

Both professionals reviewed the instrument and both contributed to revisions to insure content validity. Once data was collected, a reliability analysis was conducted. Using all 20 items on the survey, the instrument had a reliability coefficient of .71 using the Guttman split-half. To somewhat control for the short length of the instrument reliability was recomputed using a split-half corrected by Spearman-Brown prophecy formula resulting in a reliability coefficient of .72. This was still in the low range but of some value as this was a preliminary study and the instrument was only being used for group measurement and not individual measurement. Reliability results indicated that before further data is collected revisions should be made in the survey instrument to improve reliability.

### **Participants**

A convenience sample was used for this preliminary study. Participants in this study were the students enrolled in a Computers Application for Elementary Teachers class during the 1999-2000 school year. There were five sections of this class each of the two semesters. A pre-post design was used. One hundred sixty eight students completed the pre-survey; 154 students responded to the post-survey.

Information collected on the pre-survey was used to describe the participants. The majority of them were female(85%), juniors (78%), and 20-21(72%) years of age with an age range from 19 to 44 years. Almost three-quarters (73.1%) had completed the diversity class. About one-fourth had a family member who was disabled (24%). Similarly, approximately one-fourth had a friend who was disabled (23%).

### **Results**

Data were analyzed three ways. First pre-survey frequencies were reviewed to identify current attitude and knowledge and to identify areas of concern. Second, post-survey responses were analyzed to see if the same areas of concern held true after participants completed the mini-workshop. Finally comparisons in mean scores were used to detect differences between pre and post as well as differences in current attitudes and knowledge based on independent variables: diversity class, disabled friend, and disabled family member.

#### **Pre-Survey**

Pre-survey data was used to measure current knowledge of and attitudes toward assistive technology. Starred items reflect negatively worded items or items where a negative response was desirable. For purposes of analysis and to simplify comparisons, all negatively worded items were recoded to reflect agreement level. However, actual frequencies were presented in all tables. A 25% level of disagree was set by the researcher to identify areas of concern.

There were ten items included to measure attitudes toward assistive technology and special needs students. Out of the ten attitude items, five were above a 75% agreement level. All children have the same need for praise and

disabled children strive as hard as others received the highest agreement ratings of 97% agree a little to strongly agree.

Five areas of concern were identified. The statement “disabled children are more self-confident than other children” received the lowest agreement rating. Eighty-nine percent indicated that they disagreed a little to strongly disagreed with this statement. Seventy-one percent disagreed a little to strongly disagreed with the statement “there should not be special schools for disabled children”. Additionally, 47% disagreed a little to strongly disagreed that disabled children should compete with others; 36% disagreed a little to strongly disagreed that children will not be uncomfortable with disabled children; and 33% disagreed a little to strongly disagreed with the statement “most disabled children do not feel sorry for themselves”.

Responses to the ten knowledge questions were generally positive. Nine of the knowledge items received agreement ratings of over 92% agreed a little to strongly agreed. Ninety-nine percent agreed a little to strongly agreed that assistive technologies could enhance the learning of disabled children. No response was low enough to identified an area of concern. However, the lowest agreement (76% agreed a little to strongly agreed) was with the statement “assistive technologies are (not) all high-tech”.

#### **Post-survey Responses**

Similar to the pre-survey responses, five attitude items received agreement ratings of over 80% agreed slightly to strongly agreed. Rank order of items based on agreement ratings were almost identical when comparing post-survey frequencies to pre-survey frequencies. However, most responses received higher ratings. Significant differences will be discussed in the next section, comparisons.

All ten knowledge items received agreement ratings of over 89% agreed slightly to strongly agreed on the post-survey. Rank order items were very similar to those from the pre-survey. The most notable change was from 76% agreed slightly to strongly agreed on the pre-survey to 90% on the post-survey that assistive technologies are not all high-tech.

#### **Comparisons**

Overall attitude and knowledge scores for both pre and post-surveys were computed. Negative items were recoded and then a sum of responses to the ten items in each category was computed. This provided an overall attitude score and an overall knowledge score for comparison purposes. An alpha level of <.05 was used to determine significance.

The pre-survey attitude and knowledge scores were compared to detect any differences in mean scores. T-values were computed to identify any statistically significant differences. No change was detected in attitude scores, but results indicated significantly higher post-survey knowledge scores ( $t=4.857$ ,  $p<.001$ ).

*Table 1: Change in Attitude and Knowledge, Comparison of Pre-survey and Post-survey overall scores.*

		N	Mean	SD	t-value	Significance
Attitude						
	Pre	168	41.80	4.41	1.047	.296
	Post	154	42.35	4.93		
Knowledge*						
	Pre	168	49.91	4.63	4.857	<.001
	Post	154	52.56	5.15		

\*Significance <.05

Data from the pre-survey was used to examine overall attitude and knowledge based on the three independent variables diversity class (Table 2), disabled family member (Table 3), and disabled friend (Table 4). It was hypothesized that those students who had completed the diversity class and those students who had either a disabled friend or family member would have a higher overall score on attitude and knowledge. Thus, a one-tailed test of significance was used.

Students who had completed the class on diversity had a higher overall attitude score, but a lower overall knowledge score. However, no statistically significant differences were detected based on this sample.

*Table 2: Comparison Of Current Attitude And Knowledge Based On Completion Of Diversity Class*

		N	Mean	SD	t-value	Significance
Attitude	Yes	122	42.01	4.33	.904	.184
	No	45	41.31	4.66		
Knowledge	Yes	122	49.67	4.74	1.264	.104
	No	45	50.69	4.22		

\*Significance <.05

Attitudes of those with a disabled family member did not appear to be much different than attitudes of those without a disabled family member. As expected, overall knowledge scores were higher for those with a disabled family member. However, on neither attitude nor knowledge were the differences statistically significant.

*Table 3: Comparison Of Current Attitude And Knowledge Based On Having a Disabled Family Member*

		N	Mean	SD	t-value	Significance
<b>Attitude</b>	Yes	40	41.28	3.88	.868	.194
	No	128	41.97	4.56		
<b>Knowledge</b>	Yes	40	50.85	4.84	1.476	.071
	No	128	49.62	4.54		

\*Significance <.05

On both attitude and knowledge, those having a disabled friend scored higher. A statistically significant difference was detected on attitude based on having a disabled friend.

*Table 4: Comparison Of Current Attitude And Knowledge Based On Having a Disabled Friend*

		N	Mean	SD	t-value	Significance
<b>Attitude*</b>	Yes	39	43.03	4.48	1.911	.029
	No	128	41.53	4.21		
<b>Knowledge</b>	Yes	39	50.21	5.02	.471	.319
	No	128	49.80	4.54		

\*Significance <.05

## Discussion

This study attempted to look at three areas: current attitude and knowledge, impact of mini-workshop, and assessment instruments and procedures. Discussion will be organized around these three themes concluding with a discussion of future research plans in this area.

### Current Attitude and Knowledge

Data from pre-survey responses were used to determine current pre-service teachers' attitudes toward students with special needs and knowledge about assistive technology. Attitudes were very positive. It is felt that this may not be so much a factor of teacher preparation programs but relates to students' personal schooling experiences and general social attitudes. This could also be a result of the age and sex of participants. Participants in this study were predominately traditional female college students with an average age of 21.3. If there had been a larger population of older, non-traditional students and more male elementary pre-service teachers, we could have examined differences in attitudes based on age and sex.

While recognizing that attitudes are difficult to change, there were, however, some areas of concern that need to be addressed in the teacher preparation program. The participants in this study will be, for the most part,

traditional classroom teachers and not special education teachers. It was surprising to find that almost three-fourths felt that there should be special schools for students. It is difficult to determine participants reasoning and perspectives on this without further investigation.

Perhaps more troubling was the fact that over one third felt that children in a traditional classroom would be uncomfortable with a disabled child and that disabled children feel sorry for themselves. These attitudes still persist even with today's strong focus on acceptance of diversity.

We had expected that students who had already taken the required class on diversity would have a more positive attitude toward disabled children and would have more knowledge of IDEA and assistive technology. This did not prove to be the case with this sample. The content of this course has changed with the emphasis on diversity and perhaps other issues have replaced the previous inclusion of topics related to special needs populations.

Analysis of the fall semester data had indicated differences in attitude based on having a disabled family member. This difference was not detected with the full sample. In both semesters, approximately the same percentage of participants indicated that they had a disabled family member, so this probably did not account for the change. Future research will be needed in this area including identification of the relationship of the disabled family member to explore this area in more detail.

Knowledge responses were also surprisingly positive. Students appeared to have at least an awareness of assistive technology. However, it must be cautioned that this positive response could be misleading. As the survey was self-report, students may have been marking what they felt was the expected response and therefore responses are not representative of actual knowledge.

### **Impact of Mini-workshop**

Because of time restraints and an already overloaded curriculum, only one class period could be devoted to the presentation of assistive technologies. This short, one-time exposure was not enough to make a difference in attitudes. This was expected as attitudes tend to be firmly entrenched and difficult to change even with multiple exposures.

The mini-workshop was effective in changing knowledge. However, there are several variables at work here. It is not possible at this time to determine if this change was a factor of the technologies displayed or of the instructor. Participants were exposed to and had the opportunity to handle a variety of "toys". It is possible that this actual hands-on approach was the largest contributor to the changes in knowledge detected. A team of special education instructors presented all of the mini-workshops. How much of the change was a factor of the specialization and/or personality of the presenters needs to be examined in future research.

### **Instruments and Procedures**

While the instrument did show to be valid and reliable, changes should be made to improve both reliability and usability. The number of items needs to be increased to improve reliability. In addition, though the original survey adapted for use in this study included negatively worded items it is felt that these items adversely affected both student responses and reliability of the instrument and should be revised prior to future use.

### **Future Directions**

This preliminary study supports the need for the inclusion of assistive technology in the preparation of teachers. Our efforts in investigating the best way to provide this content will continue.

First, the instrument will be revised based on the results of this study. Negatively worded items will be replaced with positive statements. Attitudes will continue to be part of the pre-survey but will be eliminated from the post survey as it is difficult to impact a change on attitudes. The number of knowledge items will be increased and reworded to more closely reflect the content of the mini-workshop. The format of the knowledge items will be revised from a Likert response set to a multiple choice format that supports the overall expected competencies related to assistive technologies.

Second, the workshop be varied. A quasi-experimental design will be used to examine factors impacting change on knowledge. Experimental groups will be used to examine the impact of both the hands-on use of the technologies and the instructors. In addition, the creation of software for self-study of assistive technology is being explored.

While this preliminary study was not without limitations, it proved useful on several levels. Both individual course planning and program planning will benefit from the results of this study. The technology for teachers class and the required diversity class will be reviewed for content and the addition of assistive technology components that prepare teachers for their role in adapting the regular classroom for special needs children. Within programs, emphasis on the integration of technology, including assistive technology, across the teacher preparation program will increase.

This study was successful in building collaboration between special education and technology programs. This sets the stage for planning and funding of technology needs within the college and established a framework for



further collaborative research between these two programs. It also serves as a model for technology collaboration with other programs, departments, and colleges strengthening the technology integration across programs that is essential for the preparation of technology literate teachers.

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# Mentoring for Technology Success

Marilyn K. May  
Kansas State University

## Abstract

*Educators today are under tremendous pressure to make use of the latest in technology while continuing to provide quality educational experiences for students. Quality staff development is essential and costly, especially in rural areas. This study looked at the use of mentoring as a positive strategy for building teacher confidence in technology application skills. The study emerged as a grant to direct funds into rural schools and was specifically targeted for educational improvement through technology implementation. Qualitative and quantitative data indicated that mentoring was a positive influence on teacher technology confidence, technology integration, school climate, and staff development effectiveness.*

## Technology Manpower Needs and Teacher Technology Training

Career opportunities of today suggest that of the approximately 600,000 job openings currently advertised 450,000, are related to technology and knowledge of computer applications. Using technology as a tool to improve teaching and learning is a critical need in schools, but crucial to being employed in the future is knowing how to use advanced technology in a useful way (Dennis, 1998). In an Office of Technology Assessment (OTA) study of the use of technology in education, lack of training and limited knowledge about computers were the most commonly cited reasons for non-use of computers (1995). Recent studies continue to report that properly trained teachers make the difference between success or failure of technology integration efforts (Siegel, 1995). For technology based learning to be effective, teachers must select materials that help meet carefully defined instructional objectives and integrate them into learning experiences. It is time to acknowledge the vital role that teachers play in the successful use of technology for learning with support (Mellon, 1999). The 10-year ACOT project (Apple Classrooms of Tomorrow, Saltpeter, 1998) recommended that 30 percent of available technology resources be dedicated to providing ongoing staff development. A Time Magazine report claims that schools spent about \$88 this year per student on computer equipment, but only \$6 per student on computer training for teachers. Although 80 percent of schools have Internet access only 20 percent of teachers polled in this survey felt prepared to use technology in their classes (Nellen, 1999). A 1999 study by Market Data Retrieval (MDR) found that 61 percent of the teachers surveyed felt either "not at all prepared" or only "some what prepared" to effectively use new technology (Mckenzie, 2000)

## Professional Development

Statham and Torell (1996) have identified professional development as an essential condition necessary to maximize student achievement. Teachers are the keys to success, and training the teachers is essential. They state: "A commitment to technology integration includes a commitment to teacher training." The success or failure of technology is more dependent on human and contextual factors than on hardware or software (Valdez, et.al. 1999). Based on survey data Becker was able to determine that certain variables had 'important independent relationships to teachers use and valuation outcomes' (Becker, 1999). Significant factors were: quality connectivity, computer expertise, teacher pedagogical beliefs and practices, and adequate professional development (Becker, 1999). Research indicates that most school districts spend less than a quarter of their computer budgets on training (Bruder, 1993). Too often faculty professional development features one-shot workshops with limited support and follow-up for integration purposes (Hargreaves & Fullan, 1992). Joyce and Showers (1995) have argued that teacher development should be innovation-related, continuous over several sessions and involve a variety of formal and informal training sessions to meet the needs of the teacher. Their model emphasizes the need for the learner(teacher) to be shown how the application works, be provided an opportunity to practice with the application, then receive follow-up support to allow for further practice and related critical feedback

Recently staff developers spotlighted critical issues facing schools and identified mentoring programs as useful in teacher improvement (Ganser, 2000). Technology changes so fast, some teachers may not know how to keep up (Bray, 1999). It would be most valuable to provide both time and opportunities for on the job professional development. On activities using technology applications of skill in the work world, students of teachers with more than ten hours of training significantly outperformed students whose teachers had five or fewer hours of training

(Becker, 1999). The use of on-sight teams or mentor groups can provide valuable guidance and increase the effectiveness of staff development time. (Dwyer, 1998).

## **Rural Needs**

Many rural educators face these changes with the added challenge of geographic isolation. The unique needs of rural education have been recognized for generations (Leo-Nyquist & Theobald, 1997). When the education system was first established in the United States, technological improvements in printing and distribution made textbooks and educational information available to people living in rural areas. Yankee peddlers, in fact, influenced the content of textbooks by communicating to the printers the specific educational needs of rural America, (Smith, 1993). Distance education was first developed for use by farmers. Courses on repairing wagon wheels were offered to farmers who couldn't leave their fields. (Thomas, 1999). Beacham & Kester, (1994) identified telecommunications programs as useful to enhance professional growth in rural areas highlighting electronic mentoring as a strategy for bridging some of the challenges of rural isolation. Today advanced technology is able to provide rural communities with access to increased educational opportunities and information vital to quality education (Dennis, 1997).

Ferre and Associates (1988) and Kennedy and Barker (1986) identify financial and funding issues as the most critical issues faced by small rural school districts. Since nearly a quarter of the money for educational technology comes from state revenues, funding has been identified as a significant problem for a large segment of the country's educational community. Rural districts cannot compete with urban schools in the area of funding simply because of low enrollments. Corporations seek to fund programs that impact the largest numbers of students. In competing for grant dollars, rural schools are at a disadvantage because each staff member, from administration to faculty, is having to wear two or three "hats" (duty assignments) and do not have the time or experience to write successful grants (Dennis, 1997). So funding is difficult to obtain, technology is expensive and staff development effectiveness is essential.

## **Mentoring**

The 10-year ACOT project (Apple Classrooms of Tomorrow, Saltpeter, 1998) recommended that 30 percent of available technology resources be dedicated to providing ongoing staff development. Teachers can improve their teaching practices by engaging in frequent and planned collaborative activities with other teachers. Such activities can include mentoring (Becker, 1999). Dwyer (1998) explores the theory and practice of mentoring. He argues that on-the-job mentoring has the potential to facilitate critical insight into the changing nature of teachers' work and to transform school cultures. Nellen reported that teachers participating in mentoring activities became confident enough about using technology to train new teachers, with a success rate of 100 percent (Nellen, 1999). Mentoring allows the learner's needs to define the experience rather than following a more linear, tutorial model of instruction (Nellen & Sweeny, 2000).

Similar research indicates that teacher mentoring can assist faculty members and new teachers with ongoing support and provides technology integration instruction that characterizes effective staff development (Mac Arthur et. al., 1993; Sprague et al., 1998). Anecdotal evidence from a range of mentoring projects is showing that through mentoring more significant learning occurs; a safer environment for risk-taking is developed and learning speeds up.

Mentors benefit from an increased feeling of self-worth and mentees from increased self-confidence. Adler and Harveil (1996) identified several benefits of mentoring programs that included; enhanced recognition of the value of staff development and teaming to make effective program changes and improved self-confidence in the receipt of support and encouragement. Receiving regular, honest and constructive feedback and being part of a professional network is mutually beneficial. Mentoring is seen as job-embedded, ongoing professional development which facilitates long-term change and transforms workplaces (Dwyer, 1998).

## **Curriculum Change**

There is great deal of literature in the field on curriculum. Yet there is little empirical evidence that focuses upon attempts at curriculum change, where school districts, schools, or particular teachers are the unit of analysis (Lewis, 1998). Technology implementation requires a well-designed systemic plan, multiyear funding, and extensive professional development. Teachers, through their Internet connections, have access to resources that only a few years ago would have been impossible even for university researchers. Ninety percent of all teachers participating in Beckers research survey (with and without internet connectivity) ranked internet resources as either valuable or essential, demonstrating that teachers see the internet as a significant resource (Becker, 1999). With this

type of teacher use, sufficient staff development, and mentoring support, the integration of technology could be a supportive tool to enhance curriculum and the learning environment.

In the Mills study findings supported the position that teachers' concerns and perceptions of technology influenced the way in which they implement technology (Mills, 1999). The Lecompte, Millroy and Preissle study (1992) cited three common themes among teachers as they learned technology in the context of educational practice; 1) changes in teaching practice, 2) changes in preparation and 3) increased self-confidence with technology use. It is crucial therefore to integrate technology, pedagogy and application into competent staff development programs that demonstrate effective support for change (Moore, et. al., 1999).

Collins (1991) describes how these new teaching/learning environments differ from those of the past by citing trends identified from observations of schools that have begun using technology. The shift from lecture based, whole group instruction to coaching student-directed team-work that incorporates technology is a major change for the classroom teacher (Roblyer & Edwards, 2000). Well-developed curriculum can be the directional force that organizes and promotes technology implementation (Valdez, et.al.1999). Teachers in their critical roles as "gatekeepers" for change within their own classrooms and schools are central figures in curriculum development and change.(Leo-Nyquist, & Theobald, 1997).

## **Methodology**

This action research study made comparisons between a traditional format of technology staff development to an onsite team-mentoring format. The traditional format of staff development incorporated two 2- day sessions of hands-on group technology instruction at the service center facility. The mentoring format used an onsite mentoring activity that included development of integrated classroom projects with onsite mentoring for collaborative support. Participation in the study was voluntary and school sites were allowed to send one team. Teams were self-selected and four schools participated. None of those participating in the mentoring project reported previously integrating technology into classroom curriculum. In each team, the member who felt most comfortable with technology skills was designated as mentor. All four schools were located within a 100 mile radius of the service center facility, located in communities with a similar agri-related economy, and classified 1-A (rural). Grant funding was budgeted to include upgrading of available hardware and software to support the individual projects designed by the teams. Funding also included stipends for extra planning and student contact hours.

Data collection was based on Profiler scores, observations, interviews and anecdotal information collected by the technology facilitator. The Profiler is a standardized online survey, developed by South Central Regional Technology in Education Consortium (SCRTEC) ( <http://profiler.scrtec.org/profiler/>), which includes 30 questions that assess personal confidence in technology skill and application. The survey was taken by teachers and students participating in the study as a pre and post assessment for each activity. SCRTEC is one of six Regional Technology in Education Consortia funded by the U.S. Dept. of Education, whose goal is to help teachers and other educators create, share, or find solutions to problems encountered when integrating technology into education.

## **Treatment**

Using PowerPoint or Hyperstudio, students created presentations based on personal history. After initial instruction concerning the content of the social studies project and demonstrations of software and digital camera application, students created an outline of personal events and information that they wished to include in their presentation. Student mentoring teams then used the digital camera to collect pictures. The pictures were used as information focal points of the presentation. Students worked on formatting skills and added text to complete the history. Issues of vocabulary and editing, as well as the creative aspects of presentation development, were all part of the integrated project. Presentations were shared in a variety of ways including peer review, printed hardcopy and student conferencing. The presentations were used as examples of authentic assessment of student technology skill and social studies goals of development of personal identity, culture and community identity. Three school sites participated in teacher and student mentoring activities. Due to complications with teacher re-assignment one of the four schools did not participate in the mentoring activities.

## **Results**

Concluding data indicated that all teachers and students completing the mentoring activities increased on profiler scores indicating that self-reported confidence of technology skills ability increased. In comparing teacher mentoring team scores before and after each type of activity (traditional staff development and mentoring activity) data show that teacher scores improved 21.33 percent more from the mentoring activity than from the more traditional staff development (Figure 1.1 & 1.3). This is three times the gain of 7.78 percent made after traditional

staff development. While traditional staff development does provide positive opportunity for teacher improvement, the addition of a mentoring program appears to greatly enhance the effectiveness of technology integration training. When comparing groups of students, those participating in mentoring activities scored over 11 percent higher than those involved with technology projects without mentoring partners (Figure 1.1 & 1.4).

### 1.1 Student Perception of Comfort With Technology

School site	1	2	3	4
Class A Mentor (group 1)	5.93	11.74	8.19	18.14
Class B Mentored (group 2)	15.37	6.89	7.27	18.14
Total Avg. Increase ( School sit #3 completed the technology project without mentoring )	10.65	9.32	7.73	18.14

### 1.2 Teacher Perception of Comfort with Technology

School site	1		2		3		4	
Teacher	1	2	1	2	1	2	1	2
1=mentee 2=mentor								
Pretest	16.67	X	4.44	22.22	22.22	51.11	42.22	24.44
Staff development	20.00	32.22	57.77	31.00	25.56	60.00	60.00	30.00
Posttest	74.44	48.89	75.55	55.56	X	X	1.11	57.78
Total Avg. Increase	57.77	16.67	21.11	33.34	3.34	17.78	38.89	33.34

(Note: The X indicates that there was no profiler score and in both cases also indicates that the teacher was not involved with the project during the designated time of evaluation.)  
School site #3 did not participate in mentoring during the technology project.

### 1.3 Profiler Average Teacher Change

After Staff Development	8.46%
After Mentoring Activity	29.21%

### 1.4 Profiler Average Student Change

Without mentoring activity	7.73%
Completing mentoring activity	18.75%

## Conclusion

Final evaluation interviews indicated that teachers and students felt the project mutually beneficial. Having a team member or mentor close by for support helped to promote confidence when presenting content and having students work with technology. Teachers also believed that having a colleague/mentor for collaboration increased their ability to work through a variety of technical problems. Students demonstrated greater interest in content and were more involved in reflective evaluation to improve their work. Teachers were excited by the positive responses of their students and the increased motivation they observed. The key goal of improving student performance was realized through integration of a variety of technology tools. This success provided strong encouragement for teachers to look for other opportunities to integrate technology.

Research project results mirrored those of the Nellen study (1999), with 100 percent of teachers participating in the mentoring activity. Teachers indicated that they felt the experience so valuable they intended to continue the mentoring format during the next year by instigating new technology mentoring projects. Comments made by teachers during exit interviews provided anecdotal evidence of confidence. One teacher said, "I never thought that I could learn to use technology like this. Now we already have plans for another mentoring project next year and my students are asking if they can do other projects with the computers." Another teacher enthusiastically remarked, "I saw two other project ideas that I'm going to integrate into our standard curriculum and I'm helping

another teacher make plans for a project for next year.” Comments such as these document the increase in teacher confidence integrating technology into curriculum.

The use of mentoring adds a positive support for technology integration in the classroom. It's application is inexpensive, enhances traditional staff development and promotes positive staff team-building. The use of mentoring demonstrated effectiveness with both teacher and student teams. It was evident from observations and interviews that that mentoring projects between classes increased student interactivity and promoted positive school climate. The ability of mentoring teams to discuss, reflect and support each other encouraged risk-taking and self-improvement.

Additional study in the area of mentoring to enhance technology integration would be beneficial. To gain further statistical analysis of mentoring application it would be valuable to design research that would control for external variables such as grade level and project variation. The establishment of mentoring teams and mentoring training within a rural district would increase the effectiveness of teachers as resources and encourage growth and development. Mentoring encourages a positive teamwork effort to promotes educational improvement.

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# Expanding a Model for Affective Development: Implications for an Activity Component

Nancy E. McCrary  
University of Kentucky

## Abstract

*One useful framework for understanding and articulating instructional design to change biased beliefs is the Martin and Reigeluth model for affective development, appearing in Volume II of Reigeluth's Instructional-Design Theories and Models (1999). Using this recently developed framework to examine an instructional program aimed at affecting biased beliefs suggested that the addition of activity components and the language of activity theory may have potential to extend instructional theory on affective learning. Consideration of action as both internal and external enhances the model in a way that facilitates design and evaluation of instruction to affect biased beliefs about difference. This paper examines some of the implications of including the concept of activity in the Martin and Reigeluth model for affective development.*

## Introduction

While facilitating affective change has long been an issue in efforts to impact human performance (Simonson, 1995), it has most often played a rather cursory role in the development of instructional systems (e.g., Martin & Reigeluth, 1999; Kamradt & Kamradt, 1999). Moreover, when affect is addressed in the design of learning and performance systems it is often done so as an aside to performance outcomes and is fragmented as a separate, less significant domain. For example, the Dick & Carey (1996) model of systematic design addresses learner' attitudes as represented by behaviors that can be modeled and reinforced relative to intended performance outcomes. This model relies on attention, relevance, confidence, and satisfaction as related to performance goals. Such an approach tends to fragment internal and external processes and may serve traditional practice while actually constraining design. Until recently few alternative strategies for affecting attitudes existed in the field of instructional systems design (ISD). Whether this is the result of inadequate paradigms, a quest for certainty (e.g., Dewey, 1929), or, as Simonson (1995) suggests, the lack of a direct causal relationship between affect and achievement, is of less concern here than examining the potential of extending a conceptual model to guide the design of instruction aimed at affective change.

During an extensive search for instructional theory to guide the development of an instructional narrative simulation, the Martin & Reigeluth conceptual model emerged in ISD literature, offering a helpful tool for deeper thinking about affective instruction. An analysis of the instructional simulation, relative to this model, revealed, as Martin and Reigeluth indicate, that their model is incomplete (Reigeluth, 1999). This paper presents an analysis of an instructional multimedia program using the Martin and Reigeluth conceptual model. Additionally, it attempts to initiate consideration of certain aspects of activity theory as a means to enhance the model and advance development of instructional theory on affective learning.

## Background for Analysis

The Martin and Reigeluth conceptual model for affective development is used here to examine a web-based multimedia instructional program aimed at changing biased beliefs about difference in sexual orientation. Jeff's Story was initially designed as a paper and pencil narrative simulation using true story narrative to situate the learner as a character in an unfolding story. It was conceived as an instructional prototype to address contemporary social problems of bias and discrimination based on a range of human differences, including racism, sexism, cultural discrimination, and homophobia. Bias about differences in sexual orientation became an initial focus because it continues to be acceptable and openly expressed in contemporary American society (e.g., Rhoades, 1994; Tierney, 1997). Developing a theoretical framework for such an innovative and controversial design necessitated reaching beyond the foundation of narrative theory (e.g., Britton & Pellegrini, 1990; Bruner, 1986, 1996; Cole, 1997; Fisher, 1995; Howard, 1991; Polkinghorne, 1988; Sarbin, 1986) to include theory on situated cognition, anchored instruction, and case study (e.g., Anderson, Reder, & Simon, 1996; Bliss & Mazur, 1996; Brown, Collins, & Duguid, 1989; Cognition and Technology Group; 1990; Lave & Wenger, 1991; Mazur & Bliss, 1995; Young, 1993) culture study and critical social theory (e.g., Appiah & Gutmann, 1996; Ayers, et al., 1998; hooks, 1994; Matsuda, et al., 1993; Merry, 1990; Peshkin, 1991; Rhoades, 1994; Tierney, 1997), moral education (e.g., Kohlberg, 1971; Petrovic, 1999; Vitz, 1990), and perception and aesthetics (e.g., Dewey, 1934 ; Eisner, 1994 ; Greene, 1995). These



rich theoretical perspectives were combined with new research findings on issues such as teaching tolerance with stories and arguments (Colesante & Biggs, 1999), reactions to racist hate crimes (Craig, 1999), and anti-gay behavior (Franklin, 2000). While all of this provided important foundation for continued development of the instructional program, there was relatively little on which to rely in ISD until Charles Reigeluth published volume II of Instructional-Design Theories and Models in 1999. The conceptual model developed by Martin and Reigeluth for this volume, along with subsequent chapters dealing with topics ranging from attitude development to character and spiritual development (Kamradt & Kamradt, 1999; Lickona, 1999; Moore, 1999) offered opportunity to examine Jeff's Story through an ISD lens.

## **Rationale for Consideration of Activity Theory**

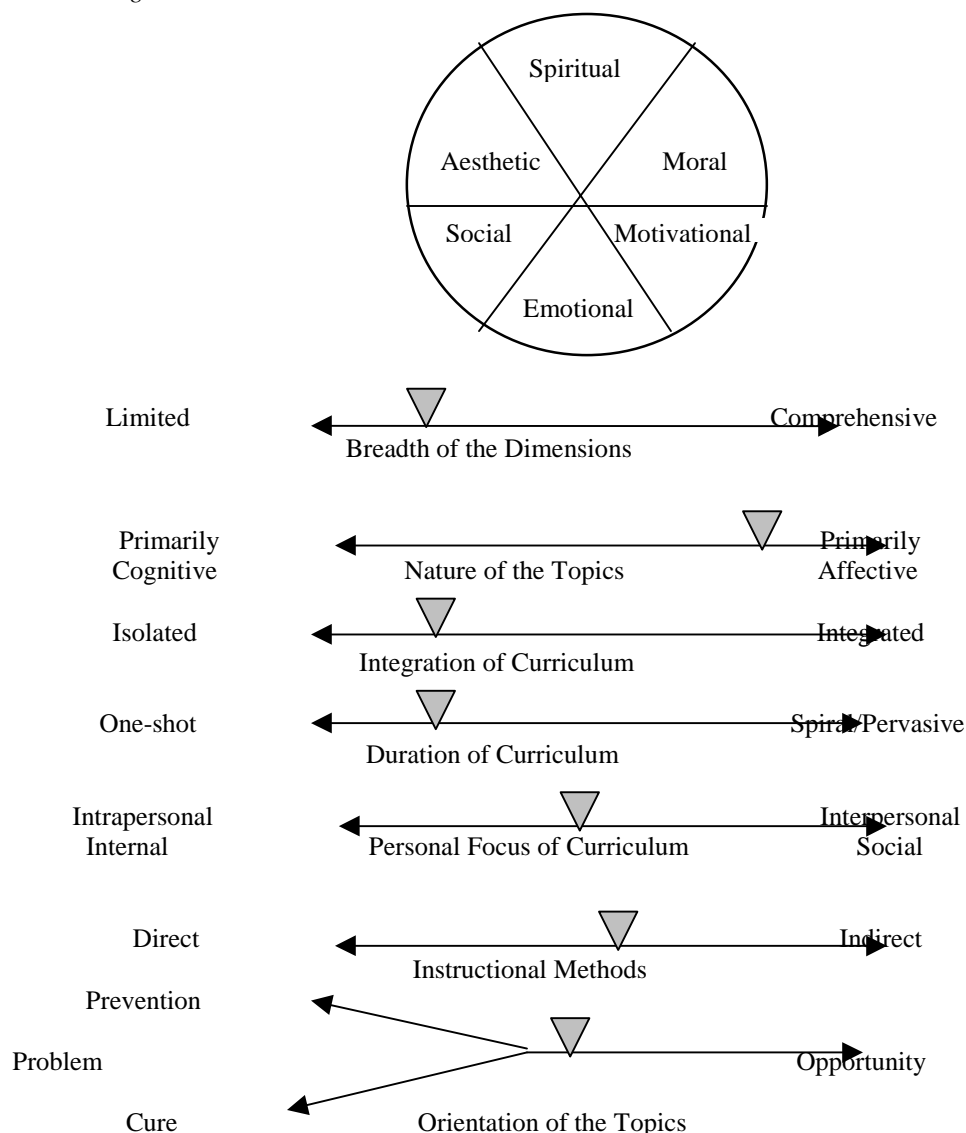
The Martin and Reigeluth model includes six dimensions of affective development and three identified components for each dimension. The dimensions are (1) emotional, (2) moral, (3) social, (4) spiritual, (5) aesthetic, and (6) motivational. The components of each dimension include, (a) knowledge, (b) skills, and (c) attitudes, as well as a fourth component labeled *other* to highlight that the model is incomplete. As such, it invites further development and encourages research and theory on affective learning in ISD. For example, according to Martin and Reigeluth, emotional development can be viewed as ability to recognize, express, and, as appropriate, control one's feelings, emphasizing understanding and managing feelings as emotional development. Yet, when applied to the design and evaluation of one instructional narrative simulation to change biased beliefs this aspect of the model lacks the means to articulate mediation of internal and external emotional activity. Designing instruction aimed at affective learning may require tools that ignite internal activity in ways that generate reflective responses not readily manifest in external form. Assessing the extent of actual change in biased attitudes about difference highlights the need to account for potentiality, intent, and generative change. Activity theory makes it possible to explain such affective changes without reducing complex processes to measures of behavior (Wertsch, 1998). It offers concepts for describing human activity and includes the central notion of mediation (e.g., Nardi, 1997; Wertsch, 1998; Zinchenko, 1997) that can be extended to instructional products. Activity theory is also concerned with setting or context in a manner that facilitates consideration of social construction of meaning, which is so crucial to design for affective learning. In these ways the language of activity theory assists in broadening the scope of instructional design aimed at affective outcomes.

Since activity theory is highly complex and offers no concrete methodology or procedural guidelines, it is important to keep in mind that it can confound design efforts, as well as extend design considerations. The challenge here is to incorporate several useful concepts of activity theory without losing sight of the focus on design of instructional products for affective learning. Therefore, this analysis is limited to the use of a few key concepts from activity theory, including 1) activity as internal and external, 2) tools as mediators of human thought, 3) thought as potential for behavior, and 4) intent as central to affective change.

## **Application Model**

Martin and Reigeluth provide an application model based on the conceptual model for affective development. Locating Jeff's Story in this application model provides the groundwork for further analysis (Figure 1). For example, Jeff's Story is an instructional response to numerous hate crimes in the United States and, as such, is designed to be both preventive, as well as curative. Perhaps the most ambitious goal of this instructional program is the opportunity it creates for users to begin a process of embracing diversity in a country with rapidly growing ethnic populations and major shifts in majority status. Jeff's Story is designed as an isolated instructional event for adults, yet, because of the breadth of resources that users may access throughout the exercise, it has structural potential to be interdisciplinary. It is a "one-shot" experience although an important goal of the program is to ignite generative reflection and continued dialogue and therefore, can also be considered a "spiraling" learning experience. For instance, if users take away from the experience an understanding that beliefs are not always based on factual information, then the potential exists for reconsideration of a range of beliefs about difference. An important component, as evidenced in user testing (McCrary & Mazur, 1999), is a group discussion that follows the instructional event, offering opportunity for learners to express personal understandings in public conversation. In this way the program is both internal and social (intrapersonal and interpersonal) to the extent users contribute fully and honestly to the discussion. The instructional methods employed in the narrative simulation are direct in the sense that users become a character in an unfolding story that includes dilemmas to which they are asked to respond. The methods can also be considered indirect in efforts to engender empathy and reflection.

Figure 1. Adaptation of the Martin &Reigeluth Application Model as Applied to Jeff's Story, positioned in the Model with a Triangle on each Continuum.



## The Conceptual Model

The design of Jeff's Story, as it incorporates concepts of activity, reintegrates the six dimensions of affective development while primarily focusing on social and emotional change. For example, it includes aesthetic mediators in the form of original music and images in an effort to enhance emotional responses, as well as to create interest and motivation. Jeff's Story includes a moral dimension by presenting possible conflicts in an effort to create cognitive dissonance (e.g., Piaget, 1970) between stereotypical beliefs and ethical standards. Affective design features are supported by didactic information in the form of historical accounts, news articles, and hyperlinks to websites that provide additional information.

## Analysis

In order to provide a detailed analysis of Jeff's Story as related to the Martin and Reigeluth model it is helpful to examine each dimension of the model separately as it is represented in the instructional program. Following Table 1, which shows the original conceptual model, each dimension is discussed briefly and represented in Tables 2-7 as

adapted to *Jeff's Story* in the language of activity theory. Each dimension, as shown in Tables 2-7, revolves around a major instructional goal or enhanced ability (e.g., Zinchenko, 1997), including empathy, reflection, imagination, aspiration, prosocial values, and democratic principles. It is important to keep in mind that Martin and Reigeluth focus their model on school-based curricula, while *Jeff's Story* is designed for adults who are parents or professionals working with adolescents. Tables 2-7 illustrate an examination of the instructional program relative to a) design components, b) mediating elements, and c) evaluation data for each affective dimension. While knowledge, skills, and attitudes are represented as distinct learning activities to compliment the structure of the Martin & Reigeluth model, it is important to remember that, from an activity perspective, these domains may be inseparable.

*Table 1. Martin and Reigeluth Conceptual Model for Affective Development*

	<b>COMPONENTS OF INSTRUCTIONAL VALUE</b>			
<b>DIMENSIONS</b>	<b>Knowledge</b>	<b>Skills</b>	<b>Attitudes</b>	<b>?</b>
<b>Emotional Development</b>	Knowing others experience the same emotions you do, such as joy and anger.	Recognizing emotions and controlling one's own emotions.	I want to be happy. I don't like to be angry.	?
<b>Moral Development</b>	Understanding moral and ethical rules of the culture, such as caring, justice, and equality.	Moral reasoning and problem-solving skills in the realm of morals.	I want to be honest and I am in favor of having ethical standards.	?
<b>Social Development</b>	Understanding group dynamics and democratic ideals.	Social skills, including interpersonal communication skills.	I want to interact positively with others and am opposed to resolving disagreements by fighting.	?
<b>Spiritual Development</b>	Knowledge of religious precepts about the spiritual world, such as the nature of the soul.	Skills for getting in touch with your inner self. Ability to love others selflessly.	I want a spiritual life and am in favor of prayer to build a relationship with God.	?
<b>Aesthetic Development</b>	Understanding the subjective nature of aesthetics, such as the relationship between one's values and one's judgments.	Skills for assessing aesthetic qualities and generating aesthetic creations.	I want to surround myself with things of beauty.	?
<b>Motivational Development</b>	Understanding internal and external rewards for sustained activity, such as joy and sense of accomplishment.	Skills for developing one's interests, both immediate and life-long.	I want a career that I enjoy.	?

### **Emotional Development as a Dimension of Affective Development**

Emotional development can be viewed as ability to recognize, express, and, as appropriate, control one's feelings. Individuals can move through feeling states without associating meaning or understanding to those emotions. Martin and Reigeluth emphasize understanding and managing feelings as emotional development. True story narrative simulation, focused on emotionally difficult topics, provides experience and practice in identifying feelings regarding dilemmas in the story.

Table 2. Analysis of the Instructional Program Relative to Emotional Dimension.

Empathy	Affective Learning Activities Relative to Emotional Dimension		
	Knowledge Activity	Skill Activity	Attitude Activity
Conceptual Model for Affective Development (Martin & Reigeluth)	Knowing others experience the same emotions you do, such as joy and anger.	Recognizing emotions and controlling one's own emotions.	I want to be happy. I don't like to be angry.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Recognizing inconsistencies between long held beliefs and new information.	Simulated problem solving as a character in an unfolding story.	Desire to understand why I feel the ways I do about homosexuality.
Design Components	Back Page News. Historical Accounts. News Articles. Links to Advocacy Groups.	Unfolding Narrative. Questions. Response Choices. Group Discussion.	Perspectives. Concerns. Voices.
Mediating Elements	User controlled navigation. Access to a variety of information presented formally, informally, and as personal statements.	Story Veracity. Fidelity to True Story. Storied Dilemmas.	Images. Music. Authentic Statements. Color.
Evaluation Data	Computer Tracking Data. Program Evaluation. Video Data. Individual Interview Data.	Computer Tracking Data. Program Evaluation. Observation of group discussion.	Retrospective Program Evaluation Questions. Follow-up Evaluation. Analysis of individual interview data.

### Moral Development as a Dimension of Affective Development

Although moral development has been addressed in many ways, Martin and Reigeluth describe it as building codes of behavior and rationales for following those codes. They offer as an example having positive attitudes about empathy as compared to understanding or experiencing feelings of empathy, which are components of emotional development. This area of affective development is concerned with what is considered right and wrong behavior or action in relation to issues like social justice. Although *Jeff's Story* attempts to avoid prescriptive codes of behavior, it offers opportunity for moral development through a process of decision making in a simulated environment. *Jeff's Story* also provides opportunities to identify biases, discuss those biases with others, and express rationales for personal views on homosexuality. The sequencing of the storied narrative follows a pattern of describing particular dilemmas followed by questions and response choices. Each response choice is linked to a discussion of possible consequences as a result of that choice. This practice of problem solving is designed to stimulate thinking that will assist users in identifying their own beliefs relative to each situated problem. This unfolding process itself has the potential to create cognitive dissonance, which in turn has the potential to stimulate reflection. Such reflection may be a necessary internal activity for generating serious reconsideration of long held beliefs. In terms of moral development, as defined by Martin and Reigeluth, *Jeff's Story* is designed to stimulate examination of beliefs about homosexuality by juxtaposing socially constructed beliefs, one's own situated code of ethics or morality, and disturbing events in the instructional narrative.

Table 3. Analysis of the Instructional Program Relative to Moral Dimension.

Prosocial Values	Affective Learning Activities Relative to Moral Dimension		
	Knowledge Activity	Skill Activity	Attitude Activity
Conceptual Model for Affective Development (Martin & Reigeluth)	Understanding moral and ethical rules of the culture, such as caring, justice, and equality.	Moral reasoning and problem-solving skills in the realm of morals.	I want to be honest and I am in favor of having ethical standards.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Understanding that biased beliefs are based (in part) on a social norm of heterosexuality.	Using independent thinking to resolve conflict between moral stance on homosexuality and moral beliefs about respect for others.	Desire to treat <u>all</u> people according to ethical standards.
Design Components	Historical Accounts News Articles Statistical Information	Strategic Questions Response Choices Response Choice Discussions	True Story Narrative Authentic Personal Statements
Mediating Elements	Juxtaposition of didactic information on particular viewpoints of homosexuality with true story narrative.	Situating the user as a character in an unfolding story.	Disturbing true story problems and outcomes.
Evaluation Data	Computer Tracking Data Program Evaluation Individual Interview Data	Observation of group discussion, comparison of tracking data with interview transcripts relative to what users say about navigation through resources in the program.	Observation of Group Discussion Retrospective Program Evaluation Questions Individual Interview Data

### Social Development as a Dimension of Affective Development

Social development relates to having and maintaining positive relationships with others. It has to do with valuing relationships and distinguishing positive ways to promote such interactions. *Jeff's Story* is perhaps focused more on social development than any of the other dimensions. It offers experience and information designed to promote group discussion in which users are expected to engage in dialogue with others to share perspectives on homosexuality and discrimination.

Table 4. Analysis of the Instructional Program Relative to Social Dimension.

Democratic Principles	Affective Learning Activities Relative to Social Dimension		
	Knowledge Activity	Skill Activity	Attitude Activity
Conceptual Model for Affective Development (Martin & Reigeluth)	Understanding group dynamics and democratic ideals.	Social skills, including interpersonal communication skills.	I want to interact positively with others and am opposed to resolving disagreements by fighting.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Hearing and understanding the views of others on prevention of adolescent suicide and homosexuality.	Identifying and articulating one's own perspectives on homosexuality.	Desire to maintain positive interactions with all others even when they are different or disagree with my views.
Design Components	Historical Accounts. Authentic Statements. News Articles. Back Page News. Links to Resources.	Strategic Questions. Response Choice Discussions. Group Discussion.	Unfolding Storied Dilemmas. Authentic Statements. Disturbing Outcome.

Mediating Elements	Juxtaposition of the effects of discrimination with negative beliefs about homosexuality.	Identifying and articulating one's own beliefs regarding same-sex orientation.	Storied consequences of discrimination based on sexual orientation. Original Music.
Evaluation Data	Computer Tracking Data Program Evaluation Group Discussion Data Individual Interview Data	Observation of group discussion.	Program Evaluation Follow-up Evaluation Individual Interview Data

### Spiritual Development as a Dimension of Affective Development

Martin and Reigeluth view spiritual development as distinct from religion. It is concerned with awareness of the human soul or spirit and the interconnectedness of all souls. Specifically, spiritual development relates to our ability to love all people based on a concept of oneness, according to these authors. *Jeff's Story* is directly related to this dimension in the sense that it juxtaposes universal concerns like caring for an adolescent who is struggling with a topic that many feel is unrelated to their own circumstances. It situates the distant other in the typical American home. This strategy is designed to encourage users to imagine the homosexual other as part of the family and as spiritually connected as anyone else.

*Table 5. Analysis of the Instructional Program Relative to Spiritual Dimension.*

Reflection	Affective Learning Activities Relative to Spiritual Dimension		
	Knowledge Activity	Skill Activity	Attitude Activity
Conceptual Model for Affective Development (Martin & Reigeluth)	Knowledge of religious precepts about the spiritual world, such as the nature of the soul.	Skills for getting in touch with your inner self. Ability to love others selflessly.	I want a spiritual life and am in favor of prayer to build a relationship with God.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Understanding that religious/spiritual beliefs are constructed through past experiences and cultural influences.	Distinguishing truth from stories held as truth or religious doctrine.	Desire to resolve conflicts between religious beliefs, personal spirituality, and new feelings arising from simulated experience as the parent of a gay adolescent.
Design Components	True Story Narrative. Historical Accounts. News Articles. Authentic Personal Statements.	Storied Dilemmas. Strategic Questions. Response Choices.	Veracity of the narrative that assists users in imagining the adolescent in the story as their own son.
Mediating Elements	Storied juxtaposition of a typical adolescent who also happens to be gay.	Making difficult decisions as a parent of the adolescent in the story.	Confronting attitudes of others and recognizing one's own through group interaction.
Evaluation Data	Computer Tracking Data. Program Evaluation. Observation. Individual Interview Data.	Computer Tracking Data. Program Evaluation. Group Observation.	Retrospective Program. Evaluation Questions. Follow-up Evaluation.

### Aesthetic Development as a Dimension of Affective Development

Aesthetic development is concerned with appreciation of beauty, which includes recognition, creation, and valuing aesthetic qualities. It is a development of sensitivity to one's internal and external environments. Aesthetics include organization of space, time, and thought in ways that are pleasing, ways that are congruent, unified, balanced, and interesting. It relates to cognitive dissonance theory in the sense that human beings may naturally seek balance and consonance in their minds, as well as in their surroundings. Beauty is in the mind of the beholder by virtue of the level of aesthetic development achieved. The design of *Jeff's Story* employs narrative and other

aesthetic mediators as central to affective instruction. These mediators include original art, chosen for qualities that have potential to enhance and extend the storied topics, original flute music, composed specifically for each story theme, and a variety of compositional elements to engender interest and facilitate the process of making meaning of the events in the program. Since this instructional design and development project focuses on facilitating enhanced perception and stimulating reflection, concern for aesthetics is viewed as essential in mediating internal activity that may lead to new perspectives.

*Table 6. Analysis of the Instructional Program Relative to Aesthetic Dimension.*

Imagination	Affective Learning Activities Relative to Aesthetic Dimension		
	Knowledge Activity	Skill Activity	Attitude Activity
Conceptual Model for Affective Development (Martin & Reigeluth)	Understanding the subjective nature of aesthetics, such as the relationship between one's values and one's judgments.	Skills for assessing aesthetic qualities and generating aesthetic creations.	I want to surround myself with things of beauty.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Understanding the subjective nature of beliefs about homosexuality and the opportunity afforded by subjectivity to imagine new ways of viewing same-sex orientation.	New appreciation of the beauty and function of human diversity, imagining positive ways to interact with homosexuals or others who are different in some way from oneself, and recreating one's own stories about same-sex orientation.	Desire to enrich and enhance one's life through interactions with those who are different from one's self and appreciate the subjective nature of diverse perspectives, as well as one's own subjectivity.
Design Components	Story Themes. Response Choices. Response Choice Discussions. Historical Accounts. Voices. Perspectives. Back Page News. Concerns.	Consonant and dissonant patterns in the narrative, imagery, and music.	True Story Narrative. Perspectives. Back Page News. Response Choice Discussions.
Mediating Elements	Images. Original music, composed to reinforce story themes. Simulated role as an actor in the in the story.	Solving problems, selecting possible responses, and reading contrasting excerpts of other's stories that inspire thinking about the subjective nature of that based on stories heard and remembered in ways that reinforce one's own beliefs and comfort.	Veracity. Fidelity. Imagery. Original music, composed to reinforce story themes. Group Interaction. Group Discussion.
Evaluation Data	Program Evaluation. Response Choices. Individual Interview Data. Group Discussion Data.	Computer Tracking Data. Program Evaluation. Individual Interview Data. Group Discussion Data.	Retrospective Program Evaluation Questions. Individual Interview Data. Group Discussion Data.

### **Motivational Development as a Dimension of Affective Development**

Developing one's own interests is the major concern in motivational development. Preference, choice, focus, and navigation are all elements of Jeff's Story that acknowledge personal style and facilitate individual interests. While this instructional program is not specifically designed to promote motivational development it offers opportunity to identify preferences and navigate according to one's particular curiosity. Computer generated tracking data is used partially to provide insight into the motivations and interests of learners.

Table 7. Analysis of the Instructional Program Relative to Motivational Dimension.

Aspiration	Affective Learning Activities Relative to Motivational Dimension		
	Knowledge Activity	Skill Activity	Attitude Activity
Conceptual Model for Affective Development (Martin & Reigeluth)	Understanding internal and external rewards for sustained activity, such as joy and sense of accomplishment.	Skills for developing one's interests, both immediate and life-long.	I want a career that I enjoy.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Understanding personal and social benefits of diversity.	Deconstructing one's own stories about people who are gay.	Desire to interact in positive ways with homosexuals or others who are different from one's self and feeling that such interaction will enrich one's life.
Design Components	Storied Dilemmas. Response Choices. Response Choice Discussions.	Simulated exposure to a variety of attitudes, beliefs, and information about homosexuality.	User Controlled Navigation. Historical Accounts. News Articles. Links to and Descriptions of Advocacy Groups. Concerns.
Mediating Elements	Reflection due to simulated experience with the perspectives of others.	Immediate feedback on response choices in the form of discussions of possible consequences associated with particular choices of action.	Stimulated experience in the role of a parent of the adolescent in the story.
Evaluation Data	Program Evaluation. Individual Interview Data.	Selected Response Choice Data. Retrospective Program Evaluation Questions. Individual Interview Data. Group Discussion Data.	Computer Tracking Data. Retrospective Program Evaluation. Observation of Group Interaction. Video Data of Group Discussion.

## Research Implications

The integration of several key concepts from activity theory with the Martin & Reigeluth model serves research, as well as design, in developing instruction aimed at bias. For example, the conceptual model describes what learners will be able to do as a result of instructional intervention, while activity theory turns attention to the mediation of internal and external to create opportunity for new activity. Consideration of mediating internal and external activity provides opportunity for asking qualitatively different research questions that have more to do with how the process of affective change evolves. Relative to Jeff's Story, it is helpful to examine each dimension of affect (Martin & Reigeluth, 1999) through mediating processes. Aesthetic change, for example, includes 1) perception of the storied nature of beliefs, 2) imagination of what can be, 3) appreciation for the beauty of and necessity for human diversity. The questions evolve from how to promote appreciation of beauty and style (Martin & Reigeluth, p. 94)" to more specific inquiry into perception and imagination. Table 8 frames Jeff's Story relative to mediating activities of instructional goals.



Table 8. Mediating Activities for Desired Instructional Outcomes for *Jeff's Story*.

Dimension	Mediating Activity	Desired Instructional Outcomes
Aesthetic	Perception	of the storied nature of beliefs.
	Imagination	of what can be.
	Appreciation	for the beauty and necessity of diversity.
Social	Articulation	of biased beliefs in a group setting.
Emotional	Empathy	for the feelings and experiences of others.
	Tolerance	for the differences of others.
Spiritual	Self reflection	on the nature and origins of one's beliefs about others.
	Connectedness	to all human beings.
Motivational	Value	for diversity.
	Desire	to be tolerant.
Moral	Principles	guiding behavior towards others.
	Fairness	in relation to issues of social justice.

## Summary

As apparent in both the Martin and Reigeluth model and the analysis of *Jeff's Story*, instructional priorities for affective outcomes, as opposed to performance or behavioral goals, may require new ways of approaching design and research. Including certain concepts of activity theory extends consideration of learning as integrated internal and external processes that are facilitated by mediating processes like perception, imagination, and reflection. This hybrid approach prioritizes mediation over information, feelings over facts, and meaning over certainty. Traditional concern for structure and sequence of instruction is transformed to artful composition of learning environments that provide opportunity and potential for new representations. Such an approach to affective learning may actually promote a broader understanding of human development, integration of interdisciplinary perspectives, and understanding design as the composition of elements in space and time to promote learning.

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# **Towards a Person-Centered Model of Instruction: Can an Emphasis on the Personal Enhance Instruction in Cyberspace?**

Christopher T. Miller  
Joan M. Mazur  
University of Kentucky

## **Abstract**

*A person-centered model of instruction has been developed for use in designing instruction in virtual, web-based environments. This model, based on the work of Carl Rogers attempts to address several issues raised in the literature regarding a) the changing role of instructors and students b) the broadening of the notion of learning outcomes, c) the isolation and dissatisfaction of students in dispersed locations and d) problems with authenticity and individualization of experience. A person-centered instructional model is described and contrasted with instructionist (Dick and Carey) and constructivist (Jonassen) approaches.*

## **Introduction**

Virtual, web-based environments, while attractive in their potential to widen the scope of users' experiences for communication, collaboration, and access to resources can also create artificial and possibly depersonalizing social circumstances. A person-centered model of instruction has been developed for use in designing instruction in virtual, web-based environments. This model, based on the person-centered theory of Carl Rogers attempts to address several issues raised in the literature regarding a) the changing role of instructors and students b) the broadening of the notion of learning outcomes, c) the isolation and dissatisfaction of students in dispersed locations and d) problems with authenticity and individualization of experience. How should instructors confront these types of issues which arise in a distributed instructional network?

In this paper we posit that Rogers' work can be used to design instruction for virtual web-based environments and we offer a conceptual analysis upon which to base this claim. A person-centered instructional model is described and contrasted with instructionist (Dick and Carey) and constructivist (Duffy and Jonassen) approaches. A discussion of problems and potentials concludes the article.

## **Defining Virtual Environments**

As with any new technology, definitions that are complementary, mutually exclusive, subsuming, and directly contradictory seem to proliferate as fast as the innovation itself. Virtual reality and its many applications are no exception. In this section we give an overview of prominent definitions and select one, to be used for purposes of analysis in this article. Virtual reality (VR) is, quite literally, an analogous reality to our own but with one significant difference--it occurs in computerized and/or networked electronic environment. Definitions of VR range from "one part computer simulation and one part consensual hallucination" (Biocca & Levy, 1995; Gibson, 1984 p.54) to a computer-created sensory experience completely immersing a participant so they believe and barely distinguish a "virtual" experience from a real one (Franchi, 1994).

Types of VR applications tend to fall into two general categories: immersion and simulated environments. VR immersion environments using specially designed hardware worn by the user can literally make the individual feel like they are in another environment in a cyberspace. In contrast, in VR simulated environments, the user experiences a particular context or situation in a much less sensory and more cognitive way, by accessing software applications on a networked hyperspace -- such as the World Wide Web. These types of WWW virtual environments have several common applications. Users can take virtual tours of on-line museums or other remote locations such as strolling around virtual parks or navigating to selected locations via a virtual map of particular areas. Another common VR simulation environment-- a chat room-- provides tools for participants to talk with people at geographically dispersed locations in real time conversations. Since simulated VR environments require less hardware and technical commitment, they have tended to flourish in educational settings.

In fact, according to Mason (1996), the many virtual classrooms and universities can be characterized by three broad categories:

1. Text based systems, including electronic mail, computer conferencing, real time chat systems, MUDs/MOOs, and other WWW applications;
2. Audio conferencing such as audiographics, and real time audio over the Internet; and

3. Videoconferencing, one-way and two-way, software driven videoconferencing and other web-based visual media.

Virtual education purportedly differs from traditional education in less obvious ways than the presentation mode. Chalmers (1997) asserts that a virtual educational space can offer increased levels of interactivity and the development of learning communities through the use of the communication tools described by Mason. One example of this increased activity level is apparent in a text-based interactive learning environment, PuebloMOO. PuebloMOO (<http://www.pc.maricopa.edu/community/pueblo/>) is a complex environment where the students are free to explore a world created completely in the computer, interact with other people, and make choices regarding the character they use (called an avatar) in the virtual environment. The opportunity to personalize one's role in a virtual environment could be beneficial because it allows learners to meld learning with recreation and socialization developing activities all at one time.

Virtual environments, while attractive in their potential to support a variety of users' interactions, also have the potential to create artificial and possibly depersonalizing social circumstances.

### **Dehumanizing Effects of Virtual Environments**

Concerns associated with the dehumanizing effects of mass-produced, one-size-fits-all instruction is framed by the largely European debate of *Fordist*, *Neo-Fordist* and *Post-Fordist* approaches (Campion, 1995). On a continuum from maximum central control, low skill, and little learner responsibility (Fordism) to less managerial control, high skill and responsibility for learning (Post-Fordism), each position implies that control emanates from the point of instruction (or the instructor) and is not shaped through negotiations between the instructor and learner. In other words, though the debate addresses issues, which arise from the social, the underlying epistemological assumptions of the positions specifically exclude the social negotiation of learning. While this theoretical debate is less publicly articulated in the United States, it is important to note how often disgruntled distance education students report they feel alienated and dissatisfied with on-line learning (Biner, Dean, & Mellinger, 1994). Students at the so-called "remote sites" complain of a lack of co-presence with the instructors and other students. In fact, the only consistently reported benefit is "convenience." While American educators claim interaction and personalized instruction are valued (Simonson, Smaldino, Albright, & Zvacek, 2000 p. 41), reports of distance learning experiences show these goals less often achieved in actual practice. How should instructional designers use and possibly modify available theory and concepts to maximize the potential of virtual environments while confronting the personalization issues that seem to develop in a distributed network of instruction?

### **In search of theory-based instruction for Virtual, Web-based Environments**

The introduction of new interactive technologies inevitably effects the learning context. In virtual environments, both the role of the instructor and the form of instruction will change dramatically. A central change will be less control for the instructor coupled with more opportunities for learner-selected and -controlled exploration and interaction. Indeed, unbeknownst to the instructor at any given point in time, students may be logging in and participating actively. Directive, didactic forms of instruction will need modification. Instruction that is shaped and enhanced by facilitation may be a key to accommodating increased learner control. Students will clearly need specialized guidance exploring their on-line learning opportunities and the design of instruction will need to take into account the special nature asynchronous interaction supported by web-based virtual environments. We hypothesize the notion of instructional design as primarily facilitation can be informed by the work of Carl Rogers.

When Rogers wrote *Freedom to Learn* (1994), he was focused on traditional schools but saw the person-centered educational approach developing its strongest roots in alternative schools and what he presciently called "universities without walls." While many instructional theories focus on the learner's achieving specific learning objectives, Rogers' instructional theory focuses on a goal of teaching the learner how to learn. It is because of this focus that Rogers felt the learner would become a freely functioning, self-enhancing, self-actualizing, creative, and dependable person.

Carl Rogers revealed that he developed his person-centered theory because we live in a constantly changing world and that people in such continually evolving contexts needed to be flexible thinkers adapting easily to change. More importantly, he claimed, the constant of change required students to learn how to learn to adapt to different types of learning required in a variety of settings for myriad purposes. Rogers boldly suggested the facilitator should encourage the learners to charge off in new directions dictated by their own interests and to unleash their sense of inquiry and exploration (Rogers & Freiberg, 1994). How can the design of instruction support such learner directed activity? What, if any, will be the outcomes of such instruction and how can evaluation take place? Will assessment

be mutual or individual? What kinds of performance are desirable? Will learner development and satisfaction lead to outcomes that will be valued personally and publicly?

The purpose of this paper is to discuss the utility of the person-centered instructional theory of Carl Rogers for designing instruction in virtual environments based on both a conceptual and a comparative analysis. The conceptual analysis focuses on outcomes ascribed to web-based learning from the literature as they can be framed by specific aspects Rogers' theory such as personal development and learners' self actualization. Next, we present a model of person-centered instruction and compare it to two prominent instructional approaches. We follow this discussion with a case example of a course, which applies aspects of the model. Finally, a discussion of problems and potentials with the model concludes the article.

## **A conceptual Analysis of Rogers' Person-Centered Instructional Theory**

### **Using an Epistemological Heuristic**

We posit that the foundational conceptual analysis for our investigation of the utility and robustness of Rogers' work as it may be applied to on-line, virtual learning environments must begin with a sound epistemological analysis of his theoretical perspective. In order to accomplish this goal, we employed the "structure of knowledge" approach developed by Gowin (1981). This approach is particularly appropriate because it is inquiry-based -- the analysis proceeds from central questions emanating from a learning event (in our case the event is "instruction in a web-based environment). Our central "focus questions" are "what are the epistemological elements (world view, principles, concepts) of Rogers' theory?" and "how can these be applied to instructional design in virtual environments?" Gowin's heuristic details several components of the underlying knowledge structure of a given theoretical approach such that world view, core principles and concepts are related to directly to a specific learner event and the various knowledge claims and value to the learner can be described. The results of this analysis follow.

### **Carl Rogers and Person-Centered Learning**

Carl Rogers developed a system of non-directive psychology called client-centered therapy that allows the client, who knows what hurts, to marshal the resources of personal experiences and discover their own meanings. The client learns through such reflective experience and uses it to grow as a person. Rogers hypothesized that core concepts of client-centered psychology could be applied analogously towards a person-centered education.

Rogers theorized that a person emerging from therapy or from the best of education has experienced optimal psychological growth (Rogers & Freiberg, 1994). Specifically, the person is able to function freely -- realizing his or her potentials, striving to be self-enhancing, continuing to develop, and always seeking newness in each moment-- resulting in a self-actualized person. Maslow (1970), describes this self-actualized person as someone who has developed or is developing into the full stature of personal capability. Of importance is that learners continue to learn creatively through life rather than becoming automatons reciting the information provided to them (Patterson, 1973). Rogers himself tied self-actualization to creativity with these words: "The mainspring of creativity appears to be the same tendency which we discover so deeply as the curative force in psychotherapy - one's tendency to actualize oneself, to become one's potentialities . . . the urge to expand, extend, develop, mature - the tendency to express and activate all the same capabilities of the organism . . ." (Davis, 1992 pp. 3-4). Building on Rogers, Davis claims creativity involves developing your talents; learning to use your abilities; exploring new ideas, places, activities; and developing a sensitivity to problems of others and humankind (Davis, 1992 p. 7). In a person-centered approach the linking of self-actualization, freedom, and creativity will be required in order to design instruction, which accommodates the largely unfettered, learner-controlled choices available to a user.

Davis' (1992) elaborated the notion of creativity in terms of what he called the "4-P's": The creative person, process, product (Barron, 1988), and press (Isaksen, 1987; Mooney, 1963; Taylor, 1988). The creative person is the individual in the creative environment, moving through the process of creativity, or having created the creative product (Davis, 1992). The creative process is the steps taken to creatively solving real problems (Davis, 1992). The creative product is the outcome of the creative process. It can emphasize originality, and a sense of value (Davis, 1992). Creative press (as in pressure) is the social and psychological environment affecting any other aspect of the creative person, process, or product or all three.

While the development of self-actualized creative people, who are life-long learners, is clearly a commendable goal, how can this goal be actually achieved? Firstly, an instructor should realize self-actualization cannot be taught and the student reaches the goal of becoming a self-actualized person through his or her own individualized learning experience. Unlike didactic teaching methods, which provide knowledge to the learners, the

teacher in a person-centered environment becomes a facilitator of the learning the students conduct. Such a facilitated experience is termed "significant learning" because the individual initiates it, allowing the individual to provide personal control with the element of learning built into the whole experience (Sahakain, 1970). In this experience the learner becomes "the creative person" engaged in a creative process. There are several tasks for an instructor wishing to move into a facilitator role. The teacher should first set the mood for the environment or the creative press. There should be a sense of cooperation and trust within the group enhancing the creative experience rather than competitive attitudes which will disrupt the sense of trust and cooperation thus creating a negative creative press on the experience. Next, the teacher as facilitator becomes one of many resources of information rather than as the main source of information for the students. Most importantly though, the teacher as facilitator should be genuine and strive for awareness of personal attitudes. The teacher also needs to feel acceptance of his or her own feelings thus developing an authentic relationship with the students (Rogers, 1961).

Furthermore, the instructor needs to be self-actualized in order to foster these qualities in the students (Patterson, 1973). When Rogers and Freiberg (1994) talked to students, they found many of the same tasks required to be become a facilitator were also wanted by students. They found students want to be trusted and respected, want freedom, a place where people care, choices to make decisions, and teachers who helped them succeed (Rogers, 1961). In a person-centered educational experience not only will the learner create a creative product from the learning experience, but the learner's increased self-actualization can also be considered a creative product. As a learner becomes more self-actualized, the learner will be able to perceive reality more accurately; accept him or herself and others; understand varying views and perspectives; become more spontaneous, independent, and more creative (Davis, 1992; Maslow, 1970).

Table one that follows describes a model of person-centered design distilled from the above conceptual analysis and illustrates how creativity operates within the model. Additionally, this person-centered model is contrasted with classic instructionist and constructivist approaches.

#### **A Person-Centered Model of Instructional Design**

In this section we move on to our second focus question "how can Rogers' theoretical elements be incorporated into an instructional design model that will be useful in virtual, web-based environments?"

*Table 1. Person-Centered Instructional Design Model to the "4-Ps" of Creativity*

<b>Person-Centered Instruction (Rogers)</b>	<b>"4-Ps" of Creativity</b>
<u>Learner Analysis</u> Emphasis is on the learners' interests, personal ability, and prior knowledge of a given topic.	<u>Creative Person</u> Emphasis on the person.
<u>Task Formation</u> Task formation proceeds through an analysis of integrating students knowledge and interests around the principles of the content or discipline.	<u>Creative Person</u> Focus on developing tasks centered around the person
<u>Learning Environment Selection</u> Select a non-competitive environment that supports cooperative learning and allows the learner to take responsible control over it.	<u>Creative Press</u> Creating a social/psychological environment to support the person, process, and product
<u>Develop Learning Goal</u> Develop individual achievable objectives within the context of the learning experience based on the students' interests and abilities and contract with the instructor.	<u>Creative Process</u> Process of selecting a goal (creative product)
<u>Individualized Assessment Development</u> Work with students to develop forms of self-evaluation.	<u>Creative Process</u> Develop ways to test goal achievement
<u>Reciprocal Teaching</u> Organize the areas of interest to cover in the topic and sequence in a format to maximize the learning potential.	<u>Creative Process</u> Organizing the process of the experience

<b>Person-Centered Instruction (Rogers)</b>	<b>"4-Ps" of Creativity</b>
<u>Selection of Instructional Resources</u> Identify and select resources to enhance the learning experience and present them to the students. The teacher presents himself or herself as a resource.	<u>Creative Process and Press</u> Selecting resources to support the process and teacher taking role of a resource to support the social/psychological environment
<u>Learner's Self Evaluation</u> Learners conduct self-evaluation based on the contract of the level of personal involvement, self-initiated involvement, and pervasiveness, which shows the significance of the learning experience.	<u>Creative Process</u> Testing and evaluating the process and the creative product
<u>Outcomes of Process</u> 1. Significant Learning 2. Self-actualization 3. Creative product  (The learner will show not only an accumulation of knowledge of the topic but also satisfaction in the learning, desire to master the experience, and a greater understanding of the problem, and potential resolutions)	<u>Creative Product</u> Learning, self-actualization, and a product emphasizing the originality of the person are created.

In table two below we provide a comparison of Rogers' person-centered elements with two design models - the classic instructional design of Dick & Carey (1996) and constructivist design as described by Jonassen (1999).

Table 2. Comparison of Instructional Design Models

<b>Instructionalist Design (Dick and Carey)</b>	<b>Constructivist Design (Jonassen)</b>	<b>Person-Centered Instruction (Rogers)</b>
<u>Needs Assessment</u> Determine what is the optimal situation and the actual situation. Find what change is needed to fill the gap between the situations. This will identify the instructional goal.	<u>Problem Definition</u> Define how the problem is represented and the manipulation space.	<u>Learner Analysis</u> Emphasis is on the learners' interests, personal ability, and prior knowledge of a given topic.
<u>Task Analysis</u> Determine step by step how the students will accomplish the goals.	<u>Determine Problem Dimensions</u> Determine what is needed to resolve the problem.	<u>Task Formation</u> Task formation proceeds through an analysis of integrating students knowledge and interests around the principles of the content or discipline.
<u>Learning Environments</u> No focus on developing a learning environment.	<u>Describe Learning Environment Supports</u> Determine the cases, resources, and tools needed to provide support for the learning environment.	<u>Learning Environment Selection</u> Select a non-competitive environment that supports cooperative learning and allows the learner to take responsible control over it.
<u>Performance Objectives Development</u> Write performance objectives of what students will be able to do upon completion of the instruction.	<u>Goals and Constraints Are Unstated</u> Uncertainty is a plus. Offer no rules for predicting the outcome.	<u>Develop Learning Goal</u> Develop individual achievable objectives within the context of the learning experience based on the students' interests and abilities and contract with the instructor.
<u>Assessment Instrument</u>	<u>Alternative Assessments</u>	<u>Individualized Assessment</u>



<b>Instructionalist Design (Dick and Carey)</b>	<b>Constructivist Design (Jonassen)</b>	<b>Person-Centered Instruction (Rogers)</b>
<u>Development</u> Develop assessment instruments to measure task achievement.	<u>Development</u> Provide opportunities for flexible, creative demonstrations of student understanding.	<u>Development</u> Work with students to develop forms of self-evaluation.
<u>Instructional Strategy</u> Sequence and organize the information as an instructional strategy for delivery.	<u>Instructional Strategy</u> Coaching, modeling, and scaffolding support and challenge the learner to succeed.	<u>Reciprocal Teaching</u> Organize the areas of interest to cover in the topic and sequence in a format to maximize the learning potential.
<u>Selection of Instructional Resources</u> Develop and select instructional resources.	<u>Provide the Problem Manipulation Space</u> Include objects and tools that are required for the learner to manipulate the environment.	<u>Selection of Instructional Resources</u> Identify and select resources to enhance the learning experience and present them to the students. The teacher presents himself or herself as a resource.
<u>Evaluation of Learning</u> Design and conduct a formative evaluation to determine the effectiveness of the instruction. Conduct a summative evaluation to verify the effectiveness of the instructional event.	<u>Evaluation of Learning</u> Evaluate the problem solving process and viability of the solution.	<u>Learner's Self Evaluation</u> Learners conduct self-evaluation based on the contract of the level of personal involvement, self-initiated involvement, and pervasiveness, which shows the significance of the learning experience.
<u>Outcome of the Process</u> Based on assessment scores, formative evaluation, and summative evaluation achievement of the goal can be determined.	<u>Outcome of the Process</u> Outcomes are understanding and further inquiry.	<u>Outcomes of Process</u> 1. Significant Learning 2. Self-actualization 3. Creative product (The learner will show not only an accumulation of knowledge of the topic as well as a creative product but also satisfaction in the learning, desire to master the experience, and a greater understanding of the problem, and potential resolutions)

## Conclusions

What are the potential benefits and drawbacks of using a person-centered model of instructional design? By emphasizing students' interests and abilities, courses taught in virtual environments such as certain applications delivered via the WWW, can create an atmosphere of mutual participation and allow for accommodations of various skill and ability levels. Students can exercise the freedom to choose, which is encouraged by the user-controlled hypermedia web environment. By utilizing the person-centered approach in design of instruction, students can take full advantage of the very features of virtual environments that are thought to promote engagement and enhance learning. In other words, the design of instruction using person-centered design is a good fit with a user-controlled, web-based instructional environment such as the one discussed in the case study above.

However, the elements promoting the success of such an approach--user responsibility, ability to be self-assessing and proactive in learning-- are the very elements, when lacking, which will result in an instructional experience that is non-productive at best and frustrating at worst. For example, how will students who have incorrectly assessed their abilities fare in such a free choice environment? Indeed, what kinds of self-assessment tools will need to be available for students (and instructors) to make such appraisals of skill and knowledge? What opportunities or interim assistance is needed to aid these students in fully participating in the course and learning the material? Will students who often expect to obtain course material via lecture and didactic instruction feel cheated

if the instructor relies on them to shape their own course experiences? Will these students have a point? What is the proper role of the instructor?

While the caveats for using a person-centered model are valid, we posit from our initial exploration of the utility of adapting central concepts and principles from Rogers' person-centered approach has shown it to be potentially useful. Designing instruction for virtual, learner-centered courses or learning experiences requires an approach focused on the learner. The use of such approaches may ameliorate the issues raised by the Fordist debate and ensure that on-line courses and virtual communication and collaboration environments develop in ways that truly exploit the instructional potential to develop self-actualized, independent learner.

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# Strategies for Creating and Supporting a Community of Learners

Melanie Misanchuk  
Tiffany Anderson  
Joni Craner  
Pam Eddy  
Carol L. Smith  
Indiana University

## Abstract

*This paper presents strategies and rationales for implementing certain instructional techniques to move a class from cohort to community. The context is the new Distance Master's program in Instructional Systems Technology at Indiana University. The authors give suggestions for instructional and non-instructional strategies that have students interacting at the levels of discussion, cooperation and collaboration. These strategies are cross-indicated with their intended outcomes, that is, strengthening the feeling of community as defined by a set of characteristics, which are adapted from Schwier (in press). Suggestions for evaluation techniques are also presented, as are questions for further research.*

## Introduction

The shift from traditional classroom education to computer-mediated distance learning poses enormous challenges to instructors and learners. The concept of the classroom where students meet to interact with other learners and the instructor no longer exists. The instructor can no longer “look” around the room to see if students are attending to the material, bored or confused. Learners lack a natural social outlet to engage with other learners thus leading to feelings of isolation. The learner is now engaged with the computer instead of other learners. The big question for our project is “How do we structure the course design so learners have mechanisms to connect with each other and form community.” How do we overcome the characteristics of the medium so that learners feel connected to the instructor and other learners?

The literature on effective teaching and learning promotes several “big ideas” that we used as foundations for our recommendations. These include Vygotsky's (1978) social development theory and the Seven Principles for Good Practice in Undergraduate Education (Chickering & Gamson, 1987). Vygotsky's social development theory states that social interaction is vital to cognitive development; all higher-order functions originate as the relationships among individuals. To scaffold learning we must require learners to interact with the content, the teacher and each other. Our strategies focus on promoting communication, social interaction and participation. Many of the principles, theories and strategies we encountered reflect the Seven Principles of Good Practice in Undergraduate education (Chickering & Gamson, 1987). At their core, each of the seven principles focuses on interaction. In 1996, Moore and Kearsley described three types of interactions that are necessary in distance education: learner to learner, learner to content and learner to instructor. We would argue that these three types of interaction are necessary in education regardless of where or how it takes place.

## Characteristics of Community

There is much discussion of learning communities, communities of practices, and virtual or online (social) communities. Although each type of community has its distinct characteristics and requirements, there are many things they share in common. What we are endeavoring to create will be a combination of all of the aforementioned communities: a community of practice (since our cohort will be from the same company) that is involved in mutual learning online. Because of these special characteristics, some things do not apply. For example, there is much talk in the virtual community literature about attracting members and defining the community based on common interests. In our case, this cohort is thrown together and “forced” to form community. Outside members are not encouraged to participate, mainly because the common interest in this case is “taking the Distance Masters in IST from IUB.” In a terrestrial community of practice, members might see each other at work, or meet in person once a week to deal with issues in their work lives. This will not exactly be the case for our community; although they will

probably have some work issues in common, they are not a group of “teachers” or “nurses” or “engineers” who share vast amounts of experience and knowledge. Unlike an informal learning community, which spins itself from nothing and is based on a variety of people coming together for informal learning purposes and where the direction of both the learning and the community is malleable, our learning community will exist within strict parameters of this coursework. Obviously, members will be encouraged to bring other experiences and knowledge to bear on their coursework, but at the end of the day, the learning in question will be much more restricted than an informal learning community.

Selznik (1996) identifies seven elements of community: *history, identity, mutuality, plurality, autonomy, participation, and integration*. With respect to virtual learning communities, Schwier (in press) adds: an *orientation to the future, technology, and learning*. Some of these characteristics of community will be present from the beginning. Others, the cohort will have to grow into. We will describe the features of these 10 characteristics, and discuss how we will use them for our purposes.

Selznik notes that communities are stronger when their members share history and culture, rather than simply abstract general interests. Unlike an established terrestrial community, the nascent community forming from the distance education masters program will not have a shared *history*. Their history, like their identity, will have to grow and develop through their interactions with each other.

We believe that a shared sense of *identity* will develop in this cohort, and will strengthen their communal identity. Schwier’s suggested strategies for fostering identity include team-building exercises, developing community logos, and public acknowledgement of individual and group accomplishments within the community. He also notes the importance of articulating the “focus or purpose of the community” and outlining the requirements and rituals. The structure of the courses allows for frequent and obvious reiteration of community focus, and events such as orientation can help the group define its own rituals and norms.

The very fundamentals of a learning community require interdependence and reciprocity, what Selznik terms *mutuality*. Since our focus is on cooperative and collaborative learning, this mutuality will develop naturally. Schwier also recommends asking “leading questions that encourage members of the community to invest in concerns held by other members, and to share ideas and possible solutions” (p. 5). This type of interaction can be encouraged at course-level in the class forum, and on a social level in the Online Café.

We combined Selznik’s terms *history, mutuality, and identity* into a larger category called *group identity*. By combining these three concepts we emphasize the fundamental importance of group identity in fostering community. Although one of our goals in the next few semesters is to help students begin to construct a history relevant to their community, this is not something that can be imposed upon the group from outside. It has to grow from the sharing of each individual’s history and the links that the learners form with each other based on their experiences. These links are characterized by interdependence and reciprocity, in other words mutuality. Group identity results from this history and mutuality, and from making the budding community history public and available to all, especially newcomers.

*Plurality*, according to Selznik, results when many different types of interactions amongst members of a community occur, often rooted by individuals’ membership in other communities (work, neighborhood, church, etc.) that intersect. We replaced *plurality* with *social interaction*. Given a virtual community, one that to some extent is externally imposed, the opportunities for plurality are limited compared to those available to geographic communities. By providing opportunity for and the expectation of social interaction among participants, we purport the program will provide the plurality needed.

*Autonomy* of individual members within the community, especially within an academic setting, is important to foster. We will encourage thoughtful, personal postings within the forum, to avoid group-think and “me too, I agree” contributions. Students will receive basic instruction on netiquette and will be encouraged to continually address evolving group norms to maintain respectful communication and to build consensus. We use *individual identity* in place of *autonomy* to underscore the importance of both group and individual identities within a virtual learning environment.

In the case of a virtual community, *participation*, both social and academic, is integral. Without active participation in discussions and other class activities, the learner is not part of the community; indeed, the learner does not even “exist.” This is one core distinction between being a passive member of a physical community where you are seen and your presence is noted and registered in the minds of others. In a virtual community, you must make a concerted effort to communicate with others in order to exist. At the same time, allowances must be made for learners to shape the participation, both in structure (number/kind of postings) and in content (managing the discussion of subjects interesting to them).

The *future orientation* of a learning community can operate at a number of different levels. A stronger community bond will be formed when a particular cohort goes through a number of courses together, moving

toward their finishing the program and earning a degree. It can be argued that a learning community can develop within the constraints of a single four-month course, but it is much more likely that students will form long-lasting academic and social bonds throughout an entire program. Visioning exercises and direction of learning activities (having participants describe how what they learned will help them in future learning and in their work) can also give the community a focus on the future. In our case, the community's view of the future may be limited to the two or three years they spend in the program. However, it is possible that they will continue to maintain community ties once they have earned their degrees and are working again. It is also possible that members of the Fall 2000 community would end up wanting to remain part of the Distance Masters community after they graduate, and would like to integrate themselves with the new incoming cohorts. This may pose particular problems of negotiation and fit; is there a role for graduated members to "return" virtually and engage with students working through the program?

Schwier notes that "the *nature of the learning* can be broadly defined and contextual" (p. 4) but is a necessary part of a virtual learning community. For our purposes, the learning involved is more specific and structured; the cohort moves through a set of core courses together, in a particular order. Our goal is to foster community among them before they finish the first year, so that although they will go on to take other courses with other distance learners, they will not only maintain ties with their initial cohort community, but will also have learned the foundations of virtual community creation and will use these skills in other classes. We have changed Schwier's term *learning* to *knowledge generation*.

According to Schwier, "communities are built or dismantled by those in the communities, not by the people organizing or managing them" (p. 2). As they mature, communities define their own social rules of conduct and select their own leaders, assuming *ownership* of their governance and norms. Learning communities, note Palloff and Pratt (1999), exhibit evidence of socially constructed meaning, willingness to critically evaluate the work of others, again assuming ownership of their knowledge creation and sharing.

*Integration* of all of these elements is necessary for a strong community. Schwier suggests creating belief statements and evolving group norms, and adhering to a learner-centered philosophy that "supports individual expression while building a group identity" (p. 5).

Finally, *technology* is an important consideration for us: although it is thanks to certain technologies that virtual community-building is even possible, there are certain limitations put upon the group because of technology. Although it is the conduit for discourse, it can also exclude or discourage people. Tools that are complicated, unavailable for a certain platform, that are slow and cumbersome can all render the discussion process less than ideal, and members who do not actively participate essentially leave the community. Although Schwier recommends using technology compatible with older, less costly equipment to render the community more inclusive, this is not a concern for us.

Based on Selznik's (1996) seven characteristics and Schwier's (in press) additional three characteristics of community, we have assembled the aforementioned six key elements of community. From these elements, we define community as: a group of people who are brought together to share and generate knowledge in a mutually supportive and reciprocal manner. Its characteristics are ownership, social interaction, group identity, individual identity, participation, and knowledge generation. Furthermore, integration of all of these elements is necessary for a strong community.

Having defined some of the particular characteristics of a virtual community, we will now turn to some basic strategies for creating community. Palloff and Pratt (1999) recommend these steps:

- Clearly define the purpose of the group
- Create a distinctive gathering place for the group
- Promote effective leadership from within.
- Define norms and a clear code of conduct.
- Allow for a range of member roles.
- Allow for and facilitate subgroups.
- Allow members to resolve their own disputes (p. 24)

In our case, many of these steps are automatic, but they should still be given careful consideration. For example, the general purpose of the community is defined as "the Fall 2000 cohort for the IST Distance Masters program." However, instructors or organizers may have more specific goals and purposes from the beginning, and even if they do not, other purposes may emerge from the community throughout the term. Palloff and Pratt (1999), surprisingly, do not put much emphasis on the communicative aspect of community without which a virtual learning community cannot exist.

We feel that one of the most important indicators of a learning community is the first: when students communicate not only on an academic level but on a personal level. Working together towards the goals of the course is what they are “supposed” to be doing. When they begin to talk about their personal lives (families, hobbies, jobs), their triumphs and trials with being a distance student (scheduling, technical problems, disagreement with pedagogy), when they seek each other’s counsel for other areas of their life (job change, which elective course to take next, family issues), this is the point at which we feel they are comfortable as a community. There is a good chance that not everyone will be everyone else’s best friend. However, when a majority of the members feel they are in a safe enough space to “speak up” about things in the public forum, rather than in individual e-mail messages, then this is evidence of a successful community. There may be a few members of the community who do not feel that the Online Café is an appropriate place to discuss non-academic subjects, and it is the role of the mentor and the community members to make the Café a welcoming place for this type of discussion. As in every type of community, there will be some people who opt out of certain discussions, or even out of all “non-official” discussion, but this is quite normal. There will probably be smaller communities within the larger online class, people who form bonds and discuss the course work and their lives, but not on the general forum. These differences can appear for a variety of reasons; Eastmond (1995) found divisions on age, gender, experience, and learning style lines. However, he also found that the groups often transcended age and gender, for example, two characteristics that might, in a traditional classroom, be impediments.

The final step in creation of an online community is to evaluate whether a community has formed, and if so, in what ways has the community aspect contributed to learning. Our project will address methods for performing the first evaluation of whether community has formed.

## Definitions

We will examine ways to use certain instructional strategies to work to move the cohort toward a community. We suggest encouraging interaction at three levels: discussion, cooperation, and collaboration.

### Cohort

The cohort is the group of students going through the core classes as a group. They may have an initial connection, such as a common employer, but it does not necessarily constitute a strong bond.

### Discussion

Discussion is the basic means of communication in an online format. Students must participate in discussion to have any sort of presence in the class whatsoever. Discussion can be focused around readings, lectures, and any other ideas based on course content or course administration. Discussion can occur asynchronously in the SSF or via e-mail, or synchronously via chat rooms or telephone.

### Cooperation

Cooperation entails students working in groups or otherwise dividing up tasks. A machine metaphor can illustrate cooperation in the classroom: different parts of the machine perform different functions and goals, but work together towards a similar end. For example, students may divide up a project, but are eventually assigned individual grades for their work. Examples of cooperative tasks include: dividing up sections of a report to write and doing peer review of each other’s work.

### Collaboration

Collaboration is the most integrated form of group work, and is therefore potentially the most difficult and the most rewarding. In the case of collaboration, the group members work toward a common goal, one that carries a mutual investment. For example, students may each work on every part of the report, consulting each other and re-reading each other’s edits. They are invested in every part of the project because they will share a common grade. Examples of collaborative tasks include group writing and creating an ID model.

### Community

A virtual learning community, as described in the introduction, is one of the ultimate goals of the core courses. The three levels of interactions can be compared by several characteristics, as in the table below.

	Discussion	Cooperation	Collaboration
Learning	Information transmission	Knowledge transmission	Knowledge generation
Inquiry	Individual inquiry	Delegation of tasks	Common inquiry
Decision-making	Agree to disagree	Vote (majority rules)	Social negotiation to

			consensus
<b>Goals/agendas</b>	Multiple goals/ multiple agendas	One goal/ multiple agendas	One goal/ one agenda
<b>Accountability</b>	Individual accountability	Individual accountability	Group accountability
<b>Learning relationship</b>	Complete independence	Partial interdependence	Complete interdependence










## Description of IST Core
































The term “Core” is used in the IST department to denote four courses that all graduate students take in their first year in the program. Traditionally R511 (2 credits), R521/522 (4 credits), R580 (1 credit) are offered in the Fall term; R561 (3 credits) is offered in the Spring. It is usually the case that the new students (both Masters and Doctoral) take these classes as a group; they form a cohort that goes through at least the first year of courses together. The cohort identity is important to the IST program, and it is something that will be actively cultivated in the online Masters program. Tangential to the cohort identity is the community-building that is undertaken to integrate new students into the IST program. The social aspect of the community is nurtured through happy hours, the IST picnic in the fall and the Follies show in the spring, and informal pairing new students with old ones. Academically, the IST community is built through the identity of the Rookie cohort, through the rookies taking non-Core classes (R547, Y520, etc.) with upper year students, through rookie interaction with upper year AIs in Core and non-Core classes, etc. The IST department is also very much linked to its alumni, through alumni presentations in R580 (Grads with Gigs) and networking at conferences.

The pedagogy is rooted in project-based learning and team-based work. Much of the learning is hands-on, and students often work with real-world clients. There is a focus on an integrated curriculum and many of the courses are team-taught. The different research areas of the faculty (for e.g., corporate vs. higher education vs. K-12) expose all students to multiple academic perspectives. The international nature of the program (approximately one-third of the students are non-U.S. citizens) exposes all students to different ways of learning and working. Because of the content, there is an emphasis on technological competence, although the skill levels of both entering and graduating students vary immensely. Although the use of technology in education is important to IST, technology is a means, not an end, and its use is firmly rooted in pedagogy.

The associations that IST has with other departments, including Educational Psychology, Language Education, the Kelly School of Business, the School of Library Science, etc., contribute to an integrated and interdisciplinary academic environment. Most of these departments offer online courses that can be used by Distance Masters students as electives.

## Core Instructional Strategies and Rationales

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	Parti	Strategies	Rationale
						Students participate in a face-to-face orientation on campus.	Face-to-face interactions allow to people to create strong initial bonds, which will lead to a greater sense of community right from the beginning.
						Students will learn about online communication, including rules of netiquette	Online communication is vastly different from more traditional forms of communications (Black, 1995).

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	Parti	Strategies	Rationale
						Students will undergo training in using SiteScape Forum, e-mail, majordomo creation, basic web searches, and MS Word for collaborative writing purposes.	To help reduce barriers to effective learning and establishing social relationships, participants should be given the opportunity to build confidence and competence with the distance education process and supporting technologies (IDE, 2.2).
						Students will post photos of in SiteScape Forum at Orientation.	Connecting people's names and faces is a first big step to forming bonds.
						Students will participate in a content-based group project that requires that they negotiate the exact content.	People will form strong personal and academic bonds through shared adversity (Ruhleder, 1999).
						Students will be required to eat lunch as a group two days during Orientation.	People who have a social connection to the group will work better together (Palloff & Pratt, 1999).
						Students will be given the opportunity to participate in at least two evening social activities.	People who have a social connection to the group will work better together (Palloff & Pratt, 1999)
						First posting should be a non-graded/non-credited assignment (e.g. biography).	Students need non-threatening, interesting ways to begin creating online community (Funaro, 1999).
						Create an online café that will serve as a non-course-specific conversation area to encourage off-task communication.	People need distinctions between work and play (Palloff & Pratt, 1999).
						Encourage instructor and distance mentors to participate in social interactions, especially in the early stages of the course.	Social interactions between and among learners enrich the learning community and should be supported in the instructional design of the course (IDE, 2.5).
						Students will be encouraged to share, in the online café, information about their non-academic lives, for example, offering mutual support in term of how they are keeping up with their job and school schedule. Students should be encouraged to offer successful strategies to the class.	Reciprocity and help are two important hallmarks of community. Students who take an interest in each other's well being, both academic and social, will have more of a support system of peers than those who do not (Wellman & Gulia, 1999).

## R511 Section

### Description of R511 (from course syllabus)

R511, Instructional Technology Foundations I, is a two-credit course that has historically been offered each fall semester. This course is required by all IST Masters students and is typically taken concurrently with R521/522, Instructional Design and Development, and R580, IST Colloquium. It is team-taught by two faculty members and one graduate assistant who has taken the course.















The overall objective of this course is to provide a comprehensive introduction to the field and profession of Instructional Technology (IT). Since most entering IST students come from fields other than instructional technology, R511 gives newcomers a sense of history and an explanation of how the components of the field fit together. There is a particular emphasis on the evolution of the "big ideas" of the field.


























In the onsite version of R511, class meetings occur once per week in 2-hour sessions. Directed readings compiled in a course packet are provided as practical resources to support assignments and class discussion activities in the course. Most class periods are divided into two portions: 1) During the first hour, each of the three instructors facilitates a group discussion among 15-20 students about assigned readings. 2) The remaining portion of the class time is devoted to further lecture and clarification about topics contained in the readings.

Students are graded according to participation in class discussion, personal synthesis and reflection (as noted in weekly minute-papers collected at the end of each class), three individual written essays (one team-based, two individual), and a final exam or written essay.

### **R511 Instructional Strategies and Rationales**

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	Parti	Strategies	Rationale
						<p>A fundamental element for success for the distance students is an understanding of the key expectations</p> <ul style="list-style-type: none"> <li>•how much time the course will require</li> <li>•the level of performance that is expected of them</li> <li>•the demands that participating in the core will have on their time.</li> </ul>	<p>Students, but especially students learning at a distance, need to have expectations, assumptions, deadlines, etc., made explicit and kept clear (Palloff &amp; Pratt, 1999).</p> <p>Understanding and respecting expectations for participation and performance will be critical to the students' success. Taking Core online will be more demanding than doing it face-to-face.</p>
						Instructors will assign discussion roles (facilitator, summarizer, devil's advocate, etc.) to encourage shy members and force students to think in different ways about the material and about the discussion of the material.	Students should be challenged to engage the material from different perspectives; different roles improve learner-learner interaction and improve learner-material interaction.
						Students will be expected to take part in regular peer reviews by critically evaluating each other's papers.	It is important to develop a critical eye towards other community members' work.
						Each week, someone from each group will summarize their group's discussion and post the results for the other groups to read.	Bringing from small groups to the larger group provides for more viewpoints and better discussion.
						Students will be divided into 3-4 small groups for discussion of	Small groups facilitate better discussion (Hiltz, 1998) for

Ownership	Know. Gen.	Ind. Identity	Shared Ident.	Social Inter.	Parti	Strategies	Rationale
						readings and course projects.	learner-material interaction.
						Students will fill out weekly “1-minute evaluation” web form, to instructor only. Possible topics include what you liked/disliked about the week’s work, how you can transfer this knowledge to your work, and generally how you are feeling.	To better assimilate and process what they have learned, students require a forum to critically reflect on the material and on themselves as learners (Palloff & Pratt, 1999). Keeping in touch with the professor improves learner-faculty interaction.
						Instructors will require high-quality online interactions with peers and discussions of readings by making a portion of the grade dependent on it. (We recommend at least 25%).	Effective learning environments should provide frequent and meaningful interactions among learners. (IDE, 2.1) Good practice encourages cooperation among students (Chickering & Gamson, 1987).
						Instructor and/or mentor will model ways to produce lively, constructive discussion: questions should be open-ended, but focused on students’ interpretation of the text.	One of the best ways to keep discussion on topic and students motivated is to participate actively in the conversation (Beaudin 1999).
						Instructor will point out excellent discussion, postings, interactions, etc. of other students to continually promote high expectations and model good interaction.	Good practice encourages prompt feedback (Chickering & Gamson, 1987). Faculty-learner interaction improved by attentive professor.
						As needed, instructor will revisit netiquette and general interaction issues, and stresses the importance of interacting in a respectful way. Have the community develop group norms based on emergent issues.	Social negotiation leads to the creation of a safe space, which is essential for learning (Palloff & Pratt, 1999).
						Students will be expected to check SiteScope Forum and e-mail every two days and post	Because of the nature of the evolving discussion, students should be constantly engaged in

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	Parti	Strategies	Rationale
						quality contributions at least twice a week. Participation points will be calculated based on these postings.	the course, without any lengthy absences from discussion. (Caldwell & Taha, 1993)
						The instructor/AI should make contact with students who are not actively participating to find out why and address their concerns.	Students need to actively feel like they're part of the community, and that the instructor is interested in their well-being, academic or otherwise (Palloff & Pratt, 1999).
						Students will work together at all three levels of interaction: <ul style="list-style-type: none"> <li>•Discussion</li> <li>•Cooperation</li> <li>•Collaboration</li> </ul>	In order for a newly-formed cohort to move to community, they must change the quality of their interactions. The community should move toward successful use of collaboration, in addition to the continued use of group discussions and cooperative tasks.

## R511 Assignment Specifications

Based on the existing assignments for R511, we have developed a set of projects and assignments that will both address the traditional content of the course, and build community based on the discussion, cooperation, and collaboration model. Where we realize that collaboration is a more rich form of thinking and working together, we also emphasize the necessity for students to work at all three levels of interaction throughout the course.

### Discussion

- At the beginning of the semester, students will be divided into readings discussion groups of 3-4 people. For purposes of community and continuity, they will remain in these groups throughout the semester.
- In SiteScape Forum, a team will be created for each readings discussion group. The group will manage that space, and can create folders for each week's readings if they so choose.
- The students will be expected to discuss the week's readings in their respective folders. Each student should post at least twice each week.
- The role of facilitator in each discussion group will rotate from week to week. The facilitator must start the conversation, and engage group members to participate.
- The role of summarizer in each discussion group will rotate from week to week. At the end of the week, the summarizer must condense the group's main discussion points, and post them to the class forum (outside the team space).
- There will be a separate folder in SiteScape Forum for discussion of the week's lecture or class activity. These posting requirements will be determined at a later time, dependent on the format of the course lecture material.

### Cooperation

#### "Letter Home" Paper

Students will review each other's papers in formative stages. For the "letter home" assignment, students will post outlines and rough drafts by set deadlines, and a selected group of peers (ideally from outside their reading group) will have to read and give feedback on them. The rationale for a number of small deliverables leading to the final paper is that distance students traditionally need regular deadlines and prompt feedback.

## **Final Exam Study Guide**

Students can still help each other out on breaking down the study guide and elaborating on certain sections of it. This could be left open for students to determine, just as in the traditional R511 class. Simply make the suggestion to the students that they may want to work together on fleshing out the study guide, and leave it to them to decide how they want to do it.

### **Collaboration**

#### **ID Model Paper**

The students will collaborate on the ID model paper as in the traditional R511 class (using their reading discussion teams as the groups). In the distance version, however, it will be critical that this process be divided into small deliverables. For instance, the students might be required to break down the task into the following deadlines:

- *Week One:* Each group member must post initial ideas of possible models to evaluate or create. This is not in any formal structure – just a brain dump. Each group member must read and respond to the discussion.
- *Week Two:* Group must decide on a model and begin explicating the model and describing its strengths/weaknesses. All group members should be posting during this week.
- *Week Three:* Someone in the group should summarize the discussion into a paper outline. Another group member should develop a paper draft. One or two group members should make suggested changes and revisions. The final group member should write the final draft and post it.

#### **“ism” Debate**

Students will participate in group debates revolving around behaviorism, cognitivism, and constructivism. Ideally, students will be placed into 3 groups that are different from their reading groups. Each group will be assigned one of the “isms” to represent in the debate. Here, a proposed timeline for the debate:

- *Week One:* Individuals will write an informal short paper (one page – perhaps even as a bulleted list) highlighting the major strengths of their “ism” as it applies to distance education courses and will post it for their teammates. Next, the team will enumerate possible rebuttals from the other groups and responses to those arguments. The first week’s discussion and postings will all take place inside a new folder established for that team.
- *Week Two:* One student from each group will post an argument about why their position is the best to a debate folder open to the whole class. Each group will respond to each of the other groups.
- *Week Three:* Debate will continue.
- *Week Four:* Each individual will write a brief reflection on how their opinion changed throughout the debate.

## **Checklist for R511 Instructor/Mentor**

### **Orientation**

- ☐ Attend Sunday night dinner with new DE students.
- ☐ Participate in 2-hour R511 class welcome session.

### **Beginning of Semester**

- ☐ Create teams in SiteScape Forum for each readings discussion group. Using a naming structure like jewels (Opal team, Ruby team, etc.) is an easy identifying factor.
  - Divide students into the groups evenly. Make sure the instructor and GA are listed as members of all teams.
- ☐ In SiteScape Forum, create a Discussion & Document Forum entitled “R511 Lecture and Class Activity Discussion.”
- ☐ In SiteScape Forum, create a Discussion & Document Forum entitled “R511 Resources & Tidbits”
- ☐ Create a class majordomo.

### **Weekly**

- ☐ Check that all class members have posted at least twice about the readings.
  - If not, make decision about contacting that person via e-mail.
- ☐ Check that all class members have posted about the lecture/class activity.
  - If not, make decision about contacting that person via e-mail.

- ☐ Post some comments to the Online Café. This could be
  - News stories
  - Responses to other students
  - Encouragement
  - Personal comments
  - IST/DE news
- ☐ Reply to at least 2 postings a week, to encourage students to post thoughtful responses and to show that you are present and actively following the discussions.

#### **Before the “ism” Project**

- ☐ In SiteScape Forum, create the following three teams: Behaviorism, Cognitivism, and Constructivism.
  - Divide students equally among the three teams. Make sure the instructor and GA are listed as members of all teams.

#### **Before the “Letter Home” Paper**

- ☐ In SiteScape Forum, create the following five teams: Peer Review Group 1, Peer Review Group 2, Peer Review Group 3, Peer Review Group 4, and Peer Review Group 5.
  - Divide students equally among the five teams. Make sure the instructor and GA are listed as members of all teams.

## **R521/522 Section**

### **Description of R521/522 (from course syllabus)**

R521/522, Instructional Design and Development, is a four-credit course that has historically been offered each fall semester in an onsite format. This course is required by all IST MS students and is typically taken concurrently with R511, Instructional Technology Foundations I, and R580, IST Colloquium. It is team-taught by at least two faculty members and one or two graduate assistants who have taken the course themselves.

Major content and experience objectives of R521/522:

- Knowledge of instructional design principles
- Knowledge and application of the ADDIE model of instructional design and development
- Understanding and application of simple formative evaluation processes
- Ability to recognize and employ fundamental principles and experiences in team-based approach to project work

#### **Pedagogical methods used in R521/522:**

- Task-oriented learning through “authentic” projects
- Diverse, team-based project groups
- Mentor/coach-based instruction for project team support
- Structured timeline of deadlines and deliverables
- Independent learning, i.e., students take responsibility for their own learning
- Assignments with specific criteria that engage students in learning specific course content, with leeway given for students to identify their own topics

Most of the learning in the course occurs within the context of projects and situations similar to those that instructional designers encounter in professional work. Projects are sequenced such that the processes and principles learned in the first ones provide foundation of understanding and competence for progressively more complex ones that follow. This progression of increasingly elaborated projects continues through the academic year into R561, Evaluation and Change Management, and is intended to carry on throughout the student’s academic experiences in completing the IST MS program.

In the onsite version of R521/522, class meetings occur twice per week in 2.5 -hour sessions. Class sessions involve one or more of a variety of activities, including lectures or presentations about specific topics, readings discussions, project group meeting time, group project presentation, or hands-on design activities. Directed readings compiled in a course packet are referenced as practical resources to support projects and class discussion activities in the course.

The instructors believe that people learn best when they are highly motivated and actively engaged in learning tasks, that learning is most useful when it is directly related to learner needs. Thus, students are expected to take responsibility for their own learning. The course begins with a fair amount of guidance from the instructors, in

terms of what information to access and how to facilitate personal learning, then gradually decreases that guidance to require students to actively seek resources on their own to perform the assigned tasks.

Major projects in R521/522 are completed by groups of three students, each mentored by an assigned instructor “coach.” To perform most satisfactorily in the course, students must spend many hours per week outside of class developing and completing these projects. At the completion of a project, each member of a given group is awarded the same grade (a “group grade”) as his/her teammates. Approximately twenty percent of that grade is awarded for the deliverable produced in the project (e.g., the instructional tool developed and a design report), whereas the remaining portion of the grade is awarded according to the way members worked within the team setting. Some students come into the program with extensive background in true teamwork, but most do not. Thus, the instructors devote a portion of instructional time early in the semester toward preparing students for the team experience. Throughout the duration of each project, group coaches continue to offer advice and guidance for the team process.

### **R521/522 Instructional Strategies and Rationales**

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	Parti	Strategies	Rationale
						Learners will be divided into 3-4 groups for discussion of readings and course projects.	Small groups facilitate better discussion. (Hiltz, 1998)
						Provide criteria that define appropriate course topics, leaving room for choice and opportunities to leverage work-related projects as course projects. <ul style="list-style-type: none"> <li>Learners select a topic and procedure for project.</li> <li>Each team selects 4 readings to read and summarize for the whole class (for discussion)</li> </ul>	In order to build community, learners need ownership. (Schwier, in press)
						Each week, someone from each group will summarize their group’s discussion and post the results for the other groups to read.	Bringing from small groups to the larger group provides for more viewpoints and better discussion.
						Students will be divided into 3-4 small groups for discussion of readings and course projects.	Small groups facilitate better discussion (Hiltz, 1998) for learner-material interaction.
						Instructional activities will require the learner to actively participate in the acquisition and processing of educational content. <ul style="list-style-type: none"> <li>Team-based authentic projects where the learners learn by doing.</li> <li>Discussing readings online and</li> </ul>	To better assimilate and process what they have learned, students require a forum to critically reflect on the material and on themselves as learners (Palloff & Pratt, 1999). Keeping in touch with the

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	Parti	Strategies	Rationale
						<p>role-playing.</p> <ul style="list-style-type: none"> <li>Require high-quality online interactions with peers and discussions of readings by making a portions of the grade dependent on it (25% recommended)</li> <li>Groups will be responsible for posting some of their work in progress (e.g., each group posts a description of a different aspect of ADDIE).</li> <li>Instructor should use open-ended questions to encourage dialogue.</li> <li>Ask learners to provide URLs that enhance learning.</li> </ul>	professor improves learner-faculty interaction.
	▲				▲	Instructor will phone each learner before class begins. (Spear & Bruce, 1997)	One-on-one verbal communication between learner and instructor solidifies relationship.
	▲				▲	Establish a virtual office hour: one hour where instructor will be available for online chats, office phone calls, or e-mail. Inform learners of the faculty member's expected e-mail or voicemail response time, e.g., within 24 hours, twice a week, etc. (Spear & Bruce, 1997) (Spear & Bruce, 1997)	Students like to know the professor is available at a particular time to address e-mail concerns.
				▲	▲	Instructor will be proactive, following up on the learner who is not participating in chats, discussions, etc.	In the distance format, it is easy for students to lose touch with the class and slowly drop out. Active intervention from the instructor can lessen attrition.
▲	▲		▲	▲		Conduct a phone conference with each team at least once during the development of each project.	Verbal communication between the team and instructor solidifies relationship and makes for easier clarification.
▲	▲				▲	Invite other professors to lead discussions (Davies and Reigeluth on concept learning) where learners can interact	Students will appreciate input from experts in the field. The will feel less isolated from the rest of the department when they can

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	Parti	Strategies	Rationale
						directly with experts to deepen understanding.	interact with other instructors.

## R521 Assignment Specifications

Based on the existing assignments for R521, we have developed a set of projects and assignments that will both address the traditional content of the course and build community based on the discussion, cooperation, and collaboration model. The students will collaborate on production projects, discuss readings or lecture topics, and reflect on activities and experiences throughout the course. While we realize that collaboration is the richest form of thinking and working together, we also emphasize the necessity for students to work at all three levels of interaction throughout the course.

### Discussion

#### Readings

Discussion activities centered around the course's major themes (e.g., usability, design, evaluation).

- At the beginning of the semester, students will be divided into readings discussion groups of 5 people (different from those in their project groups). For purposes of community and continuity, they will remain in these groups throughout the semester.
- In SiteScape Forum, a team will be created for each readings discussion group. The group will manage that space, and can create folders for each week's readings if they so choose.
- The students will be expected to discuss the assigned readings in their respective folders. Each student should post at least twice each week.
- The role of facilitator in each discussion group will rotate from assignment to assignment. The facilitator must start the conversation, and engage group members to participate.
- The role of summarizer in each discussion group will rotate from assignment to assignment. At the end, the summarizer must condense the group's main discussion points, and post them to the class forum (outside the team space).

### Cooperation

#### Group projects

- At the beginning of each project, students will be divided into groups of three. Each group will work collectively to complete its own project. A team "coach" (an instructor or graduate assistant) will be assigned to each group to offer advice and guidance for the team process.
- In SiteScape Forum, a team will be created for each project group (including the course instructors and mentors). The group will manage that space.
- Groups will be required to post all team meeting summaries and other artifacts of their team processes on the forum.

### Collaboration

Group projects For each project, the team will be intentionally diverse in gender, nationality and/or job background as much as possible to encourage multiple points of view.

- Projects will be assigned group grades, a large portion of which is assigned to the "group process."
- Give project rubrics, teams will be encouraged to brainstorm possible topics and come to consensus to identify their own topics for projects.
- Teams will engage in formative peer reviews of each others' projects and materials for projects throughout the course.
- Lectures and course topics will be presented by different instructors throughout the course, providing a model of collaboration for students.



## **Checklist for R521 Instructor/Mentor**

### **Orientation**

- ☐ Attend Sunday night dinner with new DE students.
- ☐ Coordinate a team-based project that emulates the required peer interaction and interdependence and time-limited working tensions of R521 production projects.
- ☐ Post expectations (time, participation, assignments, dates)

### **Beginning of Semester**

- ☐ Create teams in SiteScope Forum for each readings discussion group.
  - o Divide students into the groups evenly. Make sure the instructor and GA are included as members of all teams.
- ☐ In SiteScope Forum, create a Discussion & Document Forum entitled “R521 Lecture and Class Activity Discussion.”
- ☐ In SiteScope Forum, create a Discussion & Document Forum entitled “R521 Resources & Tidbits”
- ☐ Create a class majordomo listserv and direct all class members to subscribe to it.

### **Weekly**

- ☐ Post some comments to the Online Café. This could be
  - o News stories
  - o Responses to other students
  - o Encouragement
  - o Personal comments
  - o This week in IST
  - o Post reflection questions each week

### **Beginning of Each Project**

- ☐ Create teams in SiteScope Forum for each project group.
  - o Divide students into the groups evenly. Make sure the instructor and GA are included as members of all teams.
- ☐ Direct each team to construct and post its own individualized strategies and timeline for conducting the team process and completing its project.

### **Throughout Project**

- ☐ Check that each project team is posting evidence of cooperative work on project at least once per week.
  - o If not, make decision about contacting that group via e-mail.
- ☐ Reply to at least 1 or 2 postings a week per group, to encourage students to post thoughtful responses and to show that you are present and actively following the discussions
- ☐ Check that all team members are participating at least once every two weeks within their own project teams

### **End of Project**

- ☐ Review reflection essays from each team member about lessons learned from the production and team processes
- ☐ Collect peer grading of team members' participation within each team

## **Evaluation**

The final step in the creation of a learning community in these courses is to evaluate whether such a community has formed and, if so, in what ways the community aspect has contributed to learning. We are basing our strategies for evaluating the success of community-building in these courses on Palloff & Pratt's (1999) indicators that an online community has been forming:

- Active interaction involving both course content and personal communication.
- Collaborative learning evidenced by comments directed primarily student to student rather than student to instructor.
- Socially constructed meaning evidenced by agreement or questioning, with the intent to achieve agreement among students.
- Sharing of resources among students

- Expressions of support and encouragement exchanged between students, as well as willingness to critically evaluate the work of others. (p. 32)

The course evaluations will take two forms: Formative evaluations are undertaken throughout the course so that necessary adjustments in course delivery and activities can be identified and made. Summative evaluations are performed at the conclusion of the course to measure final learning outcomes and student satisfaction. Both forms provide fundamental indicators of the overall success of the course and its participants in meeting the initially stated objectives. Palloff & Pratt recommend employing evaluations over three distinct elements of a online course: student performance and learning, effectiveness of the course in supporting student learning objectives, and overall student experiences of the students in working in an online environment. For our purposes of assessing community formation, the emphasis on student performance is most the most important factor on which to focus.

We have stated already that two key indicators that the evolution of a community has occurred are evidence of participants accepting ownership of the community and realizing a shared identity. The metaphor of scaffolding activities and course strategies as mechanisms to foster community implies that the instructor provides models and activities to course members through which they exercise community-like tasks and interactions. These scaffolds are erected as temporary measures to support the desired behavioral outcomes until observed behavior indicates they are no longer used or needed, then they are gradually removed. Concurrently, formative evaluation that measures indicators of the extent to which online community is occurring becomes the key factor in determining the necessity and lifespan of each scaffolding device.

Suggested methods for formatively assessing the level of online community throughout the duration of the courses are as follows:

- Continually monitor the amount, type and effectiveness of discussion in all media, particularly student-to-student discussion
- Administer periodic interviews and web-based questionnaires to students to gather qualitative feedback about reactions to the level of community they are experiencing and its usefulness to their learning
- Look for evidence within all communication media of resource sharing and/or inter-community encouragement or support
- Compare progression of reflective essays of students to identify evolution of self-assessments that indicate personal commitment to the community or deepening of learning and thought about key issues discussed among members

We do not anticipate that a mature community will have been generated from this one semester alone. However, we do expect that the R521 and R511 experiences of these students will create a solid foundation of an infant community that will continue evolving throughout their career in the IST DE MS program. Summative evaluation in the context of assessing community building is useful for determining the overall effectiveness of the online community environment on the students' experiences both during these courses and in future ones.

Suggested methods of summative evaluation are as follows:

- Compare pre-and post-course attitudes of students regarding confidence with working collaboratively with a distributed or online project team
- Compare pre- and post-course opinions of students regarding their comfort levels with and reactions to collaborative projects
- Assign a final reflective essay in which students describe a personal action plan for applying the experiences and knowledge gained through the course, specifically those relating to collaboration and communities
- Perform longer-range (e.g., 2-3 months later) follow up interviews and surveys with students that engage them in reflection on the impact of community and collaboration on courses taken after R521 and r511

Finally, we intend these strategies of evaluating community building in R521 and R511, although holistic in spirit, merely as a framework on which more specific and precise assessments can be constructed. We believe deeper exploration of success factors in fostering online community would be a very fertile topic for further research and warrants further investigation.

## Questions for Further Research

Beyond the evaluation of the success or failure of community in the Fall 2000 Distance Masters Core, there are other topics worthy of research.

- What are some valid measures of community development?
- If community formed, what was its effect on the learning?
- How can learners be motivated to take part in virtual academic or social community activities?

- What are special features of “forced community” like the Masters cohort?
- What is the expected/observed life cycle of the Distance Masters learning community?
- How does this community develop and maintain its history?
- Should the Distance community be integrated with the residential graduate community? If so, in both academic and social ways? If so, how can this be accomplished?
- How can the community best be mentored?
- What are the different roles for instructors, graduate assistants, volunteers, upper-year IST students, etc?
- What communication/collaboration tools foster the development of a learning community?
- What are the best practices for using existing communication tools in distance education?
- What tool features lend themselves to different aspects of collaboration and community-building?
- How appropriate were the tools chosen for Fall 2000 in terms of collaboration and community formation?

## Conclusion

Having determined that richer learning takes place within the context of a learning community, this report provides background descriptions of characteristics of community and, more specifically, a virtual learning community. We discuss the goal of moving a cohort to a learning community through scaffolding activities rooted in the communication formats of discussion, cooperation, and collaboration.

The report then treats the Core classes in three separate sections: Core (principally orientation and the online café), R511, and R521/522. The courses are described, instructional strategies and rationales are presented, possible assignments are detailed, and an instructor checklist is provided.

Finally we thought it necessary to determine some strategies to evaluate a) whether community has formed within the cohort, and b) in what ways the community contributed to deeper learning. We also provide some possible topics for further study.

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# Analysis of a Customized Intervention for the Development of a Web-based Lesson by Pre-service Teachers

G. Brandon Murry  
Francie R. Murry  
University of Northern Colorado

## Abstract

This study compared the use of two developmental alternatives: a Web Editor (WE) in combination with a customized template/shell (*Teaching Not Teaching, T-N-T*) and a Web Editor (WE) only, for development of a Web-based lesson by pre-service teachers. Six hypotheses were tested to find whether the WE + T-N-T alternative was more efficient, effective, and appealing than the WE only development alternative. The efficiency, effectiveness, and appeal of developing a Web-based lesson was examined using these variables; lesson creation time, perceived effort, inclusion of six specified instructional components, functionality of six specified technical components, teacher appeal, and likelihood of intended future use (dependent variables) and the lessons development alternatives WE + T-N-T or WE only (independent variable).

A quasi-experimental design and *t*-test analyses were employed. Pre-service teachers ( $N = 103$ ) were assigned to one of the two development alternatives. Instruments included researcher-developed evaluations, self-report tools and the *Computer Attitude Scale* (CAS). Dependent variables investigated in this study include: lesson creation time, perceived effort, inclusion of six specified instructional components, functionality of six technical components, teacher appeal, and rate of future use. Statistical analysis of six hypotheses confirmed that developing Web-based lessons using WE + T-N-T was more effective than using WE only. The analysis also revealed that neither developmental alternative was superior in terms of efficiency or appeal.

## Purpose of the Study

A report from the National Center for Educational Statistics (NCES) (1999) details that although educational technology is considered a means for transforming education, only 20% of teachers feel well prepared to integrate technology into classroom instruction. This study examines a tool for promoting technology integration through pre-service teacher skill acquisition and application of Web-based lesson development when presented through two different alternatives (WE + T-N-T and WE only). This study investigated whether using a Web editor (WE) in conjunction with a custom created template/shell (T-N-T: Teaching Not Teaching) is more efficient, effective, and appealing for pre-service teachers to use in the development of Web-based lessons than using a Web editor only. The WE used in this study was Microsoft FrontPage 2000.

Each pre-service teacher created a Web-based lesson using one of two lesson development alternatives. The Web-based lessons were then evaluated using three criteria: efficiency, effectiveness, and appeal. Comparison of 16 variables/sub-variables was made between lessons created with WE + T-N-T and WE only.

The three criteria for usability was applied in the evaluation phase to determine if one Web-based lesson development alternative provides better support for pre-service teachers compared to another alternative. Teachers must have access to technological innovations that help them meet the needs of a diverse audience, get the job done quickly, and have the ability to integrate best practices into the interface design and lesson content.

## Description of the Sample

During the 1999-2000 Fall Semester, 161 pre-service teachers were enrolled in four sections of ET 347 Educational Technology Applications for Elementary Teaching, one section of ET 348 Educational Technology Applications for Middle Grades Teaching, and three sections of ET 349 Educational Technology Applications for Secondary Teaching. All of these students were invited to participate in this study. Permission to participate was received from a total of 144 students. Each student completed the Demographics Questionnaire and the Consent Form during the first class session. Of the 144 students in the study, half were identified as the Control group while the remaining students were identified as the Treatment group.

The groups were selected by nonrandom methods; however, the intact sections were randomly assigned to treatment groups. Two of the four sections of ET 347 (elementary pre-service teachers) were randomly assigned to the Control group and the remaining two sections were assigned to the Treatment group. Two groups of ET 349

(secondary pre-service teachers) were drawn and assigned to the Control and one remaining section of ET 349 and one section of ET 348 (middle grades pre-service teachers) were assigned to the Treatment group.

Forty-one of the 144 students (28.47%) who had agreed to participate in the study either did not complete their Web-based lesson or other required instruments and subsequently were eliminated from the study. Thus, this study's sample consisted of 103 students, that is, 64% of the Educational Technology students who initially had been invited to participate. Final group size for the Control group was 52 and for the Treatment group was 51.

The intact class sizes ranged from 16 to 26 students. The classes were scheduled for 50 minutes and met on the following days and times; two Monday classes at 12:20 and 1:25 PM, one Tuesday class at 9:05 AM, three Wednesday classes at 8:00 AM, 12:20, and 1:25 PM, one Thursday class at 6:00 PM, and one Friday class at 10:10 AM.

## Research Questions

The research questions were centralized around the usability/evaluation criteria efficiency, effectiveness, and appeal as follows:

### Efficiency

RQ<sub>1</sub>: Are pre-service teachers able to develop a Web-based lesson in less time when they use WE + T-N-T than when they develop a Web-based lesson using WE only?

RQ<sub>2</sub>: Will pre-service teachers perceive that less effort is required by using WE + T-N-T than when they develop Web-based lessons using WE only?

### Effectiveness

RQ<sub>3</sub>: Are the six specified instructional components (lesson goal(s), objectives written in performance-based terms, student performance, student performance evaluation, student-to-teacher contact, and location cues in the site) present when pre-service teachers develop a Web-based lesson using WE + T-N-T and when using WE only?

RQ<sub>4</sub>: If present, which of the six specified technical components (navigation, image presence, mailto links, interactive mechanism, audio and video) are functional when pre-service teachers develop a Web-based lesson using WE + T-N-T and when using WE only?

### Appeal

RQ<sub>5</sub>: What degree of teacher appeal is elicited from pre-service teachers' interaction with the development process of a Web-based lesson using WE + T-N-T and from pre-service teachers who use WE only?

RQ<sub>6</sub>: Do pre-service teachers intend to continue Web-based lesson development with the lesson development alternative they used in the study in their future instructional settings?

## Research Design

This study is quasi-experimental (Smith & Glass, 1987). That is, the independent variable is an introduced treatment, although there will not be total control over which participants receive which treatment. Participants were selected by nonrandom methods and then the intact sections were randomly assigned to treatment groups. This research paradigm may be represented as follows:

Group I WE only	R	O <sub>1</sub>		O <sub>2</sub>
Group II WE + T-N-T	R	O <sub>1</sub>	X	O <sub>2</sub>

R = Random assignment of treatment to intact classes, Consent Form, Demographic Questionnaire

O<sub>1</sub> = Instruction on how to use the Web editor

X = Intervention treatment (T-N-T)

O<sub>2</sub> = Work Time-Log, Effort Questionnaire, Instructional Components Evaluation Checklist, Technical Components Evaluation Checklist, Computer Attitude Scale (CAS), and Intended Future Use Questionnaire, Summary Data Sheet

## Data Analysis

Results regarding the evaluation of the Web-based lessons created with a Web editor combined with a template/shell structure from "Teaching-Not-Teching" (T-N-T) and those created using a Web editor (WE) only developed by pre-service teachers are presented in this section. The evaluation was based on the comparison criterion of efficiency, effectiveness and appeal. These variables were comprised of 16 sub-variables.

The *t*-test was used to analyze the data and determine if there was a significant difference between the Control and Treatment groups as measured by the 16 identified sub-variables. This study used six independent *t*-tests; therefore the probability of one or more Type-I errors was greater than the alpha set for any single *t*-test. Due to the multiple *t*-test error rate occurring from six *t*-tests, an alpha level of .0167 was set for each test resulting in an overall experiment-wise alpha of not more than .10. Given the exploratory nature of the study, this error range was judged appropriate. The research null hypotheses are presented with the related analyses and results.

H<sub>01</sub>: There is no statistically significant difference between length of time required to develop a Web-based lesson using WE + T-N-T compared to using WE only.

Based on the results of the independent *t*-test, H<sub>01</sub> was retained, indicating there was no difference in the time required by pre-service teachers to create a Web-based lesson using WE + T-N-T than when using WE only (*t* = -0.9457, *p* = 0.1733). Data were compiled and analyzed from the Work Time-Log. The results are presented in Table 1.

*Table 1. Work Time-Log*

Group	Mean Time (minutes)	SD (minutes)	df	p
Treatment ( <i>n</i> = 51)	519.1764	215.3836	101	0.1733
Control ( <i>n</i> = 52)	476.5384	241.1787		

Participants in the study used the Work Time-Log to record the number of minutes they spent designing and developing their Web-based lesson. The six specific tasks itemized on the Work Time-Log were: 1) Tinkering with the computer program, 2) Storyboarding, 3) Collecting images, audio, video, and other cool stuff, 4) Thinking about my Web-based lesson, 5) Collecting or creating lesson content, and 6) Developing Web-based lesson with the editor. Although there was not statistical significance between the total number of minutes participants from each group took to complete their lesson, participants in the Treatment group spent, on average, 43 more minutes than did the participants from the Control group.

H<sub>02</sub>: There is no statistically significant difference between perceived required effort when using WE + T-N-T compared to when WE only is used by pre-service teachers to develop a Web-based lesson.

H<sub>02</sub> was retained, suggesting no difference in the perceived effort by pre-service teachers when developing a Web-based lesson using WE + T-N-T than when using WE only (*t* = 1.8673, *p* = 0.0324). Data for this comparison were compiled from the Effort Questionnaire. The results of this analysis are found in Table 2

*Table2. Perceived Effort*

Group	Mean Effort	SD	df	p
Treatment ( <i>n</i> = 51)	7.0588	1.9226	101	0.0324
Control ( <i>n</i> = 52)	6.3750	1.7928		

H<sub>03</sub>: There will be no statistically significant difference between the frequency of presence of the six specified instructional components (e.g., lesson goal(s), objectives written in performance-based terms, student performance activity, student performance evaluation, student-to-teacher contact, and location cues in the site) in a Web-based lesson when developed by pre-service teachers using WE + T-N-T than when developed using WE only.

$H_{03}$  was rejected, indicating a significant statistical difference between the frequency of presence of the six specified instructional components in a Web-based lesson developed by pre-service teachers utilizing WE + T-N-T than when developed using WE only ( $t = 18.5048$ ,  $p = 0.0000$ ). Data were derived from a scale that ranged from a low of zero points to a high of six points. The data indicated a statistical favor for the WE + T-N-T group. See Table 3 to review the results.

*Table 3. Instructional Components*

Group	Mean Score	SD	df	p
Treatment ( $n = 51$ )	5.3333	0.9933	101	0.0000*
Control ( $n = 52$ )	2.1153	0.7586		

\* =  $\alpha < 0.0167$

The six specific instructional components itemized on the Instructional Components Evaluation Checklist are as follows: 1) Lesson goal(s), 2) Objectives written in performance-based terms, 3) Student performance activity, 4) Student performance evaluation, 5) Student-to-teacher contact, and 6) User-location within the site cues. The Treatment group scored higher than the Control group on all six instructional components. Not one Web-based lesson developed by the participants in the Control group included Objectives written in performance-based terms, or Student performance activity, or Student performance evaluation.

Some participants from the Control group and the Treatment group designed what resembled an activity and/or quiz in their Web-based lesson but did not receive points for these components on the Instructional Components Evaluation Checklist. Operational definitions of these three variables follow.

Objectives written in performance-based terms: refers to a statement that describes what learners should be able to do when they have completed the lesson. "What learners 'do' must be observable so that the learners know that they have learned and what they have learned" (Smith & Ragan, 1993, p. 91).

Student performance activity: refers to eliciting specific behavior from the student based on the performance objectives for the lesson.

Student performance evaluation: refers to supplying the student with feedback on their performance based upon student performance activity.

The protocol in awarding points for these three variables was to first look for objectives written in performance-based terms. The performance objectives are the foundation for the other two variables and if there were no performance objectives contained in the lesson there could be no points awarded for either "student performance activity" or "student performance evaluation." As stated a-priori in the definition of "student performance activity," performance was based upon stated objectives and if objectives did not exist in the lesson no points were awarded for student performance activity. Furthermore, no points could be awarded for student performance evaluation, because as stated a-priori in the definition, "student performance evaluation is to be based upon student performance activity."

$H_{04}$ : There will be no statistically significant difference between the frequency of functionality when the six specified technical components (e.g., navigation, image presence, mailto links, interactive mechanism, audio and video) are developed by pre-service teachers utilizing WE + T-N-T than when developed using WE only.

$H_{04}$  was rejected, indicating significant statistical difference between the frequency of functionality of the six specified technical components: 1) Navigation, 2) Image presence, 3) Mailto links, 4) Interactive mechanism, 5) Audio, and 6) Video in Web-based lessons when developed by pre-service teachers utilizing WE + T-N-T than when developed using WE only ( $t = 9.7680$ ,  $p = 0.0000$ ). Data are derived from a scale that ranged from a low of zero points to a high of six points. The statistical preference was in favor of the WE + T-N-T. T-N-T group. The results can be found in the following.



*Table 4. Technical Components*

Group	Mean Score	SD	df	p
Treatment ( $\underline{n}$ = 51)	3.4901	0.6744	101	0.0000*
Control ( $\underline{n}$ = 52)	2.0769	0.7883		

\* =  $\alpha < 0.0167$

The scores on the Technical Components Evaluation Checklist were based on functionality of the six specified technical components. Not one participant from either the Treatment or the Control group attempted to include component 5) Audio or 6) Video in their lesson. Of the four remaining technical components, the Treatment group scored higher on average in every component.

H<sub>05</sub>: There will be no statistically significant difference in the degree of teacher appeal expressed by pre-service teachers using WE + T-N-T toward developing Web-based lessons than from pre-service teachers using WE only.

H<sub>05</sub> was retained, indicating no statistically significant difference between the degree of positive teacher appeal from pre-service teachers using WE + T-N-T to develop Web-based lessons than from those using WE only ( $t = -0.6403$ ,  $p = 0.2617$ ). Data were compiled and analyzed from the Computer Attitude Scale (CAS). The four areas associated with the CAS (low anxiety, high confidence, liking, usefulness) revealed no statistically significant differences between the two groups. The results can be found in Table 5.

*Table 5. Computer Anxiety Scale*

Group	Mean Degree of Appeal	SD	df	p
Treatment ( $\underline{n}$ = 51)	118.2450	16.7980	101	0.2617
Control ( $\underline{n}$ = 52)	120.4807	18.5723		

H<sub>06</sub>: There will be no statistically significant difference between the likelihood of pre-service teachers' anticipation for developing Web-based lessons with either alternative in their future instructional settings.

H<sub>06</sub> is retained, suggesting no statistically significant difference in the anticipated future instructional development of Web-based lessons by pre-service teachers using WE + T-N-T to develop Web-based lessons or those using WE only ( $t = -0.3946$ ,  $p = 0.3470$ ). Data were compiled and analyzed from the Intended Future Use Questionnaire. See the results displayed in Table 6.

*Table 6. Intended Future Use of Development Alternative*

Group	Mean Score	SD	df	p
Treatment ( $\underline{n}$ = 51)	8.4019	1.9053	94.3	0.3470
Control ( $\underline{n}$ = 52)	8.5769	2.5540		

Appeal of the design/development process was addressed through the statistical examination of H<sub>05</sub> and H<sub>06</sub>. There was no statistical significance in the differences between the Control group and the Treatment group on H<sub>05</sub> or H<sub>06</sub>.

## Talk-Aloud Interviews

The post-hoc talk-aloud interviews were completed by telephone with students from both the Control and Treatment groups. Two students were selected from each group based on most and least time recorded on the Work Time-Log. Two students from each group were also selected based on the highest and lowest compiled scores of the remaining five instruments (Effort Questionnaire, Instructional Components Evaluation Checklist, Technical Components Evaluation Checklist, Computer Attitude Scale, Intended Future Use Questionnaire). In theory, eight talk-aloud interviews would be performed, however, one of the individuals identified from the Control group fit in two categories (least time spent as recorded on the Work Time-Log and high composite score on the remaining five instruments), and therefore only seven participants were interviewed.

Data obtained from the anecdotal talk-aloud interviews revealed that one participant from the Treatment group had continued using the T-N-T template/shell after the study ended. He had recently completed his seventh lesson in only 20 minutes. His completion time for the initial use of T-N-T was 450 minutes. Although this finding is based upon a single data point, the substantial, reduction in development time needs to be explored further to determine if multiple use of the WE + T-N-T template and WE only results in similar outcomes.

## Limitations

Due to several factors, the researcher or reader would be vulnerable in drawing direct conclusions from the results of this study. The following limitations of this study should be considered when attempting to generalize from the findings and/or to replicate the study.

The primary limitation of this study was the failure of the Control group to develop Web-based lessons that included the lesson components as defined within this study. According to the PTEP methods course syllabus, lessons components include goals, objectives, activities and performance evaluation. The Control group did not include these lesson components in the Web sites they created. Without such instructional components, the nature of the sites created is much more informational rather than instructional/educational. Had the Control group been required to rework their lessons so that the lessons included instructional components, the results of the comparisons between the Control group and Treatment group in regard to the efficiency (time and effort) and appeal (low anxiety, high confidence, liking, usefulness and intended future use) may have been substantially different.

Restricting this study to a university setting is the greatest strength while also being the greatest weakness. Template design and interaction of pre-service teachers may not reflect the views of students at other universities, smaller or larger colleges, and/or community colleges. The university setting, however, offers the opportunity to assess students' perspective as they create and layout their lessons using the template format. Ability to generalize is largely limited due to the sample selection.

A third limitation is that this study uses a self-report. Self-reports are susceptible to "error" through the difficulty of eliciting honest, accurate responses. In this study, the participants are not under pressure to produce in order to be paid; nor are they reporting on an issue that will influence their grade, although they may be under a certain amount of time constraint pressure because of their own organizational capabilities. The assignment will be graded "Pass" or "Fail" based upon criteria in the grading rubric; student input from the self-report is not part of the grading criteria. These factors still do not guarantee the truthfulness of the responses. However, they do alleviate the pressure and stress to answer with "teacher pleasing" responses.

A final limitation of this study is control for experimenter contamination. The intervention, T-N-T Web-based lesson template/shell, was designed and developed by the researcher and unquestionably there is researcher bias. The instruction for using the Web editor and the instruction for using T-N-T will be presented by the researcher. Maintaining fidelity during lesson presentation is a limitation. To minimize this limitation, adherence to guidelines for each scripted lesson will be described in Chapter Three. Another aspect of experimenter contamination is that data collection and data analysis is conducted solely by the researcher and subject to researcher bias. To minimize this limitation, the participants complete four of the six instruments. Of the remaining two instruments one is scored based solely upon component presence and the other is scored based solely upon component functionality.

## Description of the T-N-T Template/Shell

Essentially, the lesson template/shell is a complete Web-based lesson minus the content. The template/shell exists as a Web-based resource/tool for the teacher. This template/shell is designed to support a pedagogically sound linear presentation of materials and activities while concomitantly providing a multiplicity of instructional scaffolding cues designed to guide development of the content. Below are screen captures of two pages from the template.



Figure 1. Screen Capture of the Navigation Bar

The navigation bar includes seven links (Goals, Objectives, Readings, Activity, Quiz, Glossary and Teacher). Note that "Goals" is white (inactive link) and the others are red (active links). White text is a visual cue that the user is working in the Goals section. The title "Lesson Goals" directly below the navigation bar is another indicator of location and page purpose. Scrolling down the Lesson Goals page reveals a few lines of direct instruction to the developer.

Each page of the template (excluding Glossary and Quiz) includes such direct instruction and a brief rationale (theoretical foundation) for the suggested approach to content development within each part of the Web-based lesson. The "Glossary" and "Teacher" links are set apart within the navigation bar. This segregation is

intentional as glossary and teacher sections are provided as Tools for the teacher/designer and not as having the same instructional rationale/purpose as the other five components of the lesson. The one link located on the navigation bar that does not open a Web page is titled "Teacher." This link is an E-mail link to the instructor.

The lesson template also includes a ready-to-use ten question multiple-choice quiz. The interactive "Quiz" is a JavaScript program that solicits the user to answer questions relevant to the lesson content and receive immediate feedback on their performance.

When providing content for the Quiz section of the lesson, the teacher/designer is prompted to insert questions pertaining to the lesson and potential answers (correct and incorrect). The feedback section of the Quiz is a program designed to give students appropriate information about their performance. Note that in the following screen capture, answers to the various questions have been selected and the user has clicked on the "Calculate Results" button.

The student performance feedback section of the Quiz page provides the student two sets of information. First, it furnishes a text-based assessment of their performance and secondly it allows the student to see which questions they answer correctly and incorrectly.

Lesson Quiz - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites History Mail Print

Address C:\WINDOWS\Desktop\ProposalTemplate\q.htm Go

Links Best of the Web Channel Guide Customize Links Free HotMail Internet Start

Incorrect answer goes here  
D Incorrect answer goes here

Your Answers	Correct Answers
Q 1: A	Q 1: A
Q 2: B	Q 2: B
Q 3: D	Q 3: D
Q 4: B	Q 4:
Q 5: B	Q 5: B
Q 6: A	Q 6:
Q 7: A	Q 7:
Q 8: B	Q 8: B
Q 9: C	Q 9: C
Q10: D	Q10:

Calculate Results

Reset Quiz

Your Score:

You got 6 out of 10 correct.

My Computer

Figure 2. Screen Capture of Performance Feedback section of the Quiz Page

## Conclusions

This study examined the efficiency (time and effort), effectiveness (inclusion of specific instructional components and functionality of specific technical components), and appeal (anxiety, confidence, liking, usefulness and intended future use) of two lesson developmental alternatives (WE only and WE + T-N-T) by pre-service teachers. Statistical analysis of six hypotheses confirmed that developing Web-based lessons using WE + T-N-T was more effective than using WE only. The analysis also revealed that neither developmental alternative was superior in terms of efficiency or appeal.

Using a tool such as T-N-T significantly reduces the requirements for technical expertise in the development of a Web-based lesson. T-N-T also provides scaffolding for the creation of pedagogically sound instructional environments by focusing attention of the designer on instructional strategies and methodologies.

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# Professor Ann De Vaney and A Good Conversation

Randall G. Nichols  
University of Akron

## Introduction

The first time I met Professor Ann De Vaney (Becker), she listened well to a paper I presented at a conference. She listened attentively, and doing so is one of the very best qualities of a good academic. So, when given the chance to review her work and write a paper for this symposium, I wondered if this quality of active or good listening is somehow present in her written works. And if something like good listening is evident, how does it manifest itself? So I acquired written works from throughout her career, starting with her dissertation and ending with an end-of-the 20th century work.

My goal is not primarily to examine De Vaney's intended ideas so much as it is simply to see what her writing generally reveals in terms of something like good listening. I don't want to take the works solely at face value but to look into them to see if I can find her paying close attention to people—to research subjects, to subjects otherwise addressed in the works, even perhaps to readers of her works. So, I gathered and read the ten works listed below. They were available from my own library, from ERIC, and from Dissertation Abstracts.

## The Works

- *Verbal Ability and Visual Verbal Modes of Presentation in the Acquisition of a Poetic Concept* (1974)
- "A Model for Critical Dialogue: A Study for Enhancing Student Response to Visuals" (1982, with Robert, Roberto, Muffoletto)
- "Reader Theories, Cognitive Theories and Educational Media Research" (1985)
- "Rules of Evidence" (1990)
- "A Grammar of Educational Television" (1991)
- "Square One Television and Gender" (1991, with Alejandra Elenes)
- "Reading Educational Computer Programs" (1993)
- "Introduction: Background to Channel One" (1994)
- "Voices of the Founders: Early Discourses in Educational Technology" (1996, with Rebecca Butler)
- "Can and Need Educational Technology Become a Postmodern Enterprise?" (1998)

## Method

At first, I wanted to see if, in her written works, professor De Vaney "listens" to people as well as she had listened to me at the annual Meeting of the Association of Educational Communications and Technology in 1986. Of course, I knew that a typical or literal meaning for "listen" was not good enough; I was *reading* her work. After casting about for the concept that best means the quality I was investigating, and after considering "hearing," "listening," and various communication models, I decided simply to look for instances when, in writing, she appears to attend to people's interests in some way. Attending to another person is what we do in a good face-to-face conversation. We pay attention to people and respond based, partly anyway, on their interests, intentions, needs, and so on.

This line of thinking led me to try to understand her work by asking a rather straightforward set of questions. I wanted to start by first simply asking what each work is about, but early on, I realized that the questions being devised were emanating from the kinds of post-structural, reader, and reception theories Ann uses in her work. She (1985) says, "Meaning can only be understood as what the individual intends. It is, therefore, the individual's intentions which produce the specific relations of differences or similarities..." (p. 10). So, I ask not only what a piece is about but what she means and/or intends. Why is she writing about something? This question necessitates examining the way in which she proceeds with her work—her methodology.

Professor De Vaney says (1985), too, that in post-structural theory we need to be aware that, in discourse, certain audiences are included and "space for certain viewers [audiences], is excluded" (p. 11). So, I ask about whom, in terms of her apparent audiences, she includes and/or excludes.

Further, people and knowledge are continually changing. As De Vaney says (1985), "knowledge accrues" (p. 3). So I look for what, if anything, changes in her writing over time and in terms of the foregoing quest

So, I attempt to address each work by asking basic questions:

1. What is the work about, and what are her (and any co-author's) intent and methodology?

2. Who is her audience, and how does she attend to the interests of those she addresses?
3. What changes in her work and in her attention to people's interests?

## Analysis of the Works

Please note that Professor De Vaney has co-authors on three of the works examined here. So, in the case of those three works, the reader should not assume that what emerges or what I say is totally attributable to Ann. Of course, a reader shouldn't assume that anyway, given what we are about to learn from Ann's work.

- *Verbal Ability and Visual Verbal Modes of Presentation in the Acquisition of a Poetic Concept* (Becker, Ann De Vaney, 1974)

1. What is the work about, and what are her intent and methodology?

This first work is Professor De Vaney's dissertation. She writes that, "The main objective of this study was to determine interaction between verbal aptitude and visual-verbal modes of presentation in the teaching of a concept" (p. 3) so as to help media designers and teachers.

The concept is "poetic metaphor," and the modes of presentation are: printed verbal, printed verbal with still pictures, spoken verbal, and spoken verbal with still pictures. She also is interested in the interaction of these modes with subjects' verbal aptitudes. Measures were taken on two dependent variables, comprehension and learning retention.

She concludes that, "one strong result emerged. The sound/still picture treatment (that is, the slide tape presentation) was superior to print, print/still pictures, and sound" (p. 70) "especially for low verbal ability students" (p. 71).

2. Who is her audience, and how does she attend to the interests of those she addresses?

Her audience clearly is primarily her dissertation committee. Academics/researchers, instructional designers, and teachers are a primary, intended audience. Learners are included but only as research subjects and not directly as an audience. Research subjects and readers are treated reasonably. That is, she writes in an expository (empirical, logical, rational) style.

She studies the verbal abilities of people, which implies attending to or listening to people. She works closely with people in terms of learning and communicative ability (print verbal ability).

The study is experimental and quantitative, which indicates that it is less attentive to the subjects. Given the writing style, the audience and subjects are held at arm's length, so their best interests probably are not being served as well as they might.

3. What changes in her work and in her attention to people's interests over time?

Of course, this is the first work studied, so nothing has changed. It is a typical, rational, empirical, expository, third person study and writing from the 1970s. It is what is or was expected in a dissertation.

- "A Model for Critical Dialogue: A Study for Enhancing Student Response to Visuals" (with Robert Muffoletto, 1982)

1. What is the work about, and what are her (and any co-author's) intent and methodology?

The authors try "to explore the effectiveness of a pedagogic strategy which involved the development of descriptive tactics and individual exploration into the meanings and significance of photographic images. It was hoped that the study would reveal methods which enhanced student responses toward photographs, their production, function and value in educational and culutral [sic] settings" (p. 3).

Students took photos and discussed them, guided by categories provided by De Vaney and Muffoletto: judgment, formal or visual, poetic, and political. Each week for six weeks, students were shown a different Diane Arbus' photo. After the first and last showings and without discussion, each student wrote responses about the photos. Student replies were used to form perceptual categories.

"The results of the study revealed a number of interesting considerations for teachers of media. The study suggested that by structuring the psychological learning environment conceptual shifts could occur. It also suggested that conceptualization in one activity could be crossed over to another activity which becomes an important consideration for educators when using media in their curriculum. The study also suggested that the development of a critical dialogue model for students might enhance verbal responses to photographs" (p. 8).

2. Who is her audience, and how does she attend to the interests of those she addresses?

This work directly addresses attendees of the Annual Meeting of the Association for Educational Communications and Technology: educational technology researchers, media specialists, graduate students, and so on. Other education researchers, academics, and teachers generally are a less direct audience. Again, students are subjects of the study and, in the usual tradition, are not directly addressed as an audience or as potential users of the results of the study. All study subjects and direct or potential audience members are treated quite reasonably. As is usually the case with academic reports, a certain rhetorical distance from the reader and student/subject is present.

Given that Ann is interested in enhancing student conceptual responses to photographs, students are treated as capable learners, thinkers, and conversationalists.

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. Compared to the first work, Dr. De Vaney pays greater attention to university students and to how they conceive of and think about photographs. She works directly with them to help them be more thoughtful. She expects learners to be more critical, in the sense that they are rational. However, she does not write directly *for* or *to* students. The work is about them.

• “Reader Theories, Cognitive Theories and Educational Media Research” (1985)

1. What is the work about, and what are her intent and methodology?

This paper is, in part, an exposition of theories that have conventionally guided research in educational/instructional technology. The paper also argues that the professional field should shift to structural and/or post-structural theories and investigations, especially in that structuralism “focuses on human acts...that involve cultural construction and the ways that speech acts involve sentences” (p. 3). Structuralism is interested in the meaning one intends to convey, and “knowledge accrues by perception of meaning, not by information processing...the relationship between the observer and the observed becomes primary. Knowledge...resides in the relationships which people construct and then perceive” (p. 3). “Meaning or understanding is generated by the learner not controlled by the technology or its designer” (p. 6). Post-structural theories go farther, emphasizing viewers and their construction of meaning, and “meaning can only be understood as what the individual intends” (p. 10).

She asks, “How would the learner [reader, student, colleague, writer] be perceived in post structural studies? Essentially, he/she would be understood as the subject...of the meaning, since he/she creates meaning from the text or media presentation...the learner is viewed as a social person belonging to a group, not as an individual person whose brain is the unit” (p. 10). So group construction of knowledge is studied. Conversely, messages may be encoded so that “space for certain viewers, is excluded. Yet, these exclusions may not be obvious to the designer. It is the viewer who has to tell us” (p. 11).

2. Who is her audience, and how does she attend to the interests of those she addresses?

This work directly addresses attendees of the Annual Meeting of the Association for Educational Communications and Technology, though education and educational technology researchers, academics, theorists, and designers (and perhaps teachers) are likely to be a secondary audience, given the venue for the publication. Given that the piece is written in a mostly conventional academic fashion, the audience is treated reasonably. Here, too, learners are never directly an audience for her work, though we can surmise that learners are meant to be the ultimate receivers of the results of her work.

Even though the work is somewhat distanced from learners, Ann's meaningful attention to them is evident in this paper. After all, she views the learner “as a social person belonging to a group, not as an individual person whose brain is the unit.”

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. Because of whom she is addressing directly, she is attending again to the learner at a distance, but she writes as though learners have agency and voice and importance.

Here, Ann has left the realm of empirical/quantitative research and immerses herself in naturalistic investigations in education. But she goes beyond the mundane versions of most forms of so-called naturalistic inquiry and begins to show attraction to what I know as critical theory, which is concerned, at its best anyway, with the likes of human freedom, dignity, and social standing.

• “Rules of Evidence” (1990)

1. What is the work about, and what are her intent and methodology?

Ann writes that, “I will discuss whether the establishment of rules of evidence is possible or even necessary. An alternative framing of the question about rules of evidence is, ‘How do researchers and practitioners in a specific field know what they know?’ I will describe the concept of evidence in law and science. Specifically, I will show that the adoption of statistics as evidence in educational research was historically a clear misreading of the ‘scientific method’” (p. 8).

She argues that education, as with the social science of law, is based in context and language and, so, cannot be value free and mechanistic. Instead, law and education research are activities in which evidence is collected and judged inductively not deductively. She goes beyond now common objections to applying many parts of the scientific process to educational research to point out that, like science, “educational researchers are attempting to describe and measure capricious, discontinuous and not easily controlled experiences” (p. 16).



Among other conclusions, she says that, “the conception of science and scientific rigor which dominates the area of educational research, and which was borrowed from the field of psychology, is overly constrained by the adoption of narrow methods and limited use of the mathematics of probability” (p. 17). She wants readers to expand our understanding of educational research.

2. Who is her audience, and how does she attend to the interests of those she addresses?

Ann writes directly for educational technology researchers who try to expand their understandings of educational technology and for scholars of diverse backgrounds, interests, and disciplines. Readers are treated reasonably. Again, students are not a direct audience.

She attends to the best interests of research participants generally by arguing for a research approach that is more inclusive of and context-bound to people’s lives.

3. What changes in her work and in her attention to people’s interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. The writing style is the same expository/academic form used previously.

To the extent that she wants researchers to be more inclusive and contextual, she is closer to readers and research participants. For the first time, a bit of affect appears—when she says readers should remain “oppositional” not only in terms of conventional educational research but (she implies) in all education work. The argument to broaden research paradigms is much like the last piece reviewed here, though this piece is even more basic in that it gets at a philosophic/rational basis for post-structural research.

- “A Grammar of Educational Television” (1991)

1. What is the work about, and what are her intent and methodology?

This piece explains a way of analyzing how students read educational television and make meaning from it. The theory section of the chapter “borrows concepts from semiotics and suggests a grammatical analysis of television. Such an analysis would describe units of television construction such as frame, shot and sequence, along syntagmatic as well as paradigmatic lines” (p. 255). “In conjunction with syntactical analysis which examines the actual relationships among the categories of construction, paradigmatic analysis...would provide a description of the potential relationships between and among the units of television construction” (p. 256). She then shows how semiotics has been “the most thorough and promising description of the language of media” (p. 257) and applies the description to TV, ETV, and ITV.

She then proposes a model for the method, procedures, and data analyses of the grammar of television. A panel of experts views a program several times, generates focus questions, and identifies program formats. Program segments which are part of the format are identified, the experts record segment structures, and then they run a reliability check on these data. Then data are appraised for program segment patterns. Borrowed codes are noted and traced. Social/cultural origins of the codes are traced, and the social/cultural content and meanings are examined.

She wants to give researchers a way to include social/cultural issues when studying instructional media because often researchers have abdicated their responsibility to do so (p. 276).

2. Who is her audience, and how does she attend to the interests of those she addresses?

This work is written for an audience of educational researchers and theorists. She treats readers very reasonably. Here, too, she does not speak directly to students (or to teachers).

Not all Ann’s work exemplifies the qualities of good listening/communication that I am looking for. Some work is just expository. This work only very narrowly explicates how students, professors, or other academics do or can communicate/hear one another well! Ann has the teachers’ and students’ best interest at heart ultimately, but this piece approaches them from a distance.

3. What changes in her work and in her attention to people’s interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. “A Grammar of Educational Television” is very theoretical. The goal of thinking through and proposing a model by which educational television might better be understood is very lofty, given that few have suggested such a thing. But of the works reviewed, this is the one in which she is most distant from the people I suspect she is trying most to help or teach, i.e., learners.

- Square One Television and Gender (with Alejandra Elenes. 1991)

1. What is the work about, and what are her (and any co-author’s) intent and methodology?

The authors analyze a children’s TV program that generally is accepted as positive because it intends to teach what many of us agree is needed--math skills. The authors use a form of post structural reader theory called “reception theory” to understand *SOTV* in terms of sexism and racism.

They describe *SOTV* as “the quintessential [sic] post modern children’s program, since it employs the latest TV technology to create fractured narratives and messages which, in turn, fragment the subject positions of the viewers” (p. 7). Multiple and fast changing formats are used to gain the children’s attention about math.

Unfortunately, the children are also being taught, “how a 12- or 13-year-old boy and girl should act, dress and speak in sexual [even pornographic] fashion” (p. 18). Children are taught that people with non-American accents are to be parodied (p. 19). *SOTV* signals a return to racism, albeit a subtler form of racism (p. 20). Children are subjected to this sexism and racism in 20-40 percent of all *SOTV* programs.

2. Who is her audience, and how does she attend to the interests of those she addresses?

This work directly addresses attendees of the Annual Meeting of the Association for Educational Communications and Technology; though any reader would likely get the feeling Ann and Alejandra are primarily talking to the people at the Children’s Television Workshop (who produce and design *SOTV*), directing them to change their programming. Ostensibly, though, the piece is written for educational technologists, researchers, and designers. These audiences are treated reasonably, and they are addressed directly and strongly. Ann and Alejandra do not directly address the recipients (children) of this programming that is shot-through with racism and sexism, though we know it is for the children that they are exposing the program biases.

3. What changes in her work and in her attention to people’s interests over time?

The topic is different, though Ann (and Alejandra) remains concerned with helping and improving the field of educational technology.

This work is a cultural critique, and the authors are able to show us the full range of what children learn from this program. Further, the tone and affect of this piece are bolder than in any work so far. It has a strong, good moral tone because it involves children and it is written with a strength of belief. What is notable, given what I set out to look for in Ann’s work, is when she says that her “analysis of *SOTV* is...designed to investigate the way viewers make *sense* of and learn from *Sesame Street* and *SOTV*” (page 10) (emphasis added). The idea of “sense” indicates she wants people, especially children, to understand by more than just rational means. She wants people to understand TV more completely by using a sense of cultural.

- “Reading Educational Computer Programs” (in Muffoletto & Knupfer, 1993)

1. What is the work about, and what are her intent and methodology?

Here, Ann uses reader theory again to look at how a computer program “makes its users a subject of and subjected to particular discourses and their concomitant values and knowledge structures” (p. 181). Reception theory sees knowledge as a social construct, and in doing so, “it can uncover the manner in which cultural messages are enfolded in the rhetoric of...an educational computer program” (p. 182). The theory allows Ann “to consider the relationships among user, program, and producer...” (p. 82). With this theory, Ann sets out to uncover cultural messages in *Where in the World is Carmen San Diego* (WWCSD), the computer game.

She concludes that people are diminished by some computer programs because the programs treat them as logical problems-solvers who value immediate feedback, efficiency, and productivity, who are not frustrated by lack of spontaneity and who are mechanized subjects. At the same time computer users are people who must participate in larger social discourses of computing whose participants produce and are embedded in “a range of aesthetic, moral, and political value judgments...produced and regulated by the language of the participants”(p. 183). Critically, she notes that a person in this discourse “may be totally unaware of the constructed nature of these value judgments and may believe them to be natural or self-evident” (p. 183).

Further, WWCSD itself

provides an invitation to users to participate in a rational-logical discourse that is conflated with discourses of sexism and racism. It addresses students of any race or gender in a disrespectful manner. Young girls are not only invited to perceive themselves as objects, but also because this game is sanctioned as an “educational” imprimatur, they are encouraged to believe that this perception is appropriate. Boys fare little better, for the program empowers them in chauvinistic ways which will serve them poorly in their daily lives....People of color are ignored in the old versions and trivialized in the 1991 version. This treatment means that the majority of the California school population is eased out of subjectivity, unless people of color care to participate in a racist discourse” (p. 191).

In order to subvert these conditions, and being able to find only one good example of alternative instructional software, Ann suggests these guidelines:

- place the technology in the hands of subjects of alternative discourses whose rhetoric includes goals of equity and personal freedom
- place the technology in the hands of ethnic groups and allow them to represent their thinking and behavior in an authentic manner
- place the technology in the hands of women for the purposes of creating cooperative software (p. 195).

2. Who is her audience, and how does she attend to the interests of those she addresses?

The audience for this work appears to be educational technologists and academics generally and, perhaps, computer program designers, all of whom she treats reasonably. Those whom the programming is about and for—learners—are treated with respect. Learners themselves, recipients of the critique and anything resulting from it, are not addressed directly. Obviously, though, Ann urges that producers of computer programs should alter their programming so that users are treated as people who not only value efficiency and the like but who also are spontaneous and participate in a larger social context of aesthetics, morals, and judgments. In this fuller treatment, Ann is respectful of learners/users.

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. In this piece, she is speaking whole-heartedly about the relations of educational computing and its production of sexism, racism, objectification, over-rationalization. She urges greater self-determination, freedom, and democracy in technology uses, especially for children and women. She is more obviously subversive of biased educational thinking and materials than in any other work so far.

• “Reading the Ads: The Bacchanalian Adolescence” (De Vaney, 1994)

1. What is the work about, and what are her intent and methodology?

Ann uses reader theory again to analyze Channel One ads from 1990 and 1992. She asks, “How do these ads construct their subjects or position their viewers? In other words, just whom do these ads think their viewers are?” (p. 139)

She concludes that the ads borrow from commercial TV forms. They are postmodern in that they feature “fractured narratives, fragmented images, heightened use of jump cuts, excessive use of dancing and singing, and startling juxtaposition of images” (p. 145). The people in the ads are almost totally white, beautiful, and sexual. The ads focus on pleasure, and “no labor is depicted” (p. 146).

She does not want to suggest that teens always use the images in Channel One commercials as guidelines for living, but she does suggest that “if Hollywood and commercial television and classroom TV present only a Bacchanalian adolescence, then these images may assist teens in the construction of adolescence as primarily a party” (p. 147). In these ways, the ads are irresponsible (p. 151).

2. Who is her audience, and how does she attend to the interests of those she addresses?

The primary audience appears to be academics/researchers, though she seems also to writing directly to Chris Whittle and Whittle Communication—or to anyone trying to influence the culture and commerce. She treats the audience reasonably. Partly because of where it appears, in a text available mostly to people in higher education, she is not writing directly to teachers or students. However, we can see in the dedication in whom she is most interested: “With respect and love for the thousands of elementary and secondary students we have taught.”

Ironically, if teachers in the primary audience take this piece and/or its ideas to their own students, who are not the primary intended readers, the piece may have more effect than if the commercial interests read it. Students may change, whereas commercial interests aren't.

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. She still is trying to change the way media, in this case school/media advertising, produce and/or influence younger learners/viewers/users while ignoring minority groups and women. Though not as strongly, the sense of urgency felt in Square One Television and Gender in this piece, too.

• “Voices of the Founders: Early Discourses in Educational Technology” (with Rebecca P. Butler. In Jonassen, 1996)

1. What is the work about, and what are her (and any co-author's) intent and methodology?

In this work, De Vaney (and Butler) derives meaning from audiotapes and written text of the founders of the field of educational technology. She uses reader theory and neo-theoretical analysis to talk about the voices and texts in the “amorphous field” of educational technology/audiovisual instruction in roughly the first half of the 20<sup>th</sup> century in America.

She concludes, among other things, that “The rhetoric of the founders and those who follow indicate that the basis of this field will always be hardware, with its concomitant marketplace and governmental interests. If we turn away from this, our voices will remain within the academy. We will be talking to ourselves. Whatever tempering influence we could have had will be lost” (p. 38).

She devotes quite a bit of attention to women in the field, and concludes that “Although women in educational technology became more prominent [in the decades after WWII], the placement of women in this field is still uneven today.... today, women continue working towards equal recognition, opportunity, and responsibility within educational technology” (p. 43).

She speaks directly to a democracy and communication when she points out that the field today “gathered a berth in the academy with the discourses represented in World War II research, operant conditioning, and military training...Perhaps the audiovisual educators...noted the efficiency and effectiveness of military pedagogy operating particularly in the service of democracy, and where convinced that education should proceed down the same road” (p. 38).

She hears the people involved in the formation of the field and speaks of the ups and downs of *the valorization of humanistic discourses* and *democracy* and *the common person* associated the field of educational technology. She allows the voices of the founders to be heard. She speaks of the human condition and “One of the things that was valued in WWII was the preservation of democracy, and many projects were conflated with that desire. Unfortunately, the methods for accomplishing that preservation at that moment in time were undemocratic, i.e., hierarchical and militaristic” (p. 38). She also notes that democratic ideas of the founders included a “model of action” (p. 38) whereby they got all sorts of work *done*.

2. Who is her audience, and how does she attend to the interests of those she addresses?

This piece is directly for researchers, faculty, and students in educational technology. Ann favors women in these groups getting more prominence in the field and working toward more recognition, opportunity, and responsibility. She literally listens quite closely—and well—to the founders. Readers and audiences are treated reasonably and respectfully. In this work, she and Becky Butler give others voice by writing about others and by speaking for women, founders, democracy, freedom, and equality.

Though we know Ann cares about them, here too, she does not directly speak to students.

3. What changes in her work and in her attention to people’s interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology and the places of women and minorities. In terms of its methodology, attention to women in the field, and relations to societal-cultural issues, this is an unusual history of the field. Readers can see the importance of connections with politics, hardware, and prior economic issues. She displays a great deal of fairness toward “fathers” in the field of educational technology; she realizes the culture in which the founders existed and how that affected them and the profession.

• “Can and Need Educational Technology Become a Postmodern Enterprise?” (1998)

1. What is the work about, and what are her intent and methodology?

This piece takes a pointed look at historical, hegemonic features of educational philosophy: “European [sic] and Americans writing about democracy also voiced their values and views of humans while calling for equality for everyone. Yet, their epistemological assumptions sketched the human as a rational/logical entity that actually reflected the person of European male. Thinking they were acultural, as educational psychologists and technologists thought they were acultural, these writers called for equality for the white male.... The postmodern critique of subjectivity uncovers this fallacy” (p. 78). De Vaney describes the development of educational technology as a modern project, with its belief in progress, profits, patriotism, machines, and human equity. So, educational technologists often have exhibited a lack of caring about gender, power, race, and human equity. Effects of modernity in education include the commodification of students and, at best, an interesting construction of subjectivity. Learners became classroom capital to be sold to commercial enterprises. Learners became mental models stripped of social and cultural dimensions; notions of human diversity were constrained.

Today, many people in the field of educational technology resist the unavoidable changes brought on by a postmodern position. Postmodernists study race, gender, ethnicity, and power relations. They are skeptics who often attack/deconstruct modernity and the beliefs in which educational technology is embedded. They often deconstruct by examining discourse. Teachers/technologists are unaware of the ways in which their discourses are not only created by them but enslave them to narrow views of human diversity.

However, Ann says, “postmodern discussions of subjectivity allow teachers to discern how students are constructed by instructional media and software” (p. 77). She says that,

Alternatively, videos and software must not only picture girls and children of color but also provide respectful representations of diverse groups. If in a video a credible Muslim boy is presented with respect and given agency, there would then be room for the formation of a new subjectivity in the classroom. Knowledge about subjectivity allows teachers to resist subtly stereotypic constructions as well as to recognize when equitable representations and those with agency come along (p. 77).

She is interested in resisting the commodification of students and the capitalization of classrooms. Postmodernist positions help teachers to resist. She is interested in respect for people.

2. Who is her audience, and how does she attend to the interests of those she addresses?

She speaks directly to the readers of Theory Into Practice. The readership includes teachers and teacher educators. These audiences are treated reasonably. She also treats readers as people with agency, as she encourages them to resist problematic discourses/media. She listens and speaks to teachers and tries to help them. She respects them in this discourse. Once more, she does not speak directly to students, though we know that ultimately it is they as well as their teachers for whom she is writing.

3. What changes in her work and in her attention to peoples' interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. In the greatest detail so far, she addresses distinctions between modern and postmodern and how they relate to cultural considerations in education, educational media, classroom practices, teachers, and formation of student subjectivities. She is interested in resisting the objectifying and commodifying of students so that they may develop greater agency and self. She notes again that resistance is needed—resistance by teachers and, one suspects, resistance by students.

## Results

The following general answers to the guiding questions emerge from the analysis of the ten written works studied.

1. What is the work about, and what are her intent and methodology?

Dr. De Vaney writes about ten different topics in the field of educational technology, topics which include aptitude-treatment-interaction and media, teaching critical responses to photographs, a field shift to post-structural and reader reception theories, rules that constitute knowing in the field, how to read the structures of educational television, sexism and racism in ETV programming, the diminishing of children by TV programs, degradation of the subject by TV ads, a post-structural history reading of the field and the struggle by women in that field, and the need for a postmodern philosophy of educational technology. In general, the work is about laudable goals: human education, equality, and voice.

She often uses her writing to improve and/or defend the lives of learners. She intends to teach those in educational technology that they/we should be interested in more culturally relevant forms of work that may resist the diminishing of learners that older forms often promote. She is especially concerned with improving the lives of women and minorities. She wants to subvert the conventional paradigms of educational technology field. She wants to make our work more supportive of democracy.

Her research methodology broadens quickly in her career to sociological/cultural models of research. In most of her works, she uses qualitative, post-structural (often, reader reception theory), and inductive forms to examine the topics. She uses expository writing to report her findings. I mean “expository” to be the use of precise and logical written statements and explanations.

2. Who is her audience, and how does she attend to the interests of those she addresses?

In many of the works examined here, the primary audience is AECT convention goers: researchers, professors, graduate students, and perhaps some school media specialists. Otherwise, her audience is educational technology researchers, theorists, and academics generally. She speaks to women and minorities related to these fields. She speaks to Chris Whittle of Channel One and the Edison Project and to designers and producers at Children's Television Workshop and SOTV. Only occasionally do teachers appear to be the intended audience. She virtually never directly addresses students in her work—except as participants in studies.

All readers are treated reasonably and respectfully—even those who would use technology to diminish learners. Even when her writing approaches ire toward these diminishers, she is reasonable and respectful. Most significantly from the point of view of communicating/listening/responding, Ann's work strives (though indirectly in some cases) to give people (researchers, women, teachers, students, readers generally) greater voice, agency, and knowledge. She is dedicated to gaining greater voice, freedom, democracy, and respect for many people.

3. What changes in her work and in her attention to peoples' interests over time?

Of course, the specific topics of her works change from writing to writing, though they stay within the field of educational technology. After a very short time, her work is more foundational and philosophic in that it seeks wisdom as it deals with very basic issues. The pieces get stronger—especially when she talks about youngsters—and address democracy, freedom, respect, and voice. The work is somewhat more subversive over time; it asks readers to resist convention and change the cultural makeup of the field.

## Discussion

Ironically, to well and fully carry out an investigation such as the present one, I should have given her more voice; I should have spoken directly with Dr. De Vaney about these questions and issues. As she says, “Meaning or understanding is generated by the learner not controlled by the technology [written word] or its designer” (p. 6).

In terms of the listening I have been looking for, Ann’s writing is sometimes a very collaborative process in which she works directly with other authors (e.g., Muffelotto, Elenes, and Butler, herein). To this basic extent, she communicates well.

But from within her work, too, she carries on a conversation or, to use her language, a “discourse” with many people. Discourse is not a concept constrained to oral or even written language. As De Vaney and Butler (1996) say, “We consider discourses...to be texts ‘writ large’ (p. 5) “...discourses are invisible systems of thought” (p. 5).

It is clear in her works that Ann is respectful and careful of learners; I refer you to the dedication she makes in Watching Channel One: *With respect and love for the thousands of elementary and secondary students we have taught*. This is evidence that she is concerned with learners’ best interests and that, in this way, she is carrying on a good discourse with them.

Her discourses with students and educational technology broaden and deepen over time; at least if we look at the first and last works studied here. The dissertation is very empirical and rather narrowly focused, but the last piece, “Can and Need Educational Technology Become a Postmodern Enterprise?” is sweeping in scope and concerned with very basic issues of human education.

Ann’s work encourages the possibility of school democracy and, therefore, I believe, true school reform. Remember, she says,

- place the technology in the hands of subjects of alternative discourses whose rhetoric includes goals of equity and personal freedom
- place the technology in the hands of ethnic groups and allow them to represent their thinking and behavior in an authentic manner
- place the technology in the hands of women for the purposes of creating cooperative software (1993, p. 195).

This concern with democracy and local control of technology is evidence of her attending to and having good discourse with people. It is also unusual in that, as far as I can see, virtually no democratic schooling takes place in America.

Her work attempts to be fair, which is an attribute I would claim is essential for good discourse. In her attention to and sensibilities for helping children, women, and minorities, she cannot be accused of being unfair to males—as is evidenced by her treatment of the founders who may have made some questionable choices when they invested in technology, given its bent toward the undemocratic (De Vaney and Butler, 1996).

With this concern for what democracy can and should be, Ann keeps a sense of a good future in mind without negating or forgetting the past. This, among other attributes, makes her writing moral, which is another attribute of good discourse/conversation.

Her work is a reliable, valid analysis of educational technology in one form or another, as evidenced partly by her successful career and, mostly, by her own “rules of evidence.”

So, the quality of attending to my thoughts that I first noticed in Ann is present in her written work, too. However, I do not want to give the impression that I agree with everything she says. For example, I am not sure that too many postmodernists and modernists are too polemical, as she says in “Can and Need Educational Technology Become a Postmodern Enterprise?” Sometimes an argumentative appeal can bring democracy more quickly than a more purely reasonable appeal.

My only major question about her scholarship is that she virtually never directly speaks to the students (and sometimes the teachers) for whom she writes! If Ann were a better communicator, wouldn’t she also have spoken or written directly to learners more than she has? Wouldn’t she have used a more direct, inclusive assessment of people’s comprehension of poetic metaphor or teachers’ need to resist commodification?

## Conclusion

Those of us in educational technology would do well to consider following the paths she has gone down, be they her research topics, methodologies, and philosophies; be they the people about whom she is interested; or be they the ethical stance she takes.

I will say that examining her work has made me realize that I virtually never do my work directly *for* students—which now seems to me to be a very serious error. Writing for and speaking to academics—including

teachers, principals, media specialists, and professors—is not likely to do any good for students in schools. Of course almost no one writes or speaks for learners. But I know of almost no professors who write directly to students of any age to encourage them to work toward self-voice, agency, democracy or even learning! Maybe we should write books (or whatever) for students so that they will understand and make decisions about educational technology for themselves instead of being told what to do all the time!

It is clear that in her written work Ann is doing well at working toward understanding how people communicate, how they make meaning with one another. However, throughout this paper I have been uncertain about what I mean by Ann's ability to listen or communicate. My shifting use of terms indicates my uncertainty. Perhaps I can be clearest if I tell you that my examination of her written work leads me to conclude, mostly, that Ann is very good at carrying on the kind of good conversation Jane Roland Martin describes:

A good conversation is neither a fight nor a contest. Circular in form, cooperative in manner, and constructive in intent, it is an interchange of ideas by those who see themselves not as adversaries but as human beings come together to talk and listen and learn from one another. People have a lot to learn from Ann.

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# Faculty Point Of View Of A Faculty Development Program

H. Ferhan Odabasi  
Coskun Bayrak  
Anadolu University, Turkey

## Background

The importance of professional development of teachers in higher education has been a rising issue in the recent years. In fact the developments in education reveal that so much as the knowledge reflected, the higher education institutions should be learning organizations themselves, as well (Latchem and Lockwood, 1998). Being professional as a higher education teacher involves a knowledge base in both the subject or discipline area and in education, thus all higher education teachers must learn to create a synthesis between their knowledge of their discipline and how students learn (Beatty, 1998). Professional development activities, in HE realized to improve teaching, enhance student learning and facilitate faculty research and other scholar activities, try to overcome this “double professionalism” (Beatty, 1998). Anadolu University in Turkey, which carries the unique distance education in HE in the country and known as a pioneer institution in many different areas, started a program called “Educating the Educators” in 1999. The program is aimed to assist the faculty to enhance their teaching skills. Conscious of that many of the faculty have had no or little experience in teaching skills, the university wanted to start the program with a general teacher education program approach.

## The Purpose And Methodology Of The Study

This study was carried out in Anadolu University, Turkey. The population of the study consisted of 78 full time faculty as assistant professors.

*Table 1 Population of the Study*

Gender	f	%
Female	38	49
Male	40	51
Field of Study		
Social Sciences	37	47
Applied Sciences	16	21
Fine Arts	7	9
Technical Sciences	6	8
Health Sciences	7	9
Communication Arts	5	6
Adult Learning Experience		
Yes	21	27
No	57	73

The questionnaire used in the study was designed so as to get the necessary responses for the evaluation of the program.

The questionnaire consisted of three parts. The first part elicited the personal information. The second part consisted of questions to evaluate the given courses and the last, third tried to elicit suggestions about how the future programs should be designed.

The purpose of the study was to learn the opinions of the faculty about a faculty development program carried out and their suggestions for a future program.

## Results

Since the results of the first part of the questionnaire are summarized in Table 1, only the second and third parts will be discussed here.



### Evaluation of the Courses by the Participants

Altogether there were nine courses offered in the program. The participants were asked to evaluate the courses as from the point of view of nine criteria as;

- Efficient use of time
- Satisfactory content
- Applicability of the knowledge presented
- Level of meeting the needs
- Encouraging participation
- Solving teaching problems
- Clarity of the subject
- Enviromental Appropriateness
- Sufficient practice and case studies

The analysis of the results revealed that the courses ranked, as from the most productive to the least, as follows ;

1. Faculty-Student Relations
2. Characteristics of the Adolesence
3. Use of Technological Resources
4. Educational Technology
5. Class Management
6. Academic Counsellig
7. Instructional Methods and Strategies
8. Planning the Instruction
9. Evaluating the Instruction

### Faculty's Suggestions for a Future Program

In the third part of the questionnaire the participants were first asked to name the courses that should take part in a future program and the results were as follows;

COURSES	f
Effective Speaking &Listening	62
Use of Technological Resources	62
Faculty & Student Relations	60
Academic Counselling	60
Effective Presentation	60
Characterictics of Adolesence	55
Educational Technology	53
Academic Progress	49
Evaluating the Instruction	48
Class Management	47
Academic Regulations	32
Instructional Methods &Strategies	29
Organization and Administration of University	27
Creative Drama	23
Planning the Instruction	23

The second item of the third part of the questionnaire asked the priorities that a future program should carry and the results were as follows;

PRIORITIES OF A FACULTY DEVELOPMENT PROGRAM	f
Needs Analysis	26
Efficient Curriculum	23

Voluntary Participation	18
Effective Timing	11
Classification According to Area of Study	10
Informing the Participants Beforehand	8
Small Group Interaction	4

## Conclusion

The results of the study revealed how the faculty who attended the program evaluated the program and made suggestions about a future program. The results of the evaluation of the courses showed that the faculty mostly found the Faculty-Student Relations course to be most beneficial. However Planning & Evaluating The Instruction courses which are more teaching skill oriented came at last. This might be a clue that the faculty rather need courses that support teaching but not right in the middle of it. This fact is also revealed in the faculty's course suggestions for a future program. Here the faculty suggest Effective Speaking & Listening; Faculty & Student Relations and Academic Counselling Courses in the highest rank for future programs

When it comes to the priorities that a future program should carry; the faculty reveal that a Needs Analysis is the top priority. Then comes the Efficient Curriculum. This result shows the weakness of the program.

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# Sixth Graders' Motivation During Problem-Based Learning

Susan Pedersen  
Texas A&M University

## Abstract

*This study employed a mixed methods design to examine students' motivation during PBL, comparing it to their motivation during typical class activities. Analysis of the quantitative data shows that students demonstrate more intrinsically motivated behavior during PBL than during their regular class activities. The qualitative data suggest that the greater opportunity for collaboration and student control over class activities afforded by PBL may partially account for students' enhanced motivation.*

The literature on intrinsic motivation enumerates the many ways it can benefit learning. Intrinsically motivated students persist in the face of failure, undertake challenging aspects of a task, show creativity, and remain cognitively engaged in tasks longer than their extrinsically motivated peers (Ormrod, 1995). Given these conditions, it is no wonder that interest in learning for its own sake has been shown to be positively correlated with achievement (Alexander & Murphy, 1998; Schiefele, 1996).

How do we account for variations in motivational orientation? Research conducted within a developmental framework (e.g. Harter, 1978) cast intrinsic versus extrinsic orientation as a property of the individual, an enduring characteristic that is shaped over time by successes and failures (Schunk, 2000). Similarly, models that have arisen out of a cognitive framework have primarily examined learners' perceptions and beliefs, tacitly defining motivational orientation as a product of the covert thought processes of the individual (Bong, 1996). In both cases the effect of situational variables on motivation has largely been overlooked.

Recent theories of motivation have taken a different view, using a "learner in context" approach in the study of motivation. In their theory of situated motivation, Paris and Turner (1995) have postulated that motivation, like cognition, is situated. They argue that an individual's motivational beliefs and behaviors are derived from contextual transactions. From this perspective, motivation is necessarily unstable, varying with each context because the context itself causes variations in learners' perceptions and goals.

This interest in the role of context has led researchers to examine the types of approaches and the conditions within learning environments that can encourage learners to assume an intrinsic motivational orientation to learning. One approach that holds promise is problem-based learning (PBL). In PBL, all learning occurs as a result of students' efforts to solve a complex problem. Instruction begins with the presentation of the problem; as students grapple with the problem, they realize that they lack information and skills that they need to develop a solution. Students then engage in self-directed study to meet these learning needs. As a result, activity is largely under student control and learning is meaningful because students are the ones who have generated a need for it. PBL is widely regarded as highly motivating to students. Barrows and Tamblyn (1980) suggest that students are motivated in PBL by the internal rewards of learning, and not by grades or external rewards. Hmelo and Ferrari (1997) point out that PBL calls for an action on the part of the student (the development of a solution) and that students are often more motivated by the pragmatic goals involved in knowledge building for action than in knowledge building for its own sake. To the extent that students see the relevance of the problems used during PBL to their own lives, this approach may tap into personal interest. This is certainly the case in medical education where students are typically challenged to deal with the same types of situations they will encounter in their chosen profession.

Research findings suggest that PBL may help to promote an intrinsic motivational orientation in students. Moore-West, Harrington, Mennin, Kaufman, and Skipper (1989) found that PBL students gave higher ratings of their experience than non-PBL students on a variety of topics, including meaningfulness, emotional climate, and student interactions. Medical students enrolled in PBL programs found their education more relevant to their future careers than their traditional track peers (West, Umbland, & Lucero, 1985). PBL students were more likely to describe their preclinical program as difficult, engaging, and useful, while non-PBL students were more likely to describe theirs as irrelevant, passive, and boring (Albanese & Mitchell, 1993). In a longitudinal study of the effects of a course taught entirely through PBL, graduates were asked during telephone interviews about favorite courses, and about the course that was most helpful in teaching them problem finding, problem solving, critical thinking, and ethical decision making. Students overwhelmingly favored the class taught exclusively through PBL on all of these questions (Stepien, Gallagher, and Workman, 1993).

Taken together, these findings suggest that students enjoy the challenge of PBL, that they find topics more interesting when they encounter them through PBL, and that they feel this approach leads to more profound learning than other approaches. In this way, PBL may enhance learners' motivation, encouraging them to behave in a more intrinsically motivated manner than they do during the teacher-centered learning activities they typically encounter in school.

The theory of situated motivation may help to account for why students find PBL environments motivating. Paris and Turner (1995) identify four characteristics of contexts that may support an intrinsic orientation in learners, all of which are incorporated in PBL environments. The first, *choice*, implies the ability to choose among alternative courses of action, and reflects the personal interest of the individual. Learners who are free to choose the activity that they find most interesting and productive are more likely to be thoughtfully engaged in a task and show persistence and self-regulation. PBL environments provide some constraints for choosing (students must do work that contributes to a solution plan) yet they are rich enough to permit multiple paths through the problem space. As learners identify possible courses of action, they are free to pursue those they want, and may change course as they think best. The second characteristic, *challenge*, contributes to motivation by encouraging risk-taking, and successful performance on challenging tasks enhances the individual's cognitive self-assessments of their competence and efficacy. The problems used in PBL are selected because they are both challenging and manageable for students. *Control* has been shown to promote motivation by increasing learner interest, confidence, and sense of self-worth. The extended periods of self-directed study and the level of autonomy students enjoy during PBL offer them a high degree of control over their learning activities. Finally, *collaboration* impacts motivation in several ways. Their peers' statements and interests may stimulate learners' interests, encouraging them to pursue information they had previously overlooked. Students may be more likely to try out certain activities when their peers have modeled it, and peer modeling may offer students a means by which to monitor their own level of accomplishment. Collaboration may also foster a sense of responsibility to others that motivates learners to persist and perform up to their potential. PBL's use of collaboration therefore can be seen as supporting both student construction of knowledge and motivation.

Paris and Turner's theory of situated motivation has another implication for the examination of motivation. They stress that motivation is neither a characteristic of the learner or a property of an event, but rather the result of the interaction of the two. From this perspective, a learner's motivational orientation in a given situation should be the product of both his or her enduring motivational beliefs and the impact of the features of that situation on those beliefs. If motivation is a product of a learner by context interaction, then a difference in motivational orientation should be accompanied by a correlation between motivational levels in different environments. This correlation would be the result of some degree of stability in learners' motivational orientations. For example, a group of learners may express a greater preference for challenge under some conditions than others, but learners who generally prefer challenge should rate preference for challenge more highly in all situations than students who generally prefer easy work.

## **Purpose of the Study**

The purpose of this study was threefold. First, this study sought to expand the literature on problem-based learning by examining its impact on the motivational orientation of middle school students. PBL has been used extensively with mature learners (medical school, graduate programs) and the gifted. However, only limited information on its effectiveness with younger, regular education learners has appeared in research literature.

Second, PBL's potential impact on motivation makes it a prime candidate through which to test the implication of Paris and Turner's theory that motivation is the product of a learner by context interaction. Evidence supporting this theory would show that learners differ by context in their motivational orientation, but that their scores in different contexts are correlated. This correlation would indicate the role that the enduring characteristics of learners play in motivation, while differences in scores could be attributed to contextual factors.

Finally, using the theory of situated motivation as a starting point, this study also sought to begin an investigation into the aspects of PBL environments that may help to enhance motivation. By examining reactions to the learning environment used in this study, it may be possible to discern some of the characteristics of PBL that enhance student motivation.

Three research questions were posed:

1. Do learners report different levels of intrinsic motivation for regular science class environments and this PBL environment?
2. Do the levels of intrinsic motivation students show for regular science class predict the levels they show for this PBL environment?
3. What aspects of this PBL environment enhance student motivation?

## Method

### Participants

Students in three intact sixth grade science classes at a suburban middle school in the southwestern United States participated in the study, with N=66. The same teacher taught all three classes. The scores of four students were discarded. One of these students transferred out of the school before the completion of the study. Three other students possessed limited English proficiency, and normally received a modified curriculum. The classroom teacher and an ESL teacher worked extensively with these students, often directing their work. Because students' ownership of the problem solving process is a key feature of PBL environments and this feature may contribute to the positive impact PBL has on learners' motivation, this level of teacher directiveness might have interfered with the treatment. Data from these three participants were discarded because they may not accurately reflect the impact of PBL on motivation.

The ethnic makeup of the classes reflected the school at large. 77% of the participants were Caucasian, 15% were Hispanic, 5% were African American, and 3% were Asian. The classes were split almost evenly by gender, with two more girls than boys participating in the study.

### Treatment Variable

All participants completed the activities in *Alien Rescue*, a hypermedia delivered problem-based learning environment for use in sixth grade science classes. The science fiction premise of this program places students in the role of young scientists aboard a newly operational international space station where they are part of a worldwide effort to rescue alien life forms. To accomplish this goal, students learn about the planets and large moons of our solar system by searching existing databases and designing probes to gather additional information. While the primary learning objectives of *Alien Rescue* focus on astronomy and space travel, the program offers ties to other areas of the curriculum, including life science and mathematics. All information needed to solve the problem is contained within the virtual environment created by the program, though it is structured in such a way as to not suggest its usefulness or lead students toward a particular solution. The program normally takes fifteen forty-five minute periods to complete.

### Data Sources

#### *The Scale of Intrinsic versus Extrinsic Orientation in the Classroom*

The Scale of Intrinsic versus Extrinsic Orientation in the Classroom (Harter, 1981) was administered both before and after students participated in using the software program. During the pretest, students were asked to think about their experiences in their regular science classes up to that point. During the posttest, they were asked to reflect on their experiences with *Alien Rescue* and imagine participating in similar projects in the future. The purpose of changing the instructions was to determine if students express different levels of intrinsic motivation in the two different settings.

The Scale of Intrinsic versus Extrinsic Orientation in the Classroom comprises five subscales, though only four were used in this study. Table 1 lists the subscales used and provides information about each. The scale uses a structured alternative format. Learners are presented with two "types" of kids, then asked to decide which type they more closely resemble. Once they have chosen the type, students must then decide if that choice is "really true for me" or "sort of true for me." Items are scored on a 4-point scale, with 1 representing the maximum extrinsic orientation and 4 representing the maximum intrinsic orientation.

Table 1: Subscales in the Scale of Intrinsic versus Extrinsic Orientation in the Classroom

Subscale	Description	Sample Statement	Subscale Reliability
Preference for Challenge vs. Preference for Easy Work assigned	Does the student like hard, challenging work or prefer easier assignments?	Some kids like difficult problems because they enjoy trying to figure them out, but other kids don't like to figure out difficult problems.	.78 to .84
Curiosity/Interest vs. Pleasing the Teacher/Getting Good Grades	Does the student work to satisfy his or her own interest, or to satisfy the teacher and obtain good grades?	Some kids read things because they are interested in the subject but other kids read things because the teacher wants them to.	.68 to .82
Independent Mastery vs. Dependence on the Teacher	Does the child prefer to do his/her own work and figure out problems on his or her own, or does the child rely on the teacher for help and guidance in these areas?	If some kids get stuck on a problem they ask the teacher for help but other kids keep trying to figure out the problem on their own.	.70 to .78
Independent Judgment vs. Reliance on the Teacher's Judgment	Does the child feel he/she is capable of making judgments about what to do, or does he or she depend on the teacher's opinion about what to do?	Some kids think it's best if they decide when to work on each school subject but other kids think that the teacher is the best one to decide when to work on things.	.75 to .83

### Interviews

Brief interviews with students were conducted at the end of the unit, after students had completed the attitude questionnaire. The purpose of these interviews was to gather additional data about learners' opinions of learning in the *Alien Rescue* environment and possible reasons this environment encourages intrinsic motivation.

Students were interviewed in groups of two and three. These interviews were partially structured. Seven core questions were asked of all interviewees, then other questions were added to encourage students to elaborate on the opinions they expressed. The core questions were

What did you think of *Alien Rescue*?

What did you like most about *Alien Rescue*?

Do you think you learned any science during *Alien Rescue*?

Did you feel you had control over what you did during *Alien Rescue*? Did you like that? Would you have liked *Alien Rescue* as much if you hadn't?

How did you feel about working with your classmates? Did it help?

Did you find the problem challenging?

Would you want to do programs like *Alien Rescue* in the future?

### Procedures

The study was conducted during students' regular science class times, which were daily 45-minute periods. Students were engaged in the program for approximately thirteen class periods, with an additional four class periods used for introductions, data-collection, and a debriefing session.

Each student worked at his or her own computer. Students were encouraged to work together to share the information they discovered and to ask each other for help. They were not, however, assigned partners or told they had to divide up the work in any way. Daily whole class meetings were held at the beginning of the period so that

students could share their findings and questions, model their processes, and discuss their strategies for developing a solution. The researcher facilitated these discussions, but did not direct student activity.

The Scale of Intrinsic versus Extrinsic Orientation in the Classroom was administered on the first day and the fifteenth day of the study; because of the way the days of the study fell, administrations were exactly three weeks apart. Interviews were conducted in the last two days of the study.

### Data Analysis

Students' pre and post treatment scores on the Harter Scale of Intrinsic versus Extrinsic Orientation in the Classroom were used to address the first two research questions. For the first research question, "Do learners report different levels of intrinsic motivation for regular science class environments and this environment?" the data were analyzed using a repeated measures analysis of variance with one repeated variable (pre/post). To answer the second research question, "Do the levels of intrinsic motivation students show for regular science class predict the levels they show for this PBL environment?" a regression analysis was conducted, with the posttest scores as the dependent variable and the pretest scores as the independent variable. The resulting R squared was used to determine if a significant portion of learners' scores on the posttest could be predicted by their pretest scores. In this way, it was possible to reflect on how much of learners' motivational patterns represent enduring characteristics of the learners, and how much of that variance is attributable to other factors including the type of environment.

The interviews conducted with learners at the conclusion of the study were transcribed and analyzed using a two-level scheme following the guidelines provided by Miles and Huberman (1994). The data were examined for insights into the causes for enhanced motivational orientation. At the first level, codes were generated using the four characteristics suggested by the theory of situated motivation (choice, challenge, control, and collaboration) and by multiple passes through the data. At the second level, these codes were regrouped into more general categories. The data were sorted into categories and subcategories according to their common themes. Data were analyzed by two reviewers and disagreements between them were discussed until a .9 interrater reliability was established.

## Results

### Quantitative Data

The pre and post test scores of the participants were compared to determine if learners expressed different levels of intrinsic motivation for their regular science class environments and the PBL environment offered in programs like *Alien Rescue*. Results of the repeated measures analysis showed that students' scores on the posttests were significantly higher than on the pretest for all four subscales, as shown in Table 2. In other words, students reported a significantly more intrinsic orientation for the *Alien Rescue* environment than for their typical class activities.

Table 2: Mean Scores and Standard Deviations (in Parentheses) by Treatment Condition on Subscales of the Scale of Intrinsic versus Extrinsic Orientation in the Classroom

Subscale	Pre Treatment Means and SD	Post Treatment Means and SD	F	p
Challenge	2.58 (.77)	2.94 (.58)	21.5	<.01
Curiosity	2.53 (.95)	2.79 (.48)	5.1	<.05
Mastery	2.65 (.69)	2.90 (.51)	13.40	<.001
Judgment	2.61 (.63)	2.84 (.57)	12.47	<.001

To answer the second research question, a regression analysis was conducted to determine if students' pre treatment scores predicted their post treatment scores, and if so, to calculate the amount of variance in the post treatment scores that could be explained by enduring characteristics of the learners. The results are shown in Table 3. In three of the subscales, learners' scores on the pre and post treatment administrations showed a significant correlation. In the challenge subscale, 39% of the variance in the posttest could be explained by students' scores on

the pretest. For the mastery and judgment subscales, these figures are 37% and 36% respectively. These results suggest that there are enduring motivational characteristics of students that help to account for the level of intrinsic motivation they report for novel learning environments like the one offered in *Alien Rescue*.

*Table 3: Regression Analysis of Pre and Posttests on Subscales of the Scale of Intrinsic versus Extrinsic Orientation in the Classroom*

Subscale	t	R squared
Challenge	6.44**	.39
Curiosity	1.22	-
Mastery	6.18**	.37
Judgment	6.00**	.36

\*\*significant at  $p < .01$

### Qualitative Data

The qualitative data were examined in order to gain a more robust understanding of students' opinions of the *Alien Rescue* environment, and how these opinions influenced their level of intrinsic motivation. Four themes were chosen prior to the interviews through an examination of the theory of situated motivation. These themes were choice, challenge, control, and collaboration. Three other themes emerged from the analysis. They were perceived educational value, computer delivery, and novelty.

#### Choice

All of the students interviewed indicated that they would like to work on other problems like the one presented in *Alien Rescue*. When asked if they would want to do programs like this all the time, students' responses ranged from "Not really all the time, but once in a while" to "most of the time" and "Yeah, like everyday after school I run home and get on the computer." A few students added stipulations about how they would like to work, with one student saying he would only want to do programs like this at school, not at home. Another student commented, "I'd rather do it more often if it was with a group than by myself. Like if *Alien Rescue* was for sale and I bought it, I would want to have three computers and do it with some friends."

#### Challenge

Most of the students interviewed said that they felt *Alien Rescue* was challenging, but not overly so, that "it wasn't too hard, it wasn't too easy." When asked how they liked being challenged, students responded positively. "Yeah, it was pretty complicated. I like that. I like complicated things." One student described it as "fun challenging."

A few students noted that their classes rarely presented them with situations as challenging as the one in *Alien Rescue*. One student explained why he felt *Alien Rescue* was better at encouraging him to tackle challenges than typical school activities:

This is just like using my own steps. If I can solve it that way I would try to, instead of teachers always telling you the right way and I always end up taking the easy road instead of at least trying to do something different.

#### Control

All of the students interviewed felt that they had control over their actions during *Alien Rescue*, and liked this aspect of the program. When asked if they would have liked to have more direction from the teacher, most students gave a resounding "No," and said that the program would not have been as much fun if the teacher had taken more control over their activities. One student explained,

Cause if you want to make a probe you want to make a probe. If you want to do research, you do research. But it wouldn't be much fun if you had to make a probe or you had to do research.

The fact that students had control over their own process meant that different students were working on different aspects of the problem simultaneously. One student saw this as supportive of collaboration and a distribution of labor: "if everyone's doing the same thing you can't find different things out."

Two students commented that this level of control set *Alien Rescue* apart from typical school activities:



At first we didn't know what to do so we just looked around, but it was real fun to do it by ourselves, cause during regular classes all you have to do all year is the teacher telling you what to do, but she said we could do what we wanted to do, so it was what we supposed to be doing. It was really fun cause we got to choose what we were going to do.

Probably one of the things I liked the best about it is you always have a teacher telling you how to do something, but since you're trying to find the problem and trying to solve it, you get to solve it your own way, not the way that the teacher wants you to do it.

### *Collaboration*

Students in all three treatment conditions said that they felt *Alien Rescue* provided them with ample opportunities to collaborate with their classmates, and that they both gave and received help. Several students cited collaboration as one of their favorite aspects of *Alien Rescue*. Comments included "It made it fun and challenging at the same time," "The funnest part was working around with a whole bunch of people" and "I liked it cause it just made us come together more and learn thinking skills together."

The opportunity to collaborate led to a division of labor for many students, and there were several comments that this helped them to work more quickly. One student explained, "We just started splitting up planets, working on the same things, saying 'What's your hypothesis so far?' You can cover more space with two people, more than one." Another student explained how this sharing of responsibilities worked for himself and two of his peers:

Me, this other guy (I forgot his name) and Andey, we worked together. It's like I'm here, he's there, and he's there, and we were working together. I would go to the solar system and I would look up planets for them and he would look at the aliens and he would say if the planet would work and he would say, "Okay, it needs this much atmosphere." And I would look for a planet with that much atmosphere but like with no earthquakes.

Collaboration also led students to challenge each other's ideas, making it possible to avoid mistakes and make better decisions than they would working alone:

Yeah, and you could find out their hypotheses about that, and you could say "Well, that's not my hypothesis, so how did you come up with that?" and then they can tell you stuff that you didn't really know. You could compare the hypotheses. Like if I didn't have a piece of information that he did, then I would just send them to a totally wrong planet.

One impediment to collaboration was discussed by a group of students. Many of the students did not know each other well, and in some cases did not even know their classmates' names. Sixth grade is the first grade of middle school, and this study was conducted in November. Ten weeks of school had been insufficient for students to become acquainted, and some students did not feel comfortable talking to peers they did not know. Three students who had collaborated extensively explained that they worked together because they had gone to the same elementary school and had been friends for several years. In contrast, they did not work with another student seated next to them: "Like Jason, he sits on the other side of me, and was hard for me to get started to communicate with him because I didn't know him." Another student commented that before *Alien Rescue* she had not known the classmate seated next to her very well, but that during the course of the program they had become "very close" because of their collaborative efforts.

Several students commented that they rarely had the opportunity to collaborate in their regular classes, and when asked, all of these students said they preferred to work together as they had during *Alien Rescue*. Most said that it made learning more fun. One student explained that the freedom of movement students had during *Alien Rescue* meant less reliance on the teacher: "Sometimes we're sitting next to someone and they don't know the answer, and I can't just get up and ask someone, so I always just have to resort to a teacher. I don't really like to do that sometimes."

### *Perceived Educational Value*

Students generally felt they learned a great deal from their experience with *Alien Rescue*. When asked what they felt they had learned, most students identified specific scientific facts about the solar system and the design of probes, as well as concepts like why some worlds have magnetic field.

In addition to learning science content, a few students talked about developing problem-solving skills. Two students remarked,

It teaches you a lot about how to make steps and about the scientific method. If you just skip around and not go step by step it will usually come out wrong and you won't get all the information you need.

Yeah, and how you went through a lot of steps. First you have to do research, then you make a hypothesis, then check it, and if it was wrong you have to go over it again and study all the aliens and the solar system and everything that they need to live in.

Several students said they felt like *Alien Rescue* gave them the opportunity to work like scientists, identifying hypotheses, deciding how to gather the information they needed, and collaborating with their peers. One student commented,

Normally like in movies and stuff you think of scientists, how they talk together, they actually come together in meetings and announce everything they learned. And we did that before every class period. Really and we could get up out of our seats, so actually it does feel like scientists.

### *Computers*

Two other themes emerged from the data that suggest factors other than the characteristics of PBL may have contributed to the more intrinsic orientation students expressed for the *Alien Rescue* environment. The first is the impact of computers in general or this computer-based program in particular. The interactive nature of computers themselves may encourage students to explore, taking a mastery orientation and enjoying the challenge of figuring out the functionality of a program. Several students commented that their textbooks were often boring, and that being able to work on the computer and collaborate with their friends was more fun.

Some features of *Alien Rescue* may also encourage students to take an intrinsic orientation. While PBL encourages exploration by giving students the responsibility for generating learning needs and finding the resources to meet those needs, this software may also encourage exploration through the use of rich media and a science fiction premise. When asked what they liked best about the program, most students responded by citing their favorite feature of the program or commenting on the problem itself, not by describing aspects of the way they worked. Describing the alien computer component of the program, which contains QTVR movies of the aliens and their habitats, one student commented, "It was kinda cool when you could just look at all the aliens, and turn them around and everything. Then you could look at their habitats and their solar system." In describing the problem, another student said, "I thought the whole idea of the aliens coming and us having to find a place for them and being able to be on their computer is pretty neat." Several students also described the program as a game. One student explained, "I think of it as a game because it's on computers," indicating that both the program and its delivery medium may suggest play. Rieber (1996) suggests that by its very nature play is intrinsically motivating; learners' motivational orientation may have therefore been enhanced simply because they felt they were able to spend three weeks of science class playing.

### *Novelty*

The second theme that emerged from the data has to do with the impact that the novelty of this environment may have on students' motivational orientation. In addition to pointing out how *Alien Rescue* differed from their regular class activities within the other themes, students' comments showed that they enjoyed the change in routine that their work on this program represented. Comments such as "I've never done something like that, " "I liked getting away from class for a while, " "It's better than working in a book," and "We don't usually get to use computers," show that, for students, one positive aspect of this program was simply that it was different from regular classes. One student explained that typical class activities are of limited duration, and that he like the prolonged investigation offered by the software: "It was for an extended amount of time, not just one day, so when you go in the next day and you can say 'Oh, where was I? Oh, yeah, I've got to get information from the probe.' I liked that." Some comments suggest that students found their work in this environment less intimidating than in their regular

classes: "It was easier, it was fun, cause you usually don't get to talk in class. Be quiet and if you don't be quiet you get a detention. But we were allowed to talk." And "We get an automatic 100 everyday instead of getting like 70s and stuff." The lack of extrinsic motivators, such as punishment and grades, may have freed students to adopt a more intrinsic orientation than they do in their regular classes.

## Discussion

The findings of this study strengthen the growing literature on the effectiveness of problem-based learning in two ways. First, it shows that PBL can encourage intrinsically motivated behavior. Second, these results were achieved with regular education sixth graders, suggesting that PBL should be used with a wider audience than has been the case in the past.

These findings also lend support for the notion of the situated nature of motivation. Students' scores on the post treatment administration of the Scale of Intrinsic versus Extrinsic Orientation in the Classroom were correlated with their pre treatment scores, indicating that there are enduring motivational characteristics of learners that affect how they react to different learning environments. At the same time, the significant difference between the scores on the two administrations of this scale indicate that some environments are inherently more motivating than others. Taken together, these findings support the argument that motivation is a product of a person by context interaction.

Why do students report a more intrinsic orientation for an environment like the one posed by *Alien Rescue* than for their regular class environments? The qualitative data suggest that challenge, control, and collaboration, as Paris and Turner suggest, impact motivation positively. A PBL approach may also foster the perception in students that they are learning valuable problem-solving skills and working as scientists; seeing the value in their activities may enhance motivation, as widely suggested in the literature on motivation. However, other factors may partially account for the high level of intrinsic motivation students reported. Students used the computer lab everyday for three weeks, which they had never before done as part of a class. Unfettered by concerns over grades or detentions, students may have felt more willing to take risks and enjoy the challenging nature of the tasks involved in developing a solution plan. The interactive nature and rich media of the computer program may have promoted a sense of play and curiosity. These factors, as well as the sheer novelty of the approach and the software, may have encouraged students to react with greater intrinsic motivation than they do in their regular science classes. Certainly they suggest a need for a closer investigation of the attributes of this environment as well as the environments created by other PBL programs to determine which contextual factors unite to support an intrinsic orientation.

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# Formative Research on the Heuristic Task Analysis

Charles M. Reigeluth  
Ji-Yeon Lee  
Bruce Peterson  
Michael Chavez  
Indiana University

## Abstract

*Corporate and educational settings increasingly require decision-making, problem-solving and other complex cognitive skills to handle ill-structured, or heuristic, tasks, but the growing need for heuristic task expertise has outpaced the refinement of task analysis methods for heuristic expertise. The Heuristic Task Analysis Method was applied to three settings to generate improvements and more detailed guidance, and to identify variations in the method for different situations. The three settings were group counseling, tutoring on writing skills, and selecting artwork for a product line. The formative research methodology was used to test the method and generate improvements. The three studies produced some common and some unique findings and recommendations. A tentative revision to the HTA method is proposed.*

## Introduction

As our society in general and the workplace in particular become more complex, we are finding that a greater number of the activities that people undertake are relatively more heuristic in nature than ever before. Whether in K-12 education, higher education, corporate training, or any other context, to help people learn the heuristic elements of an expert's know-how, we must be able to identify those heuristics.

In analyzing heuristics, we find it helpful to think in terms of two major kinds of expertise—domain and task expertise. *Task expertise* relates to the learner becoming an expert in a specific task, such as managing a project, selling a product, or writing an annual plan. *Domain expertise* relates to the learner becoming an expert in a body of subject matter not tied to any specific task, such as economics, electronics, or physics (but often relevant to many tasks). (Reigeluth, 1999, p. 435).

Both procedural and declarative knowledge are important elements of both kinds of expertise. In this research, we focus on task expertise. For task expertise, we find it helpful to think in terms of two major kinds of tasks: procedural and heuristic. *Procedural tasks* are "tasks for which experts use a set of steps, mental and/or physical, to decide what to do when, such as a high school course on mathematics or a corporate training program on installing a piece of equipment for a customer. *Heuristic tasks* are "tasks for which experts use causal models—interrelated sets of principles and/or guidelines—to decide what to do when, such as a high school course on thinking skills or a corporate training program on management skills." (Reigeluth, 1999, p. 435).

The distinction between procedural and heuristic tasks is similar to the distinction between well structured and ill structured domains (Fredericksen, 1984; Resnick, 1988; Simon, 1973). In reality most tasks are neither purely procedural nor purely heuristic, but some combination of the two. We have relatively powerful methodologies for analyzing the expertise that underlies procedural tasks (i.e. the mental and physical steps upon which an expert relies). But we do not have good methodologies for analyzing the expertise that underlies heuristic tasks. This situation is exacerbated by the reality that heuristic knowledge is frequently tacit rather than explicit—that is, experts are often unaware of the heuristics that guide their performance. Therefore, there is a strong need to develop task analysis methodologies for identifying the knowledge that underlies heuristic tasks. The full paper reviews literature related to heuristic task analysis. Then it describes three research studies that have been conducted to improve one of those methodologies. This paper is a summary of the full paper.

## The Heuristic Task Analysis Method of Elaboration Theory

The Elaboration Theory (Reigeluth, 1999; in press) offers the Heuristic Task Analysis (HTA) method as part of its Simplifying Conditions Method (SCM) for task analysis. This more general method of task analysis is conducted by asking the question, "What is the simplest version of the task that an expert has ever performed?" and "What is the next simplest version?" and so forth. As each version is identified, its place in the learning sequence is simultaneously determined. Therefore, the SCM task analysis method is an integral part of the method for designing an instructional sequence. Furthermore, since most tasks have a combination of procedural and heuristic elements,

the procedural and heuristic task analysis methods are integrated into a single process. For these reasons and because this method offers a fair amount of guidance for the task analysis process, we chose this method for our research. Hence, it is described in greater detail next.

## The SCM's Heuristic Task Analysis Method

The following are some details on the SCM's heuristic task analysis method. They are an elaboration of the process described by Reigeluth (1999).

### Phase I. Prepare for Analysis and Design

1. **Prepare.** Lay the groundwork for your analysis and design.
  - 1.1 Establish rapport with a task expert.
  - 1.2 Explain the analysis process you will be using.
  - 1.3 Ask the task expert about the nature of the task in general.
  - 1.4 Identify the characteristics of the learners in general.
  - 1.5 Identify the delivery constraints of the task in general.

### Phase II. Identify the First Learning Episode

2. **Identify the simplest version.** Help the task expert to identify the simplest version of the task that is fairly representative of the task as a whole, and to describe the conditions that distinguish that version from all other versions.
  1. You may want to use some **other criteria** in addition to simple and representative, such as common and safe
  2. Ask the task expert to recall the **simplest case** she or he has ever seen. The simplest version will be a class of similar cases. Then check to see how representative it is of the task as a whole.
  3. It may be helpful to start by identifying some of the **major versions** of the task and the **conditions** that distinguish when one version is appropriate versus another.
  4. Thinking of different conditions helps to identify versions, and thinking of different versions helps to identify conditions. Hence, it is wise to do both simultaneously (or alternately).
  5. There is no single right version to choose as the "simplest." It is usually a matter of trade-offs. The very simplest version of the task is usually not very representative of the task as a whole. The more representative the simple version can be, the better, for it provides a more useful schema to which learners can relate subsequent versions.
  6. It may be wise to go through this process with several task experts before going on to Step 3. You may find it necessary to take steps to resolve differences of opinion about which is the best "simplest version" to use.
3. **Analyze the organizing content.** Analyze the organizing content for this version of the task.
  - 3.1 Ask the task expert to think of **one specific performance** of the task to analyze, or to videotape a performance for you to review with the expert during the analysis.
  - 3.2 Use a **top-down approach** to analyzing the content (the knowledge upon which the expert's performance is based). In other words, start by identifying the general categories of knowledge that an expert uses, then proceed to analyze each.
    7. Ask the task expert:
      - to **describe each decision** that the task expert made,
      - to **identify the kinds of knowledge** that the task expert drew upon to make the decision, and
      - to **describe the specific knowledge** within each kind of knowledge that the task expert used.
    8. The kinds of knowledge are likely to include:
      - **steps** (procedural knowledge),
      - **guidelines** or **rules of thumb** (heuristic knowledge),
      - **explanatory models** (which explain why the guidelines work),
      - **descriptive models** (which describe the phenomena with which the task expert interacts), and
      - **metacognitive/decision rules** (which the task expert uses to decide which steps, guidelines, and descriptive knowledge, to use when).
    9. It is generally helpful to start by asking the task expert if there are any **steps** or phases of activities that are always performed for this version of the task. If so, perform a procedural task analysis to identify the sequence of steps and to see if any of those steps can be broken down into substeps, but those substeps must be ones that an expert thinks of and uses routinely in performing that version of the task.
    10. For guidelines, use the following process:
      1. Identify the **goals** for this specific performance of the task under its conditions.

2. Identify all the important **considerations** for attaining each goal. Considerations are the major categories of causal factors that influence performance of the task. If there are a lot of causal factors for a consideration, it is useful to identify subconsiderations for it.
  3. Identify all the important **causal factors** for each consideration (or subconsideration).
  4. Analyze each causal factor to identify all **guidelines** (prescriptive principles or “rules of thumb”) that an expert uses to account for this consideration.
11. For explanatory **models**, use the following process:
    12. For each guideline, ask the task expert for the reasons why s/he believes it works.
    13. For interrelated guidelines, you are likely to identify a set of related reasons that constitute a causal model or models. Be sure to look for multiple causes for each effect and multiple effects for each cause. Also look for chains of causes and effects, and explore probabilities for each causal factor to have each effect.
  14. For descriptive **models**, use the following process:
    1. Ask the task expert what phenomena influenced this particular performance of the task. Try to identify all causal relationships that characterized those phenomena. Be sure to look for multiple causes for each effect and multiple effects for each cause. Also look for chains of causes and effects, and explore probabilities for each causal factor to have each effect.
  15. For metacognitive/**decision rules**, use the following process:
    1. Find out what rules the task expert used to decide when to use which steps, guidelines, and descriptive models during the specific performance of the task being analyzed.
  16. It is wise to query the task expert about any of these kinds of knowledge that are not initially described to you for each decision the task expert made in this specific performance of the task.
- 3.3 Ask the task expert to think of similar **performances** of the task that constitute a single version of the task. Use each such performance to broaden the steps, guidelines, explanatory models, descriptive models, and metacognitive/decision rules so that they represent the knowledge bases the task expert uses to deal with all performances for that version of the task.
  - 3.4 If time and resources permit, find a second task expert with whom to repeat this entire process (Steps 1–3.3) to identify any alternative views of the task and the knowledge that underlies its performance. It may even be wise to repeat this process with several more task experts. And you may want to go back and ask each task expert what s/he thinks about the perspectives of the other task experts, in an effort to reconcile conflicts and select among alternative ways of thinking about and performing the task.

The HTA method has not been rigorously tested and therefore is in need of further research. However, the most important research issue is not the validity of the HTA method, for, like most methods, it is likely to work some times but not always, and to varying degrees. Rather, given the immaturity of our knowledge about how to analyze heuristic tasks, what is needed most at this point is developmental research—research that is intended to further develop and improve the method. Therefore, our research question is, “In what ways can the HTA method possibly be improved?” To answer this question, it is also necessary to find out what parts of the method are working well and what parts are not working so well. Furthermore, to improve the HTA method, it will likely be important (1) to change parts of the method, (2) to provide more detailed guidance about how to accomplish particular parts of the method, and (3) to identify variations in the method for different situations, such as different kinds of tasks or even different kinds of task experts.

To answer these research questions, we conducted a series of three developmental research studies. These are described next, followed by some general conclusions.

## Study 1: The HTA Method Applied to Group Counseling

The purpose of this study was to improve the HTA method and guidance for use of that method. Thus, the formative research methodology was adopted with emphasis on exploring how the HTA method can be improved when applied to group counseling.

Formative research is a kind of developmental research or action research that is intended to improve design theory (Reigeluth & Frick, 1999). In contrast to research on descriptive theory, which emphasizes validity or how well the description matches the reality of “what is,” research on design theory is more concerned with preferability, the extent to which one method is better than other methods for achieving certain goals under certain circumstances. By creating or identifying an instance of a design theory and collecting formative data to improve

that instance, one may develop better understanding of how the theory works in the field and thus be able to propose improvements for the theory, which of course would need to undergo further testing.

**Task.** Group counseling was selected as the task to which to apply the HTA method. Group counseling is a combination task with both procedural and heuristic elements. It is procedural in that the activities of the group leader are largely determined by the stages that a group goes through (i.e., forming, norming, storming, and performing), and the leader cannot help the group to progress to the next stage without performing certain tasks (steps) at each stage. However, at a deeper level of analysis, the knowledge required for the leader to decide when and how to intervene is not a set of steps but a set of guidelines and principles, which are heuristic knowledge.

**Participants.** This study involved three participants as task experts in group counseling. Expert #1 was a professor in the Counseling Department in the Indiana University School of Education and was the most experienced of the three task experts. The other two were doctoral students in the same department. They were all experienced in conducting "personal growth" group counseling, and their expertise ranged from three to more than 20 years.

### Data Collection Methods

**Interview.** Semi-structured in-person interviews were used as the primary data collection method. The second author conducted six interviews between September and November, 1999. Each interview took 30-90 minutes and was audio taped for analysis. The purpose of the interviews was to find ways to improve the HTA method for eliciting, analyzing, and representing the expert's heuristic knowledge for performing the task of "personal growth" group counseling. The investigator played two roles, one as a task analyst proficient in the HTA method and the other as researcher searching for ways to improve the HTA method. As task analyst, the investigator developed a set of interview questions (see Appendix A) for the interview based on the HTA method, but as researcher the investigator was not restricted to the predefined questions. Depending on the expert's response, the researcher revised the HTA method for the next interview. Thus, the overall interview process was flexible and reflective in nature.

**Videotapes.** Because of the confidential nature of group counseling, direct observation or videotaping of an expert's task performance (as called for by the HTA method) was not allowed. Instead, the researcher (as analyst) used a series of instructional videos that simulated group counseling sessions for beginning group leaders, to provide the analysts with a concrete case.

### Data Analysis and Interpretation Methods

The HTA method is an iterative process: finishing the first round of HTA is not the end of the study but the beginning of the second round of HTA; and the end of the second round is, again, the beginning of the third round; and so on. The investigator went through two rounds of HTA in this study.

**Triangulation.** To enhance the thoroughness of the data, this study involved three experts as data sources. Each of them played somewhat different roles during the interviews. During each round of data collection, expert #2 provided the initial structure of the task setting and knowledge base. Then experts #1 and #3 reviewed the knowledge elements, verified them, and provided additional information. There were a few times when the three experts did not agree with one another. In such cases, expert #1's judgment was accepted, as he was the most experienced group counselor.

**Member checks.** After each interview with an expert, the researcher transcribed the interview and took the summary and interpretations to the next interview for review. Through this process, the experts corrected errors or misconceptions by the researcher, and the researcher asked additional questions to clarify the information.

**Consultation.** During the data collection and analysis process, the researcher regularly met with the other three researchers in this study and consulted them in designing the interview protocol and analyzing the data.

### Results and Discussion

The first round of data collection involved initial interviews with three experts. Instead of finishing with one expert and then starting with another, the researcher worked with the three experts simultaneously (but separately) due to their time schedules. This approach involved some tradeoffs. It worked well in the sense that the researcher could get the three experts to reach consensus on the simplest version of the task early in the HTA process. However, communicating with all three experts simultaneously was not easy for the researcher, and the researcher had to spend most of the time during the interviews explaining to each expert the previous interviews with other experts. Even though the task was a common one, the experts still had difficulty explaining the detailed decision-making process when the task had originally been defined by another expert. Facing this problem, the



researcher decided to use an existing instructional video series (with which all three experts were familiar) as a frame of reference, instead of trying to build a new scenario based on each expert's experience.

The second problem was that the researcher lacked expertise in the task of group counseling. The researcher found that, to be able to push the expert to further elaborate his/her automatized (and hence subconscious) task expertise, the analyst needed to speak the same language as the expert and be able to prompt when the expert had difficulty in finding the right words. Without a certain level of expertise in the task, the researcher as task analyst had difficulty doing those jobs smoothly.

The third problem was related to the difficulty of categorizing the types of knowledge underlying each decision made by the expert during the task analysis. The purpose of identifying the five types of knowledge identified by the HTA was to make sure that the expert did not overlook one of the important types of knowledge, but the benefits of distinguishing among the types seemed to not be worth the extra time required in this case.

The second round of HTA incorporated some new methods to deal with the problems found in the first round. First, the researcher summarized key incidents from the video series on index cards and used them as a reference during the interviews with the experts. This was very helpful in three ways: (1) it helped the experts to recall details about the task performance process, (2) it helped both analyst and experts to see the flow of the task performance process and get back on track when the experts got off-task, and (3) it saved a lot of time in revisiting previous points. One expert commented that the index cards forced him to be more precise during the review and revision process. Second, the researcher as analyst used a bottom-up approach (identifying knowledge first, then categorizing it as to type) rather than the top-down approach (identifying knowledge within each type) suggested by the HTA method.

Based on the findings of this study, the following changes are proposed as possible improvements and described in detail below: (1) incorporate various interview and observation techniques into the HTA process, (2) provide different guidelines for analysts with different levels of task expertise, (3) provide different guidelines for working with task experts with different levels of expertise, and (4) provide reference material during the interview with task experts.

## **Study 2 - The HTA Method Applied to Tutoring on Writing Skills**

As in Study 1, the purpose of this study was to improve Reigeluth's HTA process by using the formative research methodology. This study followed the steps suggested by Reigeluth and Frick outlined in study 1.

**Task.** The heuristic task chosen for this study was tutoring university undergraduate students who needed extra assistance with their writing skills. Specifically, the task concerned the decision-making process in which an expert writing tutor engages to determine the direction and focus of the tutoring session. By its very nature, a tutoring session requires a lot of heuristic expertise, because it is determined more by events that occur during the tutoring event than by any predetermined procedural steps. What occurs during the tutoring session depends on both the writing situation and the tutee. The writing situation includes why the tutee is being tutored, the relationship between the tutee and the teacher, the interest level of the topic being written about, and the number of drafts already written. The tutee includes any previous experiences, both positive and negative, that the tutee brings to the tutoring session.

**Participants.** Two experts were chosen based on their level of expertise and the approval of their supervisors. Both experts had extensive experience tutoring all levels of writing students, and both were highly recommended by their writing center supervisors. A third tutor was also recommended and interviewed as a potential participant in this study. However, the recommendation came without the experience and evaluation credentials listed above, so he was not included in this study.

## **Data Collection Methods**

**Interview:** As in study 1, the main data gathering method was the personal interview, and the researcher both elicited heuristic knowledge (analyst role) and conducted formative research (researcher role). Two interviews were conducted within one week of the tutoring session that was being analyzed. Both of the interviews were conducted within one week of the tutoring session that was being analyzed. Because of the tutors' lack of time to spend on this research, each interview was limited to approximately 60 minutes. Prior to the interviews, each of the tutors was sent emails describing terms used, definitions, an outline of the interview questions, and a brief explanation, written in their terms, of the purpose, expected results, and use of this research.

Before the actual interview, the researcher reminded each tutor of what was sent to them earlier and asked if any terms or points needed to be clarified. At this time, the researcher also pointed out to each expert writing tutor that a) it was unclear whether the task about to be analyzed was actually based on heuristic knowledge and b) it was

unclear whether the questions would be able to access that knowledge. This was done to reduce any anxiety that the writing tutors might experience if they could not produce information that the researcher desired.

Based on the first interview, the HTA methodology was altered slightly for the second interview so as to assist the tutor to better recall the tutoring situation. The analyst had the tutor respond to specific questions about the actual tutoring experience, the tutee's characteristics, and the tutee's essay prior to having the tutor recall and reflect on her decision-making processes. He then had the tutor identify the decision areas to focus on during the tutoring session. Afterwards, he had the tutor choose the concern that was most available to her. This, then, became the subject of the heuristic task analysis.

### **Data Analysis and Interpretation Methods**

There were no follow-up interviews or member checks as in Study 1 to determine the validity of the tutors' responses due to the writing tutors' lack of time to spend on these tasks. However, because of the researcher's expertise in this area, he concluded that the data collected was not spurious. At the conclusion of each interview, the experts were asked to review and modify what was recorded during the interview. The researcher asked each expert for ways to improve the interview process and to comment on its effectiveness in eliciting the knowledge underlying their decision-making thought process. Both offered suggestions about ways to help them recall the previous tutoring situation and about the limitation of focusing on only one aspect of the tutoring process. The second expert confirmed what the first had concluded. After each interview, tentative changes were made to the HTA process.

### **Results and Discussion**

In the interview after the first application of the HTA method, the first tutor mentioned how the process helped him think about his own tutoring strategies. He also mentioned that having to recall from memory a tutoring session that was done even within the last seven days was not easy. The tutor suggested the following refinements to the HTA method. 1) The top-down process seemed effective. 2) Because the tutor experienced some difficulty recalling the specific tutoring session, the analyst (researcher) asked some specific questions about the tutee, the paper, and the tutee's reactions to the tutor's suggestions. Both tutors said this helped them get into the flow of the previous tutoring session, and the researcher observed a marked increase in awareness and confidence after assisting the tutor's recall. 3) 5x8 cards were effective in that the tutor referred back to them to align his insights into the tutoring process with previous statements. 4) The tutor, when identifying the guidelines, focused more on how to hold an effective tutoring session than on what influenced his decision to focus on a specific tutoring objective. In addition, 5) the researcher suspected that the results of the HTA might have been richer if the task expert (tutor) had been given more control over the decision point selection process.

In summary, an important concern involves the task expert's tendency, when explicating the guidelines, to focus on the goals and not on the decision points for attaining the goals. During both instantiations, the writing tutors gave the guidelines they used for deciding on the goals of the tutoring situation rather than giving guidelines for deciding how to attain a goal during the tutoring session. When this occurred, the researcher gently prodded the experts to focus on the decision points rather than the goals. However, when the experts could not provide that information, the researcher decided to review previous sections and then ask that question again. After the experts referred to the goals again, the researcher decided not to push them any further, seeing that they both were unable to provide that information. Another concern involves the first expert's difficulty in recalling the tutoring session despite the fact that the session occurred only one week prior to the interview. Measures taken to assist the second expert's ability to recall the tutoring session showed a dramatic improvement.

### **Study 3: Selecting Artwork for a Commercial Product Line**

The third study tested the HTA method in a corporate setting. As in the previous two studies, formative research was the methodology, using a designed case to generate possible improvements in the HTA method. Corporate executives want a "big bang for their buck," and analysis is often looked upon as a time-consuming activity with questionable impact. The aim of this study was to develop a rapid, high-impact version of the HTA method for corporate settings. Thus, the study was designed to provide insight into the following research questions: (1) How can the speed and effectiveness of the HTA method be improved for eliciting, analyzing, and representing heuristic knowledge from experts in corporate settings? (2) What guidance could be added to the method to assist analysts in corporate settings? The time constraints for this study dictated that the research be limited to a single interview cycle with one task expert, lasting no more than a total of three to four hours.

**Task.** The heuristic task chosen for this study was deciding whether a submission of artwork was suitable for one of the company's product lines. This was a judgmental decision-making task requiring a fair amount of experience and know-how. The task expert verified that the task was important to the company, that she was

considered to be an expert at the task, and that it was not easy to articulate the expertise required to perform the task. The heuristic nature of this task was verified by an expert in the HTA method.

**Participant.** The task expert was recruited by calling a local business that had collaborated with the Instructional Systems Technology Department at Indiana University in the past. A manager in the design department enthusiastically agreed to participate in the study. The expert and the analyst discussed possible complex decision-making tasks over the telephone and came to an agreement on an appropriate task.

### Data Collection, Analysis, and Interpretation Methods

**Interview.** The researcher/analyst conducted two audio taped, one-and-a-half-hour interviews with the participant (task expert) in a conference room at the expert's place of business. The analyst/researcher referred to an interview sheet (described below) to ensure that he was adhering to the guidelines of the HTA method, although he also allowed the interview to be somewhat unstructured as seemed appropriate to gather the heuristic knowledge and data for improving the HTA process. After one-and-a-half hours he reached a saturation point in terms of gathering the essence of the task and the key heuristics and concluded he could not effectively continue the analysis without first going back to his office and organizing the information collected. The expert agreed to continue the interview the following week. The analyst/researcher logged "significant chunks" of the audio tape on 3" x 5" cards. His criterion for "significant chunks" was any piece of knowledge that fit into one or more of the types of knowledge listed in the HTA method. He examined these knowledge elements to determine what missing ones he needed to ask about in the follow-up interview. Then in the role of researcher, he re-examined the interview results for deviations from the HTA method to see where the method was effective in eliciting heuristic expertise and where deviations were helpful. He discussed his preliminary findings with Reigeluth and worked with him to plan the second interview.

### Results and Discussion

**Speed of the HTA method.** The analyst/researcher found a number of areas in which the speed of the HTA method might be enhanced. Two are discussed in this section. The others are the result of improving the effectiveness of the method and are discussed in the next section. The analyst/researcher noticed that almost an hour was spent identifying the simplest version of the task and distinguishing it from other possible versions. This can be important for training purposes, as outlined in the SCM methodology. However, in a business context, there can be other purposes for conducting the heuristic task analysis. The results of such an analysis can be used to generate job aids for experts, to help designers structure knowledge-management systems, and for other purposes. If training is not the primary purpose, then the analyst might choose to spend less time identifying the simplest version and other versions (Step 2. Identify the first learning episode). Such information might still be useful for distinguishing experts and novices, even though sequencing course material is not of concern. In this study, the analyst/researcher concluded that this step could have been concluded with significantly less time (approximately 20 minutes less), without diminishing the quality of the results.

**Recommendation:** Unless using the HTA method specifically for training purposes, perform Step 2, "Identify the simplest version," only if needed to distinguish between experts and novices or as one way of helping the expert access tacit knowledge. As the expert examines various instances of a task in search of heuristics, it may be helpful to distinguish between simpler and more complicated versions.

**Effectiveness of the HTA method.** The HTA method seemed to be effective in its primary function of eliciting heuristic knowledge from the expert. The types of knowledge delineated in Section 3.2 of the HTA Method were found to adequately cover the range and types of task knowledge described by the expert. The analyst/researcher did, however, have problems managing the two tasks of classifying the expert's knowledge and directing the interview to dig deeper into the expert's tacit knowledge. More practice with the methodology should alleviate this. The analyst/researcher noticed during the analysis that certain verbs used by the expert were indicators of tacit knowledge. Examples of these verbs are: *know*, *like*, *feel*, *see*, *determine*, *understand*, and *decide*. When the analyst/researcher asked the expert why she liked a certain piece of art, she struggled at first to find reasons, but eventually she isolated specific characteristics that distinguished artwork she liked from pieces that she did not find acceptable.

**Recommendation:** Additional guidance should be developed on how to represent explicit knowledge. Although this analyst/researcher has only begun to research this point, such guidance could come from fields such as task analysis or the expert's specific field. One area of interesting research would be collaboration between the expert and the analyst to develop an explicit representation for knowledge deemed critical.

**Guidelines for analysts.** Throughout the two interviews, the analyst/researcher made a conscious effort to avoid academic jargon, and the expert seemed to rapidly understand everything the researcher was saying. In

moments where the analyst/researcher caught himself using a technical term, he laughed it off with the expert and used the moment to increase rapport.

## Suggestions for Improving the HTA Process

The following is a tentative revision of the HTA process based on the findings of these three formative research studies. The changes and additions are in *italics*.

### Phase I. Prepare for Analysis and Design

1. *Decide on a task to analyze and be clear about the reasons for analyzing it.*
2. *Make sure you have enough task knowledge to have a good command of terminology and key ideas.*
  - *Review basic reference materials and try to become familiar with key concepts and jargon in the field.*
  - *It would be better to begin by identifying the simplest version of the task, rather than trying to expand the analysis to the next version.*
3. *Make sure you have enough knowledge about the uses of the task description.*
  - *If the task description will be used primarily for deciding on the content and sequence of instruction, identify the characteristics of the learners and the delivery constraints of the instruction in general.*
4. *Arrange to interview multiple experts.*
  - *Identify at least 2 or 3 experts to interview.*
  - *Plan to complete the analysis with one expert before initiating the analysis with another.*
  - *Plan to interview the least experienced expert first and proceed to interview progressively more experienced experts in order.*
  - *Ask one or more of the task experts to record their performance of a very simple version of the task, and review the recorded material in advance of the analysis; or observe the task expert's task performance.*
5. *Prepare in conjunction with the first (next) task expert.*
  - *Establish rapport with the task expert.*
  - *Introduce the HTA method to the expert.*
  - *Explain basic terms (i.e. guidelines, explanatory models, etc.).*
6. *Prepare for the interview.*
  - *Prepare interview materials (i.e., index cards to summarize critical incidents during task performance).*
  - *Practice the HTA interview process if you are not very experienced in it.*
  - *Arrange the interview logistics (e.g., reserve a conference room where you can work without interruptions).*

### Phase II. Identify the First Learning Episode

7. *Identify the simplest version. Hold a focus group interview with multiple task experts, and help them to reach consensus on the simplest version of the task that is fairly representative of the task as a whole. Also help them to describe the conditions that distinguish that version from all other versions.*
  - *You may want to use some **other criteria** in addition to simple and representative.*
  - *It may be helpful to have the expert briefly discuss **closely related tasks** and clearly distinguish between the main task and the related tasks during the remainder of the analysis*
  - *Ask the task experts to recall the **simplest case** they have ever seen. The simplest version will be a class of similar cases. Then check to see how representative it is of the task as a whole.*
  - *It may be helpful to start by identifying some of the **major versions** of the task and the **conditions** that distinguish when one version is appropriate versus another.*
  - *Thinking of different conditions helps to identify versions, and thinking of different versions helps to identify conditions. Hence, it is wise to do both simultaneously (or alternately).*
  - *There is **no single right version** to choose as the "simplest." It is usually a matter of trade-offs.*
  - *It is wise to go through this process with **several task experts** together and reach consensus before going on to Step 8.*
8. *Analyze the organizing content. With the least experienced expert you have not yet interviewed, analyze the organizing content (mostly heuristics and descriptive theories) for this version of the task.*
  - 8.1 *Review the recorded material (or any other visual aid) with the task expert.*
  - 8.2 *Ask the task expert to think of and describe **one specific performance** of the selected version of the task to focus on for your analysis, or ask if a videotaped performance would be a good case for you to focus on with the expert during the analysis.*

- *It is often helpful to have a videotape of a typical performance of the simplest version of the task, so you and the task expert can review it during the analysis process, but asking the task expert to recall one specific performance and keep it in mind throughout the process is a more convenient and inexpensive, albeit often less effective, alternative.*
  - *If you don't have a videotape, It may be helpful to have the expert describe contextual information and particulars of the specific performance, describing how the expert began the case, how it progressed (in sequence), how participants reacted, and how the expert dealt with any problems that arose.*
  - *It may be helpful to prioritize the problems/concerns that arose and the decisions/actions that the expert used to deal with them.*
- 8.3 *Decide whether to use a top-down or bottom-up approach to analyzing the content. If top-down, use Step 8.4 and skip Step 8.5. If bottom-up, skip Step 8.4 and use Step 8.5.*
- 8.4 *If top-down approach, start by identifying the general categories of knowledge that an expert uses, then proceed to analyze each.*
- Ask the task expert:
    - a) to describe each decision that the task expert made,
    - b) to identify the kinds of knowledge that the task expert drew upon to make the decision, and
    - c) to describe the specific knowledge within each kind of knowledge that the task expert used.
  - The kinds of knowledge are likely to include: steps, guidelines or rules of thumb, explanatory models, descriptive models, and metacognitive/decision rules.
  - It is generally helpful to start by asking the task expert if there are any steps or phases of activities that are always performed for this version of the task. If so, perform a procedural task analysis to identify the sequence of steps and to see if any of those steps can be broken down into substeps, but those substeps must be ones that an expert thinks of and uses routinely in performing that version of the task.
  - For guidelines, use the following process:
    1. Identify the **goals** for this specific performance of the task under its conditions. *It may help to have the expert explain the goals in task-specific terms rather than in abstract terms and to think of the goals as ideal outcomes.*
    2. Identify all the important **considerations** for attaining each goal.
    3. Identify all the important **causal factors** that relate to each consideration/subconsideration.
    4. Analyze each causal factor to identify all **guidelines** that an expert uses to account for this consideration.
  - For explanatory **models**, use the following guidelines:
    - For each guideline, ask the task expert for the reasons why s/he believes it works.
    - For interrelated guidelines, you are likely to identify a set of related reasons that constitute a causal model or models.
  - For descriptive **models**, use the following guidelines:
    - Ask the task expert what phenomena influenced this particular performance of the task. Try to identify all causal relationships that characterized those phenomena.
    - Be sure to look for multiple causes for each effect and multiple effects for each cause. Also look for chains of causes and effects, and explore probabilities for each causal factor to have each effect.
  - For metacognitive/**decision rules**, use the following guideline: Find out what rules the task expert used to decide when to use which steps, guidelines, and descriptive models during the specific performance of the task being analyzed.
  - It is wise to query the task expert about any of these kinds of knowledge that are not initially described to you for each decision the task expert made in this specific performance of the task.
  - *If the expert uses words such as know, feel, see, understand, like, determine, and decide, that may be an indication that heuristic knowledge underlies that particular performance.*
  - *It is often helpful to periodically ask the expert some questions about the chosen case, to keep the analysis focused on the flow of that version of the task.*
  - *It is useful to help the expert think about ways the specific case fell short of how it should have been done and to have the expert offer guidelines for how this specific case should have been done.*

- *It is wise to have some kind of reference material to provide contextual information and cues and to help the expert be more precise. During the iterative interview process, the visual aid also helps the expert keep on track.*
- *It may be helpful to use index cards for all of these kinds of knowledge, filling them out with the task expert during the analysis process with one piece of knowledge per card, and arrange the cards in some order on a table in front of both of you, so you can easily switch from one part or aspect of the task to another.*

8.5 *If bottom-up approach, ask the expert to describe each decision that s/he made and the process through which s/he went to make each decision.*

- *After the interview, try to categorize each piece of heuristic knowledge according to these categories: Steps, guidelines or rules of thumb, explanatory models, descriptive models, metacognitive/decision rules.*
- *Be sure to "member check" the interview results with the expert in a later interview to verify/identify the types of knowledge underlying each decision.*

8.6 Ask the task expert to think of **similar performances** of the task that are within the realm of the version of the task you are currently analyzing.

8.7 Repeat this entire process (Steps 5 - 8.6) with the next least experienced task expert to identify any alternative views of the task and the knowledge that underlies its performance.

- For each more experienced expert, you should summarize the previous description of the task and ask the expert to review it, in an effort to reconcile conflicts and select among alternative ways of thinking about and performing the task.

Formative research data indicate that this revised HTA process would have been more effective for the three cases investigated here. It remains to be seen whether or not this revised process will also work well for analyzing other tasks that have heuristic elements. The data in this study indicate that much additional guidance is still needed for conducting a heuristic task analysis. It is our hope that this study will encourage others to conduct additional research to improve the available guidance for analyzing heuristic tasks.

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# Dynamic Implementation Seeking Equilibrium Model

Pablo Jose Riboldi  
Brigham Young University

## Abstract

*Implementing exportable instructional systems has always been a problem for instructional developers. Even the best instructional systems lose effectiveness when they are poorly implemented. Researchers have focused their efforts on creating mechanisms to help developers and managers improve and control implementation. However, most of these efforts do not address long-term effects, or take into account how teachers feel and react during the implementation process. This study presents the Dynamic Implementation Seeking Equilibrium (DISE) model, a nonlinear model of implementation for teacher-mediated instructional systems to measure rate of implementation over time. The DISE model's main independent variable, the exportability control factor (ECF), is an intrinsic quality of teacher-mediated instructional systems. ECF is defined as the amount of instructions, support resources, schedules of activities, and accountability methods embedded in the instructional system to delineate or control teachers' actions so they use the system according to the developers' original intent. The DISE model predicts four distinct scenarios: extinction, stable low implementation, stable high implementation, and unstable implementation with catastrophic change. Beyond the implications for the implementation of teacher-mediated instructional systems, this model offers an example of how some of the concepts, techniques, and methodologies of nonlinear dynamics can be applied to the field of instructional systems development.*

## Dynamic Implementation Seeking Equilibrium Model

The primary purpose of the Dynamic Implementation Seeking Equilibrium (DISE) model is to represent the process of implementation of teacher-mediated instructional systems through time, or, in other words, how much of a given instructional system we can expect teachers to actually use consistently over time.

## General Characteristics of the DISE Model

<i>The DISE model is . . .</i>	<i>instead of . . .</i>
Descriptive	Prescriptive
Dynamic	Static
Explanatory	Evaluative
Predictive	Reactionary
Generalizable	Interventionist

The DISE model has the following general characteristics:

1. *Descriptive*: Descriptive theories show the effects that occur when a given class of causal events happen, or the sequence in which certain events take place. These types of theories do not favor one set of outcomes over another; they do not prescribe how to improve or modify a situation. The DISE model describes different scenarios of how teachers implement teacher-mediated instructional systems given a set of causal relationships. It does not evaluate one scenario to be preferable to the others, nor does it suggest how to increase or improve implementation.

2. *Dynamic*: Dynamic models are those which take the time variable into consideration as opposed to static models which give one-shot pictures of the environment or assume that the value of variables does not change over time. The variables in the DISE model are subscripted with the time variable. Their values change through time.

3. *Explanatory*: Explanatory models, a special kind of descriptive model, attempt to identify all relevant components of a system and their relationships, to explain the systemic behavior of the whole. The DISE model attempts to satisfy these requirements by analytically identifying the relevant components of the process of implementation and by representing the systemic behavior of this process with two different representational systems: one mathematical, the other schematical.

4. *Predictive*: Predictive models have the potential to describe, to some degree, a future state of the system under scrutiny, given certain present values. The DISE model can be used to predict future rates of implementation of teacher-mediated instructional systems (the dependent variable) by estimating the present values of the independent variables.

5. *Generalizable*: Generalizable theories apply to any situation within the model's scope. This characteristic is a matter of degree and limited by the scope of the theory under development. The DISE model has been

successfully applied to a variety of teacher-mediated instructional systems. However, further research is necessary to ascertain the degree of generalizability of the model.

### **Roles of Those Involved in the Implementation Process**

Before being able to delimit the scope of this study clearly, it is necessary to define the roles of all the participants in the implementation process. These roles will help delimit the scope of the model in the next section.

**Developers.** A class of instructional designers who generate explicit objectives, validated tests, and materials that are instructional and replicable (*materials developers* according to Burkman, 1987) and whose aim is to have a direct influence on the behavior of individual learners. However, in the context of the DISE model, these developers produce information for a cluster of learners who meet at a specified time, led by a teacher who controls what occurs in the classroom (*micro-instructional designers* according to Burkman, 1987).

**Teachers.** Those potential adopters of developers' instructional innovations who actually use these instructional materials, leading a group of learners to achieve a certain learning outcome. Teachers are ultimately in charge of deciding what, when, and how to implement the new instructional system. This role is defined in a broad, generic sense referring to the person(s) mediating the instruction; they could be teachers in traditional classroom settings, professors, instructors, trainers, tutors, etc. Also, depending on the scale at which the instructional system is being analyzed, the role of teacher could refer to an individual teacher, or an aggregate of teachers, such as a department, a school, a military or industrial training unit, or an entire school district.

**Learners.** Those potential adopters who are the ultimate audience and target of the instructional system. Learners should benefit from the instructional system by obtaining new knowledge or skills according to the system's learning outcomes.

**Master trainers.** Some instructional systems require teachers undergo some sort of initial training or certification training before they are qualified or certified to start teaching those particular instructional systems. Those teachers who teach this type of certification training to other teachers are called in this study master trainers. Their role is important because, even though developers may have included detail instructions on how to "correctly" deliver the instructional system's initial training, it still is their prerogative to deliver this training according to their own interpretations.

### **Scope Delimitation**

The primary purpose of the DISE model is to represent the process of implementation of teacher-mediated instructional systems through time, or, in other words, how much of a given instructional system we can expect teachers to actually use consistently over time. This purpose statement implies two scope limitations about the kind of instructional system under scrutiny: (a) The instructional system has to be exported, and (b) it has to be teacher-mediated.

Exportability means that the instructional system is designed to be used by a group of teachers different from those developers who created the system. To make an instructional system exportable, developers purposefully create devices to communicate their idea of how the system should be used to those teachers who will implement the system. This signifies that implementation starts once developers and change agents in charge of training teachers and promoting the adoption of the innovation leave the scene and teachers are not under the direct influence of those who created or promoted the instructional system.

Teacher-mediated instructional systems require a teacher to present the content to the learner. Teacher-mediated instructional systems pose a special problem for developers. Developers must not only arrange the content for learners, but also guide the teachers' actions to present this content appropriately. To do this, developers create a schema of the instructional environment, delineating interactions, schedules, activities, etc. Teachers also have a special challenge when using teacher-mediated instructional systems; they have to not only understand the content, but also interpret and implement the developers' wishes on how to present the content to learners.

For example, a self-study workbook is exportable but not teacher-mediated, so it is outside the scope of this study. On the other hand, an instructor's manual for a class that teaches word-processing is both exportable and teacher-mediated, so it would be subject to the analysis of this model.

### **Identified Assumptions**

In this section I discuss the necessary assumptions which I have been able to identify. I will explain each assumption. These assumptions are necessary to guide the modeling process while building the DISE model. Because they are assumed, these propositions are accepted as valid; however, their validity should be tested in future research efforts.



**Teachers seek equilibrium.** This assumption is based on experience, observation, and reflection upon human nature. People in general strive to find equilibrium in their lives. Just as physical systems tend toward a state of equilibrium, teachers seem to have a psychological tendency to seek after a state of equilibrium in their teaching practices. Teachers in particular seek to teach in a personal, uniform way. When teachers change the way they teach, they do so in order to improve their teaching, to polish their techniques, to find better examples and explanations. Those practices that work they keep and use the next time. Those that do not, they change, seeking better ones. All these changes are done cautiously and consciously as they seek to achieve a state of equilibrium where they feel satisfied with the learning taking place in their classes. Granted, this state is elusive and ill defined, but can be observed when a teacher teaches certain contents the same as in previous experiences. The DISE model assumes that teachers seek this state of equilibrium, and when they do not achieve it, they feel increasingly frustrated in an unstable, ever-changing environment.

Exogenous changes, such as having to implement a new instructional system, are disruptive to this equilibrium. Teachers seek to quickly adopt and adapt the features of the new instructional system and reach a new level of equilibrium. Teachers may only introduce changes to their teaching or are willing to try new things when confronted with new content or problems; however, once they find some set of teaching practices that work for them and their students, they often prefer to maintain them and use them time after time with little or no change.

**Constant quality.** Because the focus of the study is on implementation, it assumes that the instructional system's quality is constant. In other words, the effectiveness of the instructional system is not under scrutiny.

**Neutral value of implementation.** The DISE model attempts to avoid the pro-innovation bias (Rogers, 1995, p. 100) by describing the implementation process impartially, without assuming that higher levels of implementation are better, or more desirable, than lower ones. This study considers rejection, partial implementation, high levels of implementation, and anything in between as likely outcomes of the implementation process. Therefore, this study assumes not only that the quality of the instructional system is high and constant, but also that if teachers decide not to implement the instructional system or to implement something else instead, learning outcomes are not affected.

**Teacher, not learner implementation.** The DISE model analyzes implementing the instructional system from the teacher's point of view, without taking into account what learners choose to do. For example, if the teacher asks learners to complete certain worksheets, this study considers those worksheets implemented even if learners choose not to complete them.

**Teachers try their best.** This assumption implies that teachers eagerly strive to do their best in deciding what to teach and how to teach, putting the learners' instructional interest first. They do so not just because it is a job, but because they maximize their personal enjoyment when teaching at their best. This assumption removes any second-guessing on the motives for teachers' deciding for or against implementing certain parts of the instructional system. The DISE model does not take into account other types of motives.

**Teachers are free implementation agents.** Teachers are assumed to be relatively free and independent and can choose how they are going to teach their classes. This assumption recognizes that teachers are influenced by the environment in which they work to make implementation decisions; nevertheless, once the classroom door is closed, teachers are basically free to conduct their class however they want. Academic freedom is one of the most cherished and defended principles of the educational system. Teachers endure many things, even shamefully low remunerations, in order to enjoy academic freedom.

**Teachers are creative.** One of the reasons many teachers teach is to satisfy personal psychological needs. Chief among these are the needs to feel creative and needed. Of course these needs vary in nature and intensity from individual to individual, but teachers have to satisfy these psychological needs; otherwise, a continuous repressed creativity generates feelings of frustration. In this study, the expression "creativity need" is used as a general way to encompass all the personal psychological needs teachers seek to satisfy by teaching. To satisfy their creativity, teachers experiment in their classes with different teaching techniques and strategies, which should be their own creation, until they feel that their students are "getting it." When teachers are told what to do, even if it is something good for the students' learning, it does not satisfy their creativity. In fact, it may make them feel unneeded, superfluous, that anyone could do it. Some of the ways teachers express their creativity is by lesson planning, developing teaching materials, and solving instructional situations through previous experience and improvisation when necessary.

**Teachers feel frustrated when they cannot express their creativity.** As a corollary of the previous assumption, it is further assumed that teachers feel frustrated when having to repeatedly repress their creativity by having to implement very controlling or highly prescriptive instructional systems. For example, if the instructional system prescribes every interaction between teachers and learners, it would leave little or no opportunity for teachers to express their creativity. In this hypothetical situation, teachers would have to decide whether to comply with the

instructional system and repress their creative feelings or implement less and make some room to express their own creativity. If teachers find that they have to repress their creativity often, it is assumed that these feelings of repressed creativity, of disequilibrium, of being controlled, will lead to teachers' feeling frustration toward the instructional system.

**Transfer of training research applies to teachers too.** The DISE model assumes that when teachers mediate the instruction as they implement teacher-mediated instructional systems, they need to transfer the information to their own students. This implies that the transfer of training research findings (Bransford, 1979; Clark & Voogel, 1986; Cronbach & Snow, 1977; Mayer, 1980) apply to this study. The transfer of training research will be used to construct one of the variables of the DISE model.

**Developers have a specific implementation schema.** The DISE model assumes that developers have specific ideas or a schema of how the instructional system should be implemented. Even though developers may not be fully cognizant of their own implementation schema or may not fully represent it in their design, this schema exists and it corresponds to the way the instructional developers would use their own instructional system if they were teaching. Developers express these ideas not only by arranging the content for learners, but also by guiding teachers' actions to present this content appropriately. To more effectively communicate their schema and increase exportability, instructional developers carefully delineate instructions, provide resources, schedule activities, and create methods of accountability.

This assumption is necessary because the implementation of this schema is equal to 100 percent implementation. If a teacher were able to use the instructional system exactly the same way that the developer would, then this teacher would be perfectly implementing the system.

**Perfect implementation is unattainable.** An assumed corollary from the previous assumption is that teachers are never quite able to perfectly capture the developers' schema. Because of personal differences, communication problems, and previous experiences, teachers cannot attain 100 percent implementation. This assumption is necessary to set the range of the main independent variable of the DISE model.

This section listed the assumptions I was able to identify as necessary for building the DISE model. The next section defines the variables of the model.

## Variables of the Model

**Rate of implementation ( $I$ ).** One way to assess implementation in general is to measure the rate of implementation ( $I$ ). This is the main dependent variable of the DISE model. It shows what percentage of the original instructional system is being used at each point in time. A value close to 1 shows that teachers are implementing almost everything the original developers intended them to do, that most of the instructional system is being utilized. A rate close to 0 shows that teachers are utilizing only a small portion of the original instructional system.

By choosing to measure rates of implementation, instead of, let's say, actual implementation, the DISE model applies to a variety of settings and permits for comparisons among dissimilar instructional systems—the model is generalizable. However, this choice also implies that the model does not specify what parts of the instructional system will be implemented and which ones will be discarded by teachers, but it only states how much will be implemented. For example, two teachers could implement the same instructional system at the same rate but choose to use different parts of the instructional system.

**Initial rate of implementation.** The initial value of  $I$  ( $I_0$ ) represents the rate of implementation after initial training, just as the instructional developers pull away from the scene—when the transfer of the instructional system actually occurs. If developers do a good job training teachers in using the new instruction, then  $I_0$  would be high. When developers transfer the new instructional system with little or no effort to inform teachers how to use it, the starting implementation value would be low.

**Time iterations ( $t$ ).** The subscript ( $t, t + 1, t + 2, \dots, t + n$ ), introduced in the previous paragraphs, refers to how many times teachers have used the system. Thus,  $t$  is an ordinal, discrete variable instead of a real, continuous one. In the present context, this makes sense because teachers are not constantly engaged in the instructional process; instead they engage in it at intervals. Sometimes these intervals are very frequent and regular (every day, or even every shift); other times the intervals are over longer periods of time or irregular (semester, school year, or training cycle). The length of the intervals between one iteration and the next also depends on the scale at which we are analyzing the system (an individual teacher, a department, a school, or an entire school district). In the DISE model, every variable that changes through time will have this subscript.

**Complementary activities ( $I - I_t$ ).** Another component of teachers' implementation experience is  $I_t$ 's complement. All the instructional activities teachers perform during one iteration can be thought of as a whole ( $I$ ). Those activities not prescribed as part of the instructional system which teachers nevertheless purposefully perform, and which yield a perceived positive result, are here called complementary activities ( $I - I_t$ ). It is recognized that

this is a pseudo-variable because it is defined in terms of rate of implementation; meaning that it is defined by what the rate of implementation is not. This factor represents the successful activities teachers implement in the learning situation that do not originate from the instructional system. Another way of looking at this factor is as an expression of teachers' need to fulfill feelings of creativity and usefulness.

**Exportability Control Factor (ECF,  $K_i$  in the equations).** As mentioned previously, developers strive to communicate their internal schema of the instructional system. However, without direct contact, all developers can do is to train teachers, specify precise instructions, create resources, dictate schedules, and enforce accountability from teachers; in short, they can develop an exportable instructional system. The aim of these exportability devices is to communicate the developers' intentions of how the instruction should work. The amount and specificity of these exportability devices constitute an intrinsic quality of teacher-mediated instructional systems, hereby called Exportability Control Factor (ECF, in the equations, is represented by the letter  $K$ ). This name suggests the amount and specificity of control devices contained in the instructional system to ensure its exportability.

This new theoretical construct has a decisive influence on implementation. In fact, if a teacher-mediated instructional system is going to be truly exported, developers cannot have any contact with teachers after they receive the instructional system; developers can only influence implementation by designing the system's ECF (through instructions, support resources, schedules of activities, and accountability methods) and the initial rate of implementation,  $I_0$  (through initial training.) Therefore, ECF is defined as the (a) initial training, (b) instructions, (c) support resources, (d) schedule of activities, and (e) accountability methods embedded in the instructional system to delineate or control teachers' actions so the instructional system is implemented according to the developers' original intent.

For example, the ECF of an instructional system is high if it specifies each step teachers need to take in order to continue. A medium ECF would be a system which gives suggestions, explicit ideas, or a choice of exercises for teachers to pick and use or modify. On the other extreme, an instructional system with a low ECF contains broad suggestions of possible courses of action teachers should take, or visionary statements of the ideal state of affairs with few or no specifics.

1. *Initial training*

2. *Instructions*

3. *Support resources*

4. *Schedule of activities*

5. *Accountability methods*

**Transfer Alignment Coefficient ( $T$ ).** Before defining this variable, it is necessary to define two related concepts—expected transfer and elicited transfer.

Expected transfer is the type of transfer (near or far) necessary to effectively transfer different types of learning outcomes (procedural or declarative). For example, the expected transfer for a declarative learning outcome is far transfer. The more conceptual the learning objective, the farther the expected transfer would be; conversely, the more procedural the learning objective, the nearer the expected transfer would be.

Elicited transfer is the type of transfer (near or far) most likely to be achieved by the type of instructional strategy (behavioral or cognitivist) the instructional system prescribes teachers to use for teaching different outcomes. For example, if the instructional system uses cognitive strategies for the teacher to teach, the elicited transfer is far. The more cognitive or constructivist the instructional strategy of the system, the farther the elicited transfer would be; conversely, the more behavioral the instructional strategy, the nearer the elicited transfer would be.

Therefore, *transfer alignment*,  $T$ , is the correlation coefficient ( $-1 < T < 1$ ) between the expected and the elicited transfer per learning objective. If the instructional strategies used by the instructional system to teach different types of learning objectives elicit the same type of transfer as would be expected for the type of objective, then the transfer alignment would be strong (close to 1, aligned). If there is no relationship between the chosen instructional strategies and the type of objectives (for example, a uniform behavioral approach is used to teach all sorts of learning objectives), transfer alignment would be null (close to 0, unaligned). If the wrong strategy is used to teach the objectives or to teach the teachers how to teach these objectives (as in the case when the instructional system behaviorally prescribes for instructors how to teach cognitivist strategies to achieve cognitivist outcomes), transfer alignment would be negatively correlated (close to  $-1$ , misaligned).

For example, if the instructional system deals with procedural learning outcomes and uses behavioral teaching methods, then teachers only need to achieve near-transfer of the instruction to their learners. The type of learning, teaching methodology, and transfer required are aligned.

On the other hand, if the instructional system deals with declarative and conditional learning outcomes but uses behavioral teaching methods, or the system behaviorally requires teachers to use cognitive methods, then

teachers may only be able to achieve near-transfer of the instruction to the learners. Simultaneously, they must realize that the system is inadequate in achieving the level of far-transfer required to meet the declarative and conditional learning outcomes. There is a misalignment between the type of learning, teaching methodology, and transfer required.

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**Accumulated Frustration ( $A_t$ ).** Whenever teachers increase the rate of implementation of the instructional system from one interaction to the next ( $I_{t+1} > I_t$ , the rate of implementation now is greater than that during the previous iteration,) they have to sacrifice some of their freedom to use their own complementary activities and repress their creativity. This repressed creativity generates frustration, which accumulates throughout the implementation process. The amount of accumulated frustration is a function of (a) the personal degree of need to be creative, (b) the tolerance to repress this creativity, and (c) the difference in rates of implementation ( $I_{t+1} - I_t$ ) whenever this difference is positive. Only upward changes in the rate of implementation accumulate frustration. When teachers suppress their creativity in order to increase implementation,  $(I_{t+1} - I_t) > 0$ , frustration accumulates proportionally to this increase. It is assumed that when implementation decreases,  $(I_{t+1} - I_t) < 0$ , frustration remains static. The definition of this variable is based on the previously stated assumption that teachers feel frustrated when they cannot express their creativity.

The six variables discussed—rate of implementation ( $I_t$ ), time iterations ( $t$ ), complementary activities ( $I - I_t$ ), exportability control factor (ECF,  $K$ ), transfer alignment ( $T$ ), and accumulated frustration ( $A$ )—are used to model the dynamic process of implementation for teacher-mediated instructional systems. Next, the relationships among these variables are presented to build the DISE model.

## Relationships among Variables

**Implementation as a function of Exportability Control Factor.** By definition, developers design their instructional systems with a certain degree of ECF. This depends on the amount and specificity of initial training, instructions, support resources, schedule of activities, and accountability methods included in the system. The main purpose of ECF is to ensure exportability, to exercise some sort of pressure to implement the instructional system. This pressure influences teachers' decisions on how much of the instructional system to implement, and how much of their own complementary activities to include. This relationship is represented by Equation 1 (All the equations are found in Figure 1 at the end of this document.)

**Implementation as a function of previous Implementation.** One of the most powerful influences on a teacher's future rate of implementation is that teacher's previous implementation experience with the instructional system itself. Most teachers are constantly monitoring their own teaching practice, looking for those things that work to repeat them in the future, and identifying those things that fail to avoid them. The way they implemented the system the previous time ( $t$ ) they used it is going to strongly influence the rate of implementation of the system at  $t+1$ . For example, the way a teacher uses a particular instructional system during today's science class will largely depend on the perceived results of the previous time the teacher used the system, probably the day before during the science period. See Equation 2.

**Implementation as a function of previous Complementary Activities.** Another force influencing a teacher's future rate of implementation is the effect of previously implemented complementary activities. Those activities not prescribed as part of the instructional system which teachers nevertheless purposefully perform, and which yield a perceived positive result, the complementary activities, tend to lower the rate of implementation the next time teachers use the instructional system. This is represented by Equation 3.

**Combining all three relationships.** The discussion, so far, posits that future rates of implementation are a function of previous implementation, previous use of complementary activities, and ECF. Now, these three are combined in a logical manner.

As previously stated, the assumption has been made that teachers seek to achieve a state of equilibrium in their teaching practices. Thus, when faced with the implementation of new instructional materials, teachers will seek

to integrate the new materials with their own instructional practices until they achieve a state of equilibrium. They will try different mixes of components of the instructional system and complementary activities until they are satisfied with the new way of teaching. This process takes some time; implementation changes through each iteration until the new equilibrium is achieved. The equilibrium-seeking process is represented by the balancing feedback loop at the top of Figure 2. The delay in the feedback loop represents the  $t$  variable, the time interval between each iteration when teachers evaluate their previous implementation experience which influences their next implementation.

Equation 4 is not only the simplest model, but also one that appropriately combines the logical relationships among the factors affecting implementation, including ECF. It shows how  $I_{t+1}$  is proportional to the product of  $I_t$  and  $(I - I_t)$ . Equation 4 should be interpreted as follows: "The rate of implementation for the next time the teacher uses the instructional system depends on the interactions among the exportability control factor of the system, the current rate of implementation, and the current amount of complementary activities." This equation is one commonly referred to in discussions of chaos theory, and it has been applied to model a variety of settings including population growth (May, 1976), population growth of urban areas, economic growth limited by technology, city development limited by existing infrastructure (Cartwright, 1991), and organization of social environments (Marion, 1992).

Graphically, this equation is represented by the balancing loop between  $I_t$  and  $(I - I_t)$  and the external influence of ECF diagramed in Figure 2.

**The effects of Exportability Control Factor and initial implementation on the final rate of implementation.** The mathematical representation of the DISE model, thus far, affords the opportunity to analyze the model's behavior from different perspectives. For example, with Equation 4 the behavior of how  $I_t$  changes over time can be analyzed. As mentioned earlier, instructional developers can only influence ECF (directly through instructions, support resources, schedules of activities, and accountability methods) and the initial rate of implementation,  $I_0$  (indirectly through initial training.) However, according to Equation 4, no matter what the value of  $I_0$  is, teachers would tend to implement the instructional system at about the same rate after some time. The long-term implementation of teacher-mediated instructional systems is determined by the system's ECF and not by the initial rate of implementation.

This, however, should not be construed as implying that these teachers would implement the system exactly the same way. The DISE model only shows rates of implementation, but it does not specify what parts of the instructional system will be implemented and which ones will be discarded by teachers. Also, the complementary activities, which in these cases are about one-third of what the three teachers do in their classrooms, are most likely going to be different.

**The effect of Time on Exportability Control Factor.** As mentioned earlier, ECF is an intrinsic quality of instructional systems and as such it is constant; however, teachers perceive this quality differently depending on several factors. Among these, time is an important factor which changes a teacher's perception of ECF. For example, as teachers gain experience with the instructional system, they become more familiar with it and feel more comfortable with it, thus, their perceived ECF should decrease slightly. In order to account for these changes, the constant ECF (an intrinsic quality of the instructional system) should be changed to a variable ECF (the exportability control of the system as perceived by a teacher at a point in time). The constant ECF could be used as a predictive tool to guide the design process. The variable ECF should be used as an explanatory tool during the actual implementation process. Therefore, to model the changes in perceived ECF, a  $t$  subscript should be added to this variable, as shown in Equation 4. Within the context of the DISE model, I call Equation 4 the *implementation equation*.

**The effect of Transfer Alignment Coefficient on Exportability Control Factor.** Now the attention is turned to the next variable of the DISE model, transfer alignment coefficient,  $T$ . What would be the effect of the transfer alignment coefficient on perceived ECF,  $K_t$ ?

It is theorized that an aligned instructional system, one with a positive transfer alignment coefficient, would have the effect of reducing the perceived ECF because teachers would feel more confident on the instructional soundness of the system. Even highly prescriptive instructional systems, with  $ECF < 3$ , would seem less controlling when the system's instructional strategies are aligned with its learning objectives.

Conversely, a misaligned instructional system, one with a negative transfer alignment coefficient, would increase the perceived ECF because teachers would feel confused by not being able to efficiently transfer the instructions found in the system to their teaching situations.

It is further theorized that unaligned instructional systems, transfer alignment coefficients close to zero, would have little or no effect on perceived ECF. This unalignment would just solidify teachers' perceived ECF.

A simple way to model this relationship is to subtract the transfer alignment coefficient from the perceived ECF,  $(K_t - T)$ . This relationship is shown by Factor 5 in Figure 1.

**The effect of Transfer Alignment Coefficient on Complementary Activities.** Furthermore, transfer alignment coefficient also has an effect on how teachers evaluate the effect of complementary activities. Positive transfer alignment coefficients would strengthen the influence of previous implementation,  $I_t$ , over complementary activities,  $(1 - I_t)$  because aligned instructional strategies would be more appealing to continue implementing. Conversely, negative transfer alignment coefficients would strengthen the influence of complementary activities,  $(1 - I_t)$ , over previous implementation,  $I_t$ , because in these situations teachers would feel more justified to continue implementing their own activities.

The DISE model mathematically represents this relationship by dividing the complementary activities factor,  $(1 - I_t)$ , by  $(1 + T/2)$ , showing that a positive transfer alignment would lower the pressure to implement complementary activities. This relationship is modeled in Factor 6.

From my limited experience analyzing instructional systems, I suspect that most instructional systems are unaligned ( $T$  close to zero) because developers would tend to apply similar instructional strategies, those with which they feel most comfortable, to address different types of learning outcomes. For example, behaviorist instructional developers are likely to apply behaviorist learning strategies for all types of learning outcomes, be they procedural, declarative, or conditional. The same could be suspected of cognitivists and constructivists. I also forward that aligned instructional systems ( $T$  close to 1) are more likely to be those systems which have been carefully designed, paying close attention to address learning outcomes with appropriate instructional strategies. This implies that transfer alignment is unlikely to happen accidentally. Hopefully, I propose that misaligned instructional systems (negative  $T$ ) are rare.

**The Effect of Transfer Alignment Coefficient on Implementation.** The combined effect of transfer alignment on future implementation can be deduced from the discussions in the previous sections. A positive alignment would have the effect of increasing implementation because teachers would be more likely to achieve the appropriate type of transfer as they teach with the instructional system. Teachers would be willing to implement more of the instructional system because they could see that the system provided an appropriate strategy for them to teach and achieve the desired results. In a way, this positive transfer alignment would have the effect of dampening the frustration of high levels of ECF. A null transfer alignment would have no such effect, and a negative alignment would actually lower implementation of even instructional systems with moderate levels of ECF.

**Accumulated Frustration as a function of increases of Implementation.** The definition of the accumulated frustration variable stated that when teachers suppress their creativity in order to increase implementation,  $(I_{t+1} - I_t) < 0$ , frustration accumulates proportionally to this increase. The assumption was made that when implementation decreases,  $(I_{t+1} - I_t) < 0$ , frustration remains static. To describe this relationship between increases of implementation and accumulated frustration,  $A_t$ , the following Equation 8 is proposed.

**Exportability Control Factor as a function of Accumulated Frustration.** The last relationship to model is the one between ECF and  $A_t$ . It has already been mentioned that feelings of frustration, disappointment, dissatisfaction, and dejection may lead to second-order change. Below a certain threshold value, this type of change is unlikely. Above this threshold, change is imminent (Dooley, 1997). This phenomenon has been studied in neuronal patterns (de Bono, 1969) and managers' decision-making processes (aspiration theory; Cyert & March, 1963; Kiesler & Sproull, 1982). Likewise, each teacher has a tolerance threshold value to withstand the accumulated frustration. Below this value, teachers deal with the frustration the best they can, slightly adjusting their perception of ECF, due to the familiarization effect. They keep trying to implement the instructional system, probably changing the implementation mix to avoid having to repress their creativity so much the next time they use the system.

If the instructional system's ECF is not very high, implementation reaches stability before the frustration accumulates beyond the tolerance value. However, if the system's ECF is very high and implementation continues to be unstable, more frustration accumulates with each spike in implementation. Eventually, the accumulated frustration will surpass the tolerance threshold value. At this point, what can teachers do? This situation leads teachers to drastically change the instructional system to a less controlling environment by changing the instructional system's ECF.

What are some of the behaviors teachers exhibit that so drastically change their perceptions of the instructional system? Under the right conditions, teachers might go to extreme measures in order to create a more stable and tolerable environment. Some may disregard whole parts of the instructional system; others may quietly put it aside, lobby to their superiors for the system's dismissal or change, stop reporting to their superiors, or invent excuses for not using the system—claiming it doesn't work or that the students get bored. Some teachers may even quit their jobs in order to escape a controlling, intolerable situation; such cases exemplify the ultimate in non-implementation.

Mathematically, to represent the second-order change relationship between ECF and  $A_t$ , with slow changes in  $ECF_t$  below the threshold value and a drastic change above this value, Thom's cusp catastrophe equation (Thom, 1975; Zeeman, 1976) is adapted, as shown by Equation 9.

As  $A_t$  increases, pushed by the upward shifts in implementation (as modeled by Equation 8),  $K_t$  diminishes. At first,  $K_t$  diminishes very slowly, then as  $A_t$  approaches the fold in the curve,  $K_t$  diminishes at an increasing rate. When the value of  $A_t$  gets to be higher than the value of the right edge of the fold,  $K_t$  drastically jumps to the lower part of the curve. This sudden change in ECF represents teachers' decisions to respond to their accumulated frustration by changing the instructional system and transforming it into a less controlling environment. This behavior, modeled by the cusp, is called a catastrophe not because of any negative connotation of the word, but because a small change in the value of the control parameter ( $A_t$ ) can cause a sudden large change in the value of the independent variable ( $K_t$ ).

It is important to remember that the catastrophic change only occurs if frustration accumulates beyond the teachers' tolerance threshold level, which only occurs if implementation keeps oscillating in an unstable fashion. This happens when ECF is high and transfer alignment is low, or both. shows the DISE model's behavior when  $ECF > 3$  and transfer alignment is null.

**The complete DISE model.** is the complete graphical representation of the DISE model. Mathematically, the complete DISE model is Equations 10, 11, and 12 put together in a system of three equations, shown in Equation 13.

The DISE model of implementation for teacher-mediated instructional systems states the following: (a) The rate of implementation is a function of the instructional system's ECF as perceived by teachers, the previously experienced rate of implementation and the complementary activities. (b) This function is a balancing loop which leads to stable rates of implementation. (c) A positive transfer alignment coefficient strengthens the perceived ECF and weakens the effect of complementary activities; in general, it increases rates of implementation. (d) If ECF is high and implementation is unstable, teachers accumulate frustration as they need to repress their creativity when raising the rate of implementation. (e) Below a tolerance threshold value accumulated frustration reinforces the perceived ECF due to familiarization with the instructional system. (d) If implementation remains unstable and frustration accumulates beyond the tolerance point, teachers will drastically change the instructional system to one with a lower ECF.

## Implementation Scenarios

The DISE model of implementation for teacher-mediated instructional systems describes five distinct implementation scenarios: (a) extinction, (b) low stable, (c) high stable, (d) unstable with second-order change, and (e) aligned high implementations. Each scenario is discussed next.

**Extinction Implementation.** When the ECF of the instructional system is very low (between 0 and 1 when transfer alignment is null,) the rate of implementation falls toward 0. Left to themselves, teachers of an instructional system with such a low ECF feel disoriented and unsupported. Teachers cannot find enough instructional support in the system to implement it, so they eventually abandon it. They become confused and uncertain, and at the same time feel pressured to perform their duties. Under these conditions, teachers rapidly abandon the new system and revert back to their old teaching habits, or improvise and create their own solutions, which may or may not be better than the new system but which, at least, provide the much-needed equilibrium the teachers are seeking. I have studied several cases exemplifying this scenario, for example, a case where teachers in an elementary school attempt to implement but quickly abandon a new high-technology classroom program.

This extinction can be correlated with Dooley's (1997) third-order change, where a particular schema survives or dies in a Darwinian, competitive fashion. In other words, teachers compare what they are expected to do against what they have been doing, and decide between one or the other. In this case, the implementation of the instructional system dies and the teachers' complementary activities or the previous "status quo" survive. Notice that this extinction occurs no matter how high the initial rate of implementation ( $I_0$ ) was; a high  $I_0$  only delays the eventual fate of the implementation.

**Stable Low Implementation.** The second scenario, when the ECF is between 1 and 2 (null transfer alignment coefficient), can be called Stable Low Implementation. In this case, the instructional system provides enough controls to help teachers try the system on their own and appreciate its virtues. However, the relatively loose control mechanisms eventually let teachers continue using their current, personal instructional methods (fulfilling the individual's need for creativity, recognition, and security). Teachers adopt only those features of the system which are better developed, more closely match their instructional philosophies, and better fill voids in their current repertoire of instructional materials. Under these conditions, the DISE model predicts that teachers will consistently implement only a small percentage of the instructional system (less than half). The model does not predict which

parts of the system they will implement, nor whether different teachers will implement the same parts. A case study essay describing a hypothetical college professor's implementation of a textbook serves as example for this scenario.

**Stable High Implementation.** When the ECF of the instructional system is moderately high ( $2 < \text{ECF} < 3$ ,  $T = 0$ ), the system reaches the Stable High Implementation scenario ( and middle right part in Figure 1). In this case, as in the previous one, an increase in the system's ECF achieves an increase in the stable rate of implementation. However, gains in the stable rate of implementation are smaller than in the previous case (the slope of the curve in Figure 1 diminishes from 1 to 0 in this interval). The increased control included in the instructional system affords teachers a higher degree of security, guidance, and comfort to use more features of the system. However, teachers still feel the personal craving to express creativity, so they take up a portion of the available contact time to implement their own strategies, discarding what they consider the weakest parts of the instructional system. The DISE model predicts that for systems with an ECF close to 3, teachers would implement about two-thirds of the original instructional system in a stable fashion. Again, the model does not predict what parts of the system might be implemented, just that more would be implemented than in the two previous scenarios.

In these two stable scenarios, during the first few iterations, the rate of implementation oscillates around the converging value. These oscillations on the rate of implementation can be explained as what Argyris and Schon term first-order learning (1978). First-order learning occurs when agents change their course of action in order to conform to their perceived schema. This means that for this type of change teachers will adjust what they do in order to conform with what they are expected to do. This creates a negative feedback loop (like the balancing loop in ) in which actions converge toward the schema. During this process teachers try different aspects of the new instructional system until their actions converge with the new schema. At the end of this process, they would have achieved a new state of equilibrium. This part of the implementation process is what the DISE model attempts to describe by showing how teachers change the rate of implementation ( $I_t$ ) and the complementary activities ( $I_{t+1}$ ) with each iteration until they reach equilibrium.

For these three scenarios,  $\text{ECF}_t$  changes only slightly, if at all, due to increased familiarity with the instructional system. Equation 10 and are sufficient to model these three scenarios.

**Unstable Implementation with Catastrophic Change.** The next scenario corresponds to instructional systems with high ECF ( $3 < \text{ECF} < 4$ ,  $T \cong 0$ ). It can be called Unstable Implementation with Catastrophic Change (c and right side of Figure 1.) An instructional system with ECF this high imposes so many expectations on teachers that it constrains their freedom. Teachers have to battle an internal conflict between doing what they are told to do and doing what they want to do. The DISE model predicts that the rate of implementation jumps back and forth between high and low values. In general terms, the higher the ECF, the more unpredictable the rate of implementation will be. This unstable implementation does not allow teachers to achieve the equilibrium they are seeking. The situation becomes untenable. Teachers in this situation become increasingly frustrated with the instructional system, and keep trying alternatively to implement the system and to satisfy their creativity until they have had enough and decide to drastically change this intolerable situation. Teachers do so by changing the instructional system to one with a much lower ECF. Once these sudden changes occur, implementation converges to the appropriate lower rate of implementation.

The right side of Figure 1 shows  $I_t$ 's behavior when  $\text{ECF}_t > 3$ ;  $I_t$  does not settle to a single value. First,  $I_t$  suffers a bifurcation and oscillates between two values. As  $\text{ECF}_t$  increases,  $I_t$  bifurcates again and again until it reaches a chaotic region in which  $I_t$  does not settle but oscillates aperiodically within a certain range of values. As pointed out before, c shows the time series graph when  $\text{ECF}_t = 3.8$ . And shows the unstable oscillations with the catastrophic change.

In my research I have documented two case studies exemplifying this scenario. One of them shows how tutors changed a highly prescriptive reading program to a more flexible one. The other one relates the implementation of a series of managerial skills training modules in a business environment.

**Aligned High Implementation.** The previous implementation scenarios seem to imply that stable rates of implementation cannot be higher than two-thirds. However, these cases assumed unaligned instructional systems ( $T \cong 0$ , see b). As has been discussed, the DISE model posits that positive transfer alignment coefficients increase implementation. This is specially true for instructional systems with high ECF. Therefore, a highly aligned, highly prescriptive instructional system could see stable rates of implementation even above 90 percent ( $I_t \cong .90$ ). Teachers seem to be more willing to implement a prescriptive instructional system and, if needed, even to repress their creativity when the alignment between learning outcomes and instructional strategies is evident. This is depicted in a.

I have encountered two case studies describing the aligned high implementation scenario. One was a highly prescriptive two-day training workshop with very specific learning outcomes and closely aligned instructional



strategies. The other one was a highly structured reading program where some teachers perceived the program's positive transfer alignment and understood its design and were able to maintain implementation at high rates.

### Generalized Propositions Derived from the DISE Model

The DISE model has been presented. I have discussed the model's scope, assumptions, variables, relationships, and scenarios. This last section discusses those generalized propositions I have derived from the DISE model. It is important to remember that these propositions only apply to instructional systems within the scope of the DISE model: teacher-mediated instructional systems. These propositions are offered as generalizations derived from the model and suggest guidelines for developers' instructional design efforts. Their validity is subject to future theory testing and theory improvement efforts.

1. *The rate of implementation of a teacher-mediated instructional system is dependent on the perceived amount of exportability controls embedded in the system (ECF) and its transfer alignment coefficient.* The effect of ECF on implementation was demonstrated by the model in and . The effect of transfer alignment on implementation was depicted in . This proposition implies that instructional developers should pay purposeful attention to how they design an instructional system's initial training, instructions, support resources, schedules, and accountability methods to convey the desired ECF and how they align the system's instructional strategies with its learning outcomes, if they want to improve their chances that the systems gets implemented as intended.

2. *Normally, the transfer alignment coefficient is directly related to the rate of implementation.* This proposition posits that it is unlikely for a misaligned instructional system to have high rates of implementation (see ). It also implies that instructional systems with stable high rates of implementation are most likely positively aligned.

3. *The final rate of implementation of a teacher-mediated instructional system is not dependent on the initial rate of implementation.* This was clearly shown by where in spite of different initial rates of implementation, the final stable rate of implementation did not change. This proposition suggests that instructional developers should not spend undue efforts personally emphasizing high initial rates of implementation while they are still around, and implementation, strictly speaking, has not yet started. Rather they should concentrate on communicating the correct ECF and on designing highly aligned systems.

4. *The rate of implementation changes through time until it reaches a state of equilibrium.* This proposition was modeled by the outcome of the different scenarios and exemplified with case studies. According to the DISE model, even for very different conditions, the rate of implementation changes until it settles into a state of equilibrium.

5. *The way individual teachers perceive a teacher-mediated instructional system's ECF and transfer alignment can be different enough to greatly affect the rates of implementation over time.* Teachers' perceptions cannot be underestimated nor easily dismissed. Instructional designers should attempt to estimate these perceptions beforehand in order to design the most appropriate ECF and transfer alignment.

6. *After teachers' implementation reaches a state of equilibrium, only significant changes to these teachers' perceived ECF and transfer alignment could change the rate of implementation.* Such was the case of the implementation I found in one of the case studies where a significant change in the way the master trainers taught the certification training communicated very different levels of ECF to the teachers and they changed implementation accordingly.

7. *A teacher-mediated instructional systems with ECF below a certain level (extinction point) eventually will cease to be implemented.* See a. It is important to point out that, according to the DISE model, this outcome would occur no matter what the initial rate of implementation was. Probably, this is the worst-case scenario, because it wastes the most resources. Instructional developers should be careful not to attempt implementing instructional systems which run the risk of suffering extinction.

8. *A teacher-mediated instructional system with ECF above a certain level (unstable point) will be implemented at a unstable, changing rate for a period of time, until teachers significantly alter the instructional system to one with a lower ECF.* I have found a few examples for this proposition (see ). I consider this scenario to be the next worst one because when the catastrophic change occurs, all bets are off on how the instructional system will be implemented. Implementation could fall to a low stable rate or even below the extinction point to zero.

9. *Teacher-mediated instructional systems with moderate ECF (between the extinction point and the unstable point) have a non-zero, stable rate of implementation.* Several cases were presented to illustrate these scenarios (see and b). This type of incomplete or partial implementation is the most common implementation outcome for teacher-mediated instructional systems. This conclusion is supported by Rogers' (1995) evidence of how prevalent reinvention of innovations is and by the effect of innovation configurations as modeled by the CBAM model (Hall & Loucks, 1981). Other studies also support the idea that teachers adapt the instructional system and vice versa (Berman & McLaughlin, 1974, 1976; Davis, Stand, Alexander, & Hussain, 1982; Gephart, 1976).

10. *For teacher-mediated instructional systems with moderate ECF (between the extinction point and the unstable point), as ECF increases, the stable rate of implementation also increases but it does so at a diminishing rate.* This is shown by the diminishing slope of the curve in Figure 1 and . The implication of this proposition is that a developer's efforts to increase implementation by increasing the instructional system's ECF will have diminishing returns on the investment. This effect could prompt the developer to keep increasing the level of ECF, to achieve higher rates of implementation, beyond the unstable point. This could generate an unfortunate outcome.

11. *Initial training can be used to communicate the desired ECF and transfer alignment to teachers.* Developers should pay close attention to this important component of ECF. Nevertheless, unless they are planning to personally perform this initial training themselves, if developers have to rely on master trainers to deliver the initial training, then the initial training itself is subject to the implementation dynamics of the DISE model.

This presentation has described the DISE model in an analytical, step-by-step fashion. The DISE model presents a theory of how teacher-mediated instructional systems might be implemented over time. The model's scope and assumptions were carefully delimited and identified. The variables of the model were defined. The model was then represented using mathematical, graphical, and narrative representational systems, building the model's relationships. Five distinct implementation scenarios were described. Finally, several generalized propositions derived from the model were discussed, suggesting some development guidelines for instructional developers.

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# A New Historical Approach to Instructional Message Design: The Case of the *Janua Linguarum* and Its Implications for Foreign Language Pedagogy

Rebekah A. Richards  
Utah State University

## Abstract

*One of the problems that continues to plague teachers of foreign languages at the secondary and university level is the students' use of a "pony," i.e., a literal translation, to assist them in completing their translation assignments. Due to the wide availability of such translations and the tendency for students to choose the path of least resistance, the use of such crutches is not bound to end. Though I would not suggest that it is appropriate in all instances, it is my contention that as teachers of foreign languages, we can guide the students' use of the "pony" in ways that will work to their advantage rather than their detriment, as can be demonstrated through a popular language textbook from the early 17<sup>th</sup> century. The example discussed in this paper and an examination of the design methodology used by the author of the 17<sup>th</sup> century textbook also suggest the encouraging conclusion that a new historical approach to instructional design is appropriate and beneficial for modern instructional designers, especially vis-à-vis modern foreign language pedagogy.*

## Introduction

In this age of technological innovation and "advances," and especially in this very modern field of instructional design, a new historical approach to pedagogy might seem oddly misplaced. However, since we are confronting issues that are literally millennia old and that have been debated in the laboratories of experience for many centuries, we should not dismiss out of hand the solutions proposed and tested by teachers throughout the ages.

As both Classicist and instructional designer, my question is how a new historical approach to Classical language pedagogy, when viewed through the lenses of modern instructional design, informs foreign language pedagogy today. Though my interests and examples deal primarily with teaching ancient Greek and Latin, the methods revisited in this paper can be easily applied to teaching any non-native language.

At the forefront of the controversy in Classical language pedagogy in the last ten years are issues of the changing student profile. The complaints in the pedagogical discourse form a remarkably consistent refrain: the students will not study, the students do not have a foundational knowledge in grammar, the students have no motivation, the students have other priorities (Abbott, 1991; Gruber-Miller, 1998; Kitchell et al., 1996; Phinney, 1989; Sebasta, 1998).

This issue of the new model of student has also been at the forefront of instructional design and educational theory in recent years, but has been cast in a much more objective light. Rather than making a value judgment about their essential quality, intelligence, or background knowledge, educational researchers and theorists have attempted to describe *how* students learn; instructional designers, building on the findings of these educational researchers, have classified types of knowledge and produced theories describing how students learn each type *best*.

In recent years, in an attempt to shake off the shackles of the traditional "grammar-translation" method of language pedagogy inherited from their teachers and their teachers before them, Classical language teachers have largely switched over to a "more intuitive" and more modern approach dubbed the "reading" method (Burns & O'Connor, 1987; Davis, 1991; Gruber-Miller, 1998; Knudsvig & Ross, 1998; Phinney, 1989; Sebasta, 1998). The reading method, though a step in the right direction, is not, however, a panacea. We must continue to look in all corners, however unlikely, for new—or old—ideas that will help inspire language pedagogy with new life. It is in this spirit that I suggest it is time the past was exhumed and examined in the new light provided by modern theories. The eminent Hellenistic historian Peter Green noted that historical interpretation is largely affected by the *zeitgeist* of the era in which the historian works (1993). Thus, issues considered anew in each succeeding generation continue to yield rich insights. Unfortunately, the historical approach to Classical language pedagogy has been largely dispensed with in favor of more "modern" approaches (Phinney, 1989). Proponents of these approaches claim that they approximate a more authentic learning experience. This goal is a worthy one, and the efforts that have been made should be commended. However, by analogy with the historical insights gained in the last generation in areas such as Hellenistic history, gender studies, and oral poetic composition, I contend that the distantly historical approaches to Classical language pedagogy can reveal unexpected treasures when reviewed using a similar new historical approach.

For the remainder of this paper I will focus on a few of the advantages that could accrue from employing one example of these “old” techniques and methodologies to the modern foreign language classroom. Many of these techniques do not simply provide a way to work around “obstacles” presented by the new profile of student characteristics; they actually work *with* the new generation of students and are, in addition, validated for modern use by modern educational and instructional design theories.

### **Problems of Foreign Language Pedagogy**

Perhaps the most daunting problem facing foreign language students today is the tremendous amount of cognitive resources required for translation (what instructional designers would call “authentic whole-task practice”). While translating a single sentence students must analyze parts of speech, morphology, denotation of words, connotation of words, grammatical syntax, and word order, and then reconstruct the pieces into an idiomatic rendering in their native language; add to this the pressure of “performing” in front of peers and instructor or for a grade, and it becomes apparent that even in its simplest form (i.e., for the shortest sentences), the act of translation produces a nearly constant state of cognitive overload.

The teacher’s most common solution to the problem of cognitive overload is to deconstruct the practice as far as possible into its various component parts, as is evidenced by the plethora of vocabulary drills, memorization of grammar rules, and morphology drills available in both computerized and paper form (Latousek, 1998). However, the connotation of vocabulary can only be understood in context, that is, in conjunction with other words, and therefore cannot be effectively practiced simply by drilling single word equivalents as though they were the times tables. The same is true for appreciating the style and interpreting the tone of an author or passage. The result of drilling individual component skills is, consequently, a decontextualized, fragmentary type of knowledge that is often difficult to integrate during authentic whole-task practice, i.e., translation. The dilemma, though, is that without making some of these component skills recurrent or automatic by drill-type practice, the task of translation is essentially hopeless for the novice.

The obvious solution to the instructional designer is to scaffold the authentic task at various levels by recombining component skills to form intermediate practice tasks. But identifying a solution is the easy part. The more difficult question is how to implement that solution. It is for answers to difficult problems like this that we can and should look to the past for illumination.

### **Bathe’s Language Methodology**

In the early 17<sup>th</sup> century, William Bathe, an Irish Jesuit stationed at Salamanca, Spain, wrote a stunningly successful language manual, the *Janua Linguarum* [*The Gate to Languages*], based on his innovative pedagogical theory. The textbook, designed for students of both modern and “scholarly” languages, saw numerous editions published throughout the 17<sup>th</sup> century and was used to teach at least 8 different languages. Surprisingly, 11,000 copies were printed in Puritan England alone—though, for obvious political reasons, without attribution to its Jesuit author. Bathe’s book also formed the basis for several other pedagogical methods. For example, upon comparison with Bathe’s text, the *Janua Linguarum Reserata* of John Comenius, which has come to be regarded as the first modern “textbook” in the West, is discovered to be little more than a cheap imitation of this well-known and widely-acclaimed text (Corcoran, 1911).

As an instructional designer, who by definition believes that a systematic approach to designing instruction will produce a superior instructional product, I consider the overwhelming success of the 17<sup>th</sup> century textbook a natural result of an underlying systematic instructional design. The introductory matter reveals an astounding anticipation of ISD models as well as a deep understanding and appreciation of factors that significantly affect learning, as the following discussion and passages from Bathe’s text will show.

### **Analysis**

As Allison Rossett so convincingly demonstrates in her recent exegesis (1999), the analysis phase of the design process is essential to the success of the design itself. Bathe was not unaware of the importance of defining the need for his method, the target population for his manual, the component tasks that constitute the authentic whole task (i.e., translation), and the objectives on which he would focus in creating his manual and explicating his method.

### **Needs Analysis**

In the second chapter of the introduction to his first edition of the *Janua*, Bathe identifies the need for his new language methodology. He states:

For learning languages...only two ways have yet been found: the 'rule-way,' such as grammar applied to note the concord of words, and the 'ruleless-way,' the ordinary plan of learners of common tongues through reading and speaking. The two ways are related to each other, in that the 'rule-way' gives more sureness, where the 'ruleless-way' more ease in learning. The former is to be preferred where the language is not in common use, the latter in case of a [modern] tongue. But if a 'via media' [middle way] can be thought out, which would equal the 'rule-way' in sureness, and the 'ruleless-way' in ease, it would beyond question be placed several degrees higher than either. Such a way we have here...undertaken to point out. (as cited in Corcoran, 1911, p. 72).

It is interesting that several centuries before Dave Merrill arrived on the instructional design scene, Bathe was driven by the mandate to make instruction more effective and efficient and consequently more appealing.

### **Target Population Analysis**

Bathe defines the target audience for his method in the preface to the first edition of the *Janua Linguarum*: "this manual," he says, "is chiefly for those men who are missionaries in foreign regions...to learn the foreign languages" in use where they were serving. "It is also for confessors," he continues, "so that they can understand the meaning of the feelings concealed in the hearts of the foreign peoples..., especially for confessors in those areas which foreigners frequent." He adds that the book is for "those of advanced years who have been deterred from taking the orders by the tediousness of grammatical studies." It is also, he says, for those "for whom the work of learning vocabulary for many years is vexing, who do not wish to undertake the work which is common to the 'intricate' method in popular use. This manual," he says, "yields a more fruitful command of vocabulary for students of grammar and rhetoric in three months than any other will in three whole years; this is true," he claims, "not only of the vocabulary of the modern languages, but also for Hebrew, Greek, and Latin." He goes on to say:

It is very appropriate for teachers who wish to teach the fundamentals of the vocabulary that occurs in all the authors, for many words in the works examined in the *trivium* courses are contained in this volume. And it will also be helpful for travelers who will by using it be able in the shortest time possible to collect a 'forest' of words used in another country. It will also useful for those who are involved in various business dealings, for example, those who are sent to speak with the heads of state, for learning foreign idiomatic usages in a short time. And it will prove useful for remedying the negative effects of not being able to attend a public school for servants in noble houses. It is for those who wish to spare the expense of years of study in the humanities. And it will assist those who wish to learn the noble modern languages, such as Italian, Spanish, German, and French, in the comprehension of vocabulary. (as cited in Corcoran, 1911, pp. 266-269).

### **Task/Objectives Analysis**

In the first chapter of his introduction, Bathe divides the learning of languages into four elements or component skill areas: words, syntax, idiomatic phrases, and style (Corcoran, 1911). This four-fold division resembles a modern high-order task analysis. Then, in chapter three, he suggests that while both vocabulary and syntax could effectively be learned using his "via media," the first edition of his text would deal only with the first element. From his discussion throughout the introduction, it can be conjectured that Bathe intended to add to the text—or perhaps even create an additional manual—to explicate his method for learning syntax using this "middle way" method. However, he died shortly before the publication of his first edition and was unable to accomplish his plan; but two translators/editors of later editions of Bathe's work took his plans to heart and found a way to teach syntax using his "via media." These two editions will be discussed later. For now, let us remark on the practical wisdom Bathe demonstrated by focusing on an objective relating to a single element in his task analysis for the prototype of his method.

### **Design**

Bathe's prescient anticipation of modern instructional design methodology evident in his extensive analyses of need, audience, tasks, and objectives extended to the design phase, as well. As with the analysis, the primary evidence for his attentiveness can be found in the introductory matter of the first edition. Chapters three through seven, nine, and ten make explicit the plan behind the method and give guidelines for implementing it in later editions. Chapter eight, in fact, bears a startling resemblance to a management plan. Bathe leaves explicit instructions for those who will perpetuate his work about how to do so in accordance with his original design (Corcoran, 1911).

Because Bathe passed away before his product could be implemented, evaluated, and revised, that part of the ISD process were of necessity left to others. As mentioned above, two of the editors of later editions of the *Janua* added to the manual exercises to assist the learner in assimilating the second element of language identified by Bathe: the syntax. There are anecdotal records of experiments with the manual to gauge its effectiveness (Corcoran, 1911); the results of these experiments are commonly reported as testimonials in the prefatory material of various editions of the textbook and are therefore rather historically suspect. However, the important point is that some sort of evaluation was occurring per Bathe's instructions.

### **Bathe's Ideas about Learning**

As an educator, Bathe was aware of many of the problems currently being discussed by modern educational theorists. For example, in chapter three of the introduction to the *Janua*, Bathe explicitly acknowledges the problems of cognitive load and the decontextualization of knowledge caused by rote memorization of definitions and rules. "How is it," he asks, "that in learning syntax some adopt the 'rule-way,' and some the 'ruleless-way,' while in learning words no one sets before himself the 'rule-way,' by thoroughly learning a series of words? For this, three reasons can be given. First, that vocabularies contain many unusual words, useless for the purposes of many learners. Secondly," he continues, "that a close connection exists between many words, and so, when one fundamental word is known as the source of others, these are very easily inferred from it.... When the meaning of one of them is known beforehand, the rest easily follow and so do not call for any special effort on the part of a learner." And finally, he adds, "the third and main reason is that words in a vocabulary [list] lack significance; from this it follows that the memory, deprived of the assistance of the intelligence, cannot keep firm hold on them" (as cited in Corcoran, 1911, pp. 72-73). Bathe's arguments bear an unmistakable resemblance to the tenets of Meaningful Reception Learning as explicated by Ausubel, Novak, and Hanesian (1978).

Bathe's perceptiveness when it comes to learning and to the design of instructional materials, especially when his work is compared to modern theories and principles, was phenomenal. Not only does his acuity lend credence to his historically-acclaimed position as one of the preeminent educators in the post-Renaissance West (Nolte, 1768, as cited in Corcoran, 1911), but it also suggests that modern foreign language teachers and instructional designers alike could derive great benefits from examining and applying certain elements of his methodology and techniques. The following section of this paper will provide an example of how one such technique found in this historical textbook could be applied to modern foreign language pedagogy.

### **A New Historical Approach to an Old Problem**

One of the problems that continues to plague teachers of foreign languages at the secondary and university level is the students' use of a "pony," i.e., a literal translation, to assist them in completing their translation assignments. Due to the wide availability of such translations and the tendency for students to choose the path of least resistance when it comes to completing homework, the use of such crutches is not bound to end. Though I would not suggest that it is appropriate in all instances, it is my contention that as teachers of foreign languages, we can use supplemental exercises to guide the students' use of the "pony" in ways that will work to their advantage rather than their detriment, as can be demonstrated through two specific examples from Bathe's textbook.

### **The Arrangement of Bathe's Book**

One of the more interesting aspects of Bathe's text—and one of the most informative for the problem of modern foreign language pedagogy posed above—is that it employed facing text and translation, much as a modern "pony" does today. The sentences in the language to be acquired were found on the right-hand leaf and the literal translation of the sentences into the native language on the left. Some editors made the translations interlinear while others made multiple columns in order to show the sentences rendered into as many as six languages across the double leaf (Corcoran, 1911).

Though the arrangement of the book appears at first glance to be more an issue of message design than of instructional design, the exercises that encourage the learners to actively engage both the text and translation simultaneously and to manipulate the material in a way that facilitates the abstraction of vocabulary and principles of syntax reveal the centrality of message design in the overall instructional design.

### **Harmar's English Edition**

John Harmar, Regius Professor of Greek at Magdalen College, Oxford, edited and oversaw publication of two English editions of the *Janua Linguarum*. Harmar, in the introduction to his first edition (the sixth English

edition, published in 1623), reports in detail the alterations he saw fit to make to the *Janua*, alterations that were “sufficiently commended both by diverse experiments, and by five editions past.” These changes included making the translation “more significant and correspondent to the Latin, and more clearly to reflect on it” (as cited in Corcoran, 1911, p. 98). That is, he made the vernacular translation more precisely literal. He also refined the Classical Latinity of the sentences themselves so they would be of more immediate use to teachers and students of Classical Latin. Finally, he added directions for manipulating the Latin text in such a way as to make the “concord of words” (i.e., syntax and word order), the second element of language identified by Bathe, explicit to the students: he directs the students “to construe by letters pointing out the grammatical position and sequence of the words” (as cited in Corcoran, p. 99). The student, when faced with a sentence such as the one that follows (sentence number 9 of 1200 in the *Janua*), *Hoc momentum, unde pendet aeternitas*, would have written something approximating the following string of letters: Adj[ective] N[oun] Adv[erb] V[erb] N[oun], thereby indicating the part of speech of each word in the order in which it appears in the language to be acquired.

Harmar apparently believed that with the modifications described above the book would displace all other beginning Latin texts, which he styles “elementary trash,” for teaching the fundamentals of Classical Latin (Corcoran, 1911). Indeed, by increasing the Latinity of the sentences and the correctness of the translations, he prepared a text suitable for teaching all four of Bathe’s elements: vocabulary, syntax, idiomatic phrases, and style. For as the students actively manipulated the text, they would of necessity have encountered phrases and idiomatic translations as well as the general style of the Latin language.

### **Applications to Modern Foreign Language Pedagogy**

Harmar’s pedagogical method could be easily adapted to modern use for both ancient and modern languages. Working with a facing literal translation, students could be assigned to use letters to indicate the parts of speech of each element in a sentence in a passage of text by the author being studied. To increase the difficulty of the exercise, the students could be instructed to indicate the syntactical function of each word within the sentence as well as its part of speech and to note differences in syntactical function or idiom between the two languages. Ideally, the passage used for this exercise would be different than the passage used for whole-task practice but by the same author.

Several instructional advantages could be derived from such an exercise. First, the students would be able to focus on syntax and word order without any but the most cursory attention to the semantics of the sentence; such would be the advantage of having a literal translation readily available for consultation. This type of scaffolding reduces the cognitive load, thereby increasing the cognitive resources available to attend to the syntactical patterns. Second, with sufficient practice, the students will eventually assimilate schemata for the syntactical patterns not only of the language in general but also of the specific author under consideration. Each additional sentence analyzed in this way will assist in the tuning of these syntactical schemata (van Merriënboer, 1997). Third, as Bathe himself pointed out with regards to learning vocabulary, the syntax, when situated in an authentic environment is much easier to learn and remember than when learned as a list of decontextualized rules. This last point, again, is the basic tenet of the Meaningful Reception Learning theory (Ausubel et al., 1978).

### **The Portuguese Edition**

In 1623, Dom Mauro de Roboredo published his *Porta de Linguas*, a Portuguese translation of Bathe’s *Janua*. He expresses in the preface his intent to “extend the usefulness of the original edition by adding, on its own expressed plan, a Portuguese version” (as cited in Corcoran, 1911, p. 107). In addition to simply adding a literal Portuguese translation of the Latin sentences, he made slight changes to the message design, as well. Roboredo retained both the Latin and Spanish sentences in their original positions but added his Portuguese translation above the Spanish translation on the left-hand side of the page. Then he connected the corresponding elements of the sentences in all three languages with numerals (Corcoran). Using the same sentence from the *Janua* as in the previous example, an example of Roboredo’s rendering would have been as follows: *Hoc momentum, unde pendet aeternitas*. A literal English translation following the same plan would read: This is the moment from which eternity hangs.

### **Applications to Modern Foreign Language Pedagogy**

This unique element of message design found in the Portuguese edition of the *Janua* suggests possibilities for use in modern foreign language instruction. Using a passage of text in a facing literal translation, the students could be assigned to use numerals to connect corresponding elements in the sentences of the foreign and native languages.

The advantages to this exercise would be several. First, the exercise would encourage students to actively engage both text and translation simultaneously, thereby drawing attention to both the foreign word and its equivalent in the students' native tongue and taking maximum advantage of the scaffolding inherent in such a format. Second, the students would be exposed to much more vocabulary than they would be if they were expected to look up each unfamiliar word in a dictionary (van Merriënboer, 1997). Furthermore, the students would have at their fingertips a model of expert translation: they would see the various nuances of a particular word and also how the literal definitions of words are influenced by surrounding words to form a coherent thought or idiomatic expression (van Merriënboer). Fourth, students are more likely to remember vocabulary when they encounter new vocabulary words in the context of a complete thought, as Bathe himself pointed out. Today we would muster the tenets of MRL as support for this statement (Ausubel et al., 1978). Fifth, the second, third, and fourth elements of language, as articulated by Bathe (i.e., syntax, idiomatic phrases, and style) would also be called to the students' attention as they moved systematically through the passage; and, as mentioned earlier, because the semantics would not be tying up their cognitive resources, a greater amount of attentional resources would be free to assimilate syntactical schemata, idiomatic renderings of certain phrases, and the stylistic patterns of the author under consideration (van Merriënboer).

## Conclusions

Contemporary testimonials and the overwhelming popularity of the book on the basis of numbers alone aver that the exercises contained in the *Janua Linguarum* were successful for teaching the rudiments of vocabulary and syntax in the 17<sup>th</sup> century; but their effectiveness then and their potential for effectiveness now can also be verified by their correspondence to modern instructional design principles and learning theories. The major principles exemplified in the *Janua Linguarum* include: 1) scaffolding novices in several component skill areas to allow them to successfully engage in authentic practice activities as soon as possible (van Merriënboer, 1997); 2) reducing cognitive load by reducing the number of component skills being practiced at one time (van Merriënboer); 3) modeling expert translation (van Merriënboer); 4) increasing the automaticity of rule-based or recurrent component skills through more encounters with vocabulary and syntax (van Merriënboer); 5) assisting the assimilation and tuning of syntactical schemata by encouraging students to make patterns explicit through the use of semantically insignificant symbols (van Merriënboer); 6) requiring thoughtful engagement from the learner (van Merriënboer); 7) encouraging learners to assimilate vocabulary from a meaningful context rather than by rote memorization (Ausubel et al., 1978); and 8) increasing students' motivation to learn by providing authentic early experiences with the texts (Keller, 1987).

It is my argument that the adherence of the exercises from the *Janua Linguarum* discussed in this paper to principles of good instructional design justify not only reinstating this antique use of the "pony" in modern foreign language pedagogical methods, but also justifies using a new historical approach to instructional design to infuse our modern approaches to foreign language pedagogy with the sustaining lifeblood of tried and true methodology.

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## **Building a "Web-Based High School" Project - A School-University Partnership**

Wilhelmina C. Savenye  
Zane Olina  
Alexander Kim  
Howard Kopp  
Adamos Nicolaou  
Mary Niemczyk  
Arizona State University

Herb Dwyer  
Tempe High School District

### **Audience Objectives**

1. AECT audience members will be able to describe and evaluate the results of a school-university collaboration that is part of a web-based high school project.
2. AECT members will be able to briefly describe the development and evaluation of four components developed as part of the project: 1. a teacher-training and support needs assessment, 2. a "rookie camp" to support students in using WebCT, 3. an instructional unit to help teachers learn about digital copyright, and 4. a web-based "courselet" to teach students about key elements of the Odyssey of Homer.

### **Background**

One high-school district in the Phoenix, Arizona, metropolitan area, has over the past six years, built its infrastructure to support high-quality technology integration by its teachers. At one high school, McClintock High in Tempe, the technology coordinator, administrators, and several innovative teachers determined that the time had come to take advantage of what technology could now do for their teachers and students. They knew their school was ready to take the next step toward true technology integration.

The school personnel saw this next step consisting of developing several levels of web-based and web-supplemented instructional materials and programs. At one level, they partnered with the Virtual High School (VHS) out of Concord, Massachusetts, to secure access to advanced placement courses for students who could not otherwise take these courses. One teacher enrolled in the VHS's teacher-training program. During this year, five McClintock students were able to take such courses as Advanced International Politics and Advanced Microbiology, all fully web-based courses. At another level, one teacher set out to develop web-supplemented materials, such as web quests, for her lower-level English students. She found that students' interest in these innovative materials seemed to decrease the dropout rate in her course. At another level, it was hoped that teachers could develop web-based "courselets" for many content areas that students who could not attend school, due to illness or suspension, for example, could complete on their own. The school also plans to develop web-based instruction to help students prepare for state-mandated exams (Dwyer & Boyle, 1999.)

The overall goals of the initial plans were to increase access to instruction through these many means, and also to decrease instructional costs. During the strategic planning, the district evaluated several web-course authoring programs and selected WebCT for its major systems, although teachers also have access to other software.

The district had recently passed a bond issue to fund purchases of computer hardware and software, along with significant upgrades of the district's technology, infrastructure, however, here, as elsewhere in our public schools, there is little to no funding for teacher training, student and faculty support, and development of materials.

### **The Collaborative Partnership**

Meanwhile, during spring of 2000, at a nearby university, a faculty member from an educational technology graduate program sought "real-world" projects for students in her advanced instructional development class. A fortunately-timed call to the technology coordinator at the high school, not coincidentally, an alumnus of our doctoral

program, seeded the beginning of a collaborative school-university partnership that has added to the nucleus of the web-based school project.

Initially, the school district and the university program identified several needs which it was hoped would be answered through the partnership. The school district hoped to add a scholarly focus to their technology efforts. They also hoped the graduate students would provide the teachers and staff with an instructional design perspective, to complement the desired exemplary use of technology skills. It was hoped that, in addition to the extra resources the university program would provide, the educational technology graduate students and professor would bring the school and the district a fresh and different perspective.

The university professor and students, of course, hoped to fill their need for advanced real-world instructional design projects, as well as a sort of proving ground for the graduate students in which they, too, would learn more about school needs and applications of technology. Not incidentally, the school district surrounds the university and this close proximity aided all in staying in close touch.

Finally, the university professor and the school technology director, hoped that the personal relationships that developed as a result of the partnership would sow the seeds for future collaborative projects to benefit students and faculty in both the school district and at the university.

## **Development of the Project**

During the spring of 2000, five students in an advanced instructional development course learned about principles of web-based development and course delivery and techniques for conducting needs assessments. For instance, they learned some of the basic principles of distance learning, especially web-based distance learning (cf. McIsaac and Gunawardena, 1996; Kahn, 1997; Moore & Kearsley, 1996.) They discussed how to determine if a course is suitable for web delivery by learning the principles of Porter (1997) and McManus (1998.) They learned about qualities of instructors who are more successful in developing innovative internet-based programs (cf. Beaudoin, 1990; Collis, 1996; Gunawardena, 1992; Muffaletto, 1997.) They also learned about aspects of learner expectations in distance instruction (cf. Moore, 1989.)

The focus of the course then shifted to developing their projects. They discussed advanced instructional design techniques, especially instructional strategies, based on the work of Smith and Ragan (1999.) They also learned how to implement sound instructional design principles in web-based environments (cf. Eastmond & Zieghan, 1995; Hirumi & Bermudez, 1996; Ritchie & Hoffman, 1997.) They learned about some of the issues facing teachers and students who use the computer-mediated communications that such systems as WebCT allow (cf. Bull, Bull, & Sigmon, 1997; Lewis, Whitaker & Julian, 1995.) Students were reminded of the importance of good visual design in web development (cf. Grabinger, 1989.) Finally, after students developed their projects, they field-tested them according to the principles of Dick and Carey (1996.)

Four projects were completed, all developed in partnership with teachers, technology coordinators and students. These projects will be presented briefly below.

### **Rookie Camp: An Introductory Unit for Web-supplemented Instruction at the High School Level**

The Rookie Camp unit in WebCT provides students with an introduction to the elements they will be working with in a web-supplemented learning environment through (Niemczyk, 2000.) Ease of use is critical to promoting success in computer-assisted instruction. If the students continually need help in overcoming obstacles in the software, they will become frustrated quickly (Heinich, Molenda, Russell, & Smaldino, 1998). Though it is probably true that many high school students have some computer experience, relatively few have had exposure to using the web as part of their classroom instruction. In order to insure success, the learners need to be ready to work with this new tool. Learner readiness involves gaining competencies in using navigation tools and becoming familiar with the learning environment (Twigg, 1999; Winiiecki, 1999).

In order to ease the transition to web-supplemented courses and promote success, the Rookie Camp unit was developed. Rookie Camp focuses on the tools and working areas of WebCT in the "default" course template. Explanation of the course homepage depicting nine icons is described. Each of the nine icons and the course management tools they represent are then explained in detail. After the students work through the Rookie Camp course content, they are provided practice activities, review and a quiz.

This unit will become a "default tool" to be included in all WebCT courses at this high school. Rookie Camp will be the first unit the high school students in web-supplemented courses will go through. (For a more complete description of this project see Niemczyk, Dwyer, & Savenye, 2000.)

### **Poetic Devices and the Epic Hero in the Odyssey of Homer: *The Odyssey* Project**

Two graduate students (Kim & Nicolaou, 2000) developed a web-based unit to help teachers teach *The Odyssey*. The project was designed to be used both as a stand-alone unit and a supplemental unit of instruction, either synchronously or asynchronously. The project was designed to meet the teacher's needs, as well as the school partner's need of creating a working model and template of what a web-based course should look like. The unit teaches students how to identify several poetic devices and epic hero qualities in given passages. It also allows students to explore an interactive map of Greece and the Mediterranean region, with references to events in *The Odyssey*.

The project was developed over a period of several weeks, and was used and tested at the end of the school partner's spring semester. The project was field tested with eight 9th grade English students. Students checked off multiple-choice test items on a web page, and then submitted their answers electronically to the designers. The courselet included an online student attitude survey with 5-point Likert-type questions and open-ended text boxes. Students' attitudes were very favorable. Students reported that they enjoyed using the courselet and would use more courselets like *The Odyssey* unit. Teachers' attitudes were also positive. However, student achievement was rather poor and might have been influenced by the unfavorable conditions under which the field test was conducted (through an unfortunate circumstance, field testing had occurred at the same time as state-wide testing).

Future plans include a revision to include more descriptive feedback and more short activities sections to give students more opportunities to practice what they have learned. More graphics will be added to the instruction as well. The most important lessons learned from this project were that face-to-face teacher-designer meetings need to be frequent and regular, and that time management is critical.

### **Teacher Training and Support**

One doctoral student conducted a study to determine how the district could best train and support teachers in using web-based instruction. In her needs assessment study, she surveyed the literature, researched case studies on the web, and conducted structured interviews and surveys with school district technology coordinators, teachers and the VHS students (Olina, 2000.)

Olina found that the major missing component in most technology-integration projects in schools has been the lack of adequate teacher training and support (Office of Technology Assessment, 1995; President's Committee of Advisors on Science and Technology, 1997.) Based on her preliminary work with the school-district personnel, Olina determined that she would develop a "white paper" that would further inform the decision-making process regarding the implementation of web-based and web-supplemented instruction at the high school and across the district.

Olina's major findings include:

- The most common barriers to technology integration in teaching are the increased preparation time, a lack of awareness of the general benefits of distance education, faculty compensation and incentives, access to appropriate technologies, a lack of shared vision about distance education in the organization, institutional barriers, and a lack of support staff to help with course development (Berge & Muilenburg, 2000; Moore & Kearsley, 1996; Office of Technology Assessment, 1995.)
- The University of Illinois Faculty Seminar Report (1999) highlights the need for teacher training, both to help faculty adapt their pedagogical styles to the needs of online teaching, and to learn their roles in moderating online class interactions.
- It is advisable to focus training on the use of technology on teaching itself, rather than on skills using software.
- Systemic support systems should be developed to address the major barriers to technology integration described above.

A few of the implications described in Olina's white paper include:

- Develop a clear vision for technology integration that is directly linked to improvement of classroom practice.
- Set up a campus-wide task force for technology integration.
- Allocate adequate financial resources for teacher professional development.
- Use a wide range of professional development strategies that are tailored to the particular needs of different groups of teachers. (For a more complete description of this project see Olina, Dwyer, & Savenye, 2000.)

### **Digital Copyright for Teachers**

The final project developed as part of the partnership concerned helping teachers learn about copyright issues related to web development. Kopp (2000) developed a prototype design for a web-based self-instructional unit to help teachers learn about copyright issues in the digital age. Teachers learn how to identify material that can be copyrighted,

how to secure copyright permission, and how to follow guidelines of educational use of copyrighted material. The prototype materials have been field-tested with teachers and are currently being revised for dissemination.

## Implications

With the explosive growth of the internet, many schools and universities are turning to the internet to both supplement traditional course materials, in web-supported courses, and to deliver fully web-based courses.

We believe collaborations among organizations like ours hold great promise for building and developmental-testing high-quality learning materials for students and support for teachers. The school district was able to leverage its resources and teachers' time to work with university personnel and complete four projects for students and teachers.

In developing our partnership we learned many lessons. Among them are:

- People, not institutions, build relationships.
- The needs of both parties must at all times be attended to.
- There is an advantage to informal, rather than formal, partnerships.
- All parties need to have a flexible attitude.
- The right people at the right time make up the right partnership.
- The results of the partnership reflect the levels of involvement of all.
- Success builds over time.

In the future we plan to continue the partnership with a continuing emphasis on informality and quality rather than quantity of projects and goals. We intend to expand the partnership to other courses and programs at the school district and university, as appropriate. We also will continue to explore web-based technologies for communication among the partners and to look for increasingly innovative ways to partner.

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# Heuristic and Formative Evaluation: A Case Study Illustrator of a New Technique

Heidi L. Schnackenberg  
Kevin Chin  
Rocci J. Luppisini  
Concordia University

## Abstract

*In recent decades, instructional computer programs and websites have become increasingly prevalent. Programmers, academics, and free-lance computer professionals have all begun to create what they tout to be instructionally sound products that will help people learn. Many of these products however, are rarely evaluated on any level for various facets of their design. When they are evaluated, it is usually either to gather information about the navigability or functioning of the hardware/software, or even less frequently, to assess how well people have acquired the skills and knowledge taught in the program.*

*As the value of media-delivered information is increasingly emphasized as a powerful instructional tool, user knowledge gains are becoming more frequently investigated. Formative evaluation techniques that assess learning are often employed. While it is important to appraise this aspect of an instructional program or website, it is also necessary to investigate the functionality of the electronic characteristics of the same program. Heuristic evaluation techniques are rapidly becoming the evaluation method of choice to assess this aspect of instructional programs. Unfortunately, the two areas - functionality and learning - are rarely both assessed within the same evaluation due to time, money, and methodological constraints.*

*While the growing popularity of media-based instructional programs has advanced instructional design and development techniques, equally efficient and effective evaluation methodologies to correspond to this new manner of instructional design have fallen behind. Current evaluation techniques for electronically delivered instruction are either poor in their methodology or incomplete in their design. Often, all pertinent aspects of instructional programs are not assessed and the learner is left with only a partially-sound form of instruction. A new type of evaluation therefore needs to evolve to keep current with new design and development strategies. A hybrid of heuristic and formative evaluation is proposed.*

*"Evaluation is a discipline inquiry to gather facts and other evidence that allow an evaluator to make assertions about the quality, effectiveness or value of a program, a set of materials, or some other object of the evaluation in order to support decision making" (Cummings, 1998). As such, evaluation techniques and methodologies exist in many different fields, and are performed on a wide variety of materials, programs, and products. While evaluation in its purest concept adheres to Cummings (1998) definition, particular types of evaluation are performed with specific goals in mind, using unique methodologies. Heuristic and formative evaluations are among the two more prevalent methods used in the field of educational technology at present.*

## Heuristic Evaluation

Heuristic evaluation is a type of usability testing. Usability testing has its roots in classical experimental methodology (Rubin, 1994) and has experienced popular application in the field of engineering. It is a systematic way of evaluating the functionality of a product (usually electronic) by observing users and recording information about areas of difficulty and ease within a program (Dumas & Redish, 1993). Dumas and Redish (1993) describe five characteristics of every usability test as follows: 1) the primary goal is to improve product usability, 2) individual usability tests also have unique goals that are determined based on specific needs, 3) testing evaluators are actual users, 4) testing evaluators perform authentic tasks, 5) problem areas are revealed through data analysis and modifications are recommended.

Commonly, usability testing is not implemented in its purest form (Nielsen 1993; Whiteside, Bennett, & Holtzblatt, 1988). Costs for full-scale usability tests are perceived to be very prohibitive (Nielsen, 1994), and their methodologies very complex (Belotti, 1988). A simplified method of usability was therefore developed by Nielsen in 1989 called "discount usability engineering" (Nielsen 1989b, 1990a, 1993). One of the most popular types of discount usability engineering is termed "heuristic evaluation."

Heuristic evaluation (Nielsen 1994) engages a small set of evaluators, usually three to five, to examine an interface and assess its adherence to a prespecified set of usability criteria, or "heuristics". Each evaluator progresses through a program individually and either records their findings in writing or verbalizes them to an observer who is present during each session. If an observer is present, he/she is also allowed to assist the evaluator in navigating the site if necessary or to answer other questions that may arise. A debriefing session may also occur at the end of each evaluation session to gather more information. After all the evaluators have completed their sessions, the data is then analyzed and items needing to be revised are identified.

### **Formative Evaluation**

In many respects, heuristic evaluation is not unlike formative evaluation as classically defined in the educational technology literature. Coined in 1967 by Michael Scriven, the term formative evaluation is viewed as a means of identifying areas of modification in the development of educational materials through the collection and analysis of data from the target population. This is different from "summative evaluation" which occurs after development in order to determine effectiveness (Smith & Ragan, 2000).

Dick and Carey (1996) propose three phases to formatively evaluating instructional materials. These are the one-to-one or clinical evaluation, the small-group evaluation, and the field trial. The one-to-one evaluation stage occurs individually with one to three learners who are representative of the target population. Ideally the three consist of one high-ability, one medium-ability and one low-ability learner. The one-to-one evaluation is utilized in order to identify any factual errors in the instruction and to obtain initial reactions and indications of performance improvement. Questionnaires regarding learner attitudes are generally used as the main data collection instrument.

Once the instructional materials have been revised according to the information gathered from the one-to-one evaluation, a small group evaluation should be performed with approximately eight to twenty learners. Again, these learners should be representative of the target population as much as possible. Learners should be selected at random so that your results can be generalized to the entire population. Two primary purposes for the small group evaluation are to 1) determine the effectiveness of changes made following the one-to-one evaluation, and 2) identify any remaining learning problems that learners may have. In this phase, learner performance scores on pretests and posttests are typically used to evaluate instructional effectiveness. Attitudes toward the instruction are evaluated through questionnaires or follow-up interviews.

The field trial is the final formative evaluation phase that Dick and Carey (1996) discuss. It involves the participation of a randomly sampled group of about thirty individuals who are representative of the target population. It is used to determine the effectiveness of the changes resulting from the small group evaluation and whether the instruction can be used in the context for which it is intended. Much like a dress rehearsal, it provides the last chance to identify and remove any remaining errors or problems. There are many similarities between the field trial and the small group evaluation. The main difference between the two evaluation processes is in the actual authenticity of the materials, learners, procedures, instructors and setting. The field trial should mirror the intended instructional experience as much as is possible.

Several similarities exist between heuristic and formative evaluation. Some experts consider formative evaluation to be the underlying blueprint for heuristic evaluation (Hix & Hartson, 1994). The two methodologies also appear to have similar goals. They both use data collected from a target population in order to make recommendations regarding modifications to a specific product or material in the design and development phases of creation. Both employ the use of surveys, observations, interviews, and various other data collection instruments and techniques. However, despite apparent similarities, there do exist fundamental differences between the two. Formative evaluation primarily focuses instructional and learning strategies, as evidenced by the use of pretests and posttests. Heuristic evaluation concentrates more on the usefulness of a product, i.e. the user interface, navigation issues, etc.

In 1987, Patterson and Bloch called for formative evaluation to be conducted during the development of computer-assisted instruction (CAI). In their article, they propose investigating learning gains, user attitudes, interface and navigation issues utilizing Dick and Carey's (1996) three phases of formative evaluation as a structure. These areas of investigation within educational media products still remain of utmost importance today. However, with the advent of the Internet and the World Wide Web (WWW), as well as the ever-increasing rapidity with which electronic educational products are produced, the implementation of the methodology Patterson and Bloch (1987) propose is impractical in the currently fast-paced realm computerized instruction.

A methodology that would perhaps serve the needs of efficiency, practicability, and still investigate learning, attitudes, interface and navigation therefore needs to be created. The present work attempts to address such a problem with the development and testing of a new method. It consists of a combination of heuristic and formative evaluation techniques. In 1997, Corry, Frick, and Hansen incorporated usability testing techniques into



the development of university informational website. They used many facets of heuristic evaluation as the structure of their investigation. According to their results, this was a very efficient method for exploring interface, navigation, content and some attitudinal issues. Learning, however, could not be measured as the site was informational and not instructional.

The purpose of the present study was to further investigate the use of heuristic evaluation, in conjunction with formative evaluation, as a methodology for assessing instructional websites. Through this type of mixed methodology, not only can attitudes, user interface, and navigation issues be explored, learning and instructional strategies can be investigated as well. An evaluation of this nature, illustrating the proposed methodology, is described in the case study that follows.

## **Method**

### **Participants**

Participants in the study were five students at an urban university in or prior to their first semester in a graduate programme in education. All participants will soon be formally enrolled in a required Human Performance Technology course and participated in the study because the instructional program used in it covers content regularly taught in the course. Although the site content was required course material, the evaluation sessions were several hours long and it was decided that evaluators would be paid a small stipend for their time.

### **Materials**

The instructional materials were designed to teach various Human Performance concepts, including needs analysis, instructional design, and formative and summative evaluation. Actual course content and activities were adapted into an interactive instructional website for the study. The site was created initially with the intention of supplementing an on-site course. The long term goal of the website is to have it serve as a stand-alone, distance-delivered web course.

The site contained a total of 10 instructional modules, a homepage (including the course syllabus and navigation information), and a sitemap. Eight of the ten modules contained multiple-choice and/or constructed-response practice-with-feedback activities. The remaining two modules were solely informational. For the current purposes, the site is supplemental to the on-site Human Performance Technology course. In future, it will be used as the basis for a distance version of the same course. The current URL for the site is [http://doe.concordia.ca/etec512\\_712/index.html](http://doe.concordia.ca/etec512_712/index.html)

The website contained three overall course objectives and 23 learning objectives. 16 of these objectives were short-term and to be completed within the site, while seven of the objectives were subobjectives of the long-term course objectives. Each of the objectives was taught through a number of screens which presented instruction, five practice-with-feedback items (for the short-term objectives), summaries, and reviews. Seven objectives required selected responses in a multiple-choice format and nine required constructed responses. Practice items consisted of multiple-choice questions with two-to-four response choices for the seven selected-response objectives. For the constructed-response items, participants typed their answer in a field and pressed a submit button. In the next field a sample answer appeared to which participants compared their answer. The site was unable to track each participant's progress by recording response choices due to the inability of the university server to support the necessary interface.

Learners could advance through the site by selecting links to modules from the menu or site map. Once in a module, they could choose to view any screen by selecting a link from a table of contents, or they could simply advance in a linear fashion by clicking "previous" or "next" buttons that appeared on each screen. As the site was programmed to work on either a PC or a Macintosh platform, learners were also able to progress through the site using the navigation options within the web-browser they were utilizing.

### **Procedures**

Prior to engaging in the evaluation of the instructional website, it was ascertained that participants were graduate students in the department of education, who were enrolled in a degree programme. The participants also must not have taken the Human Performance Technology course prior to evaluating the website. These were the only prerequisites necessary for learners to be able to evaluate the website. Permission was given by the participants to video-tape each evaluation session in case the tapes of the sessions had to be reviewed for data gathering purposes.

During each session, each participant was then stationed at a computer terminal and given access to the website. He or she was presented with a list of heuristics and instructed to record errors and respond to the various heuristics while progressing through the site. Participants were also asked to verbalize their thoughts and questions

while utilizing the program (Smith & Wedman, 1988). A researcher sat beside each participant, recording observations as he/she advanced through the site. The researcher answered any questions that arose regarding navigation or content, although he redirected the participants to try to answer content-related questions by referring to the site. Also, the participants were asked questions in response to their comments in order to probe more deeply into the nature of participant statements. Full learner control was given to the participants due to the fact that they could progress through the site at any pace they chose, viewing any screens at any point, with the only restriction being that they must complete all the practice activities that correspond to the short-term objectives.

As the stated previously, the university server would not support any interface that would allow tracking or recording of participant progression through the site, so another method was devised to record student responses to the practice items. After each practice set, the researcher copied and pasted participant answers to the practice items into a separate word document. Correct or incorrect answers to the multiple-choice items were indicated, while statements from the participants as to the correctness of their answers in comparison to the sample answers for the constructed-response items were also recorded.

Overall, it took each participant approximately 11 hours to complete the evaluation of the website. As the evaluation was time consuming, participants completed the activity in several sessions which varied in length according to their individual preferences and schedules. Upon completion of the evaluation, each participant was interviewed in a short debriefing session to get any last impressions or thoughts he or she may want to communicate. A paper-and-pencil survey regarding attitudes toward the website, perceived future usefulness, and areas of modification was also administered at this time and participants returned the survey prior to leaving the session.

### Criterion Measures

Learner achievement was measured through performance on the practice items. The 35 multiple-choice items were scored either one or zero, and the 45 constructed-response items were scored either two (completely correct answer), one (partially correct answer), or zero (no answer or incorrect answer) according to a scoring key developed by the experimenters. Thus, the maximum possible score on the practice items was 125.

The 32-item attitude questionnaire assessed participants' satisfaction with the material, their perceived future usefulness of the skills learned in the site, and suggestions for modifications. The attitude questionnaire, containing 12 three-choice Likert-type items, seven yes/no items, and 13 constructed-response items, was administered immediately after participants completed the instructional program. A sample item from the attitude questionnaire is below:

Circle how much you liked each of the activities listed below.

4. Receiving feedback that asked you to compare your answers to a sample answer.	I liked this a lot	I liked this OK	I did not like this
--	-----------------------	--------------------	------------------------

Responses to the list of heuristics were open-ended. There were five categories in which to respond, including site content, site navigation, graphical appropriateness, readability, and communication venues. A sheet where general errors were recorded was included. Sample heuristics are presented below:

Please provide specific feedback (positive and/or negative) on the HPT website regarding the following:

- Site content (information, samples/examples, practice items, answers to practice items, links/resources)
- Site navigation (interface, platform conventions, i.e. buttons, etc., menubar, site map, navigation instructions)

Researcher observations to the think-aloud protocols were recorded per individual participants, per session. Observations were made in a variety of categories. These categories were quite similar to the heuristics and included site content, site navigation, graphical appropriateness, readability, and communication venues. Observations on learning and attitudes were also recorded.

### Data Analysis

Calculation of simple mean scores for the practice items, individually and collectively, were tabulated to indicate achievement. Responses to the attitude survey were tallied and, for the open-ended items, categories of responses were created. Categories of responses were also created to calculate data on the debriefing responses, heuristic lists and researcher observations.

## Results

### Achievement

Mean overall practice item scores per instructional objective are shown in Table 1. Within the "Interventions" module of the Web site, participants scored differently on the two module objectives. Although

participants scored relatively high when asked to classify performance solutions as instructional or non-instructional using a forced-choice format (84%), they scored significantly lower (46%) when prompted to offer possible solutions to given case scenarios using an open-ended question format. Another noteworthy result occurred within the “Practice and Feedback” module of the Web site. When prompted to identify appropriate practice activities for given objectives using a forced-choice format, a perfect mean overall score occurred (100%). Asked to write appropriate practice activities for given objectives, overall participant score lowered significantly (60%). The trend of participants scoring highly on closed-ended questions does not continue with the practice items score from the “Sequencing” module. Participants were presented with various course or workshop and asked to identify their pedagogical components. Participants answered all prompts incorrectly, resulting in an overall mean score of zero (0%). The overall percentage scores of participants ranged from 61.6% to 68.8%, with a mean overall percentage score of 65.3%.

*Table 1*  
*Mean Overall Practice Item Scores per Instructional Objective*

<u>Instructional Objectives</u>	<u>Mean Score (%)</u>
Classify performance solutions as instructional or non-instructional.	84%
Offer possible solutions to given case scenarios.	46%
Develop sections of responses to given proposal scenarios.	58%
Given various data sets from a needs analysis, develop recommendations based on your conclusions from the data.	68%
Develop sample data collection items from given case scenarios.	68%
Identify well-written instructional objectives .	92%
Write instructional objectives.	66%
Identify appropriate assessment items for given instructional objectives.	88%
Identify well-written assessment items.	72%
Write appropriate assessment items for instructional objectives.	80%
Identify appropriate practice activities for given objectives.	100%
Write appropriate practice activities for given objectives.	60%
Identify the pedagogical components, given various courses or workshops.	0%
Determine whether the evaluations described in given scenarios are formative or summative.	92%
Design a methodology and state the instruments to be used for the type of evaluation indicated in given scenarios.	76%

Note: Total number of Participants = 5.

### **Attitudes**

When asked to indicate liking of activities, participants responded positively to receiving feedback that asked to compare their answers to sample answers, with a majority of participants (80%) saying they liked the activity “a lot”. When asked to indicate the importance of activities, all participants (100%) answered that both the reading material presented and relating the information in the Web site to future, practical applications was extremely important. A majority of participants (80%) answered that completing the practice exercises in the module were extremely important.

All participants (100%) did not believe the Web site was too hard for them to understand and complete. All participants (100%) also responded that they were able to successfully compare their answers to the sample answers and they learned important techniques that would be of value in the real world. A majority of participants (80%) found the practice exercises helpful, were able to successfully navigate the Web, relate the information presented to previous learning experiences and felt they would be able to apply what they learned in the Web site to a real world setting. When prompted for the most preferred topic of the Web site, participants mentioned the “Needs Assessment” module the most stating it was relevant, informative and easy to understand. When prompted for the least preferred topic, participants mentioned the “Objectives and Assessment” module the most, stating the practice items as the deciding factor.

## Heuristic Commentaries

Participant commentaries per heuristic are shown in Table 2. When asked to remark about the content of the Web site, participants mentioned its unclear and/or confusing wording the most (31% of total heuristic comments made). Despite this, participants also stated that the Web site was clear and useful information was provided (25% of total heuristic comments made). Participants were satisfied with navigation issues (32% of total heuristic comments made). The graphics and reading level was judged as appropriate for the target audience (52% of total heuristic comments made). When prompted for errors within the Web site, the majority of statements (54% of total heuristic comments made) indicated grammatical errors in the content. The grammatical errors may also be a factor in participants stating that the content was confusing (19% of total heuristic comments made).

Table 2

*Participant Commentaries per Heuristic*

Heuristic	Number of Responses
<u>Content</u>	
Unclear or confusing wording.	(10)
Clear and useful information provided.	(8)
Examples with feedback very helpful.	(6)
Inconsistent presentation of content.	(4)
Insufficient information provided.	(4)
<u>Navigation</u>	
Satisfied with navigation issues.	(8)
Inconsistent presentation of content	(5)
Poor design issues.	(4)
Attractive site layout.	(2)
Non-working functions.	(1)
<u>Graphics and Reading Level</u>	
Appropriate reading level.	(11)
Text cut off on screen.	(4)
Insufficient graphics.	(2)
Confusing language used.	(2)
Poor design detracts from learning.	(2)
<u>Communication Avenues</u>	
Hyperlinks useful.	(5)
Sufficient for site.	(4)
Miscellaneous	(3)
<i>Other</i>	
Miscellaneous	(6)
Sufficient practice and feedback.	(3)
Informative content.	(1)
Poor design.	(1)
Poorly written content.	(1)
<i>Errors</i>	
Grammatical errors.	(60)
Confusing content.	(21)
Formatting errors.	(11)
Layout/design errors.	(8)
Miscellaneous	(5)
Non-working functions.	(2)

## Observations

When prompted for comments related to navigation of the Web site, many related to the poor interface/layout design of the Web site. Participants were also vocal about the poor presentation of the content when

asked about the graphics and reading level. Many comments about the communication avenues within the Web site mentioned the its high-level access to information (within the site and links to external information sources.) The majority of comments relating to errors in the site related to inconsistent design features and confusing presentation of its content. When asked about the learning and instruction aspects of the Web site, most comments referred to the relevant practice and feedback examples.

## Recommendations

Data from achievement on the practice items indicate that participants learned approximately 65% of the content included in the website. This would indicate that while the website appears to be an effective supplement to a course in human performance technology, it cannot at the present time be used as a stand-alone distance delivered web course. An investigation of scores per objective reveals that while participants generally attained successful scores on the selected-response practice items, scores were marginally lower on the constructed-response questions. Participants scored below 60% on objectives where they had to offer solutions to case scenarios, develop proposal sections, and write practice activities. The lowest achievement score however occurred where participants had to identify pedagogical components of an instructional design package. Attitude responses indicated that the directions for this section were unclear and that may account for the 0% success rate with these items. Conversely, attitude data also revealed that participants thought they were quite successful in comparing their answers to given sample answers. This may mean that they thought they scored well on these items but actually did not, or that they were successful in estimating that the answers they created were incorrect compared to the sample. What is clear from this data is that several of the constructed-response practice items need to be modified and that the directions for the practice items on pedagogical components need to be clarified.

Participant attitude data indicated that overall, participants like the site and thought that many of the activities in which they engaged were important. As well, participants responded that the material they learned would be useful in a “real world setting” and the skills they learned could be transferred to situations outside of the web environment. This data is revealing regarding future student potential to engage in learning the information in the website. Distance-delivered web-courses classically suffer high attrition rates. One factor that this is attributed to is motivation level. If students appear to like the website described in this study, as well as see value and transferability in the material, then it is likely that at least motivationally, the site would be a success if it is used as a stand-alone course. As a course supplement, attitude data indicates that it is more than engaging motivationally.

Heuristic response data was successful in indicating various errors within the website. The specific errors were not indicated here as they were not deemed of interest or import to anyone beyond the developers. What is of interest however is the fact that the technique of using five evaluators was successful in finding and documenting various website errors. Further, more general heuristic data revealed that while the reading level within the site was appropriate, the way certain concepts were presented was confusing and needs to be clarified for future use. Navigation issues did not appear to be of great concern as participants responded positively to the methods and venues provided for navigation within the site.

Finally, participant think-aloud responses further iterated the need for clarity of language within the site by requesting more examples and information on presented concepts. Participants also requested that more graphics and charts be included in the site. It could be presumed that this is for visual appeal, but it would also be that the increased level of appropriate charts and graphics will facilitate further explanation and clarity of concepts. Finally, while heuristic data revealed no problem areas within navigation, think-aloud response data indicated a modification to the menubar and “previous” and “next” buttons. Participants stated that page numbers as well as modules should be included on the main menubar to more easily enable users to move from one point in the site to the next.

Overall, it is clear that with some modification, the current website for this study will be an appropriate supplementary source for an onsite course in human performance technology. However, issues with respect to user learning gains need to be addressed before the site can be utilized as a distance delivered course. Further, the evaluation methodology utilized within this project appears to be highly successful in indicating navigation, attitudinal, informational and motivational issues within instructional websites. It is however still not clear as to how accurately learning gains can be measured using the same methodology. Further investigation of the methodology altering the number of participants used to measure learning gains is recommended in the future.

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# Diffusion of the Internet within a Graduate School

Lorraine Sherry  
RMC Research Corporation, Denver

## Abstract

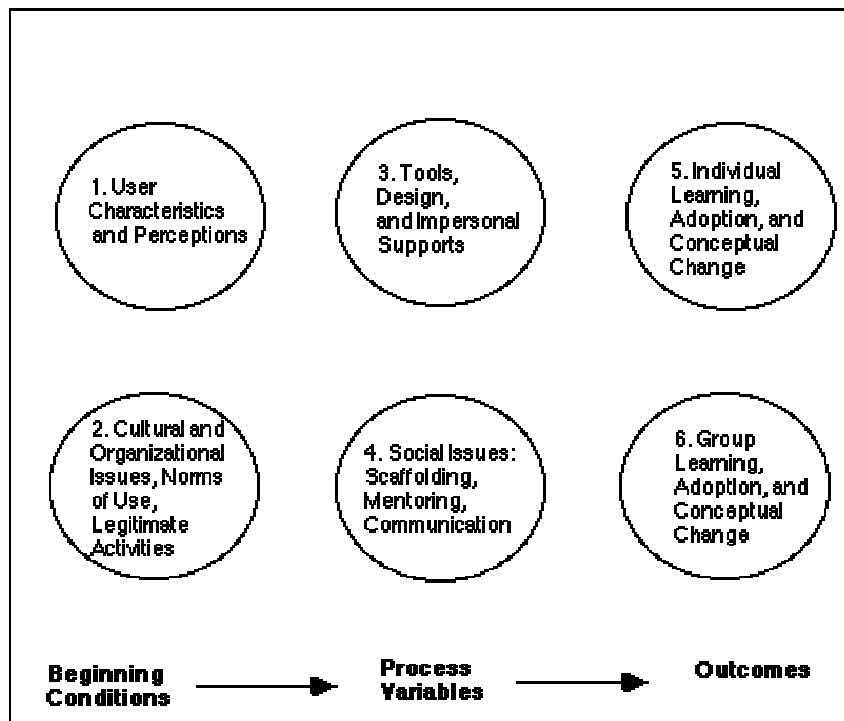
*This paper reports the results of a five-year case study of the use of online tools: Internet, e-mail, and the WWW, within a Graduate School of Education. The conceptual framework was independently developed, but because of the striking parallel with activity theory, activity theory became the overall framework for interpreting findings. Ten research questions were investigated using multiple surveys; interviews of faculty, staff, and students; a focus group; and an analysis of electronic artifacts. Principal findings included the following:*

- *Self-efficacy x perceived value persisted across time and across programs as success facilitators.*
- *Personal/cultural compatibility, rather than time, separated earlier from later adopters.*
- *"Finding a voice and having something to say", a factor identified under various names by other researchers, posed a barrier for students and faculty alike.*
- *Users valued personal scaffolding but had individual preferences concerning specific types of scaffolding.*

## Theory Base

This case study investigated the factors that affect the use of the Internet within a Graduate School of Education (SOE). In this context, "Internet tools" were defined as e-mail, a FirstClass™ BBS known as Colorado Education On-line (CEO), and the WWW. The study combined both empirical research within the school and an extensive review of relevant literature to identify 28 distinct factors. These factors grouped into six naturally emerging clusters that influence the diffusion of the Internet within the school. (See Figure 1.) These clusters acted as a starting point for formulating a new model of adoption of telecommunications by institutions of higher education.

Figure 1. Clusters of Factors Influencing Diffusion of the Internet



It is interesting to note the striking parallel between Engestrom's (1996) depiction of an activity system and the process that may be occurring in the SOE regarding the adoption and use of the Internet as the activity under investigation.

A key point in Soviet psychology, attributed to Vygotsky, is the emphasis on the use of tools in the development of human mental processes. "The tool is not simply added on to human activity; rather, it transforms it" (Tikhomirov, 1981: 270). Engestrom expands Vygotsky's notion to conceptualize human activity as an interdependent system that ties the individual to the larger cultural context: "Collective activity is realized through individual actions, but it is not reducible to a sum total of those actions" (Engestrom, 1996: 262).

In Engestrom's conceptual framework, known as an activity system, the activities in which an individual engages tend to connect six elements, namely: (a) the individual actor, (b) the object of action together with an expected outcome, (c) the tools used to carry out the activity, (d) the community of which the actor is a part, (e) the norms and conventions of use of those tools, and (f) the division of labor that characterizes individual actions within local collective activities. These elements are all interrelated; changing one will invariably affect the rest of system. The clusters of factors in Figure 1 can be loosely identified with the six elements of an activity system. This comparison is presented in Table 1.

*Table 1. A Comparison of an Activity System and the Six Clusters of Factors That Affect the Diffusion of the Internet*

An Activity System	Clusters of Factors That Affect the Diffusion of the Internet
Individual or subject	User characteristics and perceptions
Norms of use, conventions, and rules	Cultural and organizational issues, norms of use, legitimate activities, "vision of learning"
Tools or mediating artifacts	Tools, design, and impersonal supports
Division of labor	Social issues including roles, scaffolding, mentoring, communication
Object or outcome of activity	Individual learning, adoption, conceptual change
Community	Group learning, adoption, conceptual change

## Empirical Base

The investigation actually began in the fall of 1994, when an ad hoc group of graduate students, together with their advisor, formed the Internet Task Force. During the 1994-95 academic year, the group attempted to identify facilitators and challenges to Internet use within the Division of Technology and Special Services, which housed the instructional technology master's and doctoral programs (collectively known as "I.T."). Later, the population under surveillance was expanded to include the entire School of Education. The purpose of the study was to articulate the individual conceptual changes and group processes of members of the School of Education as they learn the basics of mediated communication, deal with their concerns and learning anxieties, develop expertise, adopt, and eventually reaffirm or reject the use of the Internet to support teaching and learning.

Building on a prior study of Electronic discussion groups, *Using e-mail as an instructional strategy in a graduate seminar* by Wilson, Lowry, Koneman, and Osman-Jouchoux (1994), members of the Internet Task Force explored two facets of Internet usage: *Affordances and constraints of the Internet for learning and instruction* (Ryder & Wilson, 1996) and *Cultural assimilation of the Internet* (Wilson, Ryder, McCahan, & Sherry, 1996). They also studied *The Dynamics of Collaborative Design* (Sherry & Myers, 1998) and documented the work of the Internet Task Force (Sherry, 1996) as the team created the web page for the School, using the university e-mail system and the WWW to share information and negotiate differences of opinion. All of these documents are available on line.

In spring 1995, one member interviewed representative members of the faculty; two others interviewed a focus group of students; and another member (Sherry, 1997) analyzed the results of a survey of 73 students, faculty, and staff regarding their use of e-mail and the Internet for instructional purposes. Five factors emerged from these various studies: (a) clear benefit and value, (b) self-efficacy, (c) finding a voice and having something to say (also referred to as mediated writing proficiency), (d) personal/cultural compatibility, and (e) proper scaffolding.

The first two factors to emerge from these earlier studies, namely *clear benefit and value*, and *self-efficacy*, were identified by Bandura (1982) under his theory of self-efficacy as a mediator of performance and achievement. "Finding a voice and having something to say" was identified by Berge (1997). It was also identified and explored by Fishman (1997) as written communication apprehension and by Sherry (1998) as *mediated writing proficiency*.

Rogers identified the fourth factor, *personal/cultural compatibility* (compatibility between technology and people's learning styles, self-concepts), as one of the five important user perceptions of an innovation – "the degree



to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters". In this study, compatibility includes school policies and norms of use (Rogers, 1995: 15).

The fifth factor was *proper scaffolding*. In Hall and Hord's (1987) *Stages of Concern* model, proper scaffolding is crucial in the personal-concerns stages of adoption when facilitators should visit more often with potential adopters on a face-to-face basis to offer assistance and encouragement. Scaffolding is also important at the management-concerns stage of adoption when it is important to provide "how to do it" workshops that address the constantly changing task issues as they arise (Hall & Hord, 1987: 72).

Two years later (spring 1997), the current study began. The survey was repeated with the same instrument and a stratified sampling of 278 students, faculty, and staff throughout the School of Education. At the same time, a factor analysis was performed on both the 1995 and 1997 surveys to investigate changes in trends over time. Sherry (1998) also repeated the focus group and interviews in spring 1998 using a purposeful selection of students, faculty, and staff, comprising early adopters, early/late majority, and resisters or "laggards". (See Rogers, 1995.)

## Results

In 1995, participants primarily used the university UNIX system for their e-mail accounts, except for the few who had commercial or corporate accounts. By 1997, the variety of available tools had increased. 86% of the respondents used e-mail; 74% used the WWW; and 60% used the FirstClass™ BBS.

### Efficacy x Value

A factor analysis of the responses to the survey questions that dealt with reasons for using the Internet (14 items) and barriers/facilitators to using the Internet (11 items) was performed for three subsets of data: (a) 1995 responses (I.T.), (b) 1997 responses (I.T. cohort), and (c) 1997 responses (Non-I.T. cohort). A principal components analysis with Varimax rotation was then performed on the three sets of data. This revealed the general trends and changes over two years and also highlighted the differences between the I.T. and the non-I.T. The results are presented in Tables 2 and 3.

The primary reasons for Internet use: finding information, communicating with colleagues, sharing information, and collaboration (i.e., sharing information to carry out an intentional activity) varied in importance across time and between programs. Note the emphasis on sharing information among the I.T. cohort vs. the emphasis on finding information and collaborating among the Non-I.T. cohort. In contrast, the facilitators to Internet use were remarkably consistent in all cases, with Bandura's efficacy x value accounting for about half the variance.

Table 2. Results of Factor Analysis on Reasons for Use

Survey	1995: I.T.	1997: I.T.	1997: Non-I.T.
Factor 1	Communicate and share information (42% of variance)	Share information (44% of variance)	Find information and collaborate (50% of variance)
Factor 2	Find information (12% of variance)	Communicate (11% of variance)	Share information (11% of variance)
Factor 3	Collaborate (9% of variance)	Collaborate (8% of variance)	Communicate (8% of variance)
Factor 4	Consult with advisor (8% of variance)	Find information (7% of variance)	-

Table 3. Results of Factor Analysis on Facilitators to Use

Survey	1995: I.T.	1997: I.T.	1997: Non-I.T.
Factor 1	Clear benefit and value (33% of variance)	Clear benefit and value (32% of variance)	Clear benefit and value (38% of variance)
Factor 2	Self-efficacy (17% of variance)	Time and access (15% of variance)	Self-efficacy (16% of variance)
Factor 3	Mediated writing proficiency (10% of variance)	Self-efficacy, part 1 (10% of variance)	-
Factor 4	-	Self-efficacy, part 2 (9% of variance)	-

### Personal/Cultural Compatibility

In the interviews, students, faculty, and staff alike reported that the e-mail feature of the FirstClass™ BBS (i.e., CEO) was and will continue to be an efficient means of communication between students and faculty. The faculty consensus was "it's better than voice mail", and students remarked, "I get better response from professors via e-mail than I do by phone calls". Faculty found it convenient to send and receive papers and assignments via e-mail. Students appreciated the more rapid turnaround time that electronic messaging affords. Moreover, responses from the focus group indicated that there was social pressure among some of the learning sub-communities within the school that reinforced the feeling of "If you don't participate, you may find yourself left behind". Both the interviews and the focus group presented evidence that the early adopters tended to be intrinsically motivated, whereas the later adopters often felt extrinsic coercion.

Besides being an accepted and institutionalized part of the school's culture as a handy communication tool, some faculty members predicted that using electronic conferencing and web pages on CEO for distributed learning might prove a viable alternative to traveling long distances to provide classes for geographically dispersed cohorts. At the time the interviews were conducted (spring, 1998), the Administration, Supervision, and Curriculum Development (ASCD) program had eleven electronic conferences on CEO. Their faculty members are actively exploring the use of the WWW to support distance and distributed learning. A few faculty members recently obtained grants to design on-line courses.

Not all faculty and students, however, are early adopters. Early adopters often expressed a good fit between Internet tools and their personal and cultural values. Late adopters voiced concerns about the impact of the Internet on their core pedagogical strategies, indicating that it may not support their vision of learning. Since internal resistance to innovations, especially the use of interactive technologies, tends to change the traditional role of the instructor (Apple Computer, 1995; Yocam, 1998) and his/her core of instructional practice (Elmore, 1996), institutionalization of Internet and WWW tools other than e-mail will most likely take place in fits and starts. A faculty member described her awareness of this resistance:

*I'm a little bit nervous about the thoughtful use of distributed learning, but I do see that the first and most obvious thing is reaching those audiences that are not otherwise reachable easily. And there's a lot of resistance to that. I'm in big trouble now because I've insisted that next spring when I'm supposed to go to Durango for three weekends [an eight-hour drive from Denver], an equivalent to one of those weekends is going to be distance learning, somehow. They absolutely do not want me to do that!*

Nearly all interviewees noted that there was no incentive system in place for them to adopt Internet and WWW uses other than e-mail. Interview comments made it apparent that it is going to take quite a while until distributed learning – a very different concept from traditional forms of instruction – becomes part of the school's culture.

### Finding a Voice and Having Something to Say

In an activity system, the "tool" must have the necessary affordances to enable the actor to carry out an intentional activity – to accomplish an intended outcome. If the tool does not appear to the user to be the most effective means of accomplishing his/her objective, whether due to its inherently unfriendly interface, or to the user's fear of writing to a public audience and leaving an electronic "paper trail", then it will not be used. In this case, if the Internet "tools" do not make communication easier for the user, then all the training in the world will not turn a resister into an adopter.

Students and faculty who are just beginning to experiment with electronic conferencing and online communication sometimes exhibit written communication and lack of mediated writing proficiency. Text-based communication lack social cues, and therefore, may lead to misunderstandings or misinterpretation of the author's intent. Moreover, it is perceived by some learners to be more reflective than spoken interaction. "The very act of assembling one's thoughts and articulating them in writing for a [computer] conference audience appears to involve deeper cognitive processing" (Berge, 1997: 10). This, in turn, may lead to written communication apprehension.

Fishman (1997) found a significant relationship between written communication apprehension and the use of Usenet newsgroups among students who were using a combination of CMC tools in a mediated learning environment called the "Collaboratory". If the network's interface is not particularly user-friendly (as in the older PINE e-mail interface on the university servers), and if students have concerns about their general representational proficiency (the ability to represent abstract concepts in concrete form) or their mediating writing proficiency (writing to an online audience), then these factors could potentially affect the level of use of the network.

This is exactly what Wilson and his colleagues found in the 1995 interviews. It also showed up as the Factor 3 in the 1995 factor analysis of the survey. By 1997, this factor had disappeared from the survey results, but was still flagged by an interviewed student. She alluded to new forms of literacy that needed to be explored and

developed – visual literacy, media literacy, and literacy in terms of the Internet and e-mail – other forms of literacy that she considered appropriate if the school really aspires to be a community of learning. A professor also discussed the additional cognitive skills that are necessary when dealing with on-line text:

*It's really hard for me to read on a screen. I really want to print things out if there's very much of it and have a hard copy in my hand. What we don't know is the long-term impact of making those kinds of adjustments to the learner. For example, in reading, we learn how to read stories as little kids. We don't know how to read expository text, so that when expository text gets presented to us, it's new, it's different, it's boring. We don't have the skills unless those are actively taught to us because the frameworks that we have for reading are about stories.*

This may be one of the reasons why faculty members lagged behind students in publishing on-line documents. Three faculty and eight students who had personal web pages used them to disseminate full-text versions of their publications. Contributors to the school's "Scholarly publications" page, which espouses a clearly stated set of high standards for publication, consisted of nine faculty members (three of whom were UCD students when they first carried out the research on which their publications were based), twenty students, and seven unaffiliated second authors. Another explanatory factor might be faculty members' fear of compromising intellectual property rights; but ownership and copyright issues did not arise in any of the interviews.

A totally different aspect of "finding a voice and having something to say" is the open sharing of promising practices among faculty who have used the Internet and the WWW effectively. Some faculty members are using electronic conferencing, but not all faculty members are aware of the possibilities that this new form of interactive communication and instruction might entail. Faculty meetings generally deal with administrative issues, leaving little time for professors to share innovative instructional strategies that have proved effective with their students. This is beginning to change with the introduction of workshops for honorarium (part time) professors, inaugurated by the University's Office of Teaching Effectiveness (OTE); and with the creation of the new "Teaching and Learning with Technology" (TLT/LTTS) mentoring laboratory for faculty, made possible by a new grant to the School of Education (See Grabinger, paper #199).

### **Proper Scaffolding**

This refers to a support structure that includes a non-judgmental, social support system, one-on-one mentoring relationships, and removal of technical hurdles to the innovation. Existing and proposed supports were divided into two categories: impersonal and personal. Impersonal supports comprised brochures, booklets, on-line tutorials, and other forms of print-based or electronic performance support that do not require one-on-one interaction with a graduate assistant, fellow student, faculty member, or staff member. Personal supports comprised help from graduate assistants, on-line help from the university's network services staff, direct instruction in class, and free workshops conducted by faculty, staff, technically adept students, or other perceived "experts".

Interview participants were asked to suggest improvements to the school's support structure. Survey participants were asked to rank a set of eight supports for training and performance using e-mail and the WWW, with "1" = most useful support and "8" = least useful support. The eight proposed supports were formal classes, brochures, informative booklets, on-line tutorials, paper tutorials, interactive computer demonstrations, individual assistance by graduate students, and workshops. Participants who rated, rather than ranked, the suggested supports, confounded the results in about 5% of the cases.

In 1995, the supports ranked highest by the survey participants were formal classes (ranked #1 by 32% of respondents) and workshops (ranked #2 by 30% of respondents). Booklets were least popular, with over 20% of the respondents ranking them #6 or #8. Individual attention by graduate students was bipolar: 22% of respondents ranked it #8 and 17% of respondents ranked it either #1 or #3. This was worthy of further investigation.

There were significant positive Spearman correlations ( $p < .05$ ) between the self-efficacy factor and the relative rankings of both formal classes (+.026) and individual attention by graduate students (+.029). There was a significant negative correlation ( $p < .05$ ) between the self-efficacy factor and the relative ranking of informative booklets (-.025). This led to the conclusion that respondents who were low in self-efficacy considered personal supports and scaffolding to be relatively useful as compared with impersonal supports such as booklets.

In 1997, formal classes (ranked #1 by 27% of respondents) and workshops (ranked #1 by 32% of respondents) topped the list of preferred supports. Booklets (ranked #8 by 24% of respondents) were still least popular. However, the bipolarity in the ranking for individual attention by graduate assistants had disappeared, with 25% of respondents ranking this personal support as #1. In contrast, on-line tutorials were now bipolar (ranked #2 by 18% and #7 by 19% of respondents). These rankings indicated that the respondents generally preferred personal scaffolding to impersonal supports, but held varying opinions concerning the specific type of support that they would like to see implemented.

Faculty and students alike were often unaware of the range of supports that already existed. For example, the university's network services developed an extensive set of free workshops – exactly the type of 1- or 2-hour workshops that students said they would like to see offered – but students were not aware of them. Brochures, schedules, and job aids explaining various facets of the university's computers and directions for using them were freely available outside the network services office. Copies were also available in the School of Education's computer lab. Again, staff and graduate assistants were not aware of their existence, so they did not publicize them to new users. An important aspect of an activity system – and any system, for that matter – is the fact that for it to function efficiently, information must flow freely throughout the system, to and from all participants. If a support exists, but users are not aware of it (cf. Rogers, 1995, “observability”), then it is like not being there at all!

## Recommendations

This study resulted in a set of recommendations for improving access, functionality, training, and technical support; use of communication channels to convey important information about existing support and scaffolding structures; and the use of electronic conferences to enhance and enrich classroom discussions. It also highlighted the need for an incentive system, and for ways that faculty might share promising practices that use the Internet to support instruction.

Based on the results of this study, recommendations for future investigation and development are listed in Table 4. Other colleges and universities that are considering infusing instructional technology into their general education programs (such as PT3 grantees) might find these recommendations applicable, as well.

*Table 4. Recommendations*

Have better publicity about existing aids and supports, using multiple channels of communication.
Have better communication and collaboration between the School of Education, the university, and the university network services, possibly sharing duties where they overlap.
Develop a flexible schedule of Internet demonstrations or open lab workshops with optional student attendance.
Hire more graduate students in the School of Education computer lab who have the skills and the time to help individual students with specific problems.
Create a permanent position for an in-building technical support person who will be available in person or by telephone when classes are in session.
Consider the possibility of developing on-line tutorials for commonly used Internet tools.
Encourage "show and tell" sessions among faculty members to discuss and share ideas, strategies, and promising practices for Internet use beyond simple e-mail messaging to support teaching and learning.
Encourage students to create on-line research management products and portfolios to serve as models of scholarly products for new students, and to elicit feedback from peers, colleagues, and experts.

## Implications for Institutionalization

Based on this study's findings, the use of e-mail will continue to increase because CEO has become a commonly accepted mediating artifact within the norms and conventions of the school. All interviewees and focus group members used CEO regularly in 1997, in contrast with the more sporadic e-mail use in 1995. As members of a commuter campus, students stated that it is more convenient to connect from home or work on a regular basis rather than to travel to campus and pay for parking (which may not even be available!)

Use of the WWW is increasing, and will continue to increase, now that the foremost item on the students' wish list – free ISP service through student fees to the university – has been granted. Students who primarily used CEO were beginning to discover that, contrary to the WWW, a FirstClass™ BBS does not automatically provide the types of Internet-wide search engines and database tools they would like. They stated that they would like to increase their access to research-based databases, on-line libraries, collections of legal and medical information -- resources that are freely available on the WWW and that matched their own educational goals. More importantly, there has been a recent influx of out-of-state applicants to the School of Education, who found out about the school's programs via the Web page created by the Internet Task Force, and who are already Internet-enculturated.

As a result of this study, both the School of Education and the university have become more aware that no electronic helpdesk can offer the moral support that new users need as they deal with their personal and task management concerns. There were three notable follow-ons to this study:

- A TLT/LTTS lab was established through a FPSE grant. It exists primarily for the purpose of mentoring faculty in Internet use and other forms of educational technology (See Grabinger, paper #199).

- The university's Office of Teaching Effectiveness (OTE) runs a "Boot Camp for Professors" each summer. This is beginning to gain in popularity and has been particularly successful because it does not interfere with teaching activities during the normal academic year.
- Based on requests for one-on-one scaffolding by faculty as well as students, the OTE inaugurated a new work-study program this summer. A dozen incoming freshmen in September 1999 were paid to take a July 1999 training session known as "Student Instructional Technology Corps" (SITC), where they received instruction that enabled them to serve as I.T. assistants to various academic divisions throughout the university. However, the SITC eventually ran into insurmountable barriers involving early registration and lack of funds for freshman work-study students.

Increased usage will not come without unintended side effects. What is working now may not work in the future. Students with slow modems and insufficient RAM are beginning to feel a sense of frustration with their older hardware platforms. As new users come on board, especially those who are unfamiliar with computer-mediated communication (CMC), they will continue to have problems with modem settings and other software issues. Moreover, as more and more students begin to use their free student accounts for PPP access to the WWW, system capacity will be stressed, leading to carrier drops and busy signals. All of this can be frustrating for new users. Other educational organizations (Sherry, Lawyer-Brook, & Black, 1997) have had to increase their server capacity or purchase additional servers to keep up with increased on-line traffic as new users begin to use the system on a regular basis. Any instructional technology program or educational institution will eventually have to deal with this issue.

Most importantly, linear adoption models such as Rogers' (1995) *Diffusion of Innovations* and Hall and Hord's (1997) CBAM model (in which *time*, rather than *personal/cultural compatibility*, separates early from late adopters) may not apply to learning organizations such as graduate schools. Often, it is the late adopters who have insights into unintended side effects of technological innovations. Moreover, expanded conceptual frameworks that are based on activity theory, systems theory, or complexity theory (see Wilson, Sherry, Dobrovolsky, Batty, & Ryder, in press) may provide one with deeper understandings into how individual and organizational learning and change occur over time within institutions of higher education.

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# **Making them work for the IST online program: A case study**

Feng-Ru Sheu  
Indiana University

Paul Alford  
Indiana University

## **Abstract**

*Library service is one of the critical elements for designing a successful distance program in terms of learner support at a distance. Important services of the library model for the Instructional Systems Technology (IST) online program at Indiana University (IU) were identified, based on the needs of students, faculty, librarians, and administrators. Interviews and survey were major methods used in this study.*

## **Introduction**

Since higher education involves students in inquiry, research, and critical thinking, library accessibility and support play an important role in the success of distance education. According to Lebowitz (1997), library services to distant students include instruction in the use of libraries and library resources, contact information for requesting assistance from the library, information about requesting materials not available at local site libraries, quick turnaround time for materials requested from the library collection, quick response to requests for reference assistance and guidance, and quick response time to non-library related questions. Usually, the existing library services in traditional universities do not adequately meet the special needs of distance learning. Without equitable access to library resources and librarians, students at a distance cannot perform the same research functions as on-campus students, reducing their academic experience and creating frustration. Such stressful experience could be among the factors that cause a high dropout rate in distance education. As a result, many principles, guidelines, or services have been developed to ensure quality library service for the extraordinary growth of technology-mediated distance learning in higher education (Cooper, 1998).

To develop a quality library service for distance education, the users, the instructors and off-campus students, and the service providers, the librarians and administrators, should be involved. "Regardless of which model is developed and what variation used, it is imperative that institutions and librarians recognize that distance education/off-campus students are entitled to library services which are comparable to those available to on-campus students (Lebowitz, 1997)." To make sure that students at a distance have equal access to library resources, a program designer needs to better understand these students and try to meet their needs and expectations. In addition to students, a designer must consider and support the faculty, who are the key to making all materials alive. Moreover, developing effective library services for distant students is not just a library issue; it can never be tackled without the support of an institution's administrators. Therefore, before a quality library service can be developed, three questions need to be answered. First, what are the expectations and needs of students and faculty in online programs? Second, what kinds of library services are critical to faculty and students in online programs? Finally, are these expectations and needs met by the services offered?

The purpose of this study was to identify important library services for the IST distance program, based on the needs and expectation of students, faculty, librarians, and administrators. The important library services for distance education were identified through a review of the literature, interviews with students, faculty, librarians and administrators, researchers' previous experiences, brainstorming, and discussion with librarians.

## **Library Services for Distance Education**

A literature review was conducted to compile a list of library services for distance education as a framework of this study. Guidelines for distance learning library services developed in 1998 by the Association of College and Research Libraries (ACRL), the nation's largest professional association for academic libraries, was reviewed, along with others suggested in various articles and publications (Brophy, 1997; Butler, 1997; Derlin & Edward, 1997; Jones, 1997; Kirk & Andrea, 1999; MacDougall, 1998; Niemi & Barbara, 1998; Tolsma, 1997). The authors also brainstormed in order to identify potential library services based on past experiences and observations. Considerable overlapping among services derived from these various sources were found and eliminated. Finally, library services for distance education were grouped into the following six categories:

1. **Access to research materials.** The services in this category include online databases, online library catalogs, physical library collections (both at IU and on local sites), and reserve readings.
2. **Delivery of requested materials.** This category includes services for delivering requested materials from the library to a student via postal service, FAX, or various online delivery options.
3. **Instruction.** In order to identify and utilize appropriate library research resources and materials, distant students need librarians' instruction detailing those resources and procedures. Services in this category include providing instruction as part of a program orientation, face-to-face instruction, instruction by phone, online tutorials, and online asynchronous and synchronous instruction.
4. **Help.** While instruction covers more pre-formatted techniques and formal teaching or curriculum such as tutorials, spontaneous or specified questions are answered by "Help" services, which may take the form of lists to browse, FAQ's, or possibly a Knowledge Base. The services in this category related to assistance in identifying subject materials that students may need through the program, highlighting indexes and IST core journals, standard reference books within a discipline, assistance with reference formatting, search help specific to a discipline, and identifying and accessing local library resources.
5. **Policies and procedures.** Available library services, as well as services not provided, should be clearly defined in policies and procedures. Then distant students will know the availability of certain library services, the best way to use these services, and the correct channels of communication. This category includes handling requests from individuals outside the primary audience, referring requests that the library cannot handle to the most appropriate IU or other resource, limits on services, and any costs that students may incur.
6. **Faculty assistance.** Developing relationships and collaborative efforts with faculty will be a critical factor in the success of library services for distance education. This category includes providing faculty assistance on copyright issues and procedures, reserving materials, developing library instructional components, and updating news-and-notes type of current awareness publications.

## Methods

Fourteen subjects were initially identified as interviewees based on their substantial experience, potential personal interests, or their involvement in distance education or the IST distance program. Two of these initial candidates, the Associate Vice President for Distributed Education and the Dean of University Libraries, were not interviewed due to time and scheduling constraints. However, administrative perspectives were still sustained by interviewing the Head of the IU Undergraduate Library. While there were minor variations in the questions asked of each interviewee, they typically centered on the following topics: 1) What do you think of when someone mentions a phrase like 'library services for distance/distributed education'? 2) For what type of assignments or information do you/your students/library users use the library? 3) How quickly should students expect a response or delivery of material from library services?

In addition to the interview questions, each interviewee completed a Likert-type scale to rate the importance of specific library services, as they would be applied to the online IST program. This survey instrument was designed to determine *how important* the services are to the institution's faculty, administrators, librarians, and students.

## Results

From February through mid-April of 2000, the researchers interviewed each of participants. A list of open-ended questions was initially probed which led to free-thought discussion and, sometimes, brainstorming. The interviews themselves lasted anywhere from 25 minutes to nearly 2 hours. Clearly, some individuals had much to say and sparked some creative ideas. The survey and interview questions were also distributed via e-mail to two students who were not able to physically participate in the interview process because of distance constraints. In all, three faculty members, five librarians, one IST distance education committee member, and four students were interviewed and/or completed a survey, for a total of thirteen participants. Only twelve of these were given the final official survey.

As to open-ended questions, different interviewees repeatedly mentioned a number of issues. Since these comments were unsolicited and unprompted (coming before the survey listing specific services), these indicated commonly perceived essential needs.

Database access was one of the most frequently identified services. On several occasions, the ERIC database was specifically mentioned. Along with the necessity for students to access research databases, the issue of accessibility for students beyond the IU network domain was a concern. Traditionally, the databases purchased by



libraries have only been accessible on campus, while some are more strictly, available only inside libraries. Very recently the libraries have reached agreements with a number of database vendors to allow access to IU students not physically shown on campus.

Closely related to database/literature indexing and abstracting access, availability of full-text databases was repeatedly identified as a critical service. Several databases offered now through IU libraries do contain full-text/full-image inclusion linked to the indexing. The libraries also offer a handy utility for identifying specific journals that may contain full-text entries. An alternative method of offering full-text articles may be accomplished through scanning the materials held by the libraries. While providing the full-text of research items is highly important to student research, the hit-and-miss coverage currently available may create problems in distance learning. For instance, if students are only using items they can immediately obtain in full-text and forgoing the lengthy process of obtaining potentially more relevant and academic items only physically available in libraries, is the academic quality of their research suffering?

Reserve readings also surfaced repeatedly in discussions. Both students and faculty considered electronic reserves to be an essential library service for distance education. While the Indiana University-Purdue University at Indianapolis (IUPUI) Library has offered electronic reserves for several years, the IUB libraries have not yet initiated such a service. Reportedly, the libraries are exploring this with a hoped-for availability by August 2000.

Document delivery was another commonly cited necessary service. Whether through US postal delivery, fax, or online delivery options, interviewees recognized the necessity of having books, articles, or other library materials delivered upon request. It is still unclear exactly what services would be available to IST distant students. While the Library Distributed Education Services Web pages indicated that books and articles from the IU Libraries could be checked out and delivered to distant students free of charge (<http://www.indiana.edu/~libdist/des.htm>), the Distributed Education Librarian and Head of the Undergraduate Library contradictorily pointed out that books held by the IU libraries would not be delivered to off-campus students. IU libraries similarly would not loan books from other libraries for off-campus students; however, they would interlibrary loan articles from journals the IU libraries would not subscribe to for off-campus students.

Another theme repeatedly expressed by interviewees, and previously mentioned as prominent in the literature related to library services for distributed education, was that distant students should have access to library resources and services comparable to what students with physical access to the libraries would receive. An interesting side note, faculty and students mentioned this more often than did the librarians who were interviewed.

Access to librarians or library staff was another repeated theme. The reasons for contacting library staff may include requesting research assistance, obtaining a quick reference answer, initiating or asking about services, or even asking about other IU divisions or services beyond the library.

Closely related to the above issue regarding access, several librarians interviewed mentioned the necessity of providing a "hand-holding" service to users. Depending on additional student support services offered by IU, the library could well become the "friendly voice" that students seek out whenever they have questions and do not know where else to turn. Students will also need a high degree of personal assistance and attention as they struggle to use online databases or card catalogs, explore where they should look for different types of information, need advice on research topics, etc.

The final major finding from the open-ended questions focuses on the idea of responsiveness. Interviewees were asked a two-part question: (1) "How long should students have to wait for a response to an initial query?" and (2) "If the library will deliver materials directly to students, how quickly should the students expect to get those materials?" The answers showed an enormous range, from immediately to 72 hours for the first question and from immediately (if electronic) to two weeks for the second question. Popular answers for the first part were either immediate acknowledgement of receipt or responses within 24 hours. Popular answers for the second part were either delivery in two to three days or within five days.

In particular, It is necessary to point out the disparity between user expectations and the expectations of libraries. While answers from faculty and students generally indicated a shorter response time, the answers given by librarians tended toward the longer time frames. Distant students would particularly have a need for quick access to library materials and librarians' assistance. If the library services provided were not viewed as responsive, the perception of the service as a whole would have been degraded.

At the end of each interview, participants were asked to fill out a survey to rank their perception of the necessity of several services. The results have been tabulated and are attached as Table 1. Answers were given on a scale of one to five, one being of little relevance and five being highly relevant/critical. The averaged results speak for themselves, but here are some highlights from these findings.

Table 1

	Mean
<b>Access To Research Materials</b>	
- Online Database	4.92
- Online Card Catalogs	4.42
- Physical Library Collection	4.08
- Materials From Other Libraries	3.75
<b>Delivery of Requested Materials</b>	
- Postal Service	4.08
- Fax	3.50
- Online Delivery Options	4.67
<b>Instruction</b>	
- Part of Program Orientation	4.33
- Face-to-Face Instruction	2.36
- Online Tutorials	4.42
- Online Asynchronous Help	4.42
- Online Synchronous Help	3.25
- Phone Help	4.75
<b>Help</b>	
- Highlighting Indexes and Core Journals	3.58
- Standard Reference Books w/in Discipline	3.83
- Search Help specific to Discipline	3.92
- Assistance w/ Reference Formatting	3.17
- Identifying and Accessing Local Library Resources	4.00
<b>Policies and Procedures</b>	
- Handling requests from students/others outside program	4.33
- Handling requests & referrals for services not provided	3.82
- Limits on Services Provided	4.67
- Pass-back costs	4.75
<b>Faculty Assistance</b>	
- Copyright Issues and Procedures	4.50
- Reserve Materials: Policies & Procedures	4.50
- Developing Library Instructional Components	4.25
- Library Update/News & Notes publication	3.67

Online database access (mean = 4.92) was regarded as highly critical. When options were available for delivery of materials, most preferred the ability to send or receive these through online venues (4.67). Several instructional methods were desirable for librarians to teach and to guide users in resources and procedures, but most respondents agreed that phone contact (4.75) was a necessary service to provide. While the policy and procedure questions focused more on helping library staff, the overall response indicated that users should be made aware of the limits (4.67) and pass-back costs (4.75) for services offered. Assisting faculty with policies and procedures regarding reserve readings (4.50) was rated highly. Several interviewees also looked to library services to provide guidance on matters of copyright (4.50).

## Conclusions and Recommendations

This study tried to identify important library services for successful distance education. From the open-ended questions, different interviewees repeatedly offered a number of concerns. Since these comments were unsolicited and unprompted, these indicate commonly perceived essential needs. As previously stated, several library services deemed important or critical for distant students were identified through the literature review and brainstorming. Most notable of these themes was the overarching philosophy that library services for distant students should be comparable or equitable to the services provided to on-campus students (ACRL Guidelines, 1997; Lebowitz, 1997). As the Chair of the Middle States Accreditation Association stated, "there can be no real

differences in the quality of library support on or off campus. If the same level of quality is to be maintained, comparable – not necessarily the same – library resources and services are imperative (Lebowitz, 1997)."

### **User Expectations**

A second, and often overlooked, theme emerged that may prove critical to the continued success of library services for distance education, namely customer satisfaction based on user expectations. Libraries' perceptions of user expectations often do not coincide with what the users themselves view as important. Based on a 1995 report by Edwards and Bourne, librarians "tend to emphasize empathy, tangibles, and customer/staff relationships. Yet, academic library users tend to attach greater importance to reliability and responsiveness (Cooper & Dempsey, 1998)." In order to be "successful" by user standards, library services will need to fully understand their users and user expectations and to exceed, not just meet, those expectations.

### **Access**

Access to research resources (databases and library catalogs) and to research materials is of primary importance in the process of academic inquiry. Several resources are currently available. Several of these will improve in usability. More will undoubtedly follow. What is important at this stage is for library services to actively market these resources. Students and faculty need to be made aware of the best and most appropriate tools available to them. Faculties in turn need to make students aware of these resources and encourage their use for class assignments.

### **Delivery of materials**

Information obtained on what materials are available to distant students and how they can be delivered is conflicting and somewhat confusing. Clear policies and procedures need to be established and disseminated so students will know what they are entitled to, what options are available for getting these materials, and how quickly they can expect them.

### **Instruction**

Students will continue to seek assistance from librarians at the last minute. Flexible options for interaction and just-in-time instruction will need to be offered, particularly through phone contact and online options. However, students need to be made aware of the library services available to them, who to contact, and how to use library resources. The most effective way of exposing IST online students to the library service available to them is by inviting the Distributed Education librarian to give a presentation during their initial orientation sessions in order to introduce the service, explain the service available, and demonstrate some of the tools they will use for research. With the intermediated web page to state what services are available and how to access the service, students can be reminded what services are available, where and how to access later on during the semester.

### **Help**

Several tutorials and guides are currently available on the IU libraries' Web pages. A searchable list of Frequently Asked Questions or equivalent Knowledge Base would also prove helpful. These may help students in getting connected to databases and started in their searches. However, these are geared to a more generic audience and may not answer specific questions IST students may have. The Distributed Education librarian has offered to develop specific help pages that can be geared to individual courses and linked from that course's Web pages. Given the current staffing shortage in her department, this is not a long-term option. A better alternative for IST students would be an intermediate Web site that offers advice for library research and appropriate resources.

### **Policies & Procedures**

In order to avoid confusion and ambiguity, policies and procedures outlining the services provided, including limits on service, procedures, and any costs involved need to be established and made widely available.

### **Faculty Assistance**

The Distributed Education librarian has already begun contacting departments and divisions offering distance education courses to develop rapport and advertise library services for distance learning. Librarians should also offer assistance to faculty developing online courses in order to determine the potential information and research needs of students in these courses. If any courses have an extensive research component, the librarians could be invited to serve as a "visiting faculty" resource sitting in for online courses and offering instruction or individual assistance to students. Reserves need to be addressed, and quickly. The demand is apparent.

### **Staffing**

The current staffing of Distributed Education Library Services is not sufficient. Ashley Vollmer currently works 10-12 hours serving all IUB distance education students. If any significant demand starts to flow in, she will not be able to fulfill all requests in a timely fashion. A full-time staff position is required to adequately research, plan, and build library services. Even though the ACRL Guidelines and other sources recommend that library services for distance education should be funded by the institution in addition to existing library services and not from existing library funds, it appears that the latter is the case at IU. The IU library personnel budget has also

decreased over the past several years, making it necessary for the library to do more with less staff. External funds need to be appropriated to provide sufficient staff to serve DE students.

### Implications

Based on all the evidence found in this study, several conclusions and recommendations were drawn. It should be noted that, while this document seeks to identify the library services needed to successfully serve the IST online program, the adoption or implementation of many of these conclusions would need to happen outside of IST. Some of these recommendations may be seen as impractical based on varying circumstances endemic to other offices, nonetheless we offer them based on user perceptions, literature recommendations, and personal observations.

Understanding user needs/expectations is critical if library services are to be considered successful by users. Without a firm understanding of the unique needs, constraints, and idiosyncrasies of distant students, Distributed Education Library Services will not be able to target or otherwise influence user expectations. To achieve this goal, libraries and the IST department should conduct similar surveys on a regular basis. Not only will this provide feedback on the performance of library services and student expectations, but it will also inform students of the services available.

The results of this study can assist policymakers, such as chief academic officers, head librarians, and distance program committees, as well as faculty and students, in making reasonable and informed judgments with regard to the quality of learner support for distance education.

The results obtained from interviews and document analysis will help to guide the decisions for important or critical services and resources to be included in the model. The next section will discuss the methodology that was used to investigate the research questions and to obtain the information that is the basis for identifying important services and the potential needs that should be built into the library model.

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# **Establishing Partnerships Between Instructional Technology and Teacher Education Departments: A Case Study**

Mary B. Shoffner  
Christine D. Thomas  
Laurie B. Dias  
Georgia State University

## **Abstract**

*With the current influx of grants and national technology standards, many in Instructional Technology departments that serve teacher education programs wrestle once again with working outside initial certification areas. How can Instructional Technology departments work with teacher education faculty and programs to ensure that novice teachers will be able to meet new standards? Relationships of an increasing cooperative nature are called for. This paper describes a case of IT and teacher education unit cooperation and its results.*

## **Introduction**

With the current influx of Preparing Tomorrow's Teachers To Use Technology grants, many in Instructional Technology departments who serve teacher education programs wrestle once again with working outside the initial certification areas. In light of increasing standards and accountability in teacher education programs, not only in technology but also in all content areas, how can Instructional Technology departments work with teacher education faculty and programs to ensure that novice teachers will be able to meet these standards? The technology standards are high and require significant attention in order for new teachers to meet these standards, probably more attention than most teacher education faculty are capable of giving. Experts argue the need for a stand-alone technology course as part of the preservice curriculum to adequately prepare new teachers for new roles versus the modeling of technology integration across the preservice program. While a stand-alone technology course should provide preservice teachers with adequate skills to meet technology standards, university and college administrations are reducing program credit hour requirements to assist students in graduating in a timely manner. Few programs can still afford the credit hours to devote to a stand-alone technology course. Whatever the solution, instructional technology departments are often housed outside of initial certification departments, and face challenges to influence initial certification program curriculum. Relationships of an increasing cooperative nature are called for.

At Georgia State University, the Instructional Technology unit has been working closely with the Middle Childhood Education unit for the past three years to develop just such a cooperative relationship. Working together, the units have re-designed the stand-alone technology course into an innovative, alternative approach to technology in teacher education in which introductory teaching methods are taught in a technology-rich learning environment. In addition, a multi-submission portfolio assessment plan for all Middle Childhood Education students was instituted to ensure that all students meet multiple national standards prior to graduation.

This paper explores the process and the outcomes of this partnership. Current and future plans for the partnership are provided. In addition, the authors provide their personal perceptions why this partnership worked, and continues to grow. Finally, recommendations for establishing partnerships between IT units and initial certification units are provided.

## **Instructional Technology and Teacher Education**

Computer technology has been available for use in educational settings for several decades. According to a survey of state technology officials (Trotter, 1999), 42 states require teacher preparation programs to include technology. One might think that by this time colleges of education (COEs) are successfully preparing teachers to integrate technology into instructional practices. However, this has not necessarily been the case. In 1995, the Office of Technology Assessment (OTA) published a report on the state of teachers and technology. According to the OTA, teachers were not and did not feel adequately prepared to integrate technology into their teaching practices. One of the contributing factors cited was the lack of technology training available in teacher preparation programs at colleges of education (COE). When technology instruction was provided, it involved teaching *about* technology not teaching *with* technology. In most instances, COE faculty did not model technology integration with their preservice students. Willis and Mehlinger (1996) conducted a literature review on technology and teacher education. Their findings concurred with the OTA report:

Most preservice teachers know very little about effective use of technology in education and leaders believe there is a pressing need to increase substantially the amount and quality of instruction teachers receive about technology. The idea may be expressed aggressively, assertively, or in more subtle forms, but the virtually universal conclusion is that teacher education, particularly preservice, is not preparing educators to work in a technology-enriched classroom (p. 978).

According to a recent survey of 416 teacher preparation institutions commissioned by the Milken Exchange of Education Technology, most faculty members did not model the use of instructional technology skills in their teaching (Moursund & Bielefeldt, 1999). In several studies it appears that faculty who are not modeling are also not requiring students to use technology in their lessons or assignments (Lewallen, 1998; U.S. Congress, 1995; Wetzel, 1993).

In a nationwide survey of education majors and faculty, Fulton (1989) found that while 58 percent of the faculty thought that graduates certified in secondary education were well prepared to use technology, only 29 percent of the students felt they were. However, a report produced by the U.S. Department of Education (2000) revealed refreshing news: less experienced teachers were more likely than experienced colleagues to indicate that college course work prepared them to use computers in their classrooms. "84 percent of teachers with 3 or fewer years and 76 percent of teachers with 4 to 9 years of teaching experience reported that college/graduate work prepared them to use these technologies to any extent, compared with 44 percent of teachers with 10 to 19 years and 31 percent of teachers with 20 or more years of teaching experience" (p. 78). While teacher education programs still face obstacles as they prepare preservice teachers, it is evident they are making inroads.

### **Models of IT Instruction in Teacher Education Programs**

These inroads are being made via stand-alone computer courses as well as through integrated coverage across teacher education curriculum. Early efforts to infuse technology into teacher education often resulted in a stand-alone course that focused primarily on technology literacy skills. Many of the strategies used were based on a behavioral model in which students focused on learning a prescribed set of skills and were assessed through objective computerized assessments. It was not uncommon for these courses to be taught by technology faculty with little input from education faculty (Willis & Mehlinger, 1996). In this model, teaching and technology are separated. Therefore preservice teachers are not able to integrate technology into their teaching practices.

This model is still used in many COEs. Leh (1999) conducted a study on the content of technology courses offered to education majors at 25 colleges and universities. The study revealed that while all of the courses focused on concepts and skills, only 52 percent taught about curriculum integration. Results of study by Bennett and Daniel (1999) on novice teachers who experienced a stand-alone course indicated that having only a single course in computer technology was not sufficient. It did not adequately prepare teachers to apply technology in the classroom.

A second model of instructional technology instruction in teacher education programs is one in which all teacher education faculty model technology integration across all courses. While ideal in concept, it is arguable that many teacher education faculty still lack sufficient technology skills and access to successfully practice cross-program modeling of technology integration.

In response, some COEs have re-invented the stand-alone course to make it more constructivist in nature with a greater focus on technology integration. Effective teacher education programs combine this course with technology integration in the teacher education courses. In a follow-up study to the OTA report, Wetzel and Strudler (1999) looked at four colleges deemed exemplary in their approaches to prepare inservice teachers to use technology. The study indicated that each of these programs had a required educational technology class for preservice teachers to take early in their program. In addition, each institution was part of a larger plan for preparing students to teach with technology. The Milken Exchange on Education Technology report (1999) calls for increased use of technology in curriculum courses. It too indicated that a single course in instructional technology does not provide adequate training for preservice teachers. This third model, the integrated approach along with a required technology for teachers course, may be the best approach, particularly in light of the renewed focus on accountability in teacher education.

### **Accountability in Teacher Preparation**

There is a national movement towards accountability in teacher preparation programs. New technology standards for teachers along with revised accreditation requirements will require teacher preparation programs to

more closely examine the ability of their new teacher candidates to teach with technology. Recently published National Education Technology Standards for Teachers (NETS-T) (International Society for Technology in Education, 2000) reflect this movement. Along with the standards, the International Society for Technology in Education (ISTE) has created “professional preparation performance profiles.” These profiles provide scenarios for the types of activities that teacher preparation programs can expect from their students at four phases of professional development from general preparation through their first year teaching. This publication is timely and comes on the heel of a call-to-action to the COEs by the National Council for Accreditation of Teacher Education (NCATE).

In 1997, NCATE concluded that a majority of teacher education programs were not doing what needed to be done in terms of preparing teachers to teach in the 21<sup>st</sup> century classrooms. NCATE recommended that its accreditation body recognize technology education for teachers as central to the teacher preparation process. As a result, NCATE raised the bar. Aligned with Interstate New Teacher Assessment and Support Consortium (INTASC) standards, the newest NCATE unit standards now require teacher candidates to be able to “appropriately and effectively integrate technology and information literacy in instruction to support student learning” (2000, p. 8).

States are also calling for accountability. In our state of Georgia, the Board of Regents of the University System of Georgia has adopted *Guiding Principles on Teacher Preparation* (USG News: *Principles on Teacher Preparation Approved*, April, 1998). This policy “ ‘guarantees’ the performance of P-12 teachers prepared through [the University System’s] teacher education programs for teachers who are teaching within the fields for which they have been prepared” (p.1). Under the guarantee principle, “the University System will ‘take back’ any teacher within the first two years after graduation from a System institution when a school district in Georgia determines the teacher’s performance is less than effective in helping students make satisfactory progress...If taken back, a teacher will receive additional preparation at no cost to the teacher or to the school district” (USG News: *Principles on Teacher Preparation*, March, 1998, p. 1).

In addition, Georgia Governor Roy Barnes appointed an Education Reform Study Commission to look at ways to improve Georgia’s schools. The results of the study created the *A Plus Education Reform Act of 2000*, passed into law earlier this year (2000). Out of the act came two technology-related initiatives that impact teachers and teacher preparation programs. First, the act mandates that renewable teaching certificates would not be granted unless the candidate demonstrated “...satisfactory proficiency on a test of oral and written communication skills, a test of computer skill competency, [underline added] and an assessment to demonstrate satisfactory on-the-job performance appropriate to the applicant’s field of certification” (p. 65). Second, the act holds teacher preparation programs at universities and colleges responsible for their graduates’ technology competencies. Universities and colleges

shall require students in such programs to be proficient in computer and other instructional technology applications and skills including understanding desktop computers, their applications, integration with teaching and curriculum, and their utilization for individualized instruction and classroom management. There shall be a test to assess the proficiency of students enrolled in teacher preparation programs in computer and other instructional technology applications and skills. (p. 68).

### **An Alternative Approach: Cooperative Faculty Partnerships**

In considering how to best address these accountability issues, Georgia State University explored alternative approaches to technology instruction as well as how IT faculty might be involved in preservice programs. The development of this alternative approach was made possible by a collaborative partnership established between the Instructional Technology unit and the Middle Childhood Education unit. This partnership was developed in an effort to redesign the initial certification programs at GSU to meet changing course offering calendars as well as the call for increased accountability in teacher education by professional associations and accrediting agencies. Other universities have also examined the potential of collaborative partnerships between instructional technology and initial certification programs. Duffield’s (1997) account of an instructional technology–teacher education partnership at University of Colorado-Denver chronicles a four-year journey in which Duffield served as an IT consultant to the elementary methods team. What is telling is that more partnerships haven’t been cited. Perhaps the answer to this can be found in examining how colleges of education are typically structured. Instructional technology programs teach to a more diverse audience than do initial certification programs, and as such, often have difficulty fitting in to the typical college of education structure. Historically, IT programs have developed from two theoretical foundations, audio-visual/media, and corporate training, design, and development; programs which focus on a broader than K-12 audience. Because of this diverse, non K-12 heritage, many universities have difficulty placing IT programs within their departmental structure. The simple solution is to set the IT unit as its own

department. While this solution does allow the IT unit a good deal of autonomy, it does have its drawbacks, particularly when everyone else in the college has a K-12 focus. Barriers can go up quickly, and what ensues is a lack of coordination and cooperation between IT and initial preparation programs. The other popular solution, housing IT with other broader than K-12 programs such as curriculum and instruction, educational psychology, or educational leadership departments, has also not been conducive to fostering partnerships with programs that offer initial K-12 teacher certification. It is possible that this division, however convenient it might be for the IT training persona, might be partially responsible for the lag in technology integration in the schools and in our preservice programs.

At Georgia State University, initial certification programs fall under the jurisdiction of the Professional Education Faculty, a combination of faculty of the College of Education and the College of Arts and Sciences. The IT unit was moved several years ago to the comfortable umbrella of the largest department in the College of Education, Middle/Secondary Education and Instructional Technology (MSIT). The MSIT department prepares teachers in a variety of traditional and alternative programs for certification in Middle Childhood Education (grades 4-8) and Secondary Education (grades 9-12). Although the IT unit was housed within an initial preparation department, for several years, the IT unit continued to address the broad IT audience, and until 1997, served an approximate 80% corporate audience. It was at this same time that several factors were developing to force a change not only in the focus of the IT unit, but also of the MSIT department.

### **Program Performance Analysis and Formative Evaluation**

In the mid- and late-1990s, several national organizations introduced and promoted standards for preservice teachers and their programs (Interstate New Teacher Assessment & Support Consortium principles, International Society for Technology in Education Technology Standards for All Teachers, as well as content specific standards). At the same time, the University System of Georgia Board of Regents determined that all institutions would move from a quarter to semester calendar beginning with the 1998-99 academic year. The USG Board of Regents guarantee principle mentioned earlier, as well as pending NCATE and APACE (university-wide Academic Programs and Continuing Education self-study) reviews, precipitated the entire MSIT department to participate in a program performance analysis and formative evaluation. In examining all programs, a culture of cooperation between the IT unit and the teacher preparation programs was established.

With an opportunity to revamp the entire Middle Childhood Education program, a Middle Childhood Committee (MCC) was formed. This committee was composed of faculty representing all areas of study for the Middle Childhood Education program: language and literacy, mathematics, science, social studies, reading, and instructional technology. The MCC examined all required guidelines for initial preparation programs at the state and national levels. Input from faculty and student evaluations and surveys were also incorporated into the analysis. All components of the middle childhood undergraduate program were analyzed: program admissions and exit criteria, course offerings, course experiences, field experiences, scheduling of classes, scheduling of student-cohort groups and faculty teams. As a result, major program changes were implemented. This paper focuses on two outcomes of this cooperative relationship which effected how the IT unit prepared and advised preservice teachers and interacted with the initial preparation programs: the redesign of the stand-alone technology course to a technology-methods course and the establishment of a standards-based alternative assessment process for all prospective middle grades teachers.

### **Technology-Methods Course Development**

As indicated earlier, many teacher education programs focused on either a stand-alone course, or on a model of technology infused throughout all teacher preparation courses. Some schools, including GSU, have opted to do both. Kovalchick (1997) offers, "An approach that I have found useful is to blend elements from both a competency based models and integrative models into a reflexive approach in which students use technology as both learner and teacher. In this way, preservice teacher education students are challenged through direct experience to generate personally relevant conceptions of technology" (p. 31). Smaldino and Muffoletto (1997) also promote a combination approach. "Our model attempts to blend the contents of the existing single course with the need to nurture technology applications within methods and other courses. Thus, students first gain an understanding of the applications of technology in education in the broad sense, with an in-depth examination of how technology supports learning in specific content areas" (p.37).

Prior to 1997, the technology course at GSU was a stand-alone, skills-based course that focused on the use of technology as a teacher tool. Content included such technology usage as word processing, mail merging a letter home to parents, and using a spreadsheet program to calculate grades. Little to no learning theory or instructional methods were included in the lab-based course. In addition, the technologies covered were basic in nature –



telecommunications coverage consisted of e-mail, and in later years, the Internet as a database of lesson plans. As pedagogy played virtually no role in the course, students were allowed to substitute a passing grade on a pencil and paper competency test.

In 1997, at the request of the Middle Childhood Committee, the standard skills-based preservice technology course underwent a major redesign. In the first year, the course refocused from teacher-resource-based, skills-based to a technology-integration-into-the-curriculum approach. This refocus was done in part to address a potential cause of low technology adoption in preservice teachers: deficiencies in technology-integration methods (Leggett & Persichitte, 1998).

In fall semester 1998, the IT unit worked with the MCC to redesign the course to further situate the course content in teaching methods. While maintaining a lecture/lab approach, a WWW-based, resource-based learning environment (RBLE) was introduced as part of the course (Hill, 1999; Shoffner, 1999). The course, and its related resource laden WWW site, incorporates a problem-centered, activity-based approach where the computer applications are anchored in authentic and familiar contexts in which teaching and learning occurs (Cognition and Technology Group at Vanderbilt, 1991; Vygotsky, 1978). This approach is based on the view of an open learning environment in which learners have direct input on the direction of the course based on their needs (Hannafin, 1999; Hannafin, Hall, Land, & Hill, 1994). In navigating through the environment and tackling challenges, it is proposed that students will also develop self-directed learning skills, which will serve them well as they enter the teaching profession. Along with confidence in using the technology, self-directed learning skills have been identified as a characteristic of successful technology-using teachers (Shoffner, 1996). The RBLE can be accessed at <http://msit.gsu.edu/IT/3210/index.html>

At the same time, the course serves as an introductory teaching methods course, introducing preservice students to such concepts as instructional objectives, lesson planning, evaluation, and assessment. The course offers more than teaching the basic ADDIE instructional design model as a way to develop lesson plans while teaching about technology integration skills. In the *Technology for Teachers* course at GSU, the technology is immersed in learning about what being a teacher entails – briefly, planning, learning theory, instructional strategies, classroom management, and assessment. Our hope is that by introducing the technology and the methods together, early in the program, that a) students will forever forward view technology as natural to the learning process as the textbook and the pencil; and b) both the technology *and* the methods will be reinforced throughout their other courses at GSU. One way in which continuity and reinforcement occurs is in the use of portfolios for assessment. In the *Technology for Teachers* course, preservice students generate a portfolio documenting the design of technology-supported instructional environment that facilitates student learning through the design and development of student-centered learning activities. The use of portfolio development and assessment continues throughout the remainder of Middle Childhood Education program of study.

## **MCE Standards Based Alternative Assessment**

A second outcome of the MCC was the establishment of a continuous process of portfolio development and assessment for all students. In response to the Board of Regents guarantee principle, increasing accountability in teacher preparation programs, and the Middle Childhood Committee's recommendation to strengthen the preservice teachers' overall professional development, the committee recommended that the program include an exit assessment that examined the student's ability to apply what they learned in all their courses in some cohesive manner. After examining several assessment models, both traditional and alternative, a portfolio development process with benchmarks throughout the program and final submission as an exit requirement was adopted.

Although most skills and concepts are developed in individual courses, it is important that preservice teachers have command of these concepts and skills with knowledge of how to integrate these concepts and skills into all aspects of teaching. Therefore, a major goal of portfolio requirement was to develop the preservice students' ability to integrate several components of the program across all courses and to develop knowledge and skills in applying these components in all aspects of teaching. Among key skills and concepts under discussion were: integrating technology, developing and implementing lesson plans and assessment strategies, developing and implementing a classroom management plan, working with diverse learners, developing as reflective practitioners, and so on. After a review of the principles of the Interstate New Teacher Assessment and Support Consortium (INTASC), the committee agreed that the principles of INTASC encompassed and addressed all major components of the middle childhood program and could be used to facilitate the development of the preservice teachers. Thus the committee established portfolio guidelines that focused on the ten principles of INTASC. The INTASC Principles are included below.

Principle 1	The teacher understands the central concepts, tools of inquiry, and structure of the discipline(s) he or she teaches and can create learning experiences that make these aspects of subject matter meaningful for students.
Principle 2	The teacher understands how children learn and develop and can provide learning opportunities that support their intellectual, social, and personal development.
Principle 3	The teacher understands how students differ in their approaches to learning and creates instructional opportunities that are adapted to diverse learners.
Principle 4	The teacher understands and uses a variety of instructional strategies to encourage students' development of critical thinking, problem solving, and performance skills.
Principle 5	The teacher uses an understanding of individual and group motivation and behavior to create a learning environment that encourages positive social interaction, active engagement in learning, and self-motivation.
Principle 6	The teacher uses knowledge of effective verbal, nonverbal, and media communication techniques to foster active inquiry, collaboration, and supportive interaction in the classroom.
Principle 7	The teacher plans instruction based on knowledge of subject matter, students, the community, and curriculum goals.
Principle 8	The teacher understands and uses formal and informal assessment strategies to ensure the continuous intellectual, social, and physical development of the learner.
Principle 9	The teacher is a reflective practitioner who continually evaluates the effects of his or her choices and actions on others (students, parents, and other professionals in the learning community), and who actively seeks out opportunities to grow professionally.
Principle 10	The teacher fosters relationships with school colleagues, parents, and agencies in the larger community to support students' learning and well-being.

*Table 1: Interstate New Teacher Assessment and Support Consortium Principles (Council of Chief State School Officers, 1999)*

Through the continuous collaboration of the middle childhood committee, guidelines for portfolio development were documented, benchmarks were established, implementation procedures were outlined, and an assessment instrument and procedures were designed. The committee reviewed course syllabi for all MCE undergraduate education courses to determine which INTASC principles were met in each course. The principles were aligned with the program's schedule of course sequence and experiences to establish which principles the preservice students would be able to address at established intervals. These intervals serve as benchmarks to assess the students' portfolios.

The committee decided that the preservice students would write a narrative for each principle and provide artifacts to substantiate their knowledge, growth and experiences in the program. In the narrative, students are required to discuss personal accounts that address all concepts within the principle. In that the student is required to address all concepts of the principle in the narrative, it was clear that a specific artifact might address only one or two concepts within a principle. Therefore the students are required to explain within the narrative how the artifact addresses a specific concept.

The committee established benchmarks based on experiences acquired within the prescribed course sequence. Students are expected to complete all content courses prior to the senior year in the program. The University System of Georgia Board of Regents requires, within a 120-hour semester program, that middle childhood education (MCE) majors have two content areas of concentration -- 12 semester hours in a major area and nine semester hours as a minor area. During the junior and senior years the preservice teachers are immersed in teacher education courses that include field experience components. The INTASC principles and benchmarks were aligned with the Professional Studies and Student Teaching coursework: introduction to middle schools, instructional technology, teaching reading block, topics courses in the content areas, methods block, diversity course and student teaching. The committee established the following schedule as benchmarks for assessing student growth and development in the program. Upon completion of the Professional Studies courses (at the end of the junior year), the MCE students are assessed for meeting INTASC Principles, 1,2,6,7,8, and 9. Prior to entrance to student teaching (midway in the senior year), MCE students submit portfolios demonstrating competency for all ten

principles. Next the committee established a system for portfolio evaluation, introducing the students to the process through seminars and coursework, and assigning faculty advisors to assist students.

Students are guided through the portfolio process. Early in the semester in which students begin Professional Studies course, seminars are delivered by the MCC to introduce the portfolio process to the preservice students. The *MSIT Middle Childhood Education Program Portfolio Evaluation Guide* (Many *et al*, 1998) introduces students to the INTASC principles, and explains the portfolio assembly and evaluation process. The *Converting Your IT 3210 Learning Environment Portfolio To The Junior-Year MCE Program Portfolio Guide* (Shoffner *et al*, 1998) presents strategies for reformatting the Learning Environment Portfolio produced in the *Technology for Teachers* course to the Professional Studies Portfolio.

The portfolio is accepted in a variety of formats. Students may submit an electronic portfolio (on compact disc), a website, or a notebook for faculty review. (The majority of students in program continue to favor the notebook version.) Upon portfolio submission, the MCC meets and collaboratively assesses each portfolio. A simple rubric is used to assess competency in regard to INTASC Principles. Faculty reviewers indicate whether each principle was “not met,” “met,” or “met in an exceptional manner,” and give feedback on the documentation of each principle. Students receiving a score of “not met” on any principle are required to meet with a faculty advisor to discuss what must be accomplished to achieve successful experiences and documentation for the principle.

The portfolio review process was implemented in the fall 1998 semester. Due to the iterative nature of the assessment process, all students met all principles prior to graduation. The portfolios generated by students at the close of their coursework consistently demonstrated a clear understanding of the theoretical underpinnings and application of teaching and learning knowledge. Student narratives provided rich and reflective insight into how each preservice teacher was able to apply what was learned in the college classroom to the middle grades classroom. While students were initially resistant to the added work of compiling the portfolio, by the end of their program, students enthusiastically espoused the benefits of the portfolio process in allowing them to compose a holistic vision of their preparation and educational philosophy, as well as the ability to articulate this vision. Many students comment on the benefits of the portfolio process in preparing them to successfully interview for permanent employment.

Students in the first cohort to complete the portfolio process are now certified educators employed in the schools. Several research-based initiatives are underway to examine their preparedness as inservice teachers. In addition, a study is in progress that will examine the “INTASC” portfolios for the demonstration of technology competencies (NETS-T Profiles). The MCC committee continues to formatively evaluate their program in light of national and state directives, as well as student needs.

### **Collaboration & Cooperation: Contributing Factors at GSU**

The authors would be remiss if we did not reflect on our case study to determine what factors may have contributed to our success, and from that reflection make suggestions on how IT units at other COEs might do the same. Our reflection produced three core factors that contributed to the success of our collaboration: the nature of middle grades, a committed faculty, and a culture of mutual respect within the committee, the department, the college, and the professional education faculty.

It is the nature of those who teach at the middle school level to be cognizant of multiple disciplines as well as flexible. Middle schools typically employ a teaming approach to instruction, where students are assigned to a team of teachers who cover the core subjects. To operate successfully in the team structure, middle school teachers must be flexible and cooperative. This flexibility and cooperativeness must also be present in those who prepare middle school teachers. Furthermore, teacher licensure at the middle grades level is across all content areas. Although preservice teachers prepare in a major and a minor content field, they are licensed to teach all fields, and must be ready to teach in any of the four core content areas and reading. Although it is possible to receive an advanced graduate degree in Middle Childhood Education, most faculty members teaching in our program are from a specialty content area (mathematics, language and literacy, reading, science, social studies, or instructional technology). It is imperative that those who prepare middle grades teachers work together to facilitate this broad multidisciplinary preparation.

A second factor that contributed to the success of the partnership at GSU is the nature of the faculty. Although the faculty differed in their fields of specialty and their experience in the K-12 and college level, all of the faculty involved in the Middle Childhood Committee were committed to making this program work. Georgia State University has a long history of preparing outstanding middle school educators, and the faculty was and is committed to continuing this tradition. The committee met regularly, at times weekly, to plan the program, the technology methods course, and the portfolio assessment process. One reason for the MCC’s commitment level was that they were given ownership of the program by a very supportive department administration. Committee members continue to give their time to meet and review portfolio submissions each semester.

The third factor contributing to the partnership's success was the establishment of a culture of mutual respect among the committee members. As committee members come from a variety of disciplines, each had something to bring to the table. Early on, the IT faculty members on the committee were able to establish their credibility as educators. All content areas, including instructional technology, were considered equally important to the preparation of new teachers.

### **Suggestions For Establishing Partnerships**

Although the IT unit at GSU is strategically placed to facilitate such collaborative partnerships, the authors believe that some steps can be taken to nurture such partnerships, even when the IT unit is housed outside the initial preparation programs. We offer the following suggestions to establish cooperative partnerships with teacher education program units.

First, instructional technology faculty members who wish to work with teacher education programs must become familiar with current issues in teacher education preparation and in K-12 schools. As it is possible or even likely that an IT faculty member may not be a certified K-12 teacher, other steps may be taken to develop an understanding of schools. IT faculty members can volunteer to collaborate with a K-12 teacher, designing and team teaching a unit of study. Serving on school technology committees is yet another way IT faculty can develop and understanding of the K-12 school culture.

Second, the IT unit should ideally find a single teacher preparation unit or team that is willing to work with an IT consultant. Many in IT would argue that the integration of technology should take place in a systemic fashion. However, an incremental approach is more likely to be successful, and in this instance, success will likely breed more success. In short, pick a single program with whom to establish a rapport, and then work on establishing a relationship.

To nurture this budding relationship, it is essential that the IT faculty member(s) attend teacher education department or unit meetings. It is at these formal meetings that the IT faculty can establish their credibility as educators by providing information on technology integration strategies while also garnering information about the certifying program. Duffield (1997) concurs, "Probably the most important element of the second year was the time I spent planning and working with the elementary methods team. I was able to become familiar with the content and methods they used and begin discussions about how technology could be integrated into the courses. I also served as an advocate for technology, keeping it part of every discussion" (p. 24). In order to serve as an advocate for technology, IT faculty must stay current with research and methods in instructional technology integration strategies.

### **Conclusions**

Accountability directives for new teacher preparedness are not likely to go away any time soon. Instructional technology preparation will likely continue to be a critical issue in teacher education for many years to come. Instructional technology units can no longer teach only to their corporate training design and development roots. For colleges of education to successfully prepare teachers for the 21<sup>st</sup> century, instructional technology will need to be more cohesively included in teacher preparation programs. It is imperative that more cooperative partnerships be established between instructional technology units and initial preparation programs. The authors encourage IT units to initiate and nurture these partnerships, making possible more innovative approaches to this important field of study.

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# Toward a Post-Modern Agenda in Instructional Technology

David L. Solomon  
Wayne State University

## Abstract

*"Post-modernists look to the past and future equally and position themselves in the present, seeing time as a broken continuum in need of acknowledgement" (Jencks, 1992b, p. 6).*

*Traditional views in instructional technology are often based upon the application of scientific knowledge. Post-modernism, an alternative paradigm, questions whether science alone offers the best approach to teaching and learning. Post-modernism holds promise for guiding research and development in instructional technology; however, its potential contributions to the field require clarification. Accordingly, cogent definitions of post-modernism have been constructed -- from an instructional technologist's point of view -- and implications for the field have been presented to address the concerns of critics. This paper received the 2000 ETR&D Young Scholar Award and the author notes that the term, "post-modern," shall be hyphenated to symbolize "... the continuation of Modernism and its transcendence" (Jencks, 1995, p.30).*

Throughout its history, the field of instructional technology has been focused on improving teaching and learning through technology (Ely, 1999; Saettler, 1990). Over the years, various interpretations of the word, "technology," have been at the root of inquiry and debate in our field. As a result, traditional and alternative approaches to theory development and practice have emerged. A traditional interpretation of technology is the systematic application of science (Clark & Estes, 1998) which emphasizes the utilization of scientific knowledge and principles (Seels & Richey, 1994). Grounded in the behavioral sciences, traditional approaches to instructional technology share common values including the use of precision-based methods, measurement, replicability, predictability and order (Gustafson & Tillman, 1991; Jonassen et al., 1997; Seels & Richey, 1994). Alternative perspectives in our field assume a broader interpretation of technology as the systematic application of *all* sources of organized knowledge (e.g., literature, science, the arts), suggesting that art, craft and science all have roles to play in instructional technology (Davies, 1981/1991; Richey, 1995; Seels, 1995). Whereas traditional views in our field rely solely upon scientific knowledge, post-modernism, an alternative paradigm, questions whether or not science alone offers the best path (Wilson, 1997a). Within the past 10 years, post-modern perspectives in instructional technology have been receiving greater attention within the Association for Educational Communication and Technology (Wilson, 1997a). In addition, a growing number of publications in the field have begun to define a post-modern agenda. While the *Handbook of Research for Educational Communications and Technology* (Jonassen, 1996) included postmodern theory as a foundation for research in our field, the post-modern agenda remains unclear. Agenda-building is a process through which problems or issues receive professional attention (Richey, 1997). Within this agenda-building framework, ideas that influence professional communities are aligned with the broader agendas of the field (Richey, 1997). Therefore, communication is an important part of the support building process, particularly in theory development (Richey, 1997). Post-modernism offers alternative perspectives on the theory and practice of instructional technology; however, agenda status in our field will never be achieved until communication can be facilitated. There are two major impediments to building a post-modern agenda in instructional technology: First, a widely accepted definition of post-modernism does not exist. Second, the implications for theory construction are unclear (perhaps a consequence of poor definition). Therefore, the purpose of this paper is to construct an integrative and cogent definition of post-modernism that will initiate dialogue among professionals in our field. There are several inherent challenges to accomplishing this goal. Since post-modern discourse is mostly abstract and obscure, it becomes necessary to simplify subject matter and render it less complex for our professional community. This reductionistic process is fundamentally opposed to post-modern principles. In addition, this paper summarizes the literature that has been written about post-modernism across a variety of disciplines; and, while it is always important to see the tip of an iceberg while navigating through uncharted territories, we must also acknowledge the presence of something that has far greater depth.

Part One of this paper will address several issues impacting the definition of post-modernism. Part Two will construct a cogent definition of post-modernism that will promote communication within the field; and, Part Three will explore the potential contributions of post-modern concepts in instructional technology. Despite the challenges, this paper was written with the hopes of taking a step forward in the support-building process.

## Part One: Issues Impacting the Definition

One major source of confusion regarding post-modernism has been the elusive language of post-modern discourse. Walter Truett Anderson (1995b) offers the following insight into this dilemma:

The postmodern era has given the world some really good ideas and some really bad writing. From Derrida on down to humble troopers in the trenches of academia, a style that has come to prevail among postmodernists is one of endless complexification and obscurity. The general idea seems to be that the surest way to establish yourself as a profound thinker is to make it very difficult for anybody to understand what you are saying (p. 92).

Many critics are disturbed by the conventional language of post-modern discourse, including Hooks (1995), who asserts that “as a discursive practice it is dominated primarily by the voices of white male intellectuals and/or academic elites who speak to and about one another with coded familiarity” (p. 118).

In addition, the term “post-modern” is represented in various ways in the literature. The phrase is spelled post-Modern when it refers to a historical epoch (Jencks, 1992a). Literary criticism often styles it as postmodern; and, “...in architecture and as a cultural event it is usually Post-Modern (to indicate a doubly-coded movement)” (Jencks, 1992a, p. 16). Jencks (1995) hyphenates the term to reflect “...that paradoxical dualism, or double coding, which its hybrid name entails: the continuation of Modernism and its transcendence” (p. 30). Toulmin (1985) offers additional insight into the term:

We must reconcile ourselves to a paradoxical-sounding thought: namely, the thought that *we no longer live in the “modern” world*. The “modern” world is now a thing of the past. Our own natural science today is no longer “modern” science. Instead ... it is rapidly engaged in becoming “post-modern” science: the science of the “postmodern” world, of “postnationalist” politics and “postindustrial” society – the world that has not yet discovered how to define itself in terms of what it *is*, but only in terms of what it has *just-now ceased to be* (p. 254).

Toulmin’s logic may explain some of the ambiguity associated with post-modernism because the term specifies a departure point, but leaves the final destination open-ended (Jencks, 1992a).

### *Post-Modernism is Evolving*

Any attempt to define post-modernism is a daunting task for several reasons. First, the post-modern agenda continues to evolve and is ever-changing (Jencks, 1992a). Next, post-modern thought includes contributions from many areas including philosophy, literature, the sciences and the arts (Doll, 1993; Jencks, 1992b); and, perhaps as a result, the word “post-modernism” means different things to different people (Anderson, 1995b). Jencks (1992a) suggests that there are various post-modern movements (e.g., feminism, the green and ecological movement, libertarian theology) which contribute to the overall sense of confusion surrounding post-modernism. Added to these layers of complexity are various *types* of post-modernism: Skeptical post-modernism and affirmative post-modernism (Rosenau, 1995). Skeptical post-modernism is pessimistic, negative and gloomy, suggesting “... that the post-modern age is one of fragmentation, disintegration, malaise, meaninglessness, a vagueness or even absence of moral parameters and societal chaos” (Rosenau, 1995, p. 108). Within our field, Wilson (1997a) has observed that “...postmodern thinking can lead to ... positive or negative outlooks on life” (p. 303). Although affirmative post-modernism tends to agree with the skeptical view of modernity (Rosenau, 1995), it offers “...a more hopeful, optimistic view of the post-modern age” (p. 108). Rosenau (1995) posits that “many affirmatives argue that certain value choices are superior to others, a line of reasoning that would incur the disapproval of the skeptical post-modernists” (p. 109). Further, there are extreme and moderate versions of both types of post-modernism (Rosenau, 1995).

These divergent expositions of post-modernism are a major source of confusion, which complicates any attempts at definition. This paper will consider various explanations of post-modernism and then suggest a new definition that addresses the concerns of critics.

### *Post-Modernism as a Philosophical Orientation*

It is critically important to distinguish between philosophy and theory because post-modernism is often described as a theory (Yeaman, 1996) when it is actually a philosophical orientation (Wilson, 1997a). First, philosophy is interpreted as a composite statement of beliefs and values from which personal purpose and direction are derived (Ely, 1970). Second, philosophy is a foundation for theory (Koetting, 1996; Smith & Ragan, 1999; Snelbecker, 1974). In contrast, a formal theory consists of hypotheses, propositions, and laws (Richey, 1986). Further, a theory is an organized set of related propositions that enable people to explain, predict or control events (Hoover, 1995; Richey, 1986).



Given these definitions, post-modernism is a philosophical orientation because it does not possess any predictive power. Similarly, constructivism, which has many roots in post-modern philosophies (Wilson, Teslow, & Osman-Jouchoux, 1995), is often viewed as an educational philosophy because it does not have the explanatory power of psychological learning theories (Lebow, 1995; Smith & Ragan, 1999).

### *The Role of Philosophy in Instructional Technology is Ill-Defined*

Philosophy is important in our field because it serves as a foundation for theory (Koetting, 1996; Smith & Ragan, 1999; Snelbecker, 1974). For example, Ertmer and Newby (1993) traced the origins of behaviorism, cognitivism and constructivism back to their philosophical foundations in empiricism and rationalism. The roots of any science can be traced back to philosophical origins (Koetting, 1996; Luiz, 1982; Snelbecker, 1974).

In addition, one's theoretical framework is influenced by one's philosophical orientation to the world (Koetting, 1996). For example, behavioral theory is rooted in empiricism, a philosophical view that knowledge is derived from experience (Schunk, 1991). Accordingly, someone who accepts the notion of empiricism may be more inclined to explain learning from a behavioral orientation. While it may seem odd that behaviorism can be discussed alongside post-modernism, the point to be made is that one's philosophical orientation provides insight into one's values, which exert influence over one's perceptions of the relevance of research (Richey, 1998). Philosophical orientation also serve as a screening device that mediates decision-making processes (Luiz, 1982). Recent perspectives on the role of philosophy suggest that applied "fields of study, such as instructional design, do not have educational philosophies; people who study in these fields do" (Smith & Ragan, 1999, p. 14). For these reasons, it becomes increasingly important to explore philosophy because instructional technology is an applied, decision-oriented field (Reigeluth, 1983).

Philosophy is important for other reasons, as well. Philosophical inquiry cultivates the intellectual skills of critical thinking and offers new perspectives on solving problems (Morris, 1999). James D. Finn (1953/1996) believed that our body of systematic theory needed to be constantly expanded by research and *thinking* (emphasis added). Finn believed in vigorously exploring our ideas about instructional technology; in particular, he felt that philosophizing played a critical role in future planning (McBeath, 1972). Ely (1970) felt "...that there should be a philosophy of instructional technology and that it should vary from individual to individual" (p. 81). Still, philosophical inquiry has been relatively absent from the instructional technology literature (Koetting & Januszewski, 1991). In an update to his 1970 article, *Toward a Philosophy of Instructional Technology*, Ely (1999) reminds us that philosophies change in response to social conditions. Ely (1999) suggests that "...if there is any new dimension to the philosophy held by many professionals in the field it is change itself – the readiness to consider, test and adopt new procedures and processes in the goal of obtaining more efficient and effective learning" (Ely, 1999). As with Jim Finn, philosophy plays a critical role in future planning for Ely, as well.

The emergence of post-modernist and constructivist orientations in the field are beginning to spur renewed interest in philosophical inquiry. In 1992, Hlynka, presented a paper titled "Toward a philosophy of educational technology" to the AECT Definitions Committee and concluded that "any philosophy which can help us to illuminate what we do, how we do it, and why we do it, is worth our time and our effort" (Hlynka, 1992, p. 4). Posing questions is the fundamental task of philosophy, which is the basis for research and the foundation upon which our field is built (Koetting, 1996).

## **Part Two: Toward a Definition of Post-Modernism**

Thus far, post-modernism has been defined as a philosophical orientation; however, its relevance to instructional technology requires clarification. In an effort to promote clarity, post-modernism requires further definition, beyond the domain of philosophy. An interdisciplinary review of the literature suggests that post-modernism is approached from multiple perspectives, including a general social condition (Harvey, 1990; Jencks, 1992b; Lyotard, 1979/1984), an intellectual movement (Doll, 1993) and as an historical epoch (Jencks, 1995). Anderson (1995a) believes that "...it's useful to make a distinction between postmodernity and postmodernism – the first being the time (or condition) in which we find ourselves, the second being the various schools and movements it has produced" (pp. 6-7). This perspective offers guidance for constructing a definition of post-modernism. In order to promote clarity, this paper will explore post-modernism as both a general social condition, and as an intellectual movement.



### *The Post-Modern Condition*

As with most post-modern concepts, there are multiple views regarding the condition of postmodernity. Harvey (1990) proposes that postmodernity is a pervasive condition that follows the breakdown of the “Enlightenment project,” a great historical era where rational thought and the scientific method replaced superstition and tradition. According to Harvey (1990), “the Enlightenment project ... took it as axiomatic that there was only one possible answer to any question. From this perspective it followed that the world could be controlled and rationally ordered if we could only picture and represent it rightly” (p. 27). Many definitions of the post-modern condition can be linked to the French philosopher, Jean-Francois Lyotard. In 1979 Lyotard authored *The Postmodern Condition: A Report on Knowledge*, upon request by the Council of Universities of the Quebec government. In Lyotard’s (1979/1984) report on the state of knowledge in the Western world, he asserted “... that all modern systems of knowledge, including science, had been supported by some ‘metanarrative’ or ‘grand discourse’ about the main direction of history” (Anderson, 1995a, p. 4). Anderson’s explanation is among the most lucid: “A metanarrative is a *story* of mythic proportions, a story big enough and meaningful enough to pull together philosophy and research and politics and art, relate them to one another, and – above all – give them a unifying sense of direction” (p. 4). Simply put, Lyotard’s (1979/1984) definition of postmodernity is “...incredulity toward metanarratives” (p. xxiv). Jencks (1992a) offers another view that contrasts both the negative and positive attributes of the post-modern condition:

The increase in communication (and the information glut and advertisement), the growth of knowledge (and the consumer society), the rise of leisure (and of Disneyland simulacra), the flowering of Post-Fordism (and the insecurity of workers), the emergence of a new world order (and the *Pax Americana*), the EC, GATT and global economy (and the Third World debt and IMF riots) – for every positive post-modern trend there is a corresponding negative consequence. (p. 13)

Perhaps unknowingly, Gustafson (1995) provided one of the best descriptions of the post-modern condition, as it relates specifically to the field of IT:

Rapid changes in world economic conditions are creating enormous pressures on business and industry to become more competitive and help their employees become more productive. Coupled with these pressures are the demands of ever-changing technology and the information explosion. In the past, workers could “train and then apply” what they had learned. Today the question is increasingly, how can employees “learn while applying?” The world is moving so fast that knowledge can become obsolete even before it can be analyzed, developed into training programs, and offered to employees. (p. 24)

For the purpose of defining post-modernism as a general social condition, a synthesis of these various perspectives reveals a set of common themes: globalization, rapid change in the information age and concern for (multicultural) people. Simply put, the post-modern condition refers to the milieu that currently exists in our world, today. Gustafson offers one perspective of the post-modern condition as it relates to instructional technology. Ely’s (1999) concept of a “philosophy of change” is; yet, another.

### *The Post-Modern Intellectual Movement*

The section that follows serves to illustrate that the roots of post-modernism can be traced through a variety of disciplines. In order to improve communication in instructional technology and facilitate theory construction, the elusive language of post-modern discourse is conspicuously absent. An abridged version of the post-modern intellectual movement has been constructed in order to identify the sources of post-modern thought. The author respectfully acknowledges that each of the foundations of the post-modern intellectual movement is an area of inquiry unto itself: (1) structuralism, (2) semiotics, (3) poststructuralism, (4) deconstruction, (5) knowledge and power, (6) critical theory, and (7) self-concept.

#### *Structuralism.*

Appignanesi and his colleagues (1995) suggest that “postmodern theory is a consequence of this century’s obsession with language” (p. 56). Accordingly, post-modernism has its roots in structuralism (Appignanesi et al., 1995), which is “...an intellectual movement most readily associated with the linguist Ferdinand de Saussure and the anthropologist Claude Levi-Strauss” (Bush, 1995, p. 2). Structuralism asserts that the meaning of language (and culture) can be derived from its underlying formal systems (Bush). A central premise of structuralism was the existence of “...a systemic ‘center’ that organized and sustained an entire structure” (Bush p. 2). Structuralism is concerned with “... underlying rules and conventions that enable language to operate...the social and collective dimension of language [and] the infrastructure of language common to all speakers on an unconscious level” (Appignanesi et al., p. 57). Saussure also proposed that within a language system, the signifier (the word) carried

meaning, and the signified (the concept) was that to which it refers (Appignanesi et al., 1995). Together, a signifier and the signified are a sign and meaning is derived through their relationship, which is socially constructed.

Scheel and Branch (1993) suggest that "...conversation may serve as a basis for designing and implementing culturally pluralistic instruction" (p. 13) because the goals of instruction and the goals of conversation are similar. Both attempt to focus on common topics and create shared meaning, which address some of the concerns of structuralism.

#### *Semiotics.*

Semiotics is the science of signs and sign systems and their relationships to language and human behavior (Morris, 1946). Further insight into semiotics is offered by Appignanesi and his colleagues (1995):

Saussure opened the way to analyzing **culture** itself as a system of signs by proposing that structural linguistics was part of semiology, a general science of signs which studies the various systems of **cultural conventions** which enable human actions to signify meaning and hence **become** signs.

Semiotics is clearly rooted in structuralism, which declares that meaning is founded on a system of shared conventions (or is socially constructed). While the obvious application of semiotics in our field would address message design, a body of literature in the humanities offers unique perspectives on the implications of post-modern thought in instructional technology. In particular, Jay David Bolter (1991) has explored the notion of electronic writing spaces, claiming that the computer is a self-contained system where the entire process of semiosis occurs. Bolter reminds us that in electronic spaces, people learn to read and write differently, interacting with text that is now a texture of signs that include words and graphic elements. Michael Joyce (1995), an acclaimed hypertext novelist, explores technology in relation to new forms of art, instruction, teaching and writing. Joyce addresses the nomadic movement of ideas, enabled through the electronic medium, and he challenges current conceptions of human capabilities. These ideas have implications for the various ways in which meaning can be constructed and/or facilitated through technology and instructional design processes.

#### *Poststructuralism.*

Poststructuralism attacks the structuralist notion of a systemic "center" – the underlying rules of a social system – that organizes and sustains language and culture (Bush, 1995). Poststructuralist critics argue that language lacks a central organizing structure, and is inherently unstable and ambiguous (Bush, 1995). Bush (1995) suggests that poststructuralism generally includes three main features: (1) The primacy of theory, (2) the decentering of the subject, and (3) the fundamental importance of the reader. These features are explained in the following paragraphs.

*The primacy of theory.* Bush (1995) suggests that poststructural criticism is laden with theory, the nature of which challenges and subverts the enduring assumptions and beliefs of western civilization. As a consequence, "...poststructural criticism has been associated with an adversarial stance that often takes on the established institutional and political forces in American society" (Bush, 1995, p. 2).

*The decentering of the subject.* Contrary to humanistic ideologies, "... the poststructural subject or self is seen to be incoherent, disunified, and in effect 'decentered ...' (Bush, 1995, p. 2). Steiner Kvale (1995) offers further insight:

The focus on language implies a decentralization of the subject. The self no longer uses language to express itself; rather the language speaks through the person. The individual self becomes a medium for the culture and its language (p. 22).

People are seen as "commentators" who convey "unconscious mainstream ideologies" or as transmitters of "various cultural constructs ... created by the structures of power in a given social environment..." (Bush, 1995, p. 2).

*The fundamental importance of the reader.* Bush (1995) states that "with the destabilizing or decentering of the author and in more general terms of language as a system, the reader or interpreter has become the focal point of much more poststructural theorizing" (p. 2). Essentially, this tenet posits that readers create their own meanings, regardless of the author's intentions.

Poststructural thinking in instructional technology would encourage an examination of the relationships among the designer/developer (author), the learner (reader) and the use of language in instructional systems. This type of inquiry, like Rowland's (1993) concept of "reflection-in-action," views design as a reflective conversation with the materials of the situation (Schon, as cited in Rowland, 1993). The goal of this type of intelligent activity is not a fixed understanding; but, rather a more integrative awareness of the various ways in which instructional technology can be used to help learners create their own meanings or facilitate meaning that is more closely aligned with the designer/developer's intentions. Discourse analysis is another poststructural technique for revealing systems of thought that "... operate at a linguistic level to produce and regulate knowledge" (De Vaney & Butler, 1996, p. 5). In their examination of early educational technology texts, De Vaney and Butler (1996) employed a rhetorical technique that explored the hierarchy of topics and subject matter as represented in the table of contents and indices. In addition, the authors' intentions were investigated in prefaces and forewords; and, these findings

were then related to discourse-specific systems of thought. The value of this mode of inquiry was an illustration of the systems of thought that have shaped the production of knowledge in our field and the influences that these discourses continue to exert in instructional technology, today.

#### *Deconstruction.*

Deconstruction is an offshoot of poststructural theory that was introduced by the philosopher Jacques Derrida. Hlynka and Yeaman (1992) offer a summary of the basic tenets of deconstruction in their ERIC Digest titled *Postmodern Educational Psychology*:

1. Consider concepts, ideas and objects as texts. Textual meanings are open to interpretation.
2. Look for binary oppositions in those texts. Some usual oppositions are good/bad, progress/tradition, science/myth, love/hate, man/woman, and truth/fiction.
3. “Deconstruct” the text by showing how the oppositions are not necessarily true.
4. Identify texts which are absent, groups who are not represented and omissions, which may or may not be deliberate, but are important (pp. 1-2).

One of the assumptions of deconstruction is that virtually any facet of cultural life can be interpreted as a text and subsequently deconstructed (Harvey, 1990). In instructional technology, deconstruction can shed light upon the process of interpretation and lend support to the constructivist notion that learners construct knowledge rather than acquire it. By reducing texts to a play of signs, the goal of deconstruction is to show that perfect signification between a sign and its referent can never exist; thus, an insistence on the endless quality of interpretation (Bolter, 1991).

#### *Knowledge and Power.*

The French philosopher, Michel Foucault is the postmodern theorist recognized for addressing the concerns of power and legitimation (Appignanesi et al., 1995). Appignanesi and his colleagues provide a concise summary of Foucault’s perspective: “he tackles power from the unusual angle of **knowledge** as systems of thought which become controlling, that is, socially legitimated and institutional” (p. 82). Lyotard (1979/1984) has expressed similar views; he presents knowledge as a commodity, he questions who will have access to it, and, he raises questions about its legitimation.

Knowledge is seen as the most important resource and learning the most important capability for businesses today (Zack, 1999). Knowledge management, which is concerned with “...recognizing, documenting, and distributing explicit and tacit knowledge ...” (Rossett, 1999, p. 64), can be linked to analysis activities in instructional technology. While knowledge management isn’t intended to replace training, Rossett (1999) reminds us that we have access to more information than ever before and our challenge as instructional technologists is integrative. Not only should instruction incorporate data from diverse knowledge bases, it should also complement intellectual capital.

#### *Critical Theory.*

Critical Theory emerged out of the Frankfurt School, a German philosophical and sociological movement that generally believes that scientific inquiry is riddled with non-theoretical interests because theory development is a product of social processes (Honderich, 1995). Critical theory promotes a radical change in theory and practice, encouraging that every one-sided doctrine should be subjected to criticism. In his book, *Knowledge and Human Interests*, Habermas (1971) advanced the notion of critical theory, which situates knowledge within a philosophical framework based upon three forms of valid inquiry, which produce three forms of valid knowledge (information, interpretations and analyses). Just as post-modernism means different things to different people, alternative definitions of critical theory have emerged in the literature. Anderson (1995a) states that “in literature and the arts, we have critical theorists who insist that when you experience a work of art you don’t simply take in the artist’s intention, but actively participate in creating whatever meaning or message you find” (p. 9).

In 1983, Koetting (1983) explored the notion of knowledge in instructional technology and developed an epistemological framework for inquiry in our field. Koetting’s paper, “Philosophical Foundations of Instructional Technology,” (1983) discussed the implications for future research, and, proposed alternative philosophical and theoretical frameworks for inquiry within the field. While an exploration of Koetting’s (1983) work is beyond the scope of this paper, the point is that “... the field should embrace a wide variety of research paradigms ...” (Driscoll, 1991, p. 310). Koetting’s (1983) paper may be one of the first works to directly relate critical theory to the field of instructional technology (Nichols & Allen-Brown, 1996).

#### *Self concept.*

Jacques Lacan, the French psychoanalyst, proclaimed that the unconscious is structured as a language, and that thinking was dependent upon language (Appignanesi et al., 1995). With its roots in psychoanalytic theory, post-modern assumptions about self concept posit that individual identity is “... constructed (and frequently reconstructed) out of many cultural sources” (Anderson, 1995a, p. 10).

The natural connection between self concept and instructional technology would be a refined exploration of learner characteristics. Anderson (1995a) posits that

...the postmodern individual is a member of many communities and networks, a participant in many discourses, an audience to messages from everybody and everywhere – messages that present conflicting ideals and norms and images of the world (p. 9).

This notion suggests the importance of considering more variables that could potentially affect learning and instruction. The implication is that knowledge of the “many communities and networks” to which learners belong, may yield strategies for improving the efficacy of instruction.

## General Assumptions About Post-Modernism

Post-modernism has been defined as a philosophical orientation, a social condition and as an intellectual movement. In support of the latter definition, the foundations of the intellectual movement were outlined; however, the definition is still incomplete. Doll (1993) cautions that “... it is impossible to give one overarching definition of post-modernism: The movement is too new to define itself and too varied and dichotomous for any one branch to be representative” (p. 5). In response to the question: “What is post-modernism?”, Jencks (1995) proclaims that “...its continual growth and movement mean that no definitive answer is possible – at least not until it stops moving” (p. 29).

Given these challenges, I have constructed eight general assumptions about post-modernism from an interdisciplinary review of the literature. The assumptions about post-modernism follow for consideration, discussion, and/or adoption. Clearly, this is not an exhaustive list and many more assumptions about post-modernism are sure to exist. The underlying purpose for constructing these assumptions is to synthesize a large body of information and summarize the post-modern ideology.

### *Post-Modern Assumptions*

1. *Pluralism.* An essential *goal* of post-modernism is to promote pluralism (Jencks, 1992a). Jencks believes that “...pluralism is the leading ‘ism’ of post-modernity ... [and it] means the end of a single world view and, by extension, a ‘war on totality’, a resistance to single explanations, a respect for difference and a celebration of the regional, local and particular” (p. 11). The concept of pluralism is pervasive throughout the post-modern intellectual movement as evidenced by Hlynka and Yeaman’s (1992) proclamation that “...if there are multiple ways of knowing then there must be multiple truths” (p. 3).

Pluralism can be seen as an underlying philosophy in instructional technology that allows various perspectives to co-exist. For example, a post-modern worldview would suggest that researchers should not yield to dominant research paradigms. Practitioners would celebrate a type of theoretical pluralism where traditional and non-traditional approaches to learning and instruction could complement each other.

2. *Eclecticism.* An essential *style* of post-modernism is eclecticism (Jencks, 1992b). According to Jencks (1995), “post-modernism is fundamentally the eclectic mixture of any tradition with that of the immediate past” (p. 27). According to Harvey (1990), “Derrida considers ... collage/montage as the primary form of postmodern discourse [i.e., painting, writing, architecture]” (p. 51) because it produces a signification that is “neither univocal nor stable.”

As a style, eclecticism shares the pluralistic philosophy described above; however, in instructional technology it might become manifested as the combination of models to produce viable instruction (Richey, 1995). Instructional technology is an eclectic field, in and of itself, where ideas and resources from other disciplines become integrated into our theoretical and practical bases of knowledge.

3. *Knowledge.* An essential *tenet* of post-modernism is that people construct knowledge (Wilson et al., 1995). Although the concept that knowledge is constructed rather than acquired is not necessarily a post-modern invention, it clearly positions the post-modern stance on the constructivist side of the fence. As previously discussed, constructivism has many roots in post-modern philosophies (Wilson et al., 1995). While this assumption about knowledge is seemingly innocuous, it is laden with several post-modern issues. From Lyotard (1979/1984), one of the defining characteristics of post-modernism is a disbelief in metanarratives, or established knowledge (a concept that is also linked to pluralism because it rejects single explanations). Lyotard (1979/1984) also promoted the idea that “knowledge is and will be produced in order to be sold, it is and will be consumed in order to be valorized in a new production: in both cases, the goal is exchange” (p. 4). Lyotard’s perspective appears visionary in light of contemporary issues surrounding knowledge management. Yeaman (1996) believes that “separating the author from the authority of a text requires acknowledging the political issues of knowledge and power” (p. 276), an idea that is related to post-modern assumptions about truth.

4. *Truth.* An essential *opinion* of post-modern thinking is that truth is grounded in subjective experience (Wilson et al., 1995). In addressing the question of where truth lies, Hlynka (1996) explains that “traditionally, one assumes that the author of a work is the ultimate authority ... [however] ‘truth now lies in the text itself, while the new task becomes one of interpretation’” (p. 256). Further, Hlynka illustrates how contemporary literary theory and reader response theory suggest that “...authority lies not only in the author who wrote it, or in the text that says it, but in the reader who reads it” (p. 256). The French sociologist, Jean Baudrillard, advanced the notion of the simulacrum, which occurs when the distinction between representation (e.g., art; signs) and reality breaks down, marking the absence of a basic reality (Appignanesi et al., 1995). Baudrillard’s conclusion relates to the notion of truth (albeit an extreme form of postmodernism); and, his ideas remain an important part of the movement’s intellectual history. A more common opinion is offered by the philosopher, Richard Rorty (as cited in Anderson, 1995a), who posits that “truth is made rather than found (p. 8);” a view that interprets reality as being socially constructed.

As with the assumption about knowledge, these ideas about the nature of truth are reminiscent of constructivist ideas in instructional technology. In particular, meaning is understood to be rooted in experience, which supports the argument for situating learning activities in authentic environments (Duffy & Jonassen, 1992). In this regard, authority or truth would reside not only in the learning environment and materials, but also with the learner.

5. *Language.* An essential *theme* of postmodern thought is that language is deeply involved in the social construction of reality (Anderson, 1995a). From a poststructuralist perspective, Weedon (as cited in Anderson & Damarin, 1996) suggests that “language enables people to think, speak and give meaning to the world around them” (p. 270). Further clarification about language is offered by Anderson and Damarin (1996) who state that “how people write, talk, and otherwise communicate about what they know, do, and believe reflects the ways they are shaped by particular discourse communities” (p. 270). An underlying, poststructural issue associated with the role of language is that meaning is indeterminate because language is inherently unstable and ambiguous (Bush, 1995).

Scheel and Branch (1993) have reviewed the benefits of focusing on common topics and creating shared meaning through dialogue. Another concept of learning is based upon hermeneutic principles that views learning as a process of interpretation (Jonassen et al., 1997). While the instructional designer can use language that increases the probability of “correct” interpretation, Jonassen and his colleagues (1997) also explain how hermeneutics can be used in instructional design to assist with personal interpretation. Although seemingly simplistic, discussion questions at the beginning of a lesson can be used purposefully to stimulate the development of subjective meaning (Jonassen et al., 1997).

6. *Communication.* An essential *issue* in post-modernism is communication (Harvey, 1990). Transmission models of communication typically include a sender who encodes a message, the message, a channel; and, a receiver who decodes information (Shannon & Weaver, 1949). Additional components of the model usually include noise and feedback. Communication is a foundational issue in post-modernism because each component (and every element) in the communications process is scrutinized. Post-modern assumptions, as presented here, posit that authority lies not only in the sender and the message, but also in the receiver. They also address post-modern questions of knowledge, power and legitimation as they relate to the information source and the message. Finally, with respect to noise and feedback, the post-modern concerns about communication are also entwined with post-modern sciences of complexity, described below.

7. *Complexity.* Jencks (1992a) describes a post-modern science as shifting “... from fairly inanimate matter (planets and physical objects) to living systems (social groups as well as individuals) (p. 15).” As an example, Jencks (1992a) points to a view of nature as a self-organizing system. From this perspective, systems are interpreted as dynamic, living entities which consist of non-linear processes and a high degree of feedback, which characterize all life (Jencks, 1992a). An applied example of this concept could be Artificial Intelligence, complex computer systems that are designed to adapt to environmental stimuli. Chaos methodology is another application that “... shifts emphasis from relationships of cause and effect to more interactive, multivariant approaches that stress the importance of defining patterns, form, self-organization, and adaptive qualities of complex processes” (Krippner & Winkler, 1995, p. 166).

A post-modern interpretation of chaos theory would jettison the notion of deterministic predictability and posit that chaos is inherent in all systems; thus, explaining the irregular behavior of nonlinear dynamic systems. The implications of this orientation would be an examination of the myriad variables that interact to produce learning and “developing metacognitive awareness in learners as a way of helping them deal with a complex and ill-structured world” (Jonassen et al., 1997, p. 32). There may also be implications for understanding the role of human emotion as a strategy for managing chaos in learning, as well (Jonassen et al., 1997).

8. *Self*. Post-modernism interprets an individual as a pluralistic person with a disappearing self. Anderson (1995b) states that “the postmodern person is a *multi-community* person, and his or her life as a social being is based on adjusting to shifting contexts and being true to divergent – and occasionally conflicting – commitments” (p. 128). Further, Anderson (1995b) posits that “individuals negotiate (and renegotiate) personal identity, struggling to make internal peace among the multiple components of their selves and the claims of the different communities to which they are connected” (p. 128). Gergen, (1995) a leading exponent of post-modern psychology, challenges traditional assumptions about human development as “...a single, basic self to which we can be true” (p. 137) in favor of the idea that people carry the potential for many selves which can be realized in various social settings (Anderson, 1995b).

These ideas are opposed to beliefs about the importance of establishing a strong, integrated sense of personal identity, which paints a one-dimensional picture of the learner. While there may be central tendencies related to the concept of self, post-modernists would argue that we have paid too much attention to them and have ignored the complexity of human existence (Gergen, 1995). In our field, the concept of self reminds us that instructional design needs to address more than practical issues and provide for the human spirit (Keller, 1979)

### **Part Three: Potential Contributions of Post-Modern Concepts in Instructional Technology**

The eight general assumptions just reviewed demonstrate the depth and range of post-modern thought. Together, they represent a body of ideas that could define a post-modern philosophical orientation; however, these assumptions are still difficult to relate to the field of instructional technology. Accordingly, the following section will summarize several core concepts about post-modernism, from which potential contributions to the field of instructional technology can be discussed. The core concepts that define a post-modern philosophy of instructional technology include:

1. The philosophical “core” of post-modern instructional technology is a belief in pluralism, which can be described as respect for difference and a resistance to single explanations.
2. Knowledge, truth and reality are constructed by people and groups of people.
3. Criticism is an appropriate method for inquiry in instructional technology.
4. Systems are interpreted as highly complex entities with adaptive qualities.

*The philosophical “core” of post-modern instructional technology is a belief in pluralism, which can be described as respect for difference and a resistance to single explanations.* As a defining characteristic of post-modernism, pluralism is a concept that has pervasive and far-reaching impact in instructional technology. At the surface, pluralism means that multiple perspectives may be valid and that there is no single best way to develop instruction (Davies, 1981/1991; Hlynka & Yeaman, 1992). Similarly, pluralism in our field would posit that there is no single best model or theory of learning. From an applied perspective, pluralism could be seen as an eclectic approach where multiple views of content, strategies and perspectives are offered (Wilson et al., 1995); however, this is still a surface view of the concept.

Beneath the surface; however, the concept of pluralism runs deeper. The issues of integration that affect the field (Seels, 1995) could be guided by post-modern philosophy, particularly with respect to “the integration of knowledge from the arts with knowledge from the sciences in an age of technology” (p. 252). Post-modernism accepts the idea that art, craft and science could co-exist in instructional technology. While diverse views of the art, craft and science debate continue to emerge in the literature (see Clark & Estes, 1998; Braden, 1996; Merrill, Drake, Lacy, Pratt, & ID2 Research Group, 1996; Davies, 1981/1991), post-modernism celebrates these multiple perspectives.

The implications of pluralism in relation to research and the needs of practitioners are also far-reaching. For example, the notion of the learner as a pluralistic person, situated in contexts that are continuously shifting, suggests the need to consider a multiplicity of variables related to learner characteristics and ecological systems (see Bronfenbrenner, 1979; 1988), all of which influence learning and instruction. Another example concerns alternative research methods that are emerging in the literature including multiple interpretations of data and self-reflexive technique, the recognition of one’s own values in the research process (Anderson & Damarin, 1996). These examples provide a framework for conceptualizing the implications of pluralism in instructional technology. The fundamental concept of pluralism is that multiple perspectives are valid, an ideology that can be applied to various facets of the theory and practice of instructional technology.

Knowledge, truth and reality are constructed by people and groups of people. *As a foundation for constructivism (Wilson et al., 1995), post-modern philosophies of knowledge, truth and reality are exerting great influence on the field. Post-modernists believe that knowledge is something that is created rather than found, which is mirrored in constructivist ideas about cognition (i.e., people create meaning through experience as opposed to*

*acquiring it). The concepts of subjective truth and socially constructed reality are also beliefs that constructivism and post-modernism share. Together, the concepts of knowledge, truth and reality have helped to mold and shape the emerging theory base for constructivism, including agenda-building around specific issues such as situated and collaborative learning.*

The philosophical view that reality is socially constructed can provide a framework for addressing issues surrounding cultural diversity. For example, Scheel and Branch (1993) have offered strategies for designing culturally pluralistic instruction based upon the premise that one's cultural background will influence interactions between the learner, content, teacher, media and context. Recognizing that learners are culturally inscribed and relational to the societal context, they believe that language and conversation can be used strategically to promote cultural pluralism and increase the potential for learner achievement. These ideas can be directly linked to diverse theories of language that provide a foundation for the post-modern intellectual movement discussed earlier.

Criticism is an appropriate method for inquiry in instructional technology. Scientific and critical perspectives can be complementary in the field of instructional technology (Wilson, 1997b). For example, a scientific approach in our field would pose research questions that require predictions and hypotheses while a critical perspective is more like literary or film criticism, exploring various layers of meaning. These approaches can be integrated and work together because,

Science and technology, if not checked, would tend to see things in terms of their instrumental value, in terms of their scientific classifications. Criticism, most skillfully practiced by the postmodern theorists, brings balance to the picture by closely examining the details. Technology alone tends to be problem-driven and goal-based. Most attention goes to whether objectives are achieved. Criticism looks beyond the objectives to examine the unintended side effects, the secondary meanings, the shades of gray (Wilson, 1997b, p. 25).

While criticism should not become an exclusive method of inquiry, its value in instructional technology is still misunderstood. The rationale for criticism is summarized by Belland and his colleagues (1991): "as a field which draws knowledge and practice from a wide range of arts and sciences, educational technology should be able to use a variety of ways of investigating and knowing in order to guide inquiry and practice" (p. 151).

Systems are interpreted as highly complex entities with adaptive qualities. While the humanities provide a major source of post-modern thought (Hlynka & Yeaman, 1992), post-modern science interprets systems as highly complex entities with adaptive qualities (Jencks, 1992a). Although the growing base of literature that addresses post-modern instructional technology has not yet explicated the implications of post-modern science, the concept of highly complex systems has received some attention in the field (see You, 1993). As learning and education become increasingly more complex in our knowledge-based society (Trilling & Hood, 1999) the concept of complex systems could offer a philosophical perspective to guide future inquiry. For example, the post-modern concept of complexity could offer insight into research on flexible learning systems that keep pace with rapid changes in organizational structures, processes and information technology (a by-product of the post-modern condition discussed earlier). Accordingly, a post-modern philosophical orientation might support the need for contextual analysis which broadens the number of variables that designers consider during the design of instructional systems (Tessmer & Richey, 1997).

## **Conclusion**

This paper has attempted to illustrate the relevance of post-modernism in the field of Instructional Technology. In pursuit of this goal, post-modernism was defined as a philosophy, social condition and an intellectual movement. As a philosophical orientation, post-modernism values multiple perspectives and the contextual construction of meaning (Wilson, 1997a). The post-modern condition describes a rich and diverse milieu that is influenced by globalization, rapid change in the information age and multiculturalism. As an intellectual movement, post-modernism is deeply rooted in theories of language and various disciplines including the arts, sciences and humanities. As an eclectic field, instructional technology integrates ideas from a variety of disciplines, which may help to explain the emergence of post-modern thought within the discipline. Seels (1989) describes the field as the confluence of three disciplines, including media in education, psychology of instruction and systematic approaches to education. Richey (1986) has outlined four theoretical foundations of the field: communications theory, general systems theory, learning theory and instructional/curriculum theory. Given these broad perspectives on the origins of instructional technology, the roots of post-modernism (e.g., semiotics, psychology, theories of language) can be linked to our history and should not be ignored.

The voices of our founders and the early discourses of the field have established a valuable role for philosophical inquiry in instructional technology; however, the path was never very clear. And, with post-modernism, there are multiple paths that diffuse meaning. Based upon an interdisciplinary review of the literature,

this paper has explored the sources of confusion surrounding post-modernism. Next, three definitions of post-modernism were proposed (i.e., a philosophy, a social condition and an intellectual movement). Then, the potential contributions for the field were discussed, all in order to promote communication within the field and facilitate an agenda-building process around post-modern issues.

Post-modernism holds promise for guiding research and development in instructional technology. The diversity of theories and concepts in our field, many of which have been borrowed from other disciplines, are often broadly organized around three distinct areas of inquiry such as behaviorism, cognitivism and constructivism (Ertmer & Newby, 1993). Accordingly, the theoretical perspectives in our field do not always enrich each other because research is often aligned with a particular orientation. While there is recognition that no single theoretical perspective can completely explain learning (Snelbecker, 1989; Smith & Ragan, 1993), the potential relationships between differing views could lead to stronger theories, a promise that could be realized through an affirmative orientation to post-modernism.

Finn (1962/1996) believed that technology was "... a way of thinking about certain classes of problems and their solutions" (p. 48). Post-modernism offers a way to think about thinking. It may not be everyone's "cup of tea," but our field can be enriched by exploring alternative views. At the very least, post-modernism challenges us to understand our own beliefs and recognize how our values are represented in everything that we do.

## Biography

David L. Solomon is completing his dissertation in the Instructional Technology program at Wayne State University. In addition to teaching college students at the secondary and post-secondary level, he has more than 13 years experience designing, developing and implementing instruction and performance improvement solutions for multinational and privately held businesses (he can be reached at [writchange@wnet.net](mailto:writchange@wnet.net)).

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# **The Effect of Anchored vs. Direct Instruction on Students' Learning Basic Geographical Concepts**

Ilhan Varank  
Ilhan Kaya  
Florida State University

## **Abstract**

*The purpose of this study is to compare direct instruction with anchored instruction based on students' learning performances and attitudes (n=100) in teaching basic geographical concepts in an introductory undergraduate level course. Direct instruction students will attend their regular lecture-based class sessions. Anchored Instruction students will design a lesson to teach the basic geographical concepts. It is expected that students in the both groups will perform equally on the performance posttest and the students in the anchored instruction group will score better than the ones in the direct instruction group on the attitude questionnaire.*

## **The Effect of Anchored vs. Direct Instruction on Students' Learning Basic Geographical Concepts**

In recent years, the effectiveness of direct instruction and anchored instruction has been a hot debate subject among researchers. When comparing with other instructional settings the researchers supporting the constructivist notion advocate that learning significantly occurs and is efficiently transferred through anchored instruction. Students also maintain more positive attitudes towards the instruction (CTGV, 1992). On the contrary some research reveals similar findings for direct instruction (Shuman, 1999; Bergin & Walworth, 1999).

Anchored instruction is a teaching paradigm which advocates that some subjects can be taught in the context of a situation in which that subject is applicable. The purpose of employing an anchored instruction model is to create interesting, realistic contexts through technology or other means that encourage the active construction of knowledge by learners instead of learning just facts and principles (Bransford et al., 1990; Fen et al., 1997).

Anchored instruction is based on situated learning and focuses on problem solving. Situated learning is a general theory of knowledge acquisition, promoting the idea that knowledge needs to be presented in an authentic context and that learning requires social interaction and collaboration. Authentic contexts provide an opportunity for students to experience the problems or immerse in the phenomena being investigated to produce knowledge and solutions similar to the ones experts do. Moreover, the learners within authentic environments are able to develop mental models of their authentic experiences for positive learning transfer (CTGV, 1990, 1992).

Direct instruction, a behaviorist or instructivist approach in teaching and learning, is based on the notion that learning can be facilitated through clear instructional presentations which rule out likely misinterpretations and facilitate generalizations. Also, direct instruction focuses on teaching and practicing sub skills and sub-knowledge that allow students to advance to higher-order skills (Kozloff et al., 1999; Direct Instruction, 1999). As a teaching strategy, direct instruction, on the other hand, is a systematic and highly structured instructional process that leads students to master in an extremely efficient manner (DiGhiera, 1998). Some key components of this process are scripted lesson plan that is evaluated and revised, curriculum designed to build new skills on previously learned ones and small-group sessions where teacher and students interact. (Direct Instruction, 1999).

Geography education lacks of empirical research that might provide guidelines for practitioners to evaluate alternative teaching and learning strategies (Downs, 1994). Very few studies investigated the effectiveness of different instructional techniques in terms of students' attitudes and learning performance. Nordstrom (1996) compared three instructional approaches, a traditional lecture-based direct instructional approach, a hybrid half-lecture half-collaborative approach and a fully collaborative approach, to teach an undergraduate environmental management course. Based on the students' evaluations of the course, he found that "the students view collaborative approach as a viable alternative to more traditional approach". On the other hand, another study comparing traditional lecture approach with cooperative learning to teach an introductory geography class by Hertzog and Lieble (1996) revealed the result that there was no significant difference between the two approaches based on the students' posttest performance results. Additionally, students in the lecture group and cooperative group exhibited similar attitudes towards both teaching techniques (the mean attitude scores were 2.9 and 2.8, consecutively).

The purpose of this study is to compare direct instruction with anchored instruction based on the students' learning performances and attitudes in teaching basic geographical concepts in an introductory undergraduate level course to provide practitioners with empirical data on alternative geography teaching and learning strategies. Based

on the literature review above, it is expected that the students in both groups will perform equally on the posttest. The students in the anchored instruction group will score better than the ones in the direct instruction group on the attitude questionnaire

## **Method**

### **Subjects**

The subjects in this study are 100 undergraduate freshmen and sophomore students enrolled in four sections of an introductory geography course at a university in the northeast Florida. Each section has 25 students and the gender breakdown is 60% male and 40% female. Two of the sections are randomly assigned to the direct instruction group and the other two groups are assigned to the anchored instruction group. The participation in the experiment is considered a course requirement, but the assessment results are not considered a part of the course grades.

### **Instructional Materials**

There are no specific instructional materials to be used during the study. For the direct instruction intervention, the direct instruction group will attend their regular lecture-based class sessions, and the instructors will use their regular class notes and handouts to teach the basic geographical concepts, such as the definition of geography, places and regions, physical systems, human systems, environment and society, etc. For the anchored instruction intervention, the students in the anchored instruction group will be given a scenario in which they will be asked to design a lesson based on a template to teach the basic geographical concepts. The template is the one taught in the introductory educational technology course at the university. The lesson plan template requires students to consider and specify instructional goals and objectives, instructional materials to be used during the instruction, learner level and learner characteristics, instructional procedure including motivating students, helping students recall prerequisites, presenting information, providing practice and feedback, and student assessment with the actual assessment tool. The students will be free to use all the resources to design the lesson, including the Internet and the class textbook as well as other textbooks.

### **Independent Variables**

The independent variables in the study are the types of instructional procedures: Direct instruction and anchored instruction.

#### **Direct instruction.**

Direct instruction will be used to provide students with direct information through a lecture to teach the basic geographical concepts.

#### **Anchored instruction.**

Anchored instruction is designed to provide a contextualized learning environment where the students are put in an instructor role and required to design a lesson plan on basic geographical concepts to teach in an actual classroom setting.

### **Dependent measures**

There are two types of dependent measures in this study: Students' learning performance scores and students' attitude questionnaire scores at the end of each instruction. Students' learning performance will be measured by a multiple-choice performance test that has 50 items. Students' attitudes towards the instructional procedures will be measured by Keller's 34-item Course Interest Survey (Keller, 1995) based on students' attention, relevance, confidence and satisfaction. Both performance test and Course Interest Survey have high reliability and validity.

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# What Cultural Studies Can Teach Us About Educational Technology Research: Theory Into Practice

Rick Voithofer  
Ohio State University

## Abstract

*This paper describes the background to the problem and methodology of a study that explored a reflective new media pedagogy through the design and production of a web-based learning environment. This environment addresses and invites cancer patients and their supporters to question established social and cultural discourses that shape the experiences of cancer by inviting visitors to create ways to talk about cancer that more closely relate to the uniqueness of their lives and to the characteristics of the disease. Through a collaborative approach to educational media design involving an educational media designer and cancer patients and their supporters, a web site (<http://www.cancershock.com>) was produced to support cancer patients and their supporters in creating non-linear, flexible discursive spaces for rewriting social and cultural discourses that shape and inform the experience of cancer in Western, industrialized cultures. This interdisciplinary study presents a design practice influenced by cultural studies approaches to new media pedagogy and drawn from the experience of engaging in collaborative and reflective educational new media design.*

## Introduction

Seriously ill people are wounded not just in body but in voice. (Frank, 1995, p. xii)

If I were to demystify or deconstruct my cancer, I might find that there is no absolute diagnosis, no single agreed-upon text, but only the interpretation each doctor and each patient makes. (Broyard, 1992, p. 21)

The most disorienting challenge to traditional thinking posed by developments in the postmodern era is the perception that illness is no longer a purely biological state – no longer a brute force of nature – but rather something in part created or interpenetrated by culture. (Morris, 1998, p. 70)

This paper describes the background to the problem and methodology of a study that explored a reflective new media pedagogy through the design and production of a web-based learning environment. This interdisciplinary study presents a design practice influenced by cultural studies approaches to new media pedagogy and drawn from the experience of engaging in collaborative and reflective educational new media design. It uses the design, production, and revision of a web site, <http://www.cancershock.com> (hereafter referred to as “CancerShock”), as an educational intervention to study the educational possibilities presented by a culturally informed new media pedagogy. CancerShock acts on behalf of cancer patients and their supporters to reframe notions of health, health care, and disease in ways that, compared to choices presented by traditional Western healthcare practices, are more supportive of the uniqueness of the daily lives of cancer patients and their supporters.

The pedagogy of CancerShock parallels a growing body of thought that calls for rethinking the care of chronic diseases like cancer in ways that have stronger connections to the cultural, subjective uniqueness of a patient’s lived experiences (Broyard, 1992; Frank, 1995; Kleinman, 1988; Radley, 1993; Stacey, 1997; Treichler, 1992). This literature often refers to the notion of the “postmodern”, (Morris, 1998), “postcolonial” (Frank, 1995) or “participatory” (Stacey, 1997) patient as one who actively creates their own ways (through non-linear personal narratives) of living with the disease versus being positioned by the pre-dominant rational, linear discourses of biomedicine. This study presents a culturally informed collaborative approach to educational technology design that tries to support a cultural intervention in healthcare and support discourses while offering a critique of current educational technology design models.

My critique of dominant forms of educational media design influenced by educational psychology shows an alternative approach that is guided more by theoretical frameworks contained within cultural studies (Grossberg, Nelson & Treichler, 1992) approaches to media study including poststructuralism and feminisms. The methodology of this study structures its inquiry around discursive contextualizations of the social and cultural issues surrounding cancer treatment, as well as, relating how these discourses form and interact with the participant’s cultural models

about healthcare. I use those discursive contextualizations to inform my collaborations with audience members in the design and revision of CancerShock.

The design principles that I developed for this study serve as a response to and a critique of traditional educational media design methodologies that seek to create media that deliver just the “right”, predictable message to a knowable and definable audience. In other words, I worked with design principles that work under the assumptions that one can never predict the ways that an audience will interpret a media text and that media interpretation occurs at the fluid borders of the audience's subjectivities (Ang, 1996; Fiske, 1989a; Fiske, 1989b) rather than the center of artificially created, essentialized characteristics. These design principles are derived from a reflective practice (Schon, 1983) that continuously works to resist facile descriptions of the audience.

This study is inspired by the lived, currently unfolding, experiences of a friend who is undergoing treatment for ovarian cancer. In the summer of 1998, a friend (who I will call M.) and media collaborator was diagnosed with ovarian cancer. Alienated and angered by her encounters with dominant biomedical discourses and wanting a way to “rewrite” and make sense of her life with cancer, she became interested in reframing her experience from one dominated by the fragmented linearity of her health care to one that supports her fight against a disease that is profoundly non-linear and requires, not fragmentation, but a constantly responsive adjustment and juxtapositioning of scenarios, treatments and interpretations. Her approach to cancer underscores a trend in people's approaches to the treatment of serious diseases in which patients are demanding a greater voice in the treatment process and resisting the silencing and alienating practices of traditional medical discourses (Frank, 1995; Kleinman, 1988; Radley, 1993; Stacey, 1997). The intervention of this study is informed not only by M.'s experiences but also by my collaborations with other people with cancer and their supporters, as well as by emerging discourses currently being constructed by cancer patients about health and disease (Stacey, 1997). This is especially the case in light of current communication technologies like the Internet that allow easy access to information and provide for more opportunities to participate in support communities (Klemm, 1998). Because this study involved collaboration with other cancer patients and various family and friends of cancer patients, this intervention spoke not only to M.'s situation, but to a wider audience of people with cancer and their supporters.

CancerShock was created to act as a model and workshop to help people with cancer to reframe their healthcare experiences in ways that resist the binaries that are presented to people with cancer and their supporters. These binaries include sick/healthy, patient/doctor, feeling good/feeling bad – binaries that serve to create static notions of disease and people with disease that allow and disallow specific ways of experiencing oneself with cancer. Through a collaboration with M. and a group of approximately thirty collaborators living with cancer or supporting someone with cancer, I created a social and cultural intervention that problematizes narratives about health, healthcare, disease, and quality of life that are presented to people affected by cancer (Frank, 1995; Kleinman, 1988; Morris, 1998) and rewrites those narratives so that they better support people's fight against cancer and their struggle to maintain particular senses of self and social positionings (Broyard, 1992).

The collaborations were used as a feedback and revisions mechanism for the web site through the use of an action-research oriented approach (Stringer, 1999) to educational media design that seeks to work with members of the intended audience to create the design, structures, and messages of the media. This approach allowed me to be reflective about my role as an educational media designer in ways that are responsive to the multiple subject-positions of educational media audiences. The design and production process included ongoing prototyping and discussions with cancer patients and their supporters.

Within the context of this study, the issues that were addressed revolve around how to use media as an educational tool to trouble and disrupt commonplace narratives and discourses about health and disease and to create new spaces in which to rethink the limiting ways that people talk about cancer. The stories that patients are told by medical professionals and that are implied by the time, space and aesthetics of cancer therapies, hospital rooms, and doctors' offices are the sites of intervention for CancerShock. CancerShock provides a set of activities and tools that offer its visitors (i.e. people with cancer and their supporters) an opportunity to (re)frame and (re)tell stories about fighting cancer.

The questions of this study related strongly to pedagogy and drew parallels between the art of teaching as a social and cultural approach and the science of teaching as an educational psychology approach. I developed a notion of new media pedagogy that is based on the idea of pedagogy as an artistic practice, a component of instructional design often alluded to by traditional cognitive-based theorists but rarely explored. Michael Milano and Diane Ullius in describing their book, *Designing Powerful Training: The Sequential-Iterative Model*, a traditional instructional design book write:



The truth is that designing training is part art, part science; it requires both technique and creativity. The very best training designs exhibit a kind of alchemy, a transformation of content into activities that meet specific behavioral objectives. (Milano and Ullius, 1998)

In this study I began to name the artful parts of pedagogy as they relate to the design of educational new media. My pedagogical goal for this study was to find a new media pedagogy that is artful and therefore attentive to the interaction of emotions, memory, pleasure, desire, aesthetics, representation, and learning. These are all aspects of pedagogy that are considered in a cultural studies approach to pedagogy (Todd, 1997). Sharon Todd (1997) captures this notion:

Moving away then, from essentialized views of oppression and subjecthood, pedagogy may be rethought as a process that gets tangled up in the nexus of social relations where identifications, fantasy and desire begin to emerge as pressing concerns with the field of the social. (p. 4)

In fact, cultural theorists of medicine have identified desire as the sick person's best medicine (Broyard, 1992). Because qualities such as desire are not easily definable, I explored a pedagogy that resists instrumentalization, an academic practice of containment. I developed a pedagogy for this particular project that acts as one way of approaching educational media design from cultural perspectives.

From a cultural perspective, pedagogy can be seen as invitations into a subject-positions. Therefore the new media pedagogy that I have created in this project is attentive to the subject-positions into which it invited its audience. The interplay between an audience's subject-positions, experiences of their disease and healthcare, and educational media represented important pedagogical moments.

## **Background to the Problem**

Cancer introduces a myriad of complexities into the lives of those it affects. The emotional and physical struggles presented by this disease intersect with the multiple subjectivities of the people it touches. This calls for approaches to educational media design for this audience that have not been adequately considered by traditional approaches guided by cognitive learning theories (Dick & Carey, 1996; Smith & Ragan, 1999).

This project addresses the numerous ways that a person's multiple subjectivities impact efforts to create social interventions with respect to the complex issues raised by the treatment of cancer. For this study, subjectivities will represent the social positions that are offered by discourses centered around race, class, gender, cancer, biomedicine, etc. Subjectivity presents a central theme in a cultural approach to new media design.

An important question that always must be addressed when considering a media intervention such as this is, "Why use media instead of another pedagogical or non-pedagogical intervention?". What is gained and lost in the decision to construct meaning in this manner? This question can be addressed specifically to this project. Part of the answer to this question can be found in the trend that more and more individuals are educating themselves about cancer through the Internet (Eysenbach & Diepgen, 1999).

In this study I not only explored using media like the Internet to respond to socially and culturally circulated discourses, but I investigated how a dispersed medium like the Internet broadens the field of discourses in which one becomes inscribed through the subject-positions offered. If traditional biomedical discourses, with their centralized and hierarchical structures, try to create fixed subjectivities, how might the dispersed medium of the Internet create the potential to encounter beliefs and truths which we may never have been encountered? The Internet, as a medium and source of information and communication raises many questions regarding traditional Western, modernist understandings of certainty, binaries, and progress. If the Postmodern critique of modernist notions of progress, objectivity, and binary truths (i.e. sick/healthy) values the world as a continuum (Lyotard, 1984), the Internet as a postmodern process makes such modernist understanding less feasible.

Many people who are faced with cancer use the Internet to research the disease and to communicate with others who confront cancer (Eysenbach, 1999). A search on the Internet for cancer-related sites revealed numerous web sites that reinscribe the rational discourses about cancer that this study works to disrupt. Despite the plethora of information that is available on the Internet about cancer, as Braddock, et al. (1999) found, fewer than ten percent of all patient decisions are well informed. This could be attributed to many factors including poor information, however studies have found that a great deal of the information provided on the Internet is accurate and up-to-date (Kiley, 1998; McLeod, 1998).

It is important to note that much of the medical literature focuses on techniques to evaluate the accuracy of Internet-based cancer information (Biermann, 1999; Gagel, 1999) but none addresses decision making using these techniques. This indicates that while many people are getting information each other about possible treatments they

are not putting this information to the most effective use. Patients and their supporters are not taught what to do with all this information. They are aware of many of their options but are unable to make the most informed medical decisions within those options.

By placing CancerShock within the context of other cancer-related web sites, CancerShock offers an alternative set of perspectives that may begin to provide new contexts to make sense of information about cancer and cancer treatment that is always in flux and changing. The results of this study show that this context could not be discovered/constructed by using traditional forms of educational media design. An innovative form derived through cultural theory was required.

The approach to educational media design that I explored in this study does not recognize educational media design from a strictly scientific perspective in which meaning is seen as being injected by media into audiences (i.e. students) while researchers examine the results of this “treatment.” Rather, I explored how educational media designers might acknowledge and work with the ways that media consumption is not only a cognitive experience, but also an embodied and culturally-situated experience that actively engages and invokes memory, history, desire, and senses of time and place (Ang, 1991; Ang, 1996; Fiske, 1988; Morley, 1992; Radway, 1984). This approach to educational media design rests on the assumption that the meanings people make as they use media are highly situated within their daily lives and are shaped by their generalized views about the world (Morley, 1986). on the Internet and communicating with

### **Cultural Models**

The illness narrative is a story the patient tells, and significant others retell, to give coherence to the distinctive events and long-term course of suffering. The plot lines, core metaphors, and rhetorical devices that structure the illness narrative are drawn from cultural and personal models for arranging experiences in meaningful ways and for effectively communicating those meanings. Over the long course of chronic disorder, these model texts shape and even create experience. The personal narrative does merely reflect illness experience, but rather contributes to the experience of symptoms and suffering. (Kleinman, 1988, p.49)

While people respond to media through generalized worldviews (Hall, 1973; Morley, 1980; Morley, 1991) or cultural models, important insights can also be gained by how the knowledge that people construct using media supports, contradicts, and modifies their cultural models. My use of cultural models was influenced by Strauss & Quinn (1997) and Gee (1996). Strauss and Quinn's conception of cultural models tries to understand opinion formation by showing how individuals negotiate attitudes based upon internal schemas that are influenced by social and cultural contexts. These schemas can be identified in the kinds of stories that people tell about their understandings of the world (i.e. disease), therefore I continually drew parallels between cultural models and narratives – the later providing an indication of the former.

Gee calls cultural models, “pictures of simplified worlds in which prototypical events unfold.” He notes that people are often unaware of their cultural models and therefore cultural models appear to be “natural” and inevitable even though cultural models vary across social groups and change over time. This “naturalness” can potentially lead to individuals seeing cancer and its treatment in ways that harm cancer patients by preventing them from considering every possible medical, emotional, spiritual, and physical opportunity to fight the disease – or of creating yet unimagined ones.

According to Gee, “They [cultural models] allow us to function in the world with ease, but at the price of stereotypes and routinized thought and perception.” Cultural models form the basis of choices and guesses about meaning within particular communities (i.e. healthcare, media production). They always include a conception of what is acceptable and unacceptable to do within that cultural model. For example, when one enters the world of biomedicine to be treated for cancer, one begins to take on the cultural model of a cancer “patient.” This causes people to act and speak in certain predictable ways about cancer. As Gee notes, “It's not just what you say, or even just how you say it, it's always who you are and what you're doing when you say it.”

Strauss & Quinn's work indicates how people's cultural models interact with each other and how they interact within various contexts. Cultural models vary in both content and form. The process of cultural model interaction can take the form of “integration”; as people modify their cultural models to make them more consistent with each other. They also observe that people are capable of possessing inconsistent cultural models without experiencing a sense of dissonance. For example, someone who is traditionally questioning and skeptical may place more unquestioned faith in a doctor or medical institution. They call the process of maintaining two inconsistent models “compartmentalization.” According to Strauss and Quinn, belief systems are partly integrated and partly compartmentalized. Because challenging received narratives about healthcare existed as an important goal of this

study, how the audience integrates and compartmentalize the messages of the media within their cultural models presented a consistent focus of this study.

While I draw on the work of Strauss, Quinn, and Gee to frame cultural models, I also work with postmodern approaches to address how people make sense of texts. Postmodern perspectives that examine the way audiences interpret media texts highlight the paradoxical relationship between a text and the contradictory identities, positions, imperatives, and experiences within the audience (Ellsworth, 1997). This study balanced generalized statements about individual's cultural models while acknowledging that people are not fixed by their cultural models and maintain agency through their multiple and intersecting subjectivities.

### **Educational Media Design**

The scientism of psychology is motivated by a fear that the world cannot be mastered, i.e. known directly and certainly, with scientific method. What is manifested here is a desire for 'presence' where the world can be known in an unmediated way. The unmediated and therefore certain knowledge is considered possible in principle but, equally, the possibility of presence is thought of as always under threat; a threat whose source ultimately lies in mediation in its various forms. (Usher & Edwards, 1996, p. 56)

Whereas empirical approaches to thinking about the audience of educational media often ask questions that fix the audience's subjectivities and cultural models by addressing them through essentialized descriptions produced by a "learner analysis," culturally informed approaches to inquiry frame media interpretation in terms of an individual's multiple and fluid subjectivities. For example, while a learner analysis is more likely to reveal characteristics about potential audience members including their skill levels and literacies (i.e. reading, math, etc) or attitudes about a particular concept, a culturally informed approach is more likely to problematize notions of "skill" and "literacy," articulating how they are the result of power structures based on race, class, gender, ethnicity etc. A culturally informed approach offers a language of speaking about the audience's attitudes about a particular idea (i.e. healthcare) that could directly address how their subjectivities help to form that attitude.

This approach is presented to counter theories of media design based on educational psychology, an approach which represents the dominant discourse of educational media design and as Usher and Edwards (1996) indicate, is based on notions of certainty and mastery. Traditionally, educational media design has been influenced by cognitive theories (Reigeluth, 1999) that in varying degrees isolate the mind from the social contexts in which a person learns and constructs knowledge. Developments in cognitive psychology have conceded the importance of the social context of learning in the development of "situated cognition" (Brown, 1989). Situated cognition has developed on the assumption that authentic activities (those rooted in the culture and practices of a community) are the most effective activities for developing useable, robust knowledge. While making strides towards a consideration of social and cultural processes, situated cognition still valorizes the individual mind as sense making instrument and does not problematize what is a useable, robust language. For example, it doesn't ask, "knowledge that is usable by whom? to do what? for whose benefit?"

The seemingly neutral manners (i.e. "unbiased" in its treatment of culture, race, class, gender, etc.) that the "learner" is constructed using psychological descriptions impacts the ways that the design process of educational media is carried out, and ultimately in the nature of the materials produced and the methods that are used to assess individuals after undergoing instruction. For example, many instructional design models engage in a "front end analysis" (Dick & Carey, 1996) in which one part of it attempts to summarize the characteristics of the learner based on such items as reading/math levels, test scores, and the results of questionnaires. This front end analysis leads to descriptions of a learner who is targeted with a set of learning objectives that are to be mastered through the activities using the educational media produced. This methodology often leads to essentialized descriptions of the learner and narrow, easily evaluated learning outcomes. This is similar to the way the medical model traditionally treats patients (i.e. based on fixed, observable, and assessable notions).

Despite its aspirations towards objectivity, educational psychology nevertheless represents a subjective treatment of the issues that define it as a field of inquiry. Its definition of individuals as "learners" is based on specific historical antecedents that have become reified over time and institutionalized through social mechanisms. The labels that are applied to groups and individuals in educational psychology carry with them inherent hierarchical power structures that occupy histories. "Student," "learner," "learning," "teacher," "knowledge," "motivation," and "evaluation" all possess situated expectations and constraints, yet such labels are rarely problematized in educational psychology as they are operationalized. This reification and institutionalization has been an important, if unconscious, objective of educational psychology's desire to be considered a "normal" science (Kuhn, 1970).

Practices within this discipline have produced power structures between the learner and those administering (and evaluating) the learning that values certain ways of knowing by specific types of “learners” over others. These epistemologies influence traditional educational media design models because they are biased towards specific instrumental (i.e. memorization-driven, skills based, problem solving, etc) ways of knowing. Measuring and enhancing learner performance has a long history in educational psychology and exists as one of the founding charges of the field beginning in the early 20th century (Danziger, 1990). Educational psychology, through its “scientific” claims of being the defacto authority in measuring learning, has as its primary mission the measurement of success and failure (Danziger, 1990). Educational psychology proposes to measure learning and its effectiveness through technologies that include “deficit models” and “learner motivation”.

Deficit models tend to have strong racial, classed, and gendered undertones (McKay & Wong, 1996), yet they are unable to adequately articulate why these “deficits” are structured into a particular educational setting and the complex ways that they intersect within the individual. While extensive literature has been written about pedagogical issues relating to race, ethnicity, class, gender, and sexuality, little of this literature has influenced the theoretical work done in educational media design. This study will work towards bridging this gap. This is not to say that cognitive approaches do not address learning in social settings, however, by their very nature they are unable to adequately theorize educational issues related to the inter-relationships between race, ethnicity, class, nation or gender except to look at these items in terms of quantifiable measures of performance and motivation.

Traditionally, instructional design theorists have looked at “learner motivation” from the perspective of narrowly defined conceptions of motivation. Keller's ARCS model (Keller, 1983) is typical of such an approach that ignores how motivation and satisfaction are culturally dependent (i.e. influenced by cultural models). This study examined learning using media as the result of desire rather than the result of an abstract notion of motivation. Such an approach borrows from theorists who have discussed the relationship between desire, media spectatorship (Bordwell & Thompson, 1997; Fuss, 1992; Mulvey, 1975), and education (Todd, 1997). These ideas are represented in film and television theories of narrative.

Film theory provides insights into this approach by addressing how notions of anticipation, expectation, surprise, desire and voyeurism are meaning making devices for media interpretation (Mayne, 1993). Television theories of narrative, in contrast to film theories, depart from traditional realist narratives that try to construct a self contained, internally consistent world. In a realist narrative everything makes sense within the structure of the narrative, but, of course, this does not always occur in everyday life where many narratives don't end in tidy resolutions. Television, according to Fiske (1988) invites the reader into “producerly” relations with the text, especially in relation to the most common type of television narrative, the serial. Soap operas offer a good example of television narrative that start from a place of disequilibrium and never reach a point of closure. Even series, like situation comedies, that reach a conclusion at the end of each episode, never resolve ongoing conflicts. These ongoing conflicts either exist within character relationships or the situations that they encounter within their settings.

Television theories of narrative offer fractured constructs of narrative due to television's serialization and commercial breaks. This fractured structure creates conceptual spaces for greater variation in interpretation by the reader. Television narrative according to Fiske (1987), “must be able to build into it contradictions that weaken its closure, and fragmentation that denies its unity.” These fragmented narratives serve as a more productive model with which to represent the narratives of everyday life with cancer and provide an appropriate model to think about the design of a web-based learning environment such as CancerShock. Such models of narrative can better support a design process that allows for multiple interpretations of media based on a person's multiple social positions.

### **Mode of Address**

The analytical concept of “mode of address” was used throughout this study as a lens with which to examine the social and cultural position(s) media offer to an audience, as well as interrogate a new media pedagogy for the ways that educational media offer meanings and understandings. Mode of address was developed by Althusser (1971) as a way to talk about how discourses (through address) hail people into particular subject-positions – positions that have implications for the way that people can and can't exist in the world.

Ellsworth (1997) develops the idea of mode of address to raise questions about pedagogy and to ask “who does a piece of media (or pedagogy) think you are” in terms of your subjectivities (i.e. race, class, gender, religion, ethnicity, etc). She describes modes of address as the relationship between social aspects of a text (i.e. media text, structure) and the individual experiences of a text (i.e. reader's interpretation, emotional reaction, etc.). While media interpretations are varied, some readings are more likely than others, depending on a media's mode(s) of address, as well as a person's cultural models. Ellsworth develops the parallel between mode of address of media interpretation and the mode of address of pedagogy and argues that, like media texts, all pedagogies miss their audiences/students because what one learns is never exactly what is taught.

The ways that media/pedagogy miss their audience is an important notion for Ellsworth who reasons that the difference between address and interpretation is a productive space for teachers. She makes the claim that this space is a social space, an uncontrollable space that “bears the traces and unpredictable workings of the unconscious” (Ellsworth, 1997, p. 38) and a space that can be put to use by teachers through its indeterminacy. I build on Ellsworth’s work about address to show how the design of educational new media can use a culturally informed design approach that works with this productive space by acknowledging the ways that media audiences are indefinable and educational media interpretations are uncontrollable.

Decisions in media design are based on (often unconscious) assumptions about who the user is in terms of her or his race, class, ethnicity, sexuality and gender and what cultural competencies s/he possesses (Kress, 1999). Users must take up the offered metaphors and structures and negotiate their own meanings. The reader (or in the case of healthcare, the patient), however, is rarely fully aware of who the text (or treatment) thinks s/he is. Often, multiple modes of address occur simultaneously, adding layers of complexity to individual interpretations, confounding the intended logic of a text. These notions of media interpretation borrow from cultural studies approaches to media theory.

### **Cultural Studies**

Cultural studies is a difficult field to define because it is not a traditional academic discipline grounded in a monolithic theoretical foundation. It borrows from literary history, sociology, history, linguistics, semiotics, feminisms, philosophy, anthropology, and psychoanalysis (Grossberg, Nelson and Treichler, 1992). Cultural studies has been adapted to the countries in which it is practiced including the US (Campbell & Kean, 1998), the UK (Turner, 1996), and Australia (Frow & Morris, 1993). This is significant because an important component of cultural studies is that it defines culture as dynamic and based in local contexts and histories. In addition to being developed in cultural studies programs, its theories and methods are incorporated into traditional disciplines (and have disrupted the assumptions and practices of entire academic fields) including communication studies, media studies, history, anthropology, sociology, law, medicine, political science and education.

Cultural studies can best be described as an approach to inquiry that focuses on the connection between social relations and meanings and the ways that social divisions are made meaningful. This approach generally has a political intention that seeks to illuminate the subordination of one group under another. In cultural studies the production of knowledge is always seen as either done in the interests of those who hold power or done by those who contest that hold. According to this perspective culture is partially framed as the subordination of non-dominant groups by the interests of dominant groups. In addition, culture is also seen as the resistance to this subordination. Culture, in this context, is therefore revealed as a site of social struggle. This struggle is exposed by cultural studies to show how class, race, gender, and other sources of inequalities are naturalized and represented in forms (often through media) which break the connection between these and political and economic inequalities.

Cultural studies approaches to the study of media representations and media interpretations have developed as a counterpoint to traditional media reception research that look at generalizable “media effects” (Halloran, 1970) (i.e. watching medical shows like ER causes people to have distorted perceptions of healthcare). Instead, cultural studies are more likely to look at the representations of a show like ER and see how people put those representations to use in their day-to-day lives (Morley, 1992). Cultural studies approaches to media reception stress the importance of viewing media in the context of one’s day-to-day life.

In order to discuss the methods that I mobilized to develop the design, production and revision of CancerShock, I will now review in greater detail the questions, methods, data sources, results and implications of this study. I’ll address the design of the study, as well as describe each phase of the study.

### **Study Design**

The study was divided into three phases: 1) Contextualization 2) Design and Production 3) Collaboration and Revision. The contextualization phase included a literature review that examined the notion of subjectivity in relation to discourse and agency and identified current discourses about disease and healthcare. The literature review included a description of how a culturally informed educational media design approach contrasts to traditional forms of instructional design, especially constructivism. In addition, the contextualization phase explored what kinds of cancer-related web sites are on the Internet and looks at the present discourses surrounding approaches to cancer treatment by patients and supporters through an examination of discussions on Internet mailing lists. The design and production phase included the first iteration of CancerShock as it began the production processes. The collaboration and revision phase included work with individuals fighting cancer and their supporters to revise the site. This final phase used an action research approach to constantly challenge the praxis of the underlying theories of this study. Along with this general account of the study, I will now include a more detailed description of each phase.

## **Contextualization**

The contextualization phase involved finding out what discourses are made available to people on the Internet seeking information and support related to cancer, as well as examining what people talk about (i.e. with what narratives and cultural models do they identify) when using the Internet for communication about cancer. The first question was explored by undergoing a search using five popular search engines (e.g. <http://www.altavista.com/>) and Internet portals (e.g. <http://www.yahoo.com/>) searching for the word “cancer.” The top 50 sites that the search produced were coded by general categories and summarized. In addition about 25 of the sites (10%) were analyzed for their mode(s) of address. The results provided insight into what was available to people who search for cancer-related information and support on the Internet.

To answer the question about how people use the Internet for support related to cancer, transcripts of four electronic mailing lists were examined for the themes and narratives of cancer addressed by people on the lists. A discourse analysis provided insights into the prevailing ways that people with cancer and their supporters approach cancer treatment. This information was filtered through the literature of cultural critiques of Western medical model discourses. The findings mirrored many of the perspectives presented in the cultural critiques.

This first stage of the study supported the initial hypothesis about the social construction of cancer in Western societies. It sustained the notion that individuals mostly subscribed to the subject-positions and linear, rational approaches to the disease that Western notions of biomedicine offer. This stage also revealed that new narratives were emerging that offered people with cancer opportunities to create and (re)write their own narratives about cancer that countered traditional and alternative medical (i.e. holistic medicine) healthcare discourses. This information proved useful in the design and production of the site by underscoring the importance of narrative in the way that people make sense of cancer.

## **Design and Production**

The second phase of the study included an initial design of the web site based on the findings of the contextualization phase, and also included work with a small group of collaborators including M., her family and friends. A great deal of time during this phase was spent learning the technicalities of administering and creating an interactive, multimedia web site. The technical demands and tradeoffs of creating a web site constrained how one articulates a new media design practice. The first iteration of CancerShock included both videos and animations to support the ideas that emerged from the initial inquiry. This milestone gave way to the final and longest phase of the study.

## **Collaboration and Revision**

Collaboration and revision involved work with thirty individuals who, knowing the goals of the site, were asked to offer feedback on general and/or specific aspects of the site. The collaborators not only provided feedback but also became partners in the production of the site. Because many of the collaborators were found through postings on public cancer-related mailing lists, most of the communication with them occurred through email, however, I was able to find participants locally who allowed me to personally observe them access and use CancerShock. Watching individuals interact with the site proved extremely helpful in improving the usability and interface of CancerShock. In the revision and collaboration phase I received a range of feedback from technical to conceptual to creative.

## **Conclusions**

The key elements that emerged in this study were expressed through a reflective and reflexive design process that emerged in the creation of CancerShock. A new media pedagogy that incorporates a social and cultural sensibility is one that has the capacity to be self-reflexive in its awareness of its mode of address and assumptions and is reflective in its capacity to collaborate with its audience. This collaboration has the potential to move towards responsive media-based pedagogies that not only are able to address their audiences multiply but are also able to represent content and curriculum as fluid and changing. The implications of such an approach to educational technology practice frame educational new media as only one element among many in the fluid intersections of subjectivity, power, representation, and pedagogy that occur while learning. The social and cultural approaches to new media pedagogy that I have articulated, through the design and production process of CancerShock, suggest one way to shift the discourses of educational technology practice away from the language of certainty and predictability towards one that makes uncertainty, contingency, and context productive by attending to the complex social and cultural intersections that occur while learning.

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# **Facilitating Web-Based Instruction: Formative Research on Improving an Online Undergraduate Business Course**

Jenny Wang-Chavez  
Rovy Branon  
Indiana University

Peter Mikolaj  
Indiana State University

## **Abstract**

*The purpose of this study was to assist an instructor in facilitating an online course while the class was being offered, and to provide timely interventions for improving the course during the semester. A formative approach was used to help deal with unforeseen issues in implementing the first online course this instructor had offered. Through data analysis of what worked well, what did not work well, and what improvements were needed, issues related to both students and instructor's perception of the class were identified in the findings. From a student perspective, these issues included: online interactions, assessment, and course participation. For the instructor, there were concerns about new pedagogy, technology, and workload. Based on these issues, instructional interventions were suggested and an overall evaluation was conducted through an online survey. The approach adopted, findings identified, and recommendations made in this study will have implications for other instructors and instructional designers, especially those teaching online for the first time.*

## **Introduction**

The Web is offering unparalleled opportunities for student access to learning, information and communication, and thus has growing popularity as a primary medium in distance education (Crossman, 1997). Many colleges and universities are racing to move their conventional courses online (McIsaac, 1998; Molenda & Sullivan, 2000). Despite the "virtual land rush" to grab space on the Internet and the excitement of the technology, many issues must be resolved before instruction can be delivered successfully via the Web. This study addressed some of the prominent issues encountered by an instructor offering a face-to-face course online for the first time.

There are many challenges for faculty teaching online for the first time. Using new pedagogical strategies and working with unfamiliar technology can pose some unique difficulties. Often, the only feedback the instructor gets about a course is summative, which merely allows improvement the next time the course is offered. Instead of relying on data gathered at the end of the course, the researchers in this study took a more participative role by collecting data from multiple sources to inform interventions and to deal with issues as they arose.

The purpose of the study was to assist an instructor in facilitating an online course and provide timely interventions for improving the course. This study investigated what worked well, what did not work well, and what could be done to improve or solve the problems. The results of this study describe how formative methodology was used to address pedagogical, technological, and communication concerns in the course. The findings are relevant to instructional designers and instructors involved in web-based distance education.

## **Web-based instruction**

One phenomenon seen in the realm of Distance Education (DE) is the increased use of the Web as a primary delivery system (Crossman, 1997). When the Web was first used as a delivery system, DE was often considered to be traditional correspondence education. Instruction was (and in some cases still is) delivered through pages full of self-instructional text. Interactivity was quite limited (Hirumi & Bermudez, 1996).

A number of case studies have provided some guidelines and heuristics on building WBI. But an extensive literature research of DE survey models in early 1998 revealed that there were no validated models specific to DE (Williams, Paprock, & Covington, 1999). Fitting distance learners' needs still presents a challenge for distance educators given the differences of needs, ages, cultural backgrounds, interests, and educational levels (Willis & Dickinson, 1997). Distance educators and researchers are exploring more theoretical frameworks to guide the planning, design, development, and delivery of Web-based instruction.

Pedagogical issues that arise in WBI include information overload, “lost in hyperspace,” feelings of a lack of cohesiveness, and technical problems. Among institutional issues, the amount of time for an instructor to prepare and deliver the course seems to be a one of the biggest concerns (Hill, 1997). While some guidelines have been established on how to facilitate online learning (Eastmond, 1995; Harasim, 1993), there is a scarcity of research studies on implementation and how formative evaluation can help solve unforeseen problems.

### **Formative Evaluation**

Formative evaluation (FE) is a process of collecting empirical data during the developmental stage for revision and improvement of instructional products (Guba & Lincoln, 1985; Weston, McAlpine, & Bordonaro, 1995). The primary goal of FE is to improve the quality of the product being developed so that the desired goals of the product will be met. The evaluation process involves assessment as well as judgment based on the specific information collected from the users (Beyer, 1995). Conventionally, FE has been conducted before implementing the instructional resources or curricula. The authors of this study, however, advocate using FE as an ongoing process in the implementation stage for distance education.

## **Methodology**

### **Research framework**

Given the inexperience of the instructor in online teaching and the novelty of the course delivery system, improvements were needed throughout the course. To ensure the effectiveness of the class, timely interventions were crucial. Due to the nature and purpose of the study, action research was adopted as the framework. The action research framework was used to guide the researchers to understand the problem, develop strategies for solving the problems, and transform them into best practices. The research study involved three cycles of discovery, intervention, and evaluation (Byrant 1996). It was a constant process of observation, reflection, and action (Stringer, 1996). Action research methodology, when used in the context of Instructional Technology, involves an ongoing process of formative evaluation. This approach was used to gather functional feedback by learning from the event as they occurred and promoted positive changes in a timely manner.

### **Research context**

This research study was carried out in an undergraduate business course being offered through a mid-size Midwestern university. The course was offered via Web-based courseware, Blackboard. The courseware was introduced on the campus in the fall of 1999 and was being used for the first time with this class. Fifteen students registered for this class. The majority of them were taking an online class for the first time. The professor had taught face-to-face for over twenty years but this was the first time he had taught the class at a distance. An instructional designer assisted with instructional strategies and technical concerns; however, there were a number of issues that needed to be addressed by using data gathered during the course.

The instructor used Problem-Based Learning to facilitate student-centered, self-directed learning. His plan was to prompt students with real world questions and have groups lead class discussions for the particular topics being addressed. Class activities included individual discussions and small group assignments. Individual activities involved participating in online discussions by answering questions proposed by the instructor. Group activities consisted of primarily mini-cases appropriate to the chapter in the textbook for that particular week. The class was randomly divided into three groups with five students in each group. Students were graded by their performance on two online exams (with multiple choice questions and essay questions), individual online participation, and group project participation.

### **Participants**

The participants for this study included all 15 students enrolled in the course, the instructor, and the instructional designer, who was responsible for instructional and technological support.

### **Research questions**

The focus of this study was to formatively evaluate an undergraduate business course and help the instructor improve the course when it was being offered. The research questions guiding this study included:

- What issues do instructor and students encounter in teaching and taking an online course for the first time?
- How can these issues be resolved in a timely manner to improve a course as it is being offered?
- What recommendations can be offered for instructors teaching an online course for the first time?

## **Data collection**

### **Observations**

Students' postings were observed to determine the general trend of students' participation. Postings included both individual replies to the class discussion questions posted by the instructor and also their discussions as a group member while collaborating with others to complete the group project.

### **Survey**

Two surveys were designed to gather students' feedback about the class. The first survey was administered before the middle of the semester via email. The survey included three general open-ended questions in the email survey: what went well, what problems they encountered, and what suggestions they had for improvement. Nine students out of 15 (60%) responded.

The second survey was developed based on the responses from the first survey. The interventions suggested by the researchers, and the types of interaction in distance education include the following: learner-instructor, learner-learner, learner-content, and learner-technology (Moore, 1989; Hillman et al. 1994). This anonymous, Web-based survey was delivered by using the Assessment Tool in the course site. The survey was consisted of 19 multiple-choice questions and three open-ended questions. Twelve out of 15 students (80%) responded to the survey.

### **Interviews**

The researchers carried out one semi-structured interview at the beginning of the project and two informal phone conversations with the instructor during the semester. The first interview was to obtain information about how the instructor would like to teach this class and what issues he was dealing with. Two informal phone interviews between the middle and the end of semester were to solicit instructor's opinions on the collection of feedback from students and the proposed interventions based on the feedback.

### **Document study**

Email messages sent back and forth between the instructor and the students provided another important source for understanding the issues surrounding this class. Eighty messages archived by the instructor were analyzed.

## **Data analysis**

The data collected from the observations, surveys, interviews, and email messages were triangulated to determine the students' and instructor's perceptions of the class, issues raised throughout the semester, and recommendations for future improvement. Numerical data were tabulated by survey items and corresponding percentage in each item. The data analysis on qualitative data involved an iterative inductive process. The initial data analysis started with reading and rereading email messages and coding the small complete text units into indexed categories. Through iterative induction and constant comparison with categories and data, key issues and themes were generated.

## **Findings**

The findings presented in this report reflect the process of identifying areas needed for improvement, recommendations for instructional interventions, and evaluating the course after the interventions. Observations and faculty interviews revealed issues that arose from delivering this first online course. The email survey data, web-based survey, and their email communications with the instructor revealed the students' perception of the class and the problems they encountered. The findings are divided into three sections based on the process of formative approach.

### **Early to Mid-Semester – Before Intervention**

#### **Observation**

After nearly three weeks, there had been very few postings to the course message boards. There were only 48 posts in the first three weeks of the class, an average of less than one post per student, per week. Several of these posts were related to technical issues such as where to post the answers to the individual questions and group questions.

Besides the limited postings, students were answering the case problems by copying out of the book. Once one person had posted an answer to the problem statement, the responses from each of the team members tended to be very similar and did not add new information to the discussion. There was not much interaction occurring among the group members except when they were ready to post their answers to the class discussion board. In addition, one of the postings indicated that there was not much communication occurring in other forms during the early part of the semester.

After observing the first three weeks of the class, the researchers requested an interview with the instructor to determine his perception of the class and to investigate whether other channels of communication were being used.

#### Faculty Interview

The initial interview was conducted four weeks into the semester and lasted two hours. After having taught classes in the field of business and insurance for over twenty years in a face-to-face format, the professor found that teaching via the Web presented a number of challenges. Underlying many of the specific issues that the professor was dealing with was a lack of time to develop and work on the class because it was being taught in addition to his normal class load.

#### *New Pedagogy*

When first considering how to re-structure the class to take advantage of the Web-based environment, the professor decided that he needed a new pedagogical approach. He researched a number of instructional strategies and decided that a problem-based learning approach would be most appropriate for the content of the course. Implementing this new approach, however, proved to be more difficult than anticipated.

The textbook traditionally used for the course was the primary resource for course material. The instructor adapted the textbook problems to the online environment and formed teams to work on solving a problem for each unit. Using this format, the professor hoped to stimulate conversation. By doing so, he believed that the students would become more engaged with the material and would have a stronger learning experience.

At the time of the first interview, there were few indications that the students were working beyond the material in the textbook to solve the problems. The professor expressed some frustration with the lack of depth to the responses and did not feel confident that this new approach was as effective as he had hoped. He did note, however, that there might have been some ambiguity in the stated objectives and expectations that the students had been given. While he had made clear that he would base a portion of the grade on class and group participation, he stated that he needed to communicate his expectations better to the class.

#### *New Technology*

The technology used for teaching the class was also a factor in how well interactions were occurring. While the professor was extremely competent using many computer programs such as spreadsheets, word processors and email, he was unfamiliar with the development tools for the Web. He stated that he had done some pilot testing with the courseware in the previous semester. During the semester break, however, the university had upgraded to a new version, changing the capabilities and functionality of the program. Even though the courseware had better capabilities for supporting teams, there were some unforeseen consequences.

Not having had the opportunity to test the new system, the professor did not anticipate the students' confusion with what message to post under which board: the Group Discussion Board (for team use) or the Class Discussion Board. He felt that these difficulties were hindering the classes' ability to communicate with each other and with him. Additionally, he found that he did not have the time to check all of the different areas where students might be communicating thus making it difficult to track where students might be having problems.

#### *Student Interactions*

The analysis of postings by students at an early part of the semester showed that there was very little use of the message boards, which were the intended mechanism for on-line discourse. When asking whether students were using any other mechanism (email, live chat, telephone) to communicate, the instructor stated that he did not have any indication that there were other methods being used.

The limited interaction was contrary to the instructor's goal that team members would work together to solve the problems. The instructor noted that students were reading the material because their answers on the discussion boards reflected their reading. They were not, however, interacting with each other in a way that contributed to the in-depth learning that the professor was trying to achieve.

#### Email Survey

The open-ended questions that were emailed to students near the middle of the semester gave insight into their perceptions of the course. While the questions were open ended, the responses were centered on a few key issues about the class. Given the professor's uncertainties about how well his methods and the technology were working, it was surprising to find that nearly all of the students who responded to the survey had a very favorable impression of the class.

One of the major findings in this survey was that students liked the freedom and convenience of taking a class over the Web. For some students, it was the only way they could take such a class because they had work and family commitments. Many thought the technology was being used appropriately to meet their needs and appreciated the use of message boards over email or other communication options. Additionally, the courseware was viewed as easy to use and was liked by most of the students.

While most of the respondents were satisfied with the overall structure and learning occurring in the course, there were a number of suggested improvements. Many of the changes revolved around the organization and expectations for class communication. Students wanted to have concrete guidelines for project work. Several mentioned that they were unsure about what was expected from their group in terms of final deliverables. There was also uncertainty about what criteria were being used to determine their individual participation in the class or within their teams. The most often mentioned concern from the students was that the professor did not seem to be giving enough feedback in the course Website. Students wanted more ongoing commentary from the instructor so that they would know whether they were meeting expectations.

### **Mid-semester Intervention**

Based on the major trends identified, the researchers proposed several strategies to the instructor to improve the course. While the strategies were developed as a result of the problems, they were also designed to work within the limited time budget the professor had to make changes to the course.

The first strategy researchers recommended was to use technology to improve interaction. Improving student interaction in the course is a very complex issue and is very important in a problem-based learning class with a team-based approach. Distance students needed a clear set of guidelines for how to communicate online. The recommended guidelines included two parts. One was to tell students what technology to use and when. The second component in the guidelines was to specify how the technology was to be used. The students who were less experienced in online communication did not appear to understand what they should post in the different message areas or how to use the tools effectively.

The second strategy we recommended was to provide more feedback. Given the time pressure faced by the instructor, this was a more challenging problem. Addressing the issues related to student communication might help this by encouraging the behavior the professor had hoped to occur (more student-student interaction). If, for example, students knew that there were specified areas within the course site where they could get feedback, then the professor could centralize his responses and answers to one student's questions which might help others in the class. Such an approach would prevent the instructor from having to go into each discussion area for each group and for the class to address specific issues.

Third, we recommended providing specific guidelines for the projects. While the syllabus had clearly stated objectives for the outcomes in the class, there was little explicit information about how evaluation would occur. In a face-to-face situation, issues like class participation can be defined on an ongoing basis, depending on the lesson for that day. Online, however, rules for participation have to be more clearly defined. More precise project guidelines would help clarify students' uncertainty about what was expected from them in terms of group work.

### **Post Intervention Data**

#### **Student Survey**

The student survey was designed, in part, based on issues found in the interview with the professor from students' comments sent in via email. Twelve out of the fifteen students (80%) in the class completed the survey. The survey results helped confirm trends found in the qualitative data. The survey was designed to assess students' learning experience with this online course, their opinions about the online test, and other issues that concerned them. Demographic data showed that the majority (83%) of the students had never taken an online course before this class. Interestingly, none of the students reported the courseware to be difficult to use (learner-technology interaction). The results students' opinions on group work, students' learning, online tests, and instructor's feedback will be summarized below (interactions between learners, instructor, content).

Table 1: Summary of Survey Findings (The number in () indicates the number of respondents)

Questions		Strongly Disagree	Disagree	No Opinion	Agree	Strong Agree
Our group was able to work effectively as a team.		8% (1)	25% (3)	8% (1)	42% (5)	17% (2)
I learned more by doing this project collaboratively with other team members than I would have on my own.		17% (2)	50% (6)	8% (1)	17% (2)	8% (1)
This class met the expectations I had for learning the material.		8% (1)	42% (5)	17% (2)	17% (2)	8% (1)
I found online discussions to be beneficial to my learning experience.		8% (1)	33% (4)	17% (2)	42% (5)	0% (0)
Online Test	The content of online test was a fair assessment of what I was expected to learn.	8% (1)	8% (1)	42% (5)	42% (5)	0% (0)
	The format of the test was appropriate for an online class.	8% (1)	25% (3)	33% (4)	33% (4)	0% (0)
The instructor provided sufficient feedback.		0% (0)	33% (4)	25% (3)	42% (5)	0% (0)

The results on group work showed that 59% (7 out of 12) felt they were able to work effectively with their teams. When asked if working collaboratively with other team members helped them learn more than they would have working on their own, 67% (8 out of 12) disagreed or strongly disagreed, one responded with no opinion and 3 agreed. Related to this finding was that 6 students (out of 11 who responded this question) did not think that their expectations for learning the material had been met through the class. Three of them agreed the class met their expectation, and 2 responded with no opinion. Regarding the online discussions, 5 students (41%) agreed that they were beneficial to their learning experience; 2 students (17%) reported no opinion, and 5 students (42%) did not think online discussions were beneficial to their learning.

The class was somewhat divided over issues related to an online test. About 16% (2 students) of the class did not think the test content was a fair assessment of what they were supposed to learn, 42% had no opinion (5 students), and 42% (5 students) thought the test was fair. As for appropriateness of test format for this online course (timed multiple choice questions and essay tests), 33% (4 students) responded disagree, no opinion, and agree respectively.

Students' opinions on instructor's feedback were also divided. Five students indicted that the instructor provided sufficient feedback, 3 students responded no opinion, and 4 students did not think the feedback was sufficient.

Students' responses to the opened-ended questions revealed more detailed information about their perception of the course. These and the analysis results from students and instructors' email messages will be summarized below. These qualitative data gathered from students' survey informed the quantitative results of students' perception of the class.

#### Students' Perspective on the Class

Several students mentioned that they enjoyed the flexibility and convenience of taking an online course. They also liked the professor's patience and understanding in dealing with problems they ran into. Some students enjoyed the group work and online discussions. Three prominent themes regarding to problems and concerns emerged from the qualitative data analysis.

#### **Technical concerns**

Although the courseware was relatively user-friendly, students constantly ran into technical problems throughout the semester. Several students had difficulties in taking the online exam. The restriction of the exam format and lack of flexibility in test sequence caused some students not to perform as well as they expected. Some students got a zero on particular sections due to technical restrictions. The instructor had to reset the test for these students. Other technical problems included lost connections during the test, transferring files, and posting and locating messages at the right place.

Students reported in the survey that they did not think Blackboard was difficult to use. The email messages sent back and forth between students and instructor revealed that there were more technical problems than questions about assignments or reading. The instructor had to spend a great deal of time resolving these technical problems.

## **Assessment**

Students were very concerned about their grade, and how they were evaluated on the individual participation and group participation. Several students emailed the instructor asking what grade they might get and how they could improve their grade. In addition, students were concerned and some were frustrated by the format and technical difficulty of the online test. More than a couple of students mentioned that they were not good test takers even if they knew the material well. The timed exam made it more difficult.

## **Group work**

This class used small groups to work on mini-projects. It is not surprising that there were some complaints about uneven participation. "Free ride" (no contribution to the group task but get the credit) was rather bothersome for the students who contributed more for the group project. Some students were concerned about this fairness issue in the assessment.

A couple of other issues, not reflected by majority of the students, are worth mentioning. Two students thought that the online class lacked social interaction. They felt they would learn more through hands-on and face-to-face classes. In addition, insurance is a hard subject (a comment made by one student), and that not being able to discuss it in class made it hard to understand.

## **Instructor's Perspective on the Class**

Through our informal conversations and semi-structured interview, the instructor expressed that formative evaluation was a very good reinforcement. He stated that it was good to have an independent source to provide feedback. Students seemed to like this idea and were quite open in talking about their issues and concerns. He thought a mid-term formative evaluation and recommendations were useful. If he had time to implement them, he projected these recommendations would have helped improve this class. Based on previous experience, the instructor had mixed feelings about his first online course.

The instructor did not think that students accomplished what he wanted. He expected them to go beyond the textbook, but only one or two students did that (consistent with his comment earlier in the semester). He also felt that students did not learn as much as they would have in an on-campus class. With his on-campus face-to-face class, he was able to present extra material. With this Internet class, although databases were provided, very few students used them. But one of the things that instructor really enjoyed was the rapport he and some of his students established through emailing back and forth to address questions and concerns. He found this online rapport was quite rewarding.

## **Discussion**

The researchers began the study by observing the visible interaction occurring on the course Web site. Analyzing the evaluation data identified three general major difficulties. First, very limited interaction occurred on the course message boards during early part of the semester. One of the reasons for this apparent lack of student involvement was that most of the students had never taken an online class before, and they had no experience in how that should communicate within the courseware. Additionally, although the instructor was aware of the lack of student involvement in the course, his limited time and heavy workload kept him from putting more effort into facilitating the students' online communications.

The second major problem was the amount of feedback students were getting from the instructor. The same factor, time shortage, also affected the amount of individual feedback the instructor was able to give to the students. The professor hoped that students would interact more with each other and would learn from these interactions, rather than relying on him for the majority of the feedback.

The third major issue that emerged was related to standards for the class. Students indicated that they were not sure how they were being evaluated. This uncertainty was especially true for the participation portion of their grade. Clear and specific guidelines about how participation was being evaluated (for example, by number of message board postings, depth of the posts, etc.) would help clarify the students' uncertainties. Likewise, providing explicit guidelines for group projects would have helped address students' concerns about group work, which could lead to more participation from team members.

There was a high degree of congruence between the instructor's beliefs and student attitudes on these three major issues. The instructor, however, had a much more negative view of how the class was progressing than the students did. He felt that the students were going to be very disappointed with the overall experience they were getting from the class. In contrast, email to the research team and other survey data revealed that while students had specific issues they wanted to see improved, they were generally positive about the class.

This course presented a couple of challenges for the instructor. The first challenge was time management. Due to his busy schedule and heavy workload, he was not able to facilitate the class discussions and group activities as effectively as he wanted to. Much time was spent on answering students' technical questions. If he had been free from dealing with these technical responsibilities, he would have been able to put more effort into the development of the course. Another challenge the instructor faced was finding the best fit of instructional strategy to this particular introductory course. There is very little literature about using PBL in Web-based instruction. Knowing how to implement PBL in an Internet class and how to facilitate group problem solving presented a great challenge for the instructor. With limited guidance from the literature, one had to explore the strategies through trial and error.

## Conclusion

The instructor in this study was very motivated to try innovative teaching techniques and strategies. He spent time reading pedagogical literature and pilot testing the technology before teaching the class. Additionally, the class was being taught voluntarily, despite his already busy schedule.

Even with a highly motivated faculty member, however, implementing an online class is a difficult task that requires new skills and strategies for success. More importantly, the instructor needs support from the university and his or her department to effectively work with students at a distance. The support needed most is time to plan, build the online courses, and ongoing technical support.

As universities continue the mad dash to offer their courses online, reasonable timelines for design and development should be taken into account. If faculty have to use untested methods on constantly shifting courseware with their students, sound instructional practice would suggest that this is not good for the students, faculty, or, in the long run, the university. The reality is, however, that there will continue to be uncertainty about the best practices for online course delivery for the near future. Formatively evaluating their courses and making improvements throughout the semester can reduce some of the problems faced by faculty.

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# **Performance Data in Professional Publications: Signs of Traffic on the Road Less-Traveled**

JennyLynn Werner  
SixSigma Performance

James D. Klein  
Arizona State University

## **Abstract**

*The purpose of this review is to classify articles in four Human Performance Technology publications for 1997 through 1999. Two publications are selected from each of the two largest professional organizations for performance practitioners; the publishers are the American Society for Training and Development, and the International Society for Performance Improvement. Articles were classified according to criteria derived from Klein (1997), and Dick & Dick (1989).*

## **Introduction**

Recently, a number of calls for measurement of training effectiveness have indicated that training and performance interventions should be expected to add value in a way that can be measured (Anglin, et al, 2000). Certainly the calls for data are appropriate; for performance professionals to earn any credibility, they must lead the way in demonstrating observable, measurable outcomes because those outcomes are demanded of our customers for their jobs.

Calls for data come from experienced practitioners, distinguished academics, and customers and there is now a greater focus and emphasis on development of the profession as well as related aspects such as ethics, qualifications, competencies, and standards (Merrill, et. al, 1996; Gery, 1999; Shrock, 1999; Kimball, 1999; Brethower, 2000; IBSTPI, 1998).

The increased demands on a performance professional's skill set and knowledge base require high quality and effective professional development opportunities. Often, professional organizations are utilized for most if not all of an individual's professional development efforts as many practitioners read the organization's publications as they strive to improve their skills and many attend an annual conference as well.

The increasing importance of these publications was the impetus for this review. A systematic assessment of the publications read by numerous practitioners is helpful for a number of reasons. As in any performance question, the current status must be documented in order to determine if the goal is being met. This review is not without precedence; a number of reviews have been conducted that examine the content and scope of Instructional Technology publications (Klein, 1997; Dick & Dick, 1989; Driscoll, 1997; Driscoll & Dick, 1999).

## **Publication and Article Selection**

The purpose of this review was to classify the articles in four of the most popular publications in the Human Performance Technology field, for the period from January 1997 through December 1999. Those four publications are: Training and Development, and Technical Training - both published by ASTD (American Society for Training and Development), as well as Performance Improvement Quarterly, and Performance Improvement - both published by ISPI (International Society for Performance Improvement). ISPI and ASTD are currently the two dominant professional organizations for practitioners working in the performance field.

## **Organizational Missions (quoted directly from organizational websites)**

ISPI – <http://www.ispi.org>

“Founded in 1962, the International Society for Performance Improvement (ISPI) is the leading international association dedicated to improving productivity and performance in the workplace. ISPI represents

more than 10,000 international and chapter members throughout the United States, Canada, and 40 other countries. ISPI's mission is to develop and recognize the proficiency of our members and advocate the use of Human Performance Technology. Assembling an Annual Conference & Expo and other educational events like the Institutes, publishing books and periodicals, and supporting research, and recognizing outstanding achievements through the Awards of Excellence program are some of the ways ISPI works toward achieving this mission."

ASTD – <http://www.astd.org>

"Founded in 1944, ASTD is the world's premier professional association and leading resource on workplace learning and performance issues. ASTD provides information, research, analysis and practical information derived from its own research, the knowledge and experience of its members, its conferences, expositions, seminars, publications and the coalitions and partnerships it has built through research and policy work. ASTD's membership includes more than 70,000 people, working in the field of workplace performance in 100 countries worldwide. Its leadership and members work in more than 15,000 multinational corporations, small and medium sized businesses, government agencies, colleges and universities. ASTD's publications cover all aspects of learning and performance in the workplace. Its books, magazines, periodicals and reports address the leading performance issues facing business and the profession and provide practical workplace tools for managers, professionals and technical workers."

## Publication Descriptions

### Performance Improvement (PI)

"*PI* is the preeminent journal focusing on today's issues of individual and organizational improvement. Published 10 times a year, *PI* is filled with information that can improve your skills and effectiveness. Since 1963, *PI* has consistently addressed improving human performance through a wide range of instructional and non-instructional interventions, as well as imparting the tools of performance technology and the challenges and new frontiers facing performance technologists. Published monthly except for combined May/June and November/December issues, this acclaimed journal is geared toward practitioners of performance technology in the workplace. Learn from hands-on experiences with models, interventions, 'how-to' guides, and ready-to-use job aids, as well as research articles. Performance Improvement also offers updates on trends, reviews, and field viewpoints. The journal deals with all types of interventions and all phases of the HPT process. The common theme is performance improvement practice or technique that is supported by research or germane theory."

### Performance Improvement Quarterly (PIQ)

"*PIQ* is the scholarly publication of studies reflecting research in the field of human performance technology. It provides an avenue for communication and stimulates discussion among professionals in the field who desire a sophisticated examination of issues in human performance, instructional design and development, and human learning. Now in its 11th year, this highly-regarded publication continues to be a leader in defining the field of human performance technology."

### Training and Development (T&D)

"*T&D* is the flagship publication of the industry," according to the ASTD website. "*Training & Development* is an official publication of ASTD, a not-for-profit association of professionals in the field of human resource development, workplace learning, and performance improvement. *T&D* is a monthly magazine available to ASTD national members as part of their dues, and also by subscription and single-copy sales. Our readers are degreed training and development professionals and line managers. They range from new practitioners to seasoned executives in business, government, academia, and consulting. Our goals are to:

- provide useful, how-to information on current best practices
- share new theories and their applications
- report emerging trends
- address relevant and pivotal issues to the field."

### Technical Training Magazine (TTM)

"Technical Training magazine, published by ASTD from 1990 to 1999, is the print-based predecessor to Learning Circuits. It covered news, trends, training techniques and technologies in the technical training arena."

## Methodology

The sample under investigation consisted of two publications from each of the two major professional development organizations for individuals working in training, ISPI (Performance Improvement Quarterly and Performance Improvement) and ASTD (Training & Development Magazine and Technical Training Magazine). Each publication was reviewed for three calendar years -- 1997, 1998, and 1999. Only the informational articles were reviewed from each issue; book reviews, brief notes, editorials and commentaries, and indexes and bibliographies were not included in the review. The publications contained 800 articles of all types, 700 of which met the criteria of informational articles for the review. The issues reviewed for each publication were:

- Performance Improvement Quarterly, Volume 10 (1997) Issues 1-4; Volume 11 (1998) Issues 1-4; Volume 12 (1999) Issues 1-4;
- Performance Improvement, Volume 36 (1997) Issues 1-10; Volume 37 (1998) Issues 1-9; Volume 38 (1999) Issues 1-10;
- Training and Development, Volume 34 (1997) Issues 1-12; Volume 35 (1998) Issues 1-12; Volume 36 (1999) Issues 1-12;
- Technical Training Magazine, Volume 8 (1997) Issues 1-8; Volume 9 (1998) Issues 1-8; Volume 10 (1999) Issues 1-6.

Published articles were classified according to specific criteria which were derived from Klein (1997) and Dick & Dick (1989). Categories used in previous reviews include: case studies, evaluation reports, descriptive reports, literature reviews, empirical research, procedural how-to, and others. Klein used four categories to review the articles published in ETR&D, the article which provided the framework and basic methodology for this review. Those four categories were collapsed, due to the small numbers found of empirical research and case studies, to three categories rather than four: empirical research (including case studies, which are in fact a type of empirical research), descriptions or descriptive reports (do not contain data and are not based in the literature), and literature reviews.

Inter-rater reliability was measured by comparing independent assessments of a subset of the articles reviewed for the study. Twenty-five articles, including at least one from each category, were reviewed separately by the authors, and the assessments compared. It was not possible to review at least one of each type for each publication as two of the publications were not well-distributed in terms of article types. The authors agreed on 23 of 25, and the inter-rater reliability value was .92.

## Results

Table 1 shows how many empirical studies, literature reviews, descriptive articles, and editorials were published in the four journals from 1997-1999. These data show that most of the articles published in the four journals were descriptive reports that did not contain data. Articles that included data based on empirical research accounted for only 7% of all articles included in this study. Most of these empirical studies were published in *PIQ*.

*Table 1. Numbers by types by publication:*

	Empirical Research	Literature Review	Description / Discussion	Editorial / Commentary	Totals
PIQ	37	33	31	24	125
PI	14	11	173	80	278
T&D	05	01	275	01	282
TTM	00	00	101	03	104
Totals	56	45	580	108	789

## Implications and considerations

The intent of this study is to provide information on the content of the professional publications useful for a broad audience, ranging from graduate students preparing for successful careers in Instructional/Performance Technology, professors working to prepare tomorrow's performance professionals, as well as current practitioners and their managers, with information to help them select the professional publications that best fulfill their development needs. Assessing the current status as well as annual trends provides data to those who must determine how to spend their, often scarce, resources for employee or student professional development.

There is no intent to compare these publications to each other, or to compare the organizations themselves. It is important to note that this is not a call for these organizations to publish the type of scholarly articles found in journals like ETR&D. However, a basic level of quality is still required in order for these journals to actually provide good material for professional development, and data (focus on results) is essential for this.

The data as collected and reported provide critical information for professionals in the ID/PT/IT field: The astonishing lack of data impact the credibility and respect of all practitioners in the field. If performance accountability does not start with performance experts, how can it start with anyone else? There are implications for faculty in Instructional Technology programs, because those faculty members develop and teach curricula that must include robust courses and experience in evaluation, in order for practitioners to be better trained to complete evaluations and report data routinely.

## Conclusion

Data, accountability, and credibility in ID/IT – practitioners can gain credibility and earn respect by collecting, responding to, and publishing the data from projects. Those who demonstrate this level of discipline and are willing to be accountable at the same levels of other professionals can begin the turn around.

As consumers of training become better educated about what training / instruction is and what they should expect from it, standards will rise for practitioners. Those who lack skills and knowledge necessary to routinely develop and evaluate performance-based training may find themselves in drastic career straits once the customers (the learners / trainees) and performance-owning managers begin to expect training and performance interventions to work well. Data is part of the fundamental ID process for adding value; it provides a foundation for continuous improvement. The critical nature of expertise and the power of process is captured by the following paragraph:

Perhaps the greatest strength of the ISD process is the evolutionary nature of the prescriptive, research-based model itself. While the practice of ISD still retains the strengths of the empirical evaluation and revision cycles, to the extent research and experience permit, it is prescriptive. That is, rather than depending extensively on the test-revision cycle to generate effective instruction in an iterative manner, every attempt is made to incorporate research findings and past experience into the detailed procedures and supporting ISD documentation to ensure that the instruction developed comes as close to the mark as possible the first time. This improves the validity of the process while also improving reliability. This has proven to be a powerful tool in large scale ISD. In addition, as the process provides more data from the constant evaluation process, the procedures can be continually improved.

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# Effect of Time and Level of Visual Enhancement in Facilitating Student Achievement of Different Educational Objectives

Frank Wilson  
Strategic Management Group, Inc.

Francis Dwyer  
Pennsylvania State University

## Abstract

*The purpose of this study was to determine: a. how different types of dynamic visual facilitate the achievement of specific types of educational objectives, b. whether the use of dynamic visualization influenced the amount of time needed by learners to process the information, and c. whether there is an interaction between the amount of time learners view the animation and the different levels of dynamic visualization. Two hundred students were randomly assigned to four treatments, received their respective instructional presentation and received four individual criterion measures. Results indicated that insignificant differences in achievement existed among the visual treatment groups on all criterion measures and that an insignificant interaction was found to exist between time and dynamic visualization.*

## Introduction

Visualization properly designed, and positioned in instructional presentations has been found to be an important variable in facilitating student achievement of different types of educational objectives (Dwyer, 1978). However, the use of visualization alone, while it can significantly improve achievement, does not always optimize achievement of the more complex types of learning outcomes (Dwyer, 1987). Static visuals in and of themselves are limited in their ability to instigate the higher levels of information processing since at best they represent suggested motion attributes in dramatic form (Reiber & Kini, 1996). Park and Hopkins (1993) have suggested that dynamic visual displays which utilize graphic movement in visualization to identify, interpret and reduce the level of abstraction will facilitate higher levels of information processing and lead to higher levels of achievement. It is assumed that the static visuals and narration along with increased animation would provide additive codes leading to more effective encoding and knowledge transfer of the information being presented. It was also anticipated that the use of animation (changing color, motion, etc.) in static visuals would focus learning attention more precisely, facilitate focused interaction and thereby result in improved learning outcomes. Additionally, an increased interaction with the content materials would necessitate an increased amount of time required for learners to interact and process the information being presented. Carroll (1963) reports that the amount of time required would be proportional to the complexity of the visualization, the types of animation and the level of learning to be achieved. Specifically, the purpose of this study was to: a. determine how different types of dynamic visuals facilitate the achievement of specific types of educational objectives, b. determine whether the use of dynamic visualization influences the amount of time needed by learners to process the information and c. determine whether there is an interaction between amount of time learners view the animation and the different levels of dynamic visualization.

## Methodology

The 2000 word instructional unit used in study was intended to instruct learners on the nomenclature of the heart, and the functions of the various parts of the heart during its systolic and diastolic phases. The lesson included 19 separate "instructional frames" comprised of sound and graphics elements. Each "frame" was accompanied by some audio narration that described and supported the visual being shown. In this case, it identified and described the parts of the heart and their functions. The lesson allowed the learner only one pathway (a linear progression) through the lesson, so that the 19 instructional frames comprising the lesson were presented to all students in a fixed sequence. Within each instructional frame there was a fixed sequence of audio and visual components. Macromedia Director was chosen for development and delivery since there was a need for the simultaneous presentations of audio narration and dynamic visual elements. For each of the 19 frames, the appearance of the graphic was followed by five seconds of silence, then by the appropriate narration. Following the narration the

student was given an opportunity for silent reflection. Depending on the timing treatment, this post-narration time was either 8 seconds ( $T_1$ ) or self-paced, ( $T_2$ ). A stop-watch script was written into the instructional program, which recorded each student's reflection time. The watch began automatically at the end of the narration for each frame. Simultaneously, a button appeared in the frame entitled "Continue," which the student could mouse-click at any time to move on to the next frame of instruction.

Prior to the instructional unit, the participants were given a brief orientation to the study, which explained its purpose, and informed them about the use of the silent time during each frame. It was explained that: 1) the silent time preceding the narration was designed to familiarize them with, and orient them to the new features presented in the new visual, 2) the audio narration, to communicate the instructional message, or content for the frame, and 3) the silent time following the narration, to allow a time for reflection and rehearsal. The participants also were asked to follow this strategy carefully and consistently throughout the learning module. The orientation also informed the student about the testing procedure as well as the approximate time it would take to complete the experiment. They were asked to place their complete focus on the learning at hand and to participate as fully as possible in all aspects of the learning and testing experience.

### **Instructional Time ("T" Variable)**

The instructional time variable examined how enhancements such as dynamic visualization in instruction, affected the length of time students' needed to "attend to" (study) the additional visual cues, or details. Each of the dynamic visual strategies added visual information that the learner was required to process. For the purposes of this study, pre-narration time and narration time remained constant across the treatments. Pre-narration time – when a new visual appeared, five seconds of silence was given for students to orient themselves to the components of the new visual before the narration began. Since all subjects were given this period of orientation prior to the narration, it was considered a constant. Narration time – although the timing for the narration varied from scene to scene, depending on the complexity of each explanation, it was identical from treatment to treatment. In other words, each student receiving instruction spent an equal time listening to the narrative. Therefore, narration time was considered a constant. Post-narration time – for the purposes of this study, only the period of time that followed the narration was manipulated. The students were directed to use this time to scan the visual and to reflect upon the information presented by the narration. Students were randomly assigned to one of two timing treatments.

1.  $T_1$  – Timing Treatment #1 – 8 seconds:

Post-narration time equaled 8 seconds for all frames. Once the 8 seconds elapsed, the instructional program automatically advanced to the next frame of instruction.

2.  $T_2$  – Timing Treatment #2 – self paced:

Post-narration time was controlled by the learner. When the narration for the frame was finished a "continue" button appeared on the screen. At this point, the student could study the current visual for as long as needed, and click on the button to proceed to the next frame. For this self-paced treatment, study times were recorded for each learner for each frame.

### **Treatments - Visual Enhancements ("V" Variable)**

1.  $V_1$  – Still Graphics (Control): The Control Group treatment contained 19 static visuals frames consisting of colored line drawings of the human heart. These simple illustrations contained character-generated words on the screen in combination with arrows and labels that identified the elements being presented in the narration.
2.  $V_2$  – Progressive Reveal: Progressive Reveal was a dynamic visual enhancement that entailed a sudden color change in, or a sudden addition of graphic elements. Location of the animation enhancements in each treatment was based on item analysis conducted by Torres (1990). A sudden color change was intended to draw the learner's attention (cueing) to that part of the graphic being discussed in the narration. In the heart presentation, whenever an element of the graphic is mentioned, or described, the viewer's eye is drawn to that element by a sudden change in color in the element. The sudden additional of an arrow during narration represented either the direction of some movement (blood flow), or of some hidden pressure that occurred in the heart. The Progressive Reveal is intended to help the learner locate the important elements within the whole, and to ignore the extraneous detail. Progressive Reveal was intended to improve student's abilities on identification, terminology and comprehension test items that require students to recall names of parts or functions.



3.  $V_3$  – Animation: Animation was a dynamic visual enhancement that generated graphic motion simulating the mechanics of the real world, such as the flow of blood, or motions of the valves, muscles, and other moving elements of the heart. This dynamic visual display added the element of motion, which was intended to graphically demonstrate the movement of parts or the flow of blood through the heart, as it was being described in the audio narrative. Animation was intended to promote learning at the conceptual and rule level. The animation treatment would most benefit students on terminology and comprehension questions that recalled information related to motions, operations, processes, functions and how they were interrelated.
4.  $V_4$  – Animation and Progressive Reveal: This treatment combined the elements of Progressive Reveal and Animation described above. This combination of dynamic visual elements attempted to focus students' attention on relevant details and on the movements, operations, processes, and functions inherent in the elements being described by the audio narrative. When used, this combination of methods was intended to give the student a more comprehensive understanding of the interrelationships between the parts and functions of the heart.

Each enhancement described above was assigned to a frame on the basis of its value for supporting certain instructional objectives articulated in the narration for that frame. In other words, the Progressive Reveal treatment only was used when the narration identified, described, or named parts or functions of the heart, while the Animation treatment only was used when the narration described some movement, flow, or process.

*Table 1. Summary of Visual Enhancement Strategies*

Treatment $V_1$ (control)	Narration, Color Heart Drawings, Labels
Treatment $V_2$	Treatment, Color Heart Drawings, Labels, and Progressive Reveal
Treatment $V_3$	Narration, Color Heart Drawing, Labels, and Animation
Treatment $V_4$	Narration, Color Heart Drawings, Labels, Animation and Progressive Reveal

During the presentation of one of the three visually enhanced treatments, the selection and use of that particular visual enhancement strategy was synchronized with the audio narration during any instructional frame, or any portion of a frame, according to the following criteria:

Throughout Control Treatment  $V_1$ , still graphic images were employed throughout the presentation. A total of 19 images were employed. For Frame #18, which described the Systolic Phase (in which the heart exhibits two distinct movements), two still images were presented consecutively. In treatments  $V_2$  and  $V_4$ , the still graphics were enhanced by the addition of Progressive Reveal. Whenever parts of the heart were being introduced, described, or identified, the parts and their labels would suddenly change color to attract the learner's attention to those elements. In Treatment  $V_2$  and  $V_4$ , arrows appeared as needed to show the direction of some movement or force. During Treatments  $V_3$  and  $V_4$ , animation was used only during those frames, or portions of frames that describe motion, including the contraction of the heart, the movement of internal parts of the heart, or the flow of blood from chamber to chamber. During Treatment  $V_4$ , both still and animated frames were enhanced by the addition of Progressive Reveal as needed when the narrative introduced, described or identified parts or areas of the heart. As in Treatment  $V_2$ , this enhancement involved a sudden color change for the part and for its corresponding label.

### **Criterion Measures**

The dependent variables used in this study were the achievement levels of students on specific learning objectives. Achievement of the specific learning objectives was determined by the following criterion measures (Dwyer, 1978, 45-47)

**Drawing Test (20 items):** This test consisted of a numbered list of twenty items (naming the parts of the heart) depicted in the instructional unit. The students were asked to draw a reasonable facsimile of the human heart, and to place the number corresponding to each item in its correct location on the drawing. Emphasis was placed on the accurate positioning of the numbered items, not on the quality of the drawing. The drawing test was intended to

assess the students' ability to reproduce or reconstruct the heart and to maintain the appropriate special and contextual relationship between and among the various parts.

Terminology Test (20 items): Given five choices in each item in a multiple choice test, learners were required to select the part or function of the heart described in each item. This test was designed to measure a student's ability to choose the appropriate graphic representation of a part or function, given an abstract definition or description. This related to knowledge of facts, terms, and definitions, which would be needed as prerequisites for the learning of concepts, rules, and principles, the higher intellectual skills, which would entail more complex levels of learning abstraction.

Comprehension test (20 items): Each question described the activity in a certain part of the heart, at a single moment in the cycle of the heart's movements. It required students to show how another part (or parts) would appear at that same moment by selecting an illustration which most accurately represented that condition. This test required students to have a thorough understanding of the heart, its parts, its sequence of movements and cycles, its simultaneous processes, and the relationships between and among the parts of the heart at critical moments during its cycle of activity. This test was intended to measure a students' ability to apply the facts, concepts, rules, and processes presented in the instruction.

In the case of the Drawing Test, Dwyer's original version (1965) was used. The visual version of the multiple choice tests for identification, terminology, and comprehension were taken from Dwyer (1985). In each case, the item stems were textual, while the options were visual (line drawings).

Total Comprehension Measure (80 items): This score was obtained by adding the scores for all four tests into a total test score. It was intended to provide a comprehensive assessment of the learner's overall understanding of the content presented.

### Experimental Design

The study utilized a randomized, post test only, control group design. Each of the four visual treatments was tested against the two timing patterns in a 4 (visualization) x 2 (timing) mixed factorial design (Campbell & Stanley, 1966). Each of the eight treatments were subjected to five separate post-tests, or dependent measures. In Table 3, the post-tests are represented by  $O_1$ ,  $O_2$ ,  $O_3$ ,  $O_4$ ,  $O_5$ , which refer to Drawing, Identification, Terminology, Comprehension, and Total Comprehension tests, respectively.

Table 2. Mixed Factorial Design

Timing (T)	8-Second (T1)	Self-Paced (T2)
Visualization (V)	$V_1T_1$	$V_1T_2$
Still Images – Control ( $V_1$ )	$V_2T_1$	$V_2T_2$
Animation ( $V_2$ )	$V_3T_1$	$V_3T_2$
Graphic Reveal ( $V_3$ )	$V_3T_1$	$V_3T_2$
Animation and Graphic Reveal ( $V_4$ )	$V_4T_1$	$V_4T_2$

Table 3. Combinations of Treatments and Post-Tests

Tests (O) Treatments (V&T)	Drawing ( $O_1$ )	Ident. ( $O_2$ )	Termin. ( $O_3$ )	Comp. ( $O_4$ )	Total Comp ( $O_5$ )
$V_1T_1$	$V_1T_1O_1$	$V_1T_1O_2$	$V_1T_1O_3$	$V_1T_1O_4$	$V_1T_1O_5$
$V_2T_1$	$V_2T_1O_1$	$V_2T_1O_2$	$V_2T_1O_3$	$V_2T_1O_4$	$V_2T_1O_5$
$V_3T_1$	$V_3T_1O_1$	$V_3T_1O_2$	$V_3T_1O_3$	$V_3T_1O_4$	$V_3T_1O_5$
$V_4T_1$	$V_4T_1O_1$	$V_4T_1O_2$	$V_4T_1O_3$	$V_4T_1O_4$	$V_4T_1O_5$
$V_1T_2$	$V_1T_2O_1$	$V_1T_2O_2$	$V_1T_2O_3$	$V_1T_2O_4$	$V_1T_2O_5$
$V_2T_2$	$V_2T_2O_1$	$V_2T_2O_2$	$V_2T_2O_3$	$V_2T_2O_4$	$V_2T_2O_5$
$V_3T_2$	$V_3T_2O_1$	$V_3T_2O_2$	$V_3T_2O_3$	$V_3T_2O_4$	$V_3T_2O_5$
$V_4T_2$	$V_4T_2O_1$	$V_4T_2O_2$	$V_4T_2O_3$	$V_4T_2O_4$	$V_4T_2O_5$

## Result and Discussion

Table 4. Mean Scores Achieved by Students on Each of the Criterion Tests

			Draw.	Ident.	Term.	Comp.	Total Comp.
Group	Treatment	N	Mean	Mean	Mean	Mean	Mean
V1	Static	50	17.50	17.72	14.06	13.16	62.44
V2	Progressive Reveal	50	15.78	17.40	13.20	12.76	59.14
V3	Animated	50	16.78	17.80	13.42	12.62	60.62
V3	Combined	50	16.12	16.96	12.90	12.26	58.24

ANOVAs conducted on the individual and total criterion measures indicated insignificant differences in achievement among the visual treatments. Significant differences in favor of the self-paced treatments were found to exist on the Drawing ( $F=6.81$ ,  $d_f=1/2$ ,  $p<.05$ ) and total Criterion Measures ( $F=4.59$ ,  $d_f=1/2$ ,  $p<.05$ ).

Table 5 presents the study times interacted with their respective treatments. Insignificant interactions were found to exist between the visual treatments and time on all criterion measure.

Table 5. Study Times (Means)

Group	Treatment	T <sub>1</sub> 8-Second	T <sub>2</sub> Self-Paced
V <sub>1</sub>	Static	152 sec.	173 sec.
V <sub>2</sub>	Progressive Reveal	152 sec.	190 sec.
V <sub>3</sub>	Animated	152 sec.	249 sec.
V <sub>4</sub>	Combined	152 sec.	170 sec.

The results of this study indicated that the types of animation strategies employed provided insignificant differences in student achievement on the types of criterion measures measuring achievement of different types of educational objectives. The study also found that timed sequences were most efficient in terms of amount of time students spent interacting with the visualized treatments. These results implied that, at least for this group of learners, static visualization was sufficient to facilitate learning. This contradicted the current ideas and trends concerning the selection and use of animation in educational and learning environments.

A number of possible explanations may be suggested: (a) students were not properly oriented to the importance of the animation and thereby were not prepared to profit from the information being provided, (b) the experimental environment, itself, motivated all students, so that the control students interacting with the static visuals achieved as well as the students receiving the animated visualization, (c) the animation employed may not have been sufficiently intense so as to instigate the levels of information processing necessary to move the information from short term into long term memory. Finally, (d) the high cognitive abilities of the students involved may have pre-empted the need for dynamic visual support. Consequently, the students may not have worked conscientiously to integrate the animated information into higher levels of cognitive attainment (Rieber & Keni, 1991). In actuality their attention to the dynamic visualization may have impeded rather than facilitated the required levels of information processing.

It is also important to report that studies conducted by Lumsdaine, Sultz, and Kopstein (1961) and May & Lumsdaine (1958) have indicated that animation, which is being used primarily to enhance the attention focusing or realism of a presentation, does not have a significant effect on learning. Anglin, Towers, and Levie (1996) have indicated that some progress is being made on visualization in facilitating knowledge acquisition, knowledge integration, and knowledge generation.

Considering the relationship between cost of producing different types of graphics and their relative effectiveness in promoting learning, this study demonstrated that, in some cases, still images can be as effective as more-costly animations. Hopefully, this will stimulate additional work into this important area of research.

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# The Effects Of Trained Moderation In Online Asynchronous Distance Learning

David Winograd  
State University of New York College at Potsdam

## Abstract

*Online computer conferences used to assist distance learning courses often fail because the moderator—usually the instructor responsible for the conference—is not properly trained in techniques that build a community of learners. It has often been assumed that the skills required to create a vibrant classroom discussion translated easily to an online forum. This has been rarely the case.*

*This study utilized the qualitative methods of grounded theory and narrative research to explore how a moderator, after undergoing training, would affect students in one of three segregated computer conferences supporting an online course. The training was based on both the academic literature on educational computer conference moderation and situational examples taken from the experiences of online moderators. The students' experiences with the trained moderator were compared with those students in the other two computer conferences without a trained moderator. The data analyzed were comprised of the messages collected from the three computer conferences, selected interviews, extensive journals written by the researcher, and an online survey.*

*The study also considered the problems and pressures stemming from unclear policies for constructing an online course in an environment of overlapping departmental mandates. These mandates resulted in more emphasis being given to putting courses online than the choice of the most appropriate pedagogy.*

*The results indicated that a trained moderator had a positive effect on computer conferences as a community of support and warmth was built; while another group, without such a moderator, constructed a community based on group dissent. No community of any sort was found in the third group.*

## Overview of the Problem

The rush to get online can find teachers in the position of having an excellent command of classroom pedagogy but without a full complement of the skills needed to make the most of the technologies and conventions of online distance learning. It is not unusual for there to be no clear policy to educate teachers in this regard. Frequently asynchronous Internet courses contain a computer conference wherein the class can communicate with each other. A computer conference is used as an online equivalent of classroom discussion, a place where students can participate in collaborative work and carry on other activities. Historically, the moderating of such conferences have been the responsibility of the teacher or assigned to a student to manage (Murphy, Cifuentes, Yakimovicz, Segur, Mahoney, & Kodali, 1996). An incorrect but frequently made assumption is that the ability to lead an exhilarating classroom discussion translates well to leading an online discussion. A common occurrence in computer conferencing is that the teacher poses a few questions to the group, and no one responds. Often, the conference becomes unused to the bewilderment of the teacher. Managing interaction in a distance learning environment requires different skills than in a traditional classroom (Inman & Kerwin, 1999).

It is widely assumed that students will use an online conferencing system just because it is available. This is not the case. The Apple Classroom of Tomorrow study put computers in schools for ten years as an exploratory experiment. Researchers believed that merely having technology available would increase learning. They were disappointed to find that it did not. Instead, they found that technology, by itself, does nothing. Rather than being a panacea, technology should be regarded as nothing more than a tool that has the potential to enhance innovative thinking (Sandholtz, Ringstaff, & Dwyer, 1997). It is the same with Internet based instruction.

Students often experience isolation due to the lack of the usual social aspects of a classroom (Ahern, 1995). The immediacy of interactions between instructor and student as well as among students is diminished because asynchronous communication can take days or even weeks between the time a question is asked or a point is made, and the student receiving feedback. This time lag can leave students feeling ignored (Eastmond, 1995). Attrition in distance learning courses is higher than their face-to-face counterparts, sometimes much higher (Carr, 2000; Cheng, Lehman, & Armstrong, 1991; Jewett, 1997; Noble, 1998). Studies report that completion rates of students in traditional face-to-face classes can be as high as 60% greater than online classes. This determined that the use of trained moderators did alleviate a number of these problems.

## Intent of the Study

The intent of the study was to explore how the use of a trained moderator affected both the students and instructor of an Internet based distance learning class. The moderator underwent training based on academic literature on educational computer conference moderation and examples taken from the experiences of online moderators.

## Limitations of the Study

The limitations of this study were broad and affected the generalizability of its findings. The study involved one course given over one semester. The students involved were unique individuals each taking the course for different reasons. The woman that volunteered to be the trained moderator was under a set of pressures unique to her particular circumstance. The instructor utilized one form of Internet based distance learning that had strong similarities to a correspondence course. There are many other ways of constructing a distance learning course. The specificity of what transpired in the course had a strong bearing on the generalizability of the findings of the study. Qualitative research does not purport to generate universally generalizable findings, but rather to discover and uncover a set of observations, processes, and theories that other researchers can transfer to similar research problems in other situations and fields (Charmaz, 2000; Eisner, 1997).

## Writing Myself In

In an interpretive study, such as this, all aspects of the study are filtered through the eyes of the researcher, which in this case was myself. Therefore, it has been common practice to make the interpretive process explicit (Bailey, 1996). Instead of seeming to be a neutral observer without bias, Piantanida and Garman (1999) suggested that it was incumbent upon the researcher to expose biases of the researcher by discussing why the study was personally compelling. Along with disclosure of the research process, personal disclosure helps the reader gain an understanding of my point of view and why certain decisions and interpretations were made. A discussion of what brought me to this work clarifies my point of view as it affected this study.

I have been online since the early 1980s when I bought my first computer, an Apple ][+ along with a 300 baud modem. At first, what I found was not only disheartening, it was also boring. In northern New Jersey, the BBS world was inundated with vanity and inanity. Boards were mostly run by spoiled upper middle-class boys between the ages of 14 and 16 who used the venue to pump up their egos. The systems were rife with the collection and transfer of illegal MCI telephone card codes.

The idea occurred to me that a BBS could be a warm and friendly place, appealing to a different group of people than kids skirting the law. I developed the idea of a digital restaurant where people could visit and discuss the news of the day or anything else they had in mind, in a supportive, non-threatening environment. There would be no flames (personal attacks) nor would there be pirating of software. I felt that my bulletin board should reach out to the user, not the other way around, and attempt to be an oasis of intelligence in the suburbs. I bought some BBS software and learned how to twist and turn it into a restaurant named `*+ DAVID'S PLACE +*`.

When a user logged on, he or she was greeted at the door by a loquacious Maitre'd who profusely welcomed the new user. The user, who was referred to as a guest, was met with a description of the restaurant in paragraphs of purple prose that included everything from the pile of the carpet to the richness of the oak walls. The guest was then seated at a table and proffered the menu, which contained the options that were available for ordering. These, naturally enough, were the features of the BBS software. I was Chef David, who bounded out of the kitchen and again welcomed the guest. My persona was written into each prompt and instead of the usual unfriendly response of `?` or SYNTAX ERROR, the software, when it did not understand a response would display something along the order of,

I APOLOGIZE BUT THE BROWNIES JUST BURNED AND THE SMOKE FROM THE  
OVEN GOT IN MY EYES SO I COULDN'T MAKE OUT WHAT YOU WERE SAYING.  
WOULD YOU REPHRASE THAT?

I advertised the BBS on some other BBSs and waited for the phone to ring. I did not wait very long. In a matter of weeks, word somehow got out and I had to devote my Apple ][+ to the BBS and buy myself a second computer because `*+ DAVID'S PLACE +*` quickly became busy around the clock. A core group of guests were formed, and after being prompted a bit, engaged in discussions on a fairly high plane. The group quickly coalesced into a kind of round-table that did not easily suffer idiots.

I learned that telecommunication was a wonderful medium for building powers of persuasion, organization, and thought. I found that when one wrote a message it tended to be well composed because the process of thinking, typing, and reading turned people into editors who reflected on their thoughts before making them public. There was also an implicit standard of quality that was not taken lightly by the guests. My BBS gave people the opportunity to use telecommunication in a supportive and mentally stimulating atmosphere. Frequenting the BBS taught many people who previously were unfocused and disorganized in their writing, how to write and write well. Through the use of my BBS, I gave many people a reason to become interested in computers and who, years later, wound up with computer science degrees and jobs in the computer industry.

Finding ways to manage personal conflicts and heated arguments among guests did not come easily or naturally. I found myself experimenting with a combination of private email and publicly written messages to douse verbal flames, as some of the stronger, quicker, but painfully antisocial writers tried to rout other guests. This was my first taste of moderating online conferences, I went about it totally through trial and error. Although there were times I came close to just turning off the modem, I considered it a worthy challenge. The experience taught me about using language to manipulate. Manipulate is a charged word. According to the Merriam-Webster dictionary (1998) it can mean, “a): to manage or utilize skillfully” or “b) to control or play upon by artful, unfair, or insidious means esp. to one’s own advantage” (p. 708). I preferred the former and used the word in that positive context in this study.

I decided to shut it down when it started to feel like more work than play and quickly found myself on the CompuServe Information Service’s MAUG (Micronetted Apple User Group) forums. Eventually I became SysOp (System Operator) of the Macintosh Community Clubhouse Forum (MACCLUB). This forum was languishing and had nothing to recommend itself aside from being the place that housed the classified advertisements. It logged an average of seven or eight messages per day. I saw it as an opportunity to reincarnate \*+ DAVID’S PLACE +\* on a larger scale, so I restructured the forum by getting rid of the dusty ill used message topic sections and libraries and filled it with things that excited me and that I felt would excite the Macintosh community.

After a few weeks, an average day brought over 100 posted messages. After a few months a typical day brought 250 messages which, during periods of heat and passion, grew to over 500 postings daily. This was a very creative and exhilarating time for me. I quickly learned what worked and was quick to change anything that did not work. Under the basic rule, it was allowable to attack ideas posted in a message but it was not allowable to attack the person who wrote the message. This basic rule prevented many online flames but when a flame did occur, it took creativity and wit to quell it without resorting to banishing the offending writer from the community. No one was ever sent away. My 15 years of involvement online taught me much about what builds or destroys online communities.

I decided to rejoin academia and began to read the research on educational computer conferencing written over the same 15-year period. I was not surprised to find that most researchers had discovered exactly the same concepts through research that I had found through practicing my hobby. After returning to academia I soon realized that I did not have the time to devote to the community, so I ceased being its moderator.

Most people who have moderated online conferences learned by observing other moderators and then through the trial and error of doing it (Berge & Collins, 1998; Collins & Berge, 1997). At the start of my doctoral work, a vague and shapeless idea occurred to me that learning how to moderate by trial and error was very inefficient and that the skills of a moderator were something that could be taught. As I progressed through my program of study and learned more about distance learning in the context of Internet based delivery and computer conferencing my ideas clarified and resulted in this study.

## **Research Procedures**

### **Qualitative Research**

This study used a variety of qualitative analysis techniques to attempt to clarify a series of situations that, during data collection and analysis, widened in scope and complexity as new issues arose and became integral to the story. Miles and Huberman (1994) maintained that qualitative research is more of a craft than a set of rules and that no study conforms perfectly to a predetermined methodology. Any methods that afford clear and “credible meaning from a set of qualitative data is grist for our mill regardless of its antecedents” (p. 3).

Attempting to define qualitative research is a bit like trying to describe smoke. It seems easier to explain what it is not than what it is. According to Savenye and Robinson (1996) it is marked by rich and detailed descriptions of the behaviors of people who, in their actions, construct their own realities that influence the meaning of their actions. It questions just what is going on and what variations can be found in the phenomenon being examined (Lofland, 1971).

### **Participants and Conference**

The students were 30 upper level undergraduates enrolled in ICJ-450, Implications of Supreme Court Decisions on Law Enforcement at a large Southwestern University. The gender distribution of the class was 21 women and 9 men. I decided to break the class into three conferences that were called law firms due to the context of the subject matter. Each conference was restricted to reading and responding to messages within the particular conference assigned to the student. The initial design called for one conference to be lead for the entire semester, by a moderator who would undergo training consisting of both face-to-face training and a written job aid of my design. For the other two conferences, one student each week would be assigned the job of moderating. Due to the Instructor failing to communicate with students regarding moderating the two conferences without a trained moderator, most weeks, any moderating activities in these conferences was ad-hoc. The class used the FirstClass conferencing system.

### **Structure of the Course**

The way that Stanley Pike, the Instructor, structured the course was not very conducive to interaction. Each week the students were required to read a number of supreme court decisions, answer questions about them and send the results back to the Pike who would send a one line email detailing if the work was sufficient or needed to be redone. There was no student-student interaction built into the course and the student-teacher interaction was quite minimal. The course was conducted via distance once before I got involved and the conferencing, although there was presented as something for the students to use if they chose. The messages may or may not be read by Stanley. The result was a total of four messages written over the entire semester from a class of approximately 30 students.

### **Data Collection**

Data were collected from 763 online messages, which were written by the members of the three segregated computer conferences. My role was that of an observer. Throughout the study I wrote detailed memos explaining the process and my perspectives on what had transpired. Detailed coding memos were also written as the data were analyzed. Data were also provided by email and phone conversations between myself and the trained moderator; Rob Janesh from the College of Distributed Education; Barbara Malik, the technology support analyst from the School of Legal Services; and Stanley Pike, JD, the instructor of the course. After the end of the course I conducted audio taped interviews with each of these people; the transcription of the tapes added to the data. Near the end of the course, an online survey was completed by 22 of the 30 students who finished the course.

### **Data Analysis**

I used a combination of grounded theory and narrative analysis to interpret and describe the data. The thrust of grounded theory is toward developing theory without regard to the type of data, or lines of research, which makes it not a method or technique, *per se*. Instead, it is a "style" of engaging in qualitative research that includes a number of distinct features and guidelines, such as using constant comparisons and a paradigm of coding to ensure the development of concepts (Strauss, 1987). In assessing a grounded theory, the research process must be explicated and conform to the rather broad requirements of the constant comparative method such as engaging in comparisons between data as soon as data is collected. For the study to be considered adequate, the resulting theory should fit the phenomenon studied and be general enough to broadly cover a range of situations (Wells, 1995).

Although grounded theory began as a postpositivist mode of inquiry, when it is subjective and relativist, grounded theory can evolve to fit a constructivist perspective (Anells, 1996). Charmaz (2000) proposed a constructivist approach to grounded theory that does not attempt to find truth that can be generalized, instead its use is to generate concepts that can be transported to similar problems in other fields. An interpretivist mode of grounded theory was used in this study. To assist me in the massive task of analyzing 763 text messages posted to the computer conferences, I coded using the software program QSR NUD\*IST. The acronym stands for Non-numerical Unstructured Data Indexing Searching and Theorizing (Qualitative Solutions and Research Pty Ltd., 1997). NUD\*IST is a program designed for the flexible storage, coding, retrieval, and analysis of text. Weitzman and Miles (1995) declared that it is one of the best software options available. They contend that the developers did a masterful job of determining and providing for the actions and features required for a wide variety of text analyses. After a sizable number of iterations of coding one major criteria emerged: 'What built or destroyed community'.

Narrative research refers to any study that analyzes narrative materials (Lieblich, Tuval-Mashiach, & Zilber, 1998). It is a form of qualitative analysis using plot and stories to describe events and situations and has a variety of meanings and procedures dealing with how protagonists interpret things (Bruner, 1990; Riessman, 1993).



Polkinghorne (1995) divided narrative research into two classes: paradigmatic and narrative construction. Narrative construction is not merely a retelling of the actions and thoughts of the protagonist; it attempts to bring meaning and significance to them. The researcher, in this form of narrative inquiry, is the narrator who tells the story in his or her own voice. The paradigmatic type of narrative research produces knowledge of concepts that classify instances to categories with shared common attributes. Paradigmatic narrative research has apparent similarities to grounded theory. Often referred to as analysis of narrative, the researcher inspects a number of stories to discover connections and similarities between them.

The presentation of analysis of narrative often takes the form of extended quotations from unedited data, along with the stories leading up to the data, and attempts to analyze what took place through the perspectives of the commonality emergent from the data under study and varied other data. This study uses both types of narrative.

## **Struggling Toward the Firms**

The course almost didn't get offered due to serious medical problems experienced by the Instructor which prevented any preparation or moderator training before the first day of class. A grad student that I was promised to take on the role of the moderator dropped out and I was left with trying to convince a student to take on the daunting task of moderating. Mimi Denomme did volunteer but a month passed before the training could take place due to her out of class responsibilities. She had three small children, a full time job and was taking three other classes. This gave her next to no time for moderating. I was quite frustrated and disappointed with the amount of time and effort that Mimi devoted to moderating, but I certainly understood the underlying reasons for this lack of participation.

Stanley Pike was not sold on the idea of interaction being a long time lecturer who easily fell into the correspondence course model of distance learning. He neither received or solicited any training in the differences between a face-to-face course and one conducted at a distance. Stanley felt that he had put enough time into the course by being required to send short emails.

It was a full month after the start of the course before the conferences started, and two weeks after that that I convinced Stanley that a participation requirement was a critical component of conferencing. Hacker and Wignall (1997) observed that participation of students with low degrees of computer experience declined significantly over time. Therefore, a minimum level of participation should be mandated at the start of the conference. This can be accomplished either by establishing a written or verbal contract between the moderator or teacher and the students (Rohfeld & Hiemstra, 1995). Eastmond and Ziegahn (1995) maintained that along with mandating a certain number of messages per week, that there be standards established for the quality and relevance of the messages. They suggested that participation accounted for 30% of the course grade. It has also been proposed that the amount and quality of participation should be able to raise or lower assessment by a full letter grade (Cifuentes, Murphy, Segur, & Kodali, 1997). Many conferences take time to get established and spark general interest to the extent that the members need no incentive to post messages; therefore, it is important to establish a mandate to give the conference time to come into its own.

## **Results**

Mimi tried her hand at welcome messages for each of the three-conferencing spaces within her conference (Firm two). I decided that three spaces made sense from an organizational perspective and to eliminate confusion on where to post. What was developed was The Coffee Shop, a social space, The Board Room, a content oriented space and The Tech Room, a place for technical problem solving. Each of the other two groups only had one group space.

I gave Mimi feedback on my feelings on what would work and provoke discussion and what wouldn't. Soon we agreed upon three messages that would suffice.

The number of messages posted per week shed some light on the scope of the firms and serves a point of reference and departure.

*Figure 1. Total postings per week in each firm*

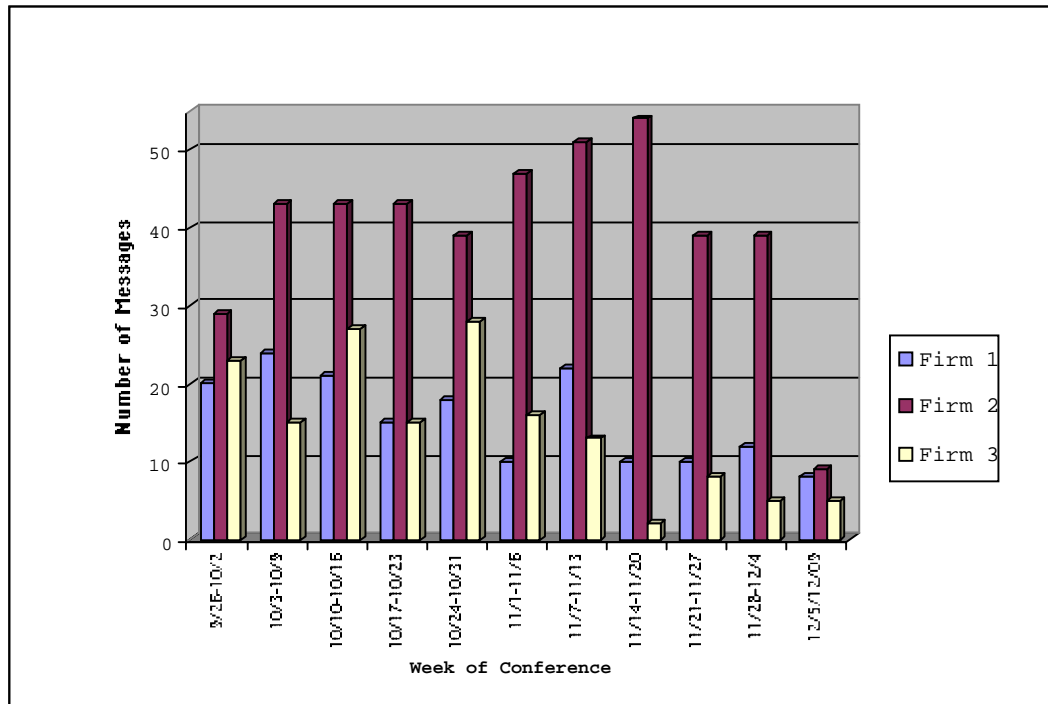
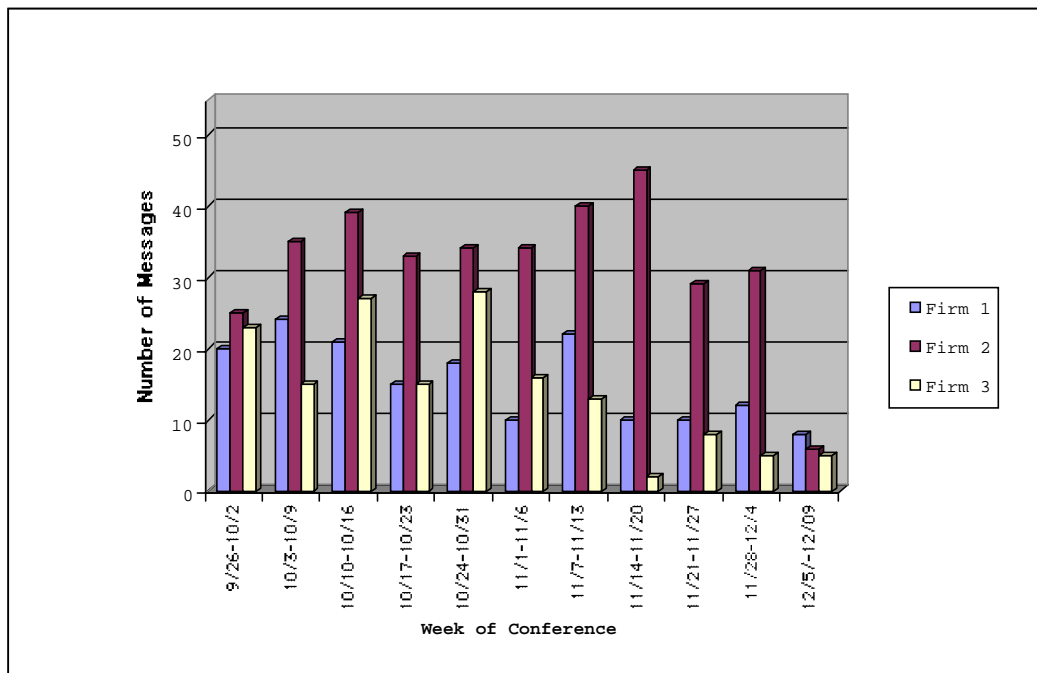


Figure one shows many more messages being posted in group two (the group with a trained moderator than the other two groups, but one might easily see a flaw in this by positing that the majority of messages were written by the moderator.

*Figure 2. Total postings per week in each firm with the moderator postings removed.*



Subtracting the firm 2 moderator messages from total messages still shows many more messages posted to firms two than in the other two firms. What happened in the firms to make such a difference?

### **Firm One**

At the start of data collection, firm 1 demonstrated no particular leadership. Messages were concerned with organizational issues such as questions dealing with due dates for assignments and questions regarding grading procedures. A number of people were confused regarding what was expected of them and how to find Supreme Court cases required for homework. There was one thread that went on for a number of weeks, soliciting employees for a security firm. This thread upped the message count considerably. Overall, there was no focus to this firm in the first few weeks. The threads were mostly concerned with asking single questions and receiving single answers. There was quite a bit of talk about how much harder the course was than what was expected, which also became a major concern in other firms.

Within a few weeks the firm evidenced a strong sense of pointlessness of participating in the discussions whether it was for credit or not. Since the firm was not in any way integrated into the class, the majority of participants considered it a waste of time and by the end of the course, the people who did participate, and that number dropped every week, were posting messages without any content just because it was a requirement.

DO NOT WASTE YOUR TIME READING THIS!! I'm just sending an email to fulfill the three-a-week requirement. Unfortunately I have nothing to say or ask, so I am writing about my writing about nothing.

Soon thereafter, most message traffic from Firm one stopped due to no purpose, no leadership and no momentum.

Community was not built in firm one since the participants never found a center or any salient reason to be there at all. It was generally considered a waste of their time.

### **Firm Three**

During the first week of messaging Karla Schwartz asserted leadership of group. Karla had a strong personality and quickly fomented discontent with the amount of homework that the class was responsible to accomplish each week. Although the group had no indication that the Instructor was not reading the messages Karla started a thread entitled 'Dr. Pike is Insane', making the point that the workload is totally unreasonable. This is a part of a representative message from Karla:

I am sorry but I must vent again. I am absolutely sick of this sh\*t. I have answered 18 questions and I still have like 15 to go. This is absolutely ridiculous and I am SICK OF IT! This class is taking up my whole goddamn life and I do nothing but work and come home and work on this sh\*t.

This created a mob mentality where everyone seemed to jump on the 'bandwagon' and state that they also weren't going to take it. The class decided to distribute answers to their take home midterms and discussed emailing each other long homework assignments where they intended to change the wording so it wouldn't appear as plagiarism. These messages were posted in public forums demonstrating uninhibited behavior that many researchers have noted as being inherent in asynchronous communication.

Eventually the workload was decreased and message traffic lessened to the point of being nearly non-existent. Since there was nothing left to complain about, they had nothing to say.

Community was built in firm three, but not the sort proposed by advocates of online learning. What built this community was group dissent and communal complaints lead by Karla Schwartz and fomented by the members of the firm that posted messages. During the week of the midterm eight people posted, followed by seven people just before Dr. Pike changed the assignments. Once the change was made only four people posted. Once there was nothing left to rally around, everyone seemingly packed up and went home. There was nothing left to talk about.

### **Firm Two**

The amount of intervention by the moderator was much less than what I, at first considered adequate, the conference started quite late into the course the conference was generally well received and an enjoyable and helpful addition to the class. An interesting side-note is that in interviewing the Instructor, his opinion was that the conferencing had nothing to do with the class, most of the attitude surveys from members of Firms two stated that the messaging was well integrated into the class.

Community was built in firm two. There was a heavy social use of The Coffee Shop section that the firm used to connect and form relationships. There was a large amount of personal information revealed as an ongoing

system of empathy and warmth was developed. What built the community was the construction of a warm and friendly atmosphere prompted by Mimi, and the camaraderie that grew out of what became a place to come for support friendship and humor.

## Summary

This study attempted to explore the effects of a trained moderator in an asynchronous distance learning class. The study was designed to use grounded theory and narrative research to report on the experiences of a graduate assistant expected to be trained as a moderator, and the members of the computer conference managed by the moderator. These experiences were to be compared with the experiences of two other segregated computer conferences, each run by a moderator that would change each week. These moderators would receive no formal training of any sort. The computer conferences were to support a distance learning course offered by the School of Legal Services at a campus of a large southwestern university.

The study almost did not take place due to a litany of problems, including the graduate assistant meant to undergo the moderator training dropping out, the instructor experiencing life-threatening medical problems, and a course that was previously devoid of any form of interaction among the students. The instructor, a long time lecturer, had no distance learning training and the resulting class resembled an electronic correspondence course with little regard given to student-student interaction.

A student volunteered to undergo training and moderate one of three-segregated computer conferences for the semester. Time pressures and other commitments prevented her from practicing a number of the techniques of good conference moderation. It became necessary for me to be in constant contact with the moderator, heavily guiding her actions until late into the semester. The other two-segregated computer conferences did not employ moderators due to technical complications.

The study found that even with a low degree of intervention the use of moderation techniques allowed the moderated group to form a community based on camaraderie, support, and warmth. Conference messages in this group amounted to over 2.5 times that of the next highest group. It was also found that structuring places to post messages by dividing the conference into a content oriented space, a social space, and a technical space had positive implications, which assisted and at times became a substitute for certain moderation techniques.

Analysis of the other two groups found one group forming no community whatsoever and the other group forming a community based upon group dissent and communal complaint initiated by a strong personality and what the group considered an inordinate amount of work. This group demonstrated extremely uninhibited behavior using words and concepts that would be inappropriate in a classroom situation.

In a discussion of how online courses are constructed on the campus under study, it was discovered that there was a wide variety of overlapping options that could easily become confusing. Major emphasis was given to putting courses online while little thought was given to the appropriateness of the pedagogy that should be employed.

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# USING THE BIG SIX INFORMATION SKILLS AS A Metacognitive Scaffold TO Solve Information Based Problems

Sara Elizabeth Wolf  
Auburn University

Thomas Brush  
Arizona State University

## Abstract

*The purpose of this research study was to determine whether a specific information problem-solving skills model was an effective metacognitive scaffold for students solving information-based problems. Specifically, thirty-five eighth grade students in two intact classes were asked to write newspaper articles that summarized the events surrounding the Selma March during the African-American Civil Rights Movement. Achievement and attitudinal data were collected at the end of the treatment period, and observational data were collected throughout the treatment period. One class of students followed the procedures of the Eisenberg and Berkowitz Information*

*Problem Solving model while the other followed the procedures provided by the classroom teacher. Results revealed that the students following a specific metacognitive scaffold performed better on the achievement measure. However, the students using a teacher-managed process reported more positive attitudes than the scaffolded students. Possible reasons for the differences in reported attitudes between the two groups include differing responsibility levels of students and teachers within the groups as well as differences in time spent in on-task behaviors throughout the study.*

## Introduction

Information literacy has been a topic of research for a number of years. Through the examination of searcher behavior, several models have been developed that describe the processes used by people who are seeking information (Eisenberg & Berkowitz, 1990; Kuhlthau, 1983; Stripling & Pitts, 1988). Organizations such as the American Association for School Librarians and the American Library Association have collaborated to develop standards for information literacy. These standards call for students who access information efficiently and effectively, evaluate information critically and competently, and use information accurately and creatively (American Association of School Librarians, 1998). Students who use information in this manner to explore and solve problems are identified as being information literate. It has been noted that students need various resources, tools and scaffolds to support their efforts to solve the educational problems they encounter (Hannafin, Land, & Oliver, 1999; Hannafin, Hall, Land, & Hill, 1994). The role that scaffolding plays in student achievement has also been explored (Saye & Brush, 1999; Hannafin et al., 1994; Hannafin, Hannafin, Land, & Oliver, 1997a). This study sought to enrich the body of knowledge concerning the role of metacognition and metacognitive scaffolds in supporting student research activities.

## Metacognition

Metacognition has been described as thinking about thinking. More specific definitions include references to knowledge and control of factors that affect learning, such as knowledge of self, the task at hand, and the strategies to be employed (Baker & Brown, 1984; Palincsar & Brown, 1981). In order to perform metacognitively learners must be able both to be aware of their own cognitive activities, and to control and monitor that cognitive activity. The distinction between awareness and control was examined in order to determine what differences existed between learning disabled and non-learning disabled students. Slife, Weiss, and Bell (1985) found that when these two groups of students were compared in metacognitive skill activities, the differences were in metacognitive strengths rather than skills deficiencies.

McGregor (1993) examined the thinking processes that students engaged while writing research papers. She found that students seemed to be unaware of their own cognitive processes. That is, "students do not instinctively operate in a metacognitive manner" (McGregor, 1993 p. 131). Other researchers have found that student success in a learning environment is impacted by the lack of metacognitive ability of the students (Hill, 1995; Land & Hannafin, 1997). This lack of metacognitive skill and awareness supports the need for instruction

that teaches learners to “plan, implement and evaluate” (Palincsar, 1986 p. 123) strategies for learning and problem-solving.

### Scaffolding

How can teachers provide the instruction students need in order to develop strong metacognitive skills that are inherently difficult both to observe and teach? One way is to incorporate the use of scaffolds into the curriculum. While the basic concept of scaffolding has been defined as a support structure for learners engaged in activities just beyond their independent abilities (Vygotsky, 1978), some have further delineated differences between specific types of scaffolding. Hannafin et al. (1999) identified four different types of scaffolds, metacognitive, procedural, conceptual, and strategic. Figure 1 provides an overview of these scaffold types and the situations where they might be used.

Scaffold Type	Description	Used when...
Metacognitive	Guidance in what to think during a learning activity	Students are engaged in an independent metacognitive activity such as research-based problem solving
Procedural	Assistance with a particular tool or feature of a learning environment	Technology is being utilized; job aids are needed
Conceptual	Assistance with what to consider; Vygotskian scaffolding	The various possible methods for achieving success can be known ahead of time by the teacher
Strategic	Guidance in the approach that might be needed in a learning situation	Alternative strategies have not been considered by students; participation in planning and implementing decision making skills in open-ended learning environments.

Figure 1. Scaffold descriptions and uses

Research indicates that how scaffolds are used in various learning situations has impacted student achievement and attitudes (Saye & Brush, 1999; Hill, 1995; Krajcik, Soloway, Blumenfeld, & Marx, 1998). For example, Oliver (1996) and Brush and Saye (2000) both found that the use of a scaffold rather than its presence impacted student success within a particular learning situation. Other researchers (Hill, 1995; Land & Hannafin, 1997) suggest that deficiencies found in student metacognitive skill could be mitigated through the use of strong metacognitive scaffolds. In addition, the school library community has recognized the need for students to possess strong metacognitive skills.

### Information Problem-Solving

Within the school library media community several researchers have studied searcher behavior in a variety of contexts, including print (Dreher, 1993; Dreher & Sammons, 1994), Electronic (Marchionini, 1989), and multimedia (Perzylo & Oliver, 1992) environments. Others sought to describe the search process in descriptive (Kuhlthau, 1993), and prescriptive (Eisenberg & Berkowitz, 1990; Stripling & Pitts, 1988) ways.

A common theme through the research on information seeking involves the need to increase the metacognitive skills of students. A general metacognitive scaffold is needed so that students do not have to rely on situation specific scaffolds each time they encounter a problem or unfamiliar situation (Costa, 1984). Several information problem-solving models exist (Kuhlthau, 1983; Stripling & Pitts, 1988; Eisenberg & Berkowitz, 1988) that could function as metacognitive scaffolds. The Eisenberg and Berkowitz Information Problem-Solving (IPS) model is well suited for use in this capacity. Figure 2 provides an illustration of the IPS model. Each step or task is comprised of two sub-tasks that students should accomplish in order to use information in an effective and efficient manner to solve educational problems.

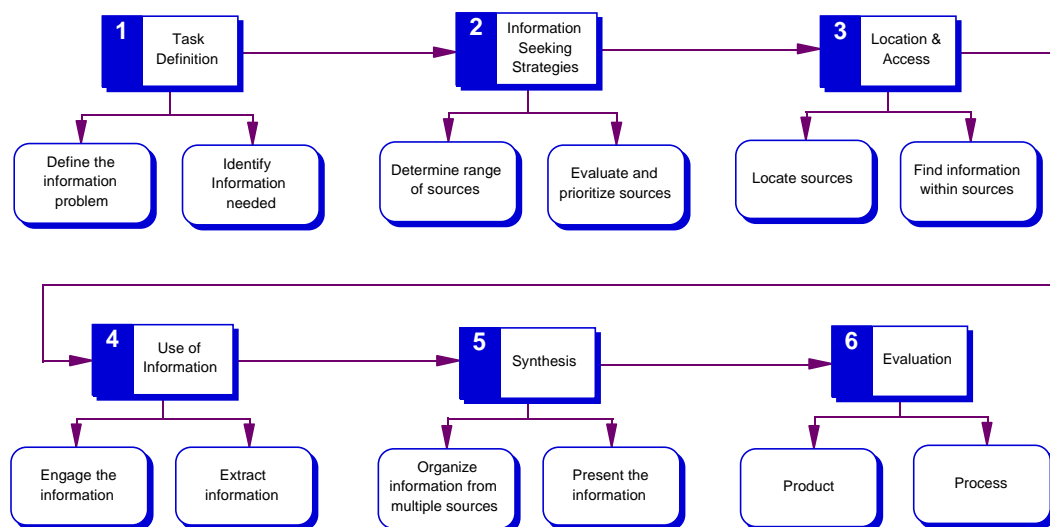


Figure 2. The Big Six Information Skills (Eisenberg & Berkowitz, 1990)

### Integrating Scaffolding, Metacognition and IPS

The implementation of an information problem-solving model involves more than teaching students a series of steps and directing them to the research materials in the library. In order for learning to occur in these situations, students must actively interact with materials and information in such a way as to construct their own meaning from the interaction (Kuhlthau, 1993). However, as has been previously noted, this does not always occur particularly with student who are unfamiliar with the research process (McGregor, 1993; Perkins, 1991; Steinberg, 1977, 1989). However, if the “purpose of strategy instruction is to influence how the learner interacts with the learning situation” (Palincsar, 1986 p. 118), then the use of IPS as a metacognitive scaffold is warranted.

There are many references to the Eisenberg-Berkowitz IPS model on the World Wide Web and in the literature read by professional school library media specialists. While this body of anecdotal evidence is compelling as to the far-reaching effects this model has had on educational practices, it is lacking in rigorous research to support the conclusions presented. The only research that discusses the impact this IPS model might have on student achievement was conducted by the authors of the model (Eisenberg, 1999; Eisenberg & Berkowitz, 1998). This case study reported an improvement from 53% to 95% of students passing a high school American History examination over a period of one year.

While a variety of research has been conducted in order to understand the information seeking behaviors of searchers (Kuhlthau, 1991; Marchionini, 1989; Stripling & Pitts, 1988) and there has been an identified need to strengthen metacognitive skills in students (Hill & Hannafin, 1997; Brush & Saye, in press; Oliver & Perzylo, 1994) a detailed examination of the effectiveness of particular information problem-solving models has not been conducted. If a particular model were shown to be effective in strengthening metacognitive skills in students several of the performance gaps identified in research could be addressed. Students would effectively and efficiently access and use information, students would monitor their own thought processes, teachers would design effective scaffolded problem spaces, and students would begin to transfer problem-solving skills from one academic situation to another.

### Method

Thirty-five students in two eighth-grade social studies classes in a major southwestern city participated in the study, divided equally between male and female genders. The researcher acted as both participant and observer during the course of the study by conducting one of the classes for the students and providing technical support for the participating teacher while he conducted his class. The participating teacher conducted the other class for the study according to his established classroom procedures. Students in this study were provided with their own computer (either a laptop or a desktop system) to use for research activities.

A two group (scaffolded vs. non-scaffolded), quasi-experimental design was implemented to determine achievement differences within this study. One group (scaffolded class) received training and guidance in the use of a specific IPS model while completing their reports and the other group (non-scaffolded class) received no explicit IPS training. Each student completed a 15 item, multiple choice pre-test prior to the onset of the study. Items covered knowledge-level information about the Selma March as well as the African-American Civil Rights



Movement. Subject matter content was delivered via *Decision Point!* (DP), an “integrated set of multimedia content resources and tools” (Saye & Brush, 1999, p. 11) relating to the African-American Civil Rights Movement. Restricting the activity to a single event allowed the researcher to control the problem space students engaged while allowing students relative freedom to explore an even however they deemed appropriate (Oliver & Perzylo, 1994; Saye & Brush, 1999; Yang, 1997). The researcher created job-aids for all participating students to use during the study activities. These procedural scaffolds (Hannafin et al., 1999) helped students maintain focus and remain oriented in the open-ended environment.

Students in the scaffolded class were provided with an additional job-aid to remind them of the steps involved in the information problem-solving process (see figure 1). Some elements of this metacognitive scaffold were incorporated directly into DP through the “guides” and “journal” tabs of the electronic notebook. While these scaffolds were available to all of the students, only the students in the scaffolded class were explicitly told to use them. “Guides” questions consisted of a series of questions organized around the five questioning words associated with news article writing (who, what, where, when, why). The journal contained prompts for the students to complete that provided guidance in thinking about their own progress, and in making a plan for the next class meeting day.

The study was conducted over 11 class days, with one additional class day being used for the administration of the study pre-test. The participating classes met on alternating days, beginning each Monday. Classes that met on Monday or Wednesday lasted 85 minutes, while classes that met on Friday lasted 35 minutes. Prior to the beginning of the study one of the classes was chosen to receive the scaffolded activities. The other class received instruction that the classroom teacher designed and felt was appropriate for the unit as a whole.

One week prior to the beginning of the study activities the researcher visited the classroom in order to acclimate herself to the regular activities for each class. During this week the researcher administered the pre-test to the students. Although the scaffolded class scored slightly higher ( $M=4.5$ ) than the non-scaffolded class ( $M=4.0$ ) a Mann-Whitney analysis of the pretest scores indicated that there were no differences in prior knowledge between the two groups,  $U(18,17) = 116.50$ ,  $p = .36$ . Upon completion of the pretest, an introductory activity was conducted with both classes. The activity consisted of a short scavenger hunt using the DP software. This helped insure that students were familiar with the basic components of the event that they investigated as a part of their final activity. After completion of the scavenger hunt, the structured unit activities began.

Each class received a different first activity to begin the study. The first activity for the scaffolded class was an information problem-solving training session. The orientation focused on the IPS process students were asked to engage during the study activity. The first activity for the non-scaffolded class was an introduction to newspaper article writing, conducted by the teacher. Once each class completed their orientation activities, the students spent three class days collecting information related to the Selma March and creating their initial (rough-draft) reports. They were given two class periods to make final revisions to their work. Students in the scaffolded class determined their own methods of information gathering with only mild guidance from the researcher.

Students in the scaffolded class began their study activities by determining exactly what was being asked of them. They then generated lists of questions that they could use to answer and fulfill their article requirements. Once the questions were generated students used the DP database to find answers to their questions. They also used the questions in the Guides section of the DP notebook to focus their research. Once the students finished answering their own questions and those featured in the guides questions, they used that information to create a handwritten rough draft. Students then used the scoring guide to evaluate their neighbor’s article. Students took those comments and made revisions to their work and submitted the final form of their article. The teacher guided his students during the newspaper article writing process according to established classroom procedures. After the initial introduction to the structure of news articles the classroom teacher told his students to “find the information you need in order to write your articles.” Students turned in handwritten rough drafts that the teacher took home to edit. The next class period, he returned the rough drafts to the students so that they could make the indicated changes. Students turned in their final copies with an attached picture on a separate piece of paper.

The articles that the students created were news articles that reported on the events surrounding the Selma March. Students in both classes submitted the reports in written format. As a part of the IPS scaffold, students in the scaffolded class were given the criteria for grading prior to their submission of the assignment. The reports covered the following elements of the Selma March: a general overview or timeline of events, key people involved in the event, causes of the event, and results of the event. Observers took field notes and audiotaped each class session in order to collect qualitative data concerning student engagement, attitudes, and behaviors during the information problem-solving process. After each of the classes the teacher and researcher conferred for a short debriefing session. During this time the teacher had the opportunity to discuss any significant occurrences that the researcher may have missed during the class session and share his impressions of student attitudes and progress.

All of the students participating in the study completed exit surveys during the final class period. The 4-point Likert-type survey collected attitudinal data from the students, such as the students' feelings about the unit, the topic, their preferred way of learning social studies information and their feelings about future research projects. In addition, students were asked to respond to open-ended questions regarding the elements of the project they liked and disliked as well as whether they would recommend the project to their peers. Following the submission of student reports the researcher conducted exit interviews with selected students. The classroom teacher recommended students for selection based on their willingness to be interviewed and their ability to express and elaborate on their thoughts. The interviews were conducted in pairs to help alleviate any anxiety associated with the interview process as well as to gain a more complete understanding of what the student knew regarding the research study (Graue & Walsh, 1998). Interview questions were based on journal entries and observations from class sessions. Students were asked to explain and expand on comments made in their journals, to verify assertions made during classroom observations, and to give their opinions about the study activities.

Two neutral scorers used the evaluation rubric to assign scores to each report. To help ensure inter-rater reliability each scorer independently scored each report and then compared their ratings. If the scores were highly divergent the researcher conferred with the scorers to clarify any confusion about the rubric, and how to interpret student reports so that subsequent grading would have a higher level of agreement between the two scorers. At the conclusion of this procedure the correlation between the two groups of scores was .91.

## Results

Both quantitative and qualitative data were collected during this study. Results as they pertain to data types are discussed below.

### Newspaper Articles

A Mann-Whitney test of the report scores revealed that there were significant differences between the report scores for students in the scaffolded ( $N = 18$ ,  $M = 12.72$ ,  $SD = 1.64$ ) and the non-scaffolded ( $N = 15$ ,  $M = 11.00$ ,  $SD = 1.36$ ) classes,  $U(18,15) = 61.00$ ,  $p < .01$ .

### Student Questionnaires

Table 1 provides an illustration of student responses to selected questions from the attitude survey ( $N_{\text{non-scaffolded}}=17$ ,  $N_{\text{scaffolded}}=18$ ). Responses were provided on a four point Likert-type scale and then coded as either agree or disagree for analysis purposes. Chi-square analyses were conducted on each item to determine differences in attitudes. There were significant differences in the attitudes of the two classes regarding items "I felt smart while doing the project,"  $\chi^2(1,N=35)=6.89$ ,  $p < .01$  and "I would like to do more projects like this on other social studies topics"  $\chi^2(1,N=35)=5.93$ ,  $p < .05$ . There was also consensus on several other survey items. The majority of students in both classes disagreed with the statements: "This project made me feel nervous" and "This project made me feel dumb." Also, the majority of students in both classes agreed with the statements: "This project helped me understand The Civil Rights Movement better than if I had just read about it in my textbook," "I felt comfortable researching topics I know little about," and "I felt comfortable writing my newspaper article about the Selma March."

Open-ended questions asked students to provide for the researcher things they liked best and liked least about doing the project; ways to improve the assignment; things they would have liked to have more time to do; and whether they would recommend this project to other eighth grade students. Students from both classes liked the computers and the software that they used for their activities. The next most popular answer was that they liked learning about the Civil Rights Movement. These answers included responses referring to the era, the decade, or the event. Other comments included references to the lack of homework during the unit activities, the format of the product they produced and being able to do something different, or at their own pace. However, the scaffolded class mentioned the research process in greater numbers than did the non-scaffolded class.

When asked what they liked least about the unit, the most common answer from both classes concerned the physical act of writing the paper. Students were unable to use a word processor to write their papers because 14 of the 18 students in each class were using laptop computers that were not connected to the single classroom printer. There were also two sets of students who did not like aspects of the technology used and aspects of having observations conducted in their classrooms. Most students in both groups responded that they would recommend this project as well as similar ones to other eighth grade students. Their reasons ranged from "because it was fun and interesting" to "it is an important event for people to learn about."

Table 1 Student Attitudes.

Statement	Class				$\chi^2$
	Scaffolded		Non Scaffolded		
	Agree	Disagree	Agree	Disagree	
This project made me feel nervous.	11.1% (2)	88.9% (16)	11.8% (2)	88.2% (15)	.00
I felt smart while doing this project.	38.9% (7)	61.1% (11)	82.4% (14)	17.6% (3)	6.89**
This project helped me understand The Civil Rights Movement better than if I had just read about it in my textbook.	77.8% (14)	22.2% (4)	88.2% (15)	11.8% (2)	.67
I would like to do more projects like this on other topics in social studies.	50% (9)	50% (9)	88.2% (15)	11.8% (2)	5.93*
I felt comfortable researching topics that I know little about.	83.3% (15)	16.7% (3)	82.4% (14)	17.6% (3)	.01
I felt comfortable writing my newspaper article about the Selma March.	76.5% (13)	23.5% (4)	82.4% (14)	17.6% (3)	.18
This project made me feel dumb.	11.1% (2)	88.9% (16)	11.8% (2)	88.2% (15)	.00

\* $p < .05$ ; \*\* $p < .01$

### Classroom Observations

During periods of direct instruction, students in both classes demonstrated their understanding of the proper behavior of a school classroom. They raised their hands, tended not to speak all at once, and listened to the comments of their classmates. Also, when they knew the answer to a question from a classmate they were fairly quick to answer and provide help.

During periods devoted to research activities students in the scaffolded class exhibited behaviors that suggested they were more self-directed in their activities. Students in the non-scaffolded class, however, spent the majority of their writing time traveling back and forth between their desks and wherever the teacher was standing. They were less willing to make decisions on their own and relied on the teacher to do the majority of their editing.

Students in both classes asked many questions that were focused on the technology of the DP database. These questions ranged from "Why don't my movies plan?" to "How do I get to do the typing party?" Any questions of this type were answered by the researcher, regardless of which class was in the room. Most of the comments made by students in the non-scaffolded class were directed at the teacher. Usually, a student would ask the teacher to review a sentence or paragraph that had just been written and wait for specific feedback from him. Comments between students generally were initiated only when the teacher was extremely busy, and were superficial in nature. For example, a common question students would ask each other was "how do you spell..." Also, they would ask their neighbor how to find a particular video or picture that was displayed on their computers or ask for help with technical issues on the CD-ROM. The majority of the comments directed to the teacher had to do with the physical construction of their final products. Students asked the teacher to "check-over" each sentence as they wrote them. Sometimes, students would ask the teacher to hold their papers and call them when he had finished with the ones ahead of them in line. Students who used his technique for holding their place in line were observed talking about movies, parties, homework assignments from other classes, and other topics that had nothing to do with the Selma March. Once the students reached the teacher the most frequently asked question was, "Is this ok for a lead/title/sentence?"

Students in the scaffolded class also asked each other spelling and technical questions, but they interacted with each other in terms of the content they were exploring. One student was heard to ask, "Who was this Lyndon Johnson?" The reply was, "Duuuhhh, he was the President during all of this stuff!" Students sitting next to each other were observed talking about the information they found in the articles they read during the activity. Usually this was in connection with a question they asked the researcher about specific information they did not understand, or had difficulty finding within the CD-ROM. Students also discussed the social issues they were finding in the videos and articles of the DP database. Two students were heard discussing the video of the attack on the marchers at the Edmund Pettus bridge. They discussed how the video demonstrated elements of racism based on the attacking dogs and police officers only "going after" the African-American people.

During the final portion of the activity the students in the scaffolded group were asked to review their neighbor's reports. Comments during this activity were centered around the structure of the article itself. Several students were heard to say "the green guide [scoring guide] says that you have to have six paragraphs, and you only have one," or similar types of comments. No comments were made about spelling or grammar, only about the physical layout of the articles.

During the two class periods designated as primarily research days the noise level in the class was markedly lower than during any other days during the study. Students in both classes were observed intently viewing their computer screens. The students in the non-scaffolded class were also using notebook paper and pens to take notes. However, these students were observed copying directly (verbatim) from the articles onto their papers. For the most part, students worked independently. Brief comments were made between table partners, but the research process was primarily conducted on an individual basis. Students in the scaffolded class were typing directly into the computer. Upon observation, these students were typing the answers to the Guides questions that were incorporated into the DP database. Usually, their answers were typed in a list format. For example, one of the Guides questions was, "who was involved in this event?" A typical student's entry would be, "MLK, black voters, federal judge, Jimmie Lee Jackson, President Johnson." Some students were seen to be working together to gather the information for their Guides.

Student behavior on the days designated for writing rough drafts was different between the two classes. The students in the non-scaffolded class alternated their activities between writing one or two sentences at a time and waiting for the teacher to check their work. As a result, there were many students walking around the room during this period of time. During the consultations with the teacher most students in the non-scaffolded class would get part of a question out and then the teacher would interrupt and finish it, or provide the answer to their question without letting them finish. Many times, the teacher would write directly on the students' papers with the wording that he wanted them to use and they would copy it verbatim into the next revision of their article. In most cases the teacher was in possession of the student's paper and pencil during these consultations.

These behaviors contrast with those observed during the scaffolded class. During the days designated as writing days, these students were observed going back and forth between the computer and their papers. While they did consult with the researcher, she maintained a different relationship with the students than observed in the non-scaffolded class. When students asked, "Is this an ok title?" or "Is this all right so far?" the researcher replied, "You have a copy of the exact scoring guide that I will use to give you a grade on the article. You can make those decisions yourself." After answering approximately half of the class' questions like this, the types of questions shifted to content-oriented or technologically-focused ones. During the final evaluation activity for the scaffolded class, the noise level increased, but upon observation this was due to increased occurrences of debate between students. During this activity students were more likely to consult with the researcher to clarify the elements of the scoring guide. After the peer evaluation, students made any corrections to their work that they felt were necessary.

Interviews with the teacher revealed that he thought the unit was generally a success for both classes. He said, "I thought they were interested and engaged." He also noted some differences between the two classes such as attitudes of specific students, time spent in on-task behaviors, and the quality of the work submitted by the students.

Two of the students in the researcher's group were seen by the teacher to be exceptionally interested and engaged with the material. One of these students exhibited what to the teacher was unusual maturity during the completion of the project. Usually this particular student failed to work up to his potential and maturity level, yet still managed to get fairly good grades in school. This student's attitude stood out to the teacher because it was so different from his normal behavior. Other students demonstrated differences in their behavior as well. One student voiced her concern over the quality and correctness of her work to the classroom teacher. "Her paper's decent; it's not great, but she normally, if she doesn't understand, her defense mechanism is to laugh it off and screw around...But she acted like she wanted to do this or was concerned about am I doing this right? Is this good?" A difference the teacher noticed between the two groups was their time spent on-task during the research assignment. "Your group was a little more on task as a whole than mine," said the teacher. He attributed this difference to the difference in presentation styles between himself and the researcher.

The teacher also thought that the quality of the student reports was different between the two groups. Prior to evaluation of the final reports, the researcher asked the teacher to predict whether or not there would be differences in the scores between the two classes. The teacher predicted that the quality of the students in the scaffolded class would be higher than in the non-scaffolded class. He felt that the steps of the information problem-solving model provided a structure that was detailed in such as way as to make failure difficult to achieve.

Overall, the students interviewed from both classes felt that their experience with the unit was a positive one and that they would do something like this again, that the teacher should have provided an overview of the Selma March, and that they wished the content of the news articles were organized chronologically rather than by information type. Differences in attitudes between the two classes were expressed through their perceptions of the newspaper article assignment, what made the unit fun, the role of the teacher, and the types of information within the DP database. The students in the non-scaffolded class felt that writing newspaper articles was a good way to process information and demonstrate their understanding of a topic, but did not like to do it. When the researcher asked students from the non-scaffolded class how they would improve the unit, they focused on providing their

teacher with an assistant. They felt that the teacher was overextended during the study activities. They also spoke strongly about having to wait for long periods of time to get their questions answered about their articles. This paralleled the responses on the exist surveys where one student stated "It would have been better if [the teacher] had time to answer everyone's questions."

Students in the scaffolded class mentioned different aspects of the unit during their interviews. Their comments tended to focus on the research process and differences in the types of information they encountered while conducting research for their newspaper articles. These students indicated that the implementation of the unit was cumbersome to them. They would have preferred to have a single sheet of paper to follow rather than the packet that was provided for them. They also indicated that the steps [of the IPS model] were generic enough that they would try to use them in other classes for other research projects. Students from the scaffolded class also noted that the nature of the information they explored was different than the information they usually used during social studies classes. These students differentiated between the types, and value, of information found in primary sources and in textbooks. They did this despite not having had class discussions about differences between primary and secondary sources. For these students, the primary source documents provided more authentic and accurate information than their textbooks.

## Discussion

Using specific information problem-solving models as metacognitive scaffolds has not been widely studied. This research suggests that a particular information problem-solving model might act as an effective metacognitive scaffold for students engaging in complex research-based activities.

Results showed that students who completed research writing activities (newspaper article creation) supported by the IPS model created newspaper articles that were more accurate, utilized a wider variety of information resources, and contained richer details than students who did not have this support. Achievement scores between the two classes of students differed significantly, with the mean achievement score for the scaffolded class being nearly two raw score points higher than the non-scaffolded class. In addition, this study showed that the use of an information problem-solving model increased student engagement, but may have affected the attitudes of students.

There are two potential reasons for the significant differences found in student achievement scores: increased metacognitive activity and differences in time-on-task between students in the scaffolded class and students in the non-scaffolded class. Metacognitive skills such as task analysis, strategy selection, and self-monitoring were strongly supported for students in the scaffolded class. Students in the non-scaffolded class relied on their teacher for support in these tasks, rather than executing the processes themselves. This is illustrated by the role the classroom teacher assumed for his students. The teacher's proposed role, that of "editor-in-chief," was demonstrated while his students were writing their rough and final drafts of their articles. Each student approached the teacher to get his final approval on each sentence or paragraph as they wrote it. This contrasted with the scaffolded class where the students received their guidance and support from the scaffold that the researcher provided to them. Each of the six information problem-solving steps was provided to the students in a booklet that they could use to monitor their own progress. Additionally, it provided them with an explicit process to follow in completing their work. Students in the scaffolded class knew exactly what to do while students in the non-scaffolded class had to ask their teacher for direction at each step of the writing process.

Researchers have claimed that students who can successfully analyze tasks, identify strategies for task completion (Palincsar & Brown, 1981), apply problem-solving strategies in appropriate situations (Eisenberg & Berkowitz, 1990; Palincsar & Brown, 1981) and engage in self-monitoring behaviors (Bondy, 1984) can be considered metacognitively successful. However these skills are difficult for children to acquire (Brown, 1985). Bondy (1984) makes several recommendations to educators interested in strengthening students' metacognitive skills. These include: (1) modeling metacognitive strategies in order to provide students with an understanding of how to mentally negotiate difficult cognitive tasks, (2) requiring students to keep a daily learning log to shift the cognitive focus from product to process, (3) providing instruction in self-questioning techniques to redirect attention, and (4) adapting a learning and studying model to assist students in applying strategies in a wide variety of situations. The relationship between the IPS model and metacognitive skills discussed in the literature was illustrated through the data acquired in the current study.

Gradually, students in the scaffolded class began to understand that the steps of the IPS model could help them understand where they were supposed to be at the end of each day, and where they were supposed to start at the beginning of the next day. Journal entries confirmed this. Except for one student who exhibited extremely high levels of anxiety in relation to the assignments, most students indicated that they were either moderately or highly confident that they knew what to do the next day. Eisenberg & Berkowitz (1988, 1990) argue that the Big Six

Information Skills is a model that students and teachers can use in learning, studying, and problem-solving situations. As such, it can be utilized as a learning or studying model, as recommended by Bondy's (1984).

The second possible explanation for the significant differences in achievement scores was the time-on-task students demonstrated in each class. Due to the more highly defined path and the more frequent opportunities to check their work, students in the scaffolded class spent more time on task, rather than waiting for feedback from their teacher. This may have been due to the fact that the procedures in the scaffolded class provided a pre-defined structure for students to follow while completing their study activities. This structure included opportunities for peer feedback and personal reflection on the quality of their work. The procedures students were to follow were provided in written form. This allowed students to know the next step and allowed the researcher opportunities to shift research responsibilities back to the students by having a tangible reference point available during discussions. Neither the students nor the teacher in the non-scaffolded class utilized this structure. Thus, these students needed much more hands-on guidance from the teacher.

Students from both classes sought out either the researcher or teacher for guidance during the activities. However, students in the non-Scaffolded class were more often waiting in line for their teacher's input, while students in the Scaffolded would frequently form groups to ask the researcher a common question. The classroom teacher assumed a high degree of control in his classroom. This contrasts with the role the researcher assumed for her class. She encouraged the students in her class to assume responsibility for the completion of their tasks, according to the methodology of the IPS. Consequently, engagement with the topic was higher for the scaffolded class. The increased level of engagement allowed students in the scaffolded class more time to create their initial article and to correct any mistakes or omissions in relation to the content of their articles. This supports prior research showing a correlation between time spent engaged in instructional tasks and increases in student achievement (Doyle, 1983; Montazemi & Wang, 1995; Van Dusen & Worthen, 1995).

The results in this study suggest that following the procedures of the IPS may have caused students to shift their mental focus from a procedural activity to an internal mental process (Bondy, 1984). Previous research on children's thinking processes has found that for some students the thinking process occurred without conscious direction on their part (McGregor, 1993). The students in the scaffolded class demonstrated that they were more aware of how their thinking affected the decisions they made. One student told the researcher, "I'm finished with the Information Seeking Strategies activity and will start my Use of Information activity tomorrow." Many students in the scaffolded class demonstrated this rudimentary identification of thought processes.

A second finding that is significant to educators is that the IPS might have an impact on student engagement with the topic. The benefits of increased engagement include increased time on task, opportunities for learning through repetitive exposure to material, readiness for higher-order thinking and opportunities for richer evaluation of student work (Newmann, 1992). By focusing the students' decision making on whether they are satisfied with the current situation and what they can do to change that situation, IPS strategies increase the opportunity for learners to become engaged.

Lastly, the IPS process did not increase anxiety levels for students in the scaffolded class. Students in both classes agreed with statements indicating generally positive feelings toward the study unit as a whole. Additionally, the classroom teacher liked the accountability the IPS scaffold provided for the students and the structure it provided to students. He stated that he would be willing to use it if he were to implement another unit of this type in his classroom.

When interpreting the results from this study, readers should consider that due to the unique population of participants and the following limitations the results presented are not generalizable beyond the current study. The teaching styles of the two adults in the classroom may have affected the results. The researcher acted as a participant in the study. As such, her biases and influences must be considered in light of the research question. The researcher did not have prior knowledge about the school performance of the students in the Scaffolded class. Therefore, her impressions of the students were based on what she observed during the implementation of the study. The classroom teacher had spent the entire school year with the students and had formed opinions about the students based on their performance over the previous six months. These differences in opinions concerning the students may have impacted the interactions between the teacher and researcher and the students in each class.

## Implications

Prior research has found that one of the essential skills students must possess in order to be successful in problem-based learning activities is metacognition (Hill & Hannafin, 1997; Land & Hannafin, 1997). IPS models act as metacognitive scaffolds that support students while they become more adept at monitoring their own thought processes during the problem solving process. The structured vocabulary the IPS model provides allows teachers and students to label behaviors and clarify terminology, two activities that are recommended to enhance

metacognitive ability in students (Costa, 1984). Consequently, an unobservable process can be monitored and tracked through a set of prescribed steps and described using a standardized vocabulary.

In addition to shifting the focus of student metacognition from covert to overt, implementing the IPS model allows students to spend more time on task in a problem-solving situation. Increasing the time on task is likely to increase student achievement (Doyle, 1983; Montazemi & Wang, 1995). The IPS process provides a cognitive map for students to follow as they solve information-based problems. This map encourages students to assume ownership and responsibility for their problem-solving process. An added benefit of increased time on task is that students are exposed to the content involved with the problem situation more frequently. This may assist students in better comprehending the information relevant to their problem.

IPS models may provide overarching processes that students can employ in a variety of learning situations. The benefit of strengthened metacognitive skills is that students can then apply these skills to a variety of learning situations that may differ from the area in which the process was initially introduced (Bondy, 1984).

The results in this study provide support for a growing body of research suggesting that with appropriate support, students can succeed at complex, learner centered, research-oriented tasks (Brush & Saye, 2000; Eisenberg & Berkowitz, 1998; Hill & Hannafin, 1997; Land & Hannafin, 1997; Marchionini, 1989; Perzlyo & Oliver, 1992). However, implementing a new process for completing activities in school might be difficult at first. Students may be uncomfortable with the accountability the IPS models place on them. By introducing the process in small steps and infusing IPS vocabulary throughout the school day, teachers can help students become more comfortable and skilled at implementing the metacognitive skills that are supported by this model.

## Conclusion

Research suggests that implementing a process approach to research skills can be effective when certain conditions are met (Kuhlthau, 1993). These conditions include strong team-based planning and implementation activities, an emphasis on student engagement, and the presence of a collaborative learning environment. The current study suggests that a specific process, the Big Six Information Skills (Eisenberg & Berkowitz, 1988), might be effectively used as a metacognitive scaffold for students solving information-based problems.

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# The Effects Of Collaborative Problem Solving On Individual Problem-Solving Ability

Yann-Shya Wu  
Indiana University-Bloomington

## Abstract

*The purpose of this paper is to investigate how collaborative mathematical problem solving affects individual mathematical problem-solving ability. This paper begins with a review of the applicable theoretical notions on problem solving, and on collaboration as it relates to problem solving. Next it explains the experiment's method and procedures, and then goes on to analyze and discuss its results. Finally it presents some conclusions, along with a brief discussion of the project's implications for further research. The results show no quantitative differences between collaborative and individual problem solving. However, some qualitative differences were evident.*

## Introduction

"Problem solving" has been regarded and designated by many mathematics educators and researchers (see, for example, Goldin, 1982; Lester, 1982; Mayer, 1982; Schoenfeld, 1982, 1985) as an important activity in mathematics learning. Indicative of the perceived importance of this topic is its inclusion by the National Council of Teachers of Mathematics (NCTM) as a heading in its new standards for the mathematics curriculum, which list mathematics as problem solving along with mathematics as reasoning, mathematics as connection, an mathematics as communication (NCTM, 1989).

"Collaboration" too has been much advocated recently as a powerful factor both in learning in general and in problem solving in particular. This advocacy is based on social interaction frameworks (see, for example, L. S. Vygotsky, 1978), and is supported by the findings of research experiments (for example, Forman, 1981). These results confirm that for many types of problem solving the results of collaboration are superior to those of individual efforts. But how and why does collaboration function so effectively? More specifically, what are the mechanisms through which collaboration promotes problem-solving abilities? This has been the motivating question behind my research effort; and the purpose of this paper is to provide at least some partial, tentative answers.

In order to gain some answers, an experiment was designed and conducted that would enable the experimenter to observe both individual and collaborative problem-solving activities together, and to compare their results in terms of both quantitative and qualitative ethnographic perspectives. This paper will begin with a review of the applicable theoretical notions on problem solving, and on collaboration as it relates to problem solving. Next it will explain the experiment's method and procedures, and then go on to analyze and discuss its results. Finally it will present some conclusions, along with a brief discussion of the project's implications for further research.

## Theoretical Background

It is not too overwhelming to say that the human civilization is a history of problem solving activities (Yang, 1994). Often in our daily lives we find ourselves working to solve problems in our lives, whether these problems are big or small, important or unimportant. We try to gain knowledge and skills both from school and in our daily lives in order to solve these problems. For example, we learn mathematics in order to solve those problems related to number, quantity, shapes, area, volume, and so on. And indeed, "mathematical problem solving" is both the main goal of mathematics learning (Brodinsky, 1977; LeBlance, 1977) and the most important activity of mathematics learning (Lester, 1980). In recent years advocacy from mathematics educators and researchers has resulted in increasing attention given to issues concerning mathematics problem solving and in the adoption of this activity as a major focus of a new set of standards for K-12 mathematics curriculum.

In traditional mathematical problem-solving activities in school settings, the most often used learning method is individual problem solving, rather than collaboration. Moreover, collaboration, often regarded as cheating, is commonly prohibited as a mathematical problem solving activity. Mason (1972) has the following impressive observation, "We isolate students by pitting them against each other competitively, and imposing on them a fierce decorum of silence and regimentation" (p. 6).

In view of the fact that collaboration has become a popular, effective, and efficient form of learning in daily life and in the work place, and has been advocated as a mode of working style to meet the rapid changes and big challenges of modern society (Senge, 1994), it seems reasonable to suppose that the mathematics curriculum should also increase its acceptance of collaborative-oriented problem solving in order to prepare the learners to collaborate with others in order to solve problems in daily life.

The significance of collaboration can be understood from two perspectives: first regarding it as a practical phenomenon, and then from the viewpoint of developmental psychology. In the following paragraph I shall consider each of these perspectives in more detail.

As a practical phenomenon, collaboration, or “working together”, is in the very nature of society (Mason, 1972), and “inherent in everyday interaction” (Choi & Hannaffin, 1995, p. 62). As Forman and McPhail (1993) put it, “The everyday lives of adults are full of complex and ill-defined problems that require high-level reasoning and organizational skills. These problems are often solved in collaboration with other people. For example, a husband, wife, and babysitter may need to coordinate their weekly occupational and domestic work schedules in order to supervise one or more young children” (p. 213).

To acknowledge the fact that all human progress is a result of collaboration amounts not only to a simple affirmation that collaboration is the most common mode of social functioning (Resnick, 1987), but also to an indication of its status as the most magical of all human activities. In common-sense terms, progress is possible because “collectively, we can be more insightful, more intelligent than we can possibly be individually. The IQ of the team can, potentially, be much greater than the IQ of the individuals” (Senge, 1994, p. 239).

But how and why does collaboration function so universally, so effectually? The anthropologist Edwin Hutchin gives us an example that lets us begin to see how collaboration structures the efforts of a society, the formation of knowledge, and even the nature of cognition (in Resnick, 1987). In Hutchin’s view, guiding a ship by triangulation on coastal landmarks entails both a complex interaction between helmsman and lookouts and a collaborative articulation of the fabric of knowledge itself, involving distance experts such as cartographers and gyrocompass-builders. Here we cannot speak of collaboration without saying something about the knowledge-structures involved, nor can we speak of the required knowledge without saying something about the collaborative processes through which it is put into effect.

When we look at the social deployment of knowledge, we find it inseparable from collaborative processes. That is to say, social learning—at any rate, social learning outside of school—takes place through collaboration. As Resnick (1987) remarks, “much activity outside school is socially shared. Work, personal life, and recreation take place within social systems, and each person’s ability to function successfully depends on what others do and how several individuals’ mental and physical performance mesh” (p. 41). Even if we choose to view learning as an individual process, we will find that it is collaboration that provides the “context in which supports for, constraints on, and challenges to an individual’s thinking occur” (Forman & McPhail, 1993, p. 213). Yet there is reason to believe that knowledge is best measured as the collaborative achievement of a group. Barnes and Todd (1977), studying groups engaged solely in assigned talk, found that these groups attained cognitive levels higher than those attained by individual members. Under such a notion, knowledge is distributed in nature. To return to Resnick’s analogy (1987) from Hutchin: “No individual in the system can pilot the ship alone. The knowledge necessary for successful piloting is distributed throughout the whole system” (p. 41). Resnick’s conclusion is that most work and learning in a society is a matter of “shared cognition,” not “individual cognition.”

L. S. Vygotsky (1896-1934), from the perspective of developmental psychology, provided a conceptual framework to deal with this question through his analysis of the relationship between social interaction and higher mental processes. He felt that higher functions originate first in the social interactions, before they are integrated into the cognitive structure of the mind: “Every function in the child’s cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological), and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relations between human individuals” (Vygotsky, 1978, p. 57).

Moreover, according to Vygotsky’s view of development as a dialectical process, the individual cognitive structure of mind, having been internalized through interaction with the social environment, is then promoted to a state in which it will itself influence the social environment. So there is an ongoing reciprocal interaction, a bi-directional relationship, between the individual and the social environment. On the one side, the social environment or cultural frame within which the individual participates and interacts plays a crucial role in the development of human cognition; on the other side, the individual self is also an essential source in the social environment for fostering the ongoing reciprocal processes of interaction.

Vygotsky further proposed that any learning exploits a “zone of proximal development” or “ZPD.” Vygotsky defined ZPD as “the distance between the actual developmental level as determined by independent

problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (Vygotsky, 1978, p. 86). Vygotsky observed that children learning mathematics seemed to be using the ZPD they created for themselves in the course of collaborative problem-solving, in such a way as to attain higher levels of achievement than they would have been able to manage while working along (Yackel, Cobb, Wood, Wheatley, & Merkel, 1991). ZPD can be fostered by collaboration with adult or more competent peers, who supply a context “in which support for, constraints on, and challenges to an individual’s thinking occur” (Forman & McPhail, 1993, p. 213). Within the resultant ZPD a group can attain cognitive levels not attained by individual members, leading the child on ahead in his or her development.

## **Purpose of the Research**

The above section has explored the practical phenomenon of collaboration and some theoretical notions from developmental psychology about why collaboration works. These perspectives constitute the general background underlying the author’s interest in investigating how collaboration might affect individual ability in mathematical problem solving. More specifically, what are the mechanisms through which collaboration promotes individual mathematical problem-solving abilities? To carry out this investigation a research experiment was designed in terms of the following questions:

- Is individual mathematical problem-solving ability after collaboration significantly different from individual mathematical problem-solving before collaboration? If so, what, quantitatively speaking, are the differences? And what, qualitatively speaking, are the important characteristics of these differences?
- Is collaborative mathematical problem-solving ability significantly different from individual mathematical problem-solving before collaboration? If so, what, quantitatively speaking, are the differences? And what, qualitatively speaking, are the important characteristics of these differences?
- Is collaborative mathematical problem-solving ability significantly different from individual mathematical problem-solving after collaboration? If so, what, quantitatively speaking, are the differences? And what, qualitatively speaking, are the important characteristics of these differences?

## **Method**

A quantitative evaluation and a qualitative ethnographical investigation were conducted, focusing on four students in the same 4th grade mathematics class as they participated in two steps of individual problem-solving activities and one step of collaborative problem-solving activity.

## **Participants**

The data-collection phase of the research was carried out using students from a 4th-grade class in an elementary school in Taipei, Taiwan, Republic of China. All these students were Chinese-Mandarin speakers. A group of four students out of a class of thirty-five was selected to participate in this study. This group of four students represented four different levels of achievement: high, median-high, median, and low. The selection method for this class was as follows:

A copy of the research proposal was sent to the school’s research office, which in turn solicited teachers interested in letting their students to participate in the project. The class group selected for this study was one taught by one of the interested teachers who taught, initiated, and guided mathematics collaborative problem solving and discourse. Because the participants were members of a class group that was already familiar with collaborative problem solving and discourse, and also with non-synchronous thinking-aloud skills (Yang, 1994), an adaptation of thinking-aloud (Ericsson & Simon, 1985), the research project did not necessitate introducing the participants to any unfamiliar models of collaborative problem solving. No problems involving the establishment of a collaborative relationship were anticipated, because the participating students had practiced collaborative discourse and problem-solving since they were in the third grade.

The design of the selection of participants proposed by the researcher was: All of the students in the class were grouped into four ranks, based on their fourth-grade mathematics achievements level. One student from each rank was randomly selected by means of a random number table. Four students, representing a mixture of mathematics achievement levels, high, median-high, median, and low, were assigned to each group. The design of the selection of group size is consistent with the suggestions of the way of grouping in cooperative learning (which suggests small group size of 3-5 persons) (Johnson & Johnson, 1994). The design of forming group members is consistent with Vygotsky’s ZPD notion which suggests heterogeneous grouping (Vygotsky, 1978).

In the research report, the participants’ responses necessarily be described. However, no real names were be used. Rather, the participant with high level achievement was given by a letter “H,” the participant with median

high level achievement was given by a letter “MH,” the participant with median level achievement was given by a letter “M,” and the participant with low level achievement was given by a letter “L”.

### **Materials and Instrumentation**

The purpose of the study is to investigate how collaboration might affect individual ability in mathematical problem solving. A vital preliminary to this project is to understand the context, *Jen's Choice*, where the participants of the research study were working with problem solving. Therefore, there is a need to introduce at the beginning of this section about *Jen's Choice*.

#### ***Jen's Choice***

*Jen's Choice* is a Chinese-language computer-anchored 4th-grade mathematics instruction program, designed and developed by Dr. Hsin-Yih Shyu (1997) and associates at Tamkang University in Taiwan. Based on the notions of anchored instruction and situated cognition (CGTV, 1990), it provides an inquiry, and real life learning environment and authentic tasks for learner to solve mathematics and other cross-subject problems. The story describes that Jen, a fifth grader was accused by her classmates of stealing a watch from the class model student, because she showed her watch after the model student lost her watch. In order to find the giver of her watch, Jen's grandmother, to approve that the watch was really given by her grandmother, Jen, accompanied by her three friends, planned and took a trip to visit her grandmother. In order to do so, they had to encounter several plans and decisions, such as time planning, expense planning, among others, and these need them to apply 4th-grade mathematics and across-subject knowledge to solve problems and plans.

At the end of the story, two types of problems, one type is about life problem, the other is about mathematics problems, are provided to challenge the learner who view this program. In this research study, only mathematics problems are given to the participants to solve. The mathematics problems contain the following three mathematics problems:

Question #1: Up to now (“now” meaning before they buy tickets for the rides), how much money does each person have left?

Question #2: At the Children's Recreation Center, if everyone wants to ride the same rides, then how should they spend the remaining money on tickets? (Note that the cheapest ride at the recreation center costs three tickets.)

Question #3: Supposing that Jen's apartment is 15 minutes away from the Tamsui Station bus stop, and taking into consideration that she has to be home before 5:30 p.m., answer the following questions.

- a) What is the longest possible time they can stay at the Children's Recreation Center?
- b) What is the latest possible time they can leave the Children's Recreation Center? (supposing that it will take them 10 minutes to wait for a bus in front of the recreation center)
- c) Which show can they see at Tomorrow's World Theater? 1:00 p.m., 2:00 p.m., or 4:00 p.m.

Because the nature of these three mathematics problems: authentic tasks, complex situations, real-life, therefore, it makes meaningful that *Jen's Choice* was used as instruments for test problem solving.

### **Procedures**

The research experiment consisted of three steps. In step 1, participants, working individually on PC computer in a separated decent room, solved mathematics problems. First, each of the participants was shown *Jen's Choice*. After that, three mathematics problems from this program were given to each individual participant to solve using paper and pencil. The participants were asked to show their mathematical problem-solving procedures, and also to engage in non-synchronous thinking aloud (Yang, 1994), an adaptation of thinking-aloud method (Ericsson & Simon, 1985) Thinking aloud is a research method that involves asking each participant in an experiment to speak out loudly, explaining as fully as possible, for every process he/she performs, how, why, and what he/she is thinking and doing. This is a vital method for investigating a participant's thinking processes. However, since the participant has to think aloud at the same time that he/she is doing a task, this procedure could interfere with the participant's thinking and acting. Therefore, the method of non-synchronous thinking aloud, was employed: participants were requested to ‘think aloud’, not while performing, but a little after completion of each segment of the task, in order not to interrupt the participant's thinking and doing the task. There was a facilitator with each of the participants to encourage non-synchronous thinking aloud and to remind the participants not to forget the non-synchronous thinking aloud.

In step 2 participants undertook group collaborative problem solving. One hour after the completion of step 1, the four participants were gathered together in a decent room having a PC computer, to solve, collaboratively, the same three problems they had solved individually in step 1. And as above, they were asked to engage in non-synchronous thinking aloud while, working as a group, they worked out their collaborative approaches to the problems with paper and pencil.

In step 3 participants again undertook individual problem solving, on a PC computer in a separated decent room. One hour after the completion of step 2, each of the four students was asked to solve, individually, the identical three problems again. All the procedures in step 3 were identical to those in step 1.

All three steps of the experiment were video recorded and audio taped. Cordless microphones were distributed to each participant to ensure that each participant's voice was clearly recorded and clearly heard by the others. These three groups of written solutions and video-recorded non-synchronous thinking-aloud protocols were compared and analyzed for quantitative and qualitative differences. Quantitative comparisons were made by evaluating the degree of correctness of the different final answers given to each of the three questions during each of the three steps. For qualitative comparison, these protocols were analyzed in terms of the following five components (Yang, 1994):

1. Problem perception, understanding and representation: evaluates the problem solver's understanding of what the problem is, and what the situation of the problem is; evaluates the problem solver's ability to draw a figure to introduce situational notation.
2. Mathematics knowledge and concepts: evaluates the participant's ability to access and apply the mathematical knowledge and concepts that are relevant to the problem.
3. Devising and carry out the plan: evaluates the problem solver's ability to devise a plan based on the problem, and to implement the plan step by step.
4. Consciousness and control of the plan: evaluates the problem solver's ability to consciously control what he/she is doing—to judge if it is meaningful or reasonable, and to adjust it when appropriate.
5. Looking back: evaluates the problem solver's ability to check the process of what he/she has done, identifying and correcting any mistakes or inappropriate solutions.

## Results and Discussion

Figure 1 shows a summary of the total number of right answers for each of the three steps of problem solving.

Participant	H	MH	M	L
Step	Total no. of right answers (Total no. of questions = 3)			
Step 1 (individual p-s)	0	0	0	0
Step 2 (collaborative p-s)	¼			
Step 3 (individual p-s)	0	0	0	0

Fig. 1. Number of right answers achieved by the participants in each of the three steps of the experiment

It seems that the results for collaborative problem solving were not significantly better than those for individual problem solving. Furthermore, collaborative problem-solving experience did not seem to facilitate later individual problem solving. But these conclusions, representing strictly quantitative results, are inherently limited in scope; they reveal nothing about the actual processes through which the participants constructed their understanding. At this point the learning process remains a 'black box.' An additional, qualitative, analysis is required in order to identify and evaluate the changes in thinking that took place over the three steps of problem-solving activity. Because the space limitations in this paper, the findings of this additional analysis are only briefly summarized here (Figures 2 to 5):

Participant: H									
Question #	#1			#2			#3		
Step/Compo.	step 1	Step 2	Step 3	step 1	Step 2	step 3	step 1	step 2	Step 3
Problem Perception...		x							
Math knowledge...	x	x	x	x	x	x	X	x	x
Devising... the plan		x							
Conscious... the plan		x			x			x	
Looking back...									

Fig. 2. Components of problem solving that participant H performs

Participant: MH									
Question #	#1			#2			#3		
Step/Compo.	step 1	Step 2	Step 3	step 1	step 2	step 3	step 1	step 2	Step 3
Problem Perception...		x							
Math knowledge...	x	x	x	x	x	x	x	x	x
Devising... the plan		x							
Conscious... the plan		x			x			x	
Looking back...									

Fig. 3. Components of problem solving that participant MH performs

Participant: M									
Question #	#1			#2			#3		
Step/Compo.	step 1	Step 2	step 3	step 1	step 2	step 3	step 1	step 2	Step 3
Problem Perception...		x							
Math knowledge...	x	x	x	x	x	x	x	x	x
Devising... The plan									
Conscious... The plan									
Looking back...									

Fig. 4. Components of problem solving that participant M performs

Participant: L									
Question #	#1			#2			#3		
Step/Compo.	step 1	Step 2	Step 3	step 1	step 2	step 3	step 1	step 2	Step 3
Problem Perception...									
Math knowledge...	x	x	x	x	x	x	x	x	x
Devising... The plan									
Conscious... The plan									
Looking back...									

Fig. 5. Components of problem solving that participant L performs

One of the reasons that all of the participants had very low achievement in solving the three problems was that they did not fully understand the problems when individually solving these problems. For example, when Question #1, “Up to now (meaning before they bought tickets for the rides), how much money does each person have left?” can serve as an example here. In the first step, the participants misunderstood it as meaning either ‘how

much money did each of them have before they started the journey?’ or ‘how much total money did they, collectively, have left before paying for the rides?’ Accordingly, they devised wrong plans, carried out wrong plans, and arrived at wrong things.

Doubtless the relatively high degree of complexity of the problems contributed to these frequent misunderstandings. Traditional educational approaches had accustomed the participants to less complex problems, for which all they needed was simply to put all of the numbers together without thinking too deeply. Thus, when they met with this experiment’s much more complex problems, they were totally lost and confused, and tended to revert to just putting the numbers together. In such complex and challenging situations, collaboration does not seem to help, as can be seen in the results from the second and third problems. Even though the participants came to the experiment with considerable prior experience in collaborative problem solving and related mathematics knowledge and concepts needed for solving problems, collaboration at this time did not facilitate successful solutions.

Also, deficiencies in the categories of consciousness and looking back resulted most participants reaching wrong answers for almost all of the problems, even though they performed reasonable problem-solving procedures.

However, collaboration did facilitate control and monitoring of the collaborative problem-solving process. From the protocols, we were able to see that solutions and plans were revised due to the reminders from peer participants: when some peers were unable to find the errors, others, having found them, reminded those peers to be cautious and to rethink; the resultant back-and-forth arguments often resulted in reasonable solutions. This striking collaborative phenomenon may represent the most essential aspect of the collaborative function. As Forman (1981) said, “Both Vygotsky and Piaget would agree that social interaction provides the individual with feedback about his own thoughts and action which enables him to reflect upon and modify his behavior” (p. 2). Thus, The potential effectiveness of collaborative control in the problem-solving process is evident, for example, in the results from problem #1. Here, none of the participants were able, individually, before or after collaboration, to solve the problem correctly, or even to find the correct data to on which to do the calculation; but in collaboration, they were able to identify almost all the data needed to do the calculation.

Although the above findings do not support the conclusion that collaboration significantly promotes later individual problem-solving ability, the qualitative comparison data show that collaboration does have an effect on collaborative problem-solving strategies.

## Conclusions

The aim of this research effort was to develop a deeper understanding of how collaboration affect individual mathematical problem-solving ability. In this research, we investigated how individual and collaborative mathematical problem solving took place in instructional contexts when anchored in authentic problem situations. The results of the research help us to see the different ways in which individual and collaborative problem solving approaches contributed to the participants’ problem-solving strategies. These findings remain tentative, due to the participants’ unfamiliarity with the style of the problem items (in particular, their high complexity), the small sample size, and the restricted components of observation. Further research designed to circumvent these limitations should achieve more complete and definitive results.

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# **Using a Lesson Template to Integrate General and Special Education: Teaching Lesson Template Use to Educators of Students with Special Needs**

Francie R. Murry  
G. Brandon Murry  
University of Northern Colorado

During the last 50 years, the major tenets of most educational subjects areas have undergone little change; however, the characteristics of the student population and methods of teaching the concepts have evolved. The student population has been transformed by the differing ethnic, disabled, and cultural backgrounds that have entered the educational system. The methods of teaching have been impacted by the multimedia software and hardware.

The movement of including students with disabilities in the general education curriculum, specifically students with learning disabilities (LD), behavioral and/or emotional disorders (EBD), promoted by The Individuals with Disabilities Education Act (IDEA) has created a persistent challenge for the teachers who work with them. These students may have near average or above intellectual abilities, but disengage when in the general education setting for a variety of reasons (Kauffman, 2001; Koyangi & Gaines, 1993). The tight spot special educators find themselves in is how to connect these students to the curriculum, age-appropriate peers, and teachers while still ensuring effective learning.

Even though many of these students have the intellectual power, they cannot function in the general education curriculum due to skill deficits they show in performance. These perceived intellectual gaps complicate the connection between these students and their same-age peers because of the lower level of schoolwork they appear to be doing. If they are to remain in the inclusive setting these skills must be integrated with their daily learning of new skills. They attend programs where the emphasis is on behavior management and social adjustment ahead of academics and vocational preparation (Knitzer, Steinber, & Fleisch, 1990). They are underserved (Lewis, Chard, & Scott, 1994) and placed in more restrictive environments due to the availability of adequate public school education programs (Kauffman & Lloyd, 1992). Dodge and Coie (1990) found that the strength of the bond between students with special needs and their same-age peers resulted from how competent students with special needs felt at school. This competency also influenced the students with special needs level of self-concept, self-esteem, and self-identity. That is, it is necessary to develop lessons that engage this population and allow students to perform close to grade level for their affective as well as academic success.

The demand for educational accountability by policy makers and constituents increases the pressure for general education teachers who already have onus for teaching diverse populations of students. The additional responsibility of addressing state content standards and assessment while simultaneously addressing the affective needs of these students overshadows their ability to embrace a student with special needs into their classroom. Thus, special education must focus support in the modification and accommodation of the student's academic needs in order to free the general education teacher to address their affective needs and their social inclusion.

Teacher preparation programs have recognized their obligation to provide solutions for the dilemmas their teachers face once in the inclusive educational environment. The changing demands required by both general and special education teachers at the K-12 level are being addressed. One of these solutions is to provide access to technological innovations that help teachers meet the needs of a diverse population, complete the job quickly and efficiently, and have the ability to integrate best practices into the interface design and lesson content.

The study described here was designed to contribute to the field's knowledge of the use of technology to support modifications for students with LD and EBD in the general education curriculum. The process and outcomes of thirty teachers in a Special Education Master degree program using a template design system to modify lessons for students with learning, behavioral, and/or emotional disabilities in a general education curricular subject of science or language art was examined for efficiency, effectiveness, and appeal.

The researcher applied Gagne, Briggs, and Wager's (1992) condition of learning model to teaching the template use to the special education teachers. Gagne's five identified categories of learning are verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes. The Kemp instructional system design (Kemp, 1997) identifies nine elements to step teachers through developing their modified lesson using the template. The Jerrold Kemp Design Model shown in Figure 1 takes a holistic approach by considering factors in the learning environment and includes learner characteristics, subject analysis, learning objectives, teaching activities, resources

(computers, books, etc.), support services and evaluation. Gagne's categories integrate nicely with the Kemp Design model. The entire process includes the best practice of teach, assess, teach, as well as being subject to continuous revision.

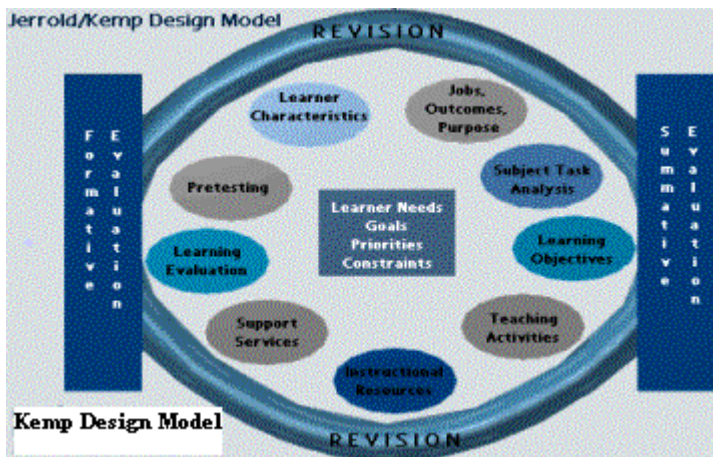


Figure 1. The Kemp ISD Model

## Method

### Participants

The participants in this study were 30 teachers pursuing a Masters degree for Colorado licensure in Special Education. Fifteen teachers taught in juvenile facilities and 15 taught in public schools. All 30 teachers taught at the secondary grade levels. Each of these teachers was responsible for teaching using the Colorado State Content Standards and preparing students to take the Colorado Student Assessment (CSAP). The students these teachers taught qualified for special education services in the primary categories of learning disabilities and emotional disturbances (designated in Colorado as Moderate Needs and Significantly Identifiable Emotional Disturbance (SIED), respectively). Eighteen of the master level teachers were earning general education licensure while simultaneously working under a state temporary teaching eligibility (TTE) for special education licensure. That is, 12 had a previously earned B.A. in Education while 18 did not have any previous teaching coursework and were on Emergency Teaching Licensure. In addition, all of the participants were earning the master degree in special education while teaching with a TTE. See Table 1 for details of the educational qualifications of participants.

Table 1. Teacher Education Qualifications

	Juvenile Facility Teachers (N=15)		Public School Teachers (N=15)
Teach Grades 8-10	7		0
Teach Grades 9-12	8		15
Earned B.A. in education	3	0 -- Special Education -- 1 2 -- Elementary -- 5 1 -- Physical Education-- 1 Secondary (Science, 0 -- English, or Math) -- 2	9
Temporary Teaching Eligibility	15		15
Emergency Education Licensure	12		6

There were 6 males and 9 females employed in juvenile facilities and 2 males and 13 females employed in the public schools with an average age of 27 years and 31 years, respectively. See Table 2 for a participants' personal characteristics report regarding teachers' gender, age, and years of experience in teaching.

Table 2. Teacher Demographics

<b>Juvenile Facility Teachers</b>				<b>Public School Teachers</b>			
	Gender	Age	# of Years Teaching		Gender	Age	# of Years Teaching
1	M	24	1	1	M	23	1
2	M	26	1	2	M	26	1
3	M	28	2	3	F	26	3
4	M	30	2	4	F	26	1
5	M	33	4	5	F	29	4
6	M	35	6	6	F	30	6
7	F	25	2	7	F	30	5
8	F	26	1	8	F	26	1
9	F	27	1	9	F	26	1
10	F	29	1	10	F	27	3
11	F	31	1	11	F	28	3
12	F	31	2	12	F	29	2
13	F	31	2	13	F	30	6
14	F	32	3	14	F	32	12
15	F	35	10	15	F	32	10

### Measures and Procedures

To begin the study each of the teachers were given two pre-instruments. The first assessed each teacher's level of technological sophistication and level of technophobia. Technological sophistication was measured by a researcher-developed questionnaire. The questionnaire solicited information on teachers' use of consumer technology (e.g., video-cassette recorder, automated banking, computer/video games, home care software), academic technology (e.g., word processing, programming use, library/research technology, classroom presentation packages/technology), and technology ownership. Technophobia was measured by level of computer anxiety. The Computer Anxiety Rating Scale (Form C) (CARS-C) (Rosen, Sears, & Weil, 1988) contains 20 items on a five-point scale that when scored derived a level of "no technophobia," "moderate technophobia," or "high technophobia."

The second evaluation tool examined the teachers' ability to develop lesson plans that included modifications/adaptations for students with specified characteristics of learning disabilities and emotional/behavioral disabilities. According to the Colorado State Department (CDE, 2000) special education teachers are to link state content standards to each student's IEP annual goals. Therefore, teachers were also required to include the state content standard they were addressing in their lesson plan. Teachers were in need of support that allowed flexibility. Thus, the dependent variables were (1) efficiency of the Web-based lesson template, (2) effectiveness of the template use on technical and instructional component inclusion in lesson plans, and (3) the appeal of the template use to special and general education teachers.

The training (independent variable) began with each participant being taught how to develop necessary modifications and/or adaptations to promote success of students with affective and academic disabilities on daily general education assignments and assessments. The areas of emphasis for modifications were lesson activities, required readings, and evaluations. In addition to teaching possible modifications, each teacher was taught how to write lesson goals that introduced the broad topic, learning objectives that included performance-based terms, action verbs, links to the goal, and were measurable and observable.

Each teacher was then instructed in the use of a web-editing program (Microsoft Front Page) and Teaching-Not-Teaching (T-N-T) (Murry, 1998), a web-based lesson template. Each instruction period lasted 2 hours with ½ hour for questions and guided hands-on experimentation. T-N-T was designed to include each of the 7 components the teachers had been taught to use and include in a lesson plan for their students with special needs. The T-N-T template included navigation for goals, objectives, readings, activities, evaluation, glossary or chat room, and teacher e-mail link. See Figure 2 for a screen capture of the navigation found on each page of the T-N-T lesson template.

**Figure 2. T-N-T Template Navigation**



After selecting their topic area (Science or Language Arts) the teachers were provided time-log worksheets to track time that they spent thinking, tinkering, developing, and collecting items for their Web-based lesson. They were then instructed to begin the development of their first Web-based lesson using the steps listed below.

- Step 1: Consider the learner characteristics;
- Step 2: Matching characteristics to the instructional problem the lesson presented;
- Step 3: Articulate what the student will accomplish in this lesson using performance-based terms;
- Step 4: Write measurable goal(s) and objectives for the specific lesson using evidence from the students' Individualized Education Plan (IEP);
- Step 5: Use the subject matter expert (SME) (e.g., the general education Science or Language Arts teacher) to provide ideas on materials, graphics, and other resources;

Step 6: Identify and determine which modifications and/or accommodations are necessary for success;

Step 7: Identify and collect the online readings and activities that relate back to the lesson goal(s) and objectives;

Step 8: Develop your lesson, planning the delivery and content outline;

Step 9: Develop evaluation instruction to conduct the assessment for your lesson;

Over the following 10-week period, the teachers developed 8 other Web-based lessons using Front Page and T-N-T for use with students needing parallel curriculum adaptation/modifications in the general education classroom.

## A.

### Results

The same battery of measurement instruments was administered to all 30 teachers before and after the training program. The performance of the teachers on the pretest and posttest measures is shown in Table 3. Mean group raw gain scores were observed on each of the lesson plan instructional and technical components (see columns 1 and 2). To determine whether the gains were educationally and statistically significant, the researchers subtracted the pretest score from the posttest score to yield a gain score. The mean gain on each component for the total sample is shown in column 3 of Table 3.

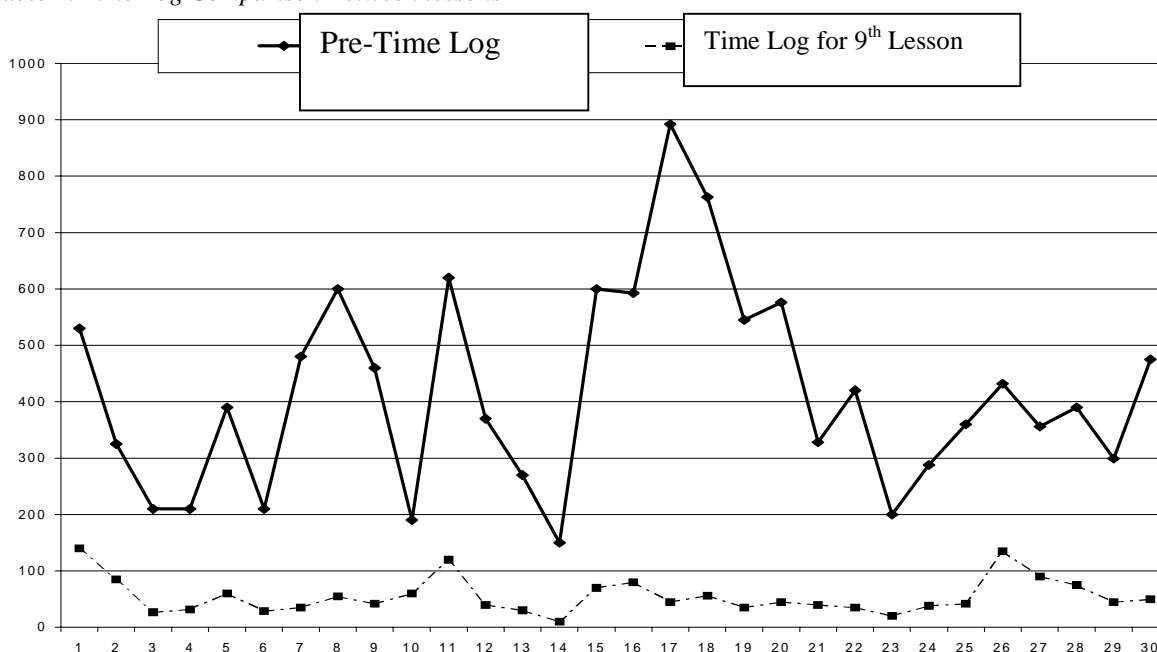
*Table 3. Group Gain Scores on Dependent Variables*

	Group Pretest Score	Group Posttest Score	Group Gain Score
Efficiency Lesson Development Time	347 minutes	56 minutes	291 minutes
Effectiveness			
Instructional (7 total)	2.1	6.4	4.3
Technical (3 total)	.5	2.9	2.4

Appeal			
Future Intended Use	15	27	12
Technophobia	25	8	17

The T-N-T template efficiency was defined as amount of time gained between the first Web-based lesson and the ninth lesson development. Teachers kept track of the minutes they spent thinking about content of the lesson, tinkering with Front Page and T-N-T, surfing the World Wide Web for graphics, collecting audio, video, and other resources. The average amount of time spent on the development of the first lesson was 347 minutes compared to 55 minutes on the ninth Web-based lesson. See Table 4 for a detailed comparison of each participant's development time between the first and ninth lesson.

Table 4. Time Log Comparison Between lessons



Effectiveness for the purpose of this study was defined as the inclusion and functionality of technical and instructional components in the Web-based lesson plans. The T-N-T lesson template navigation included each of the instructional components with the exception of a Content Standard link, thereby making it difficult for a teacher to ignore the need to include them. The technical components were also included in the template design; however, the lesson developer could alter the functionality. See Table 5 for pretest and posttest results of each participant's inclusion of instructional components and Table 6 for pretest and posttest results of functionality of the lesson technical components.

Table 5. Pre and Post Instructional Scores for Each Participant

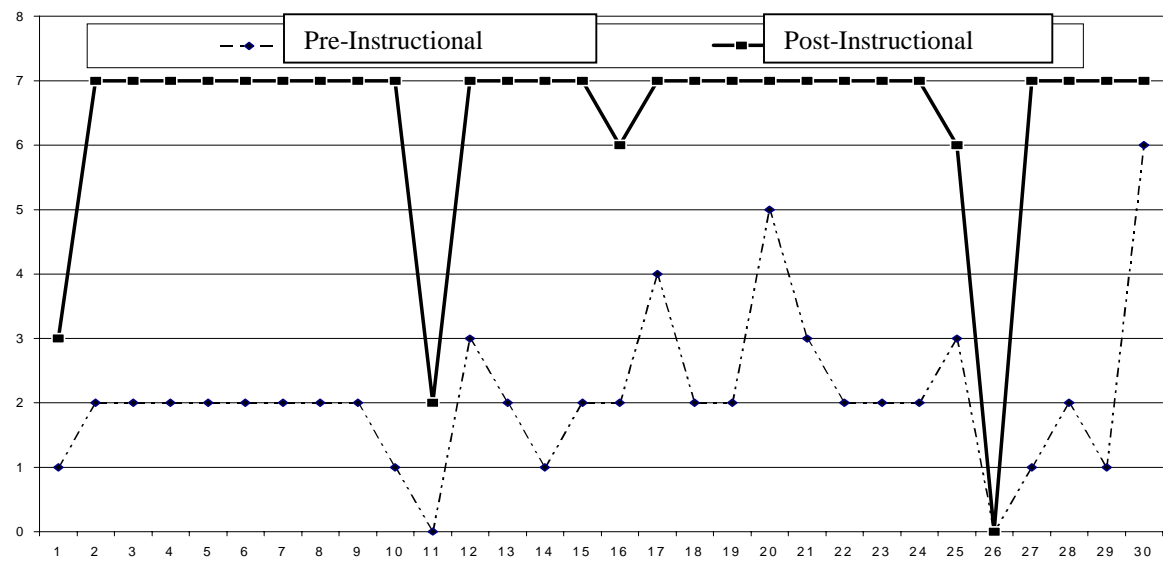
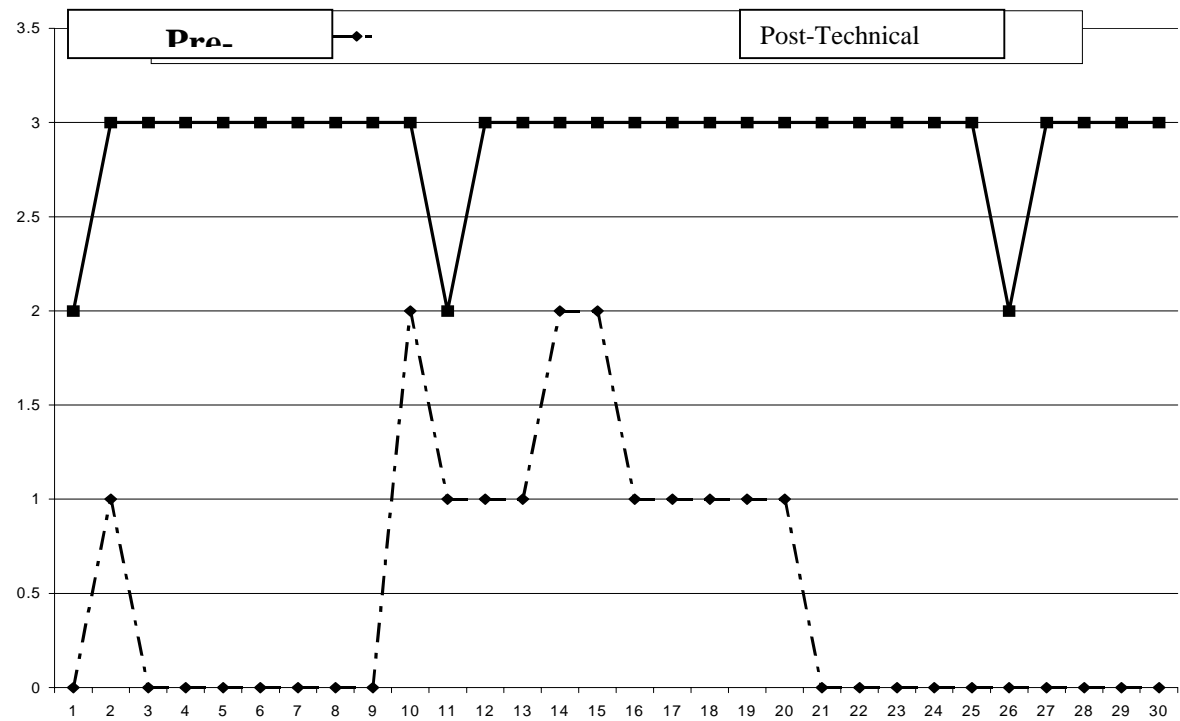


Table 6. Pre and Post Technical Scores for Each Participant



The dependent variable of appeal was characterized by the intended future use of the template by the special and general education teachers and by the change in pretest to posttest technophobia scores. The results of intended future use survey and the pretest posttest technophobia scores are reported in Tables 7 and 8, respectively.

Table 7. Pretest and Posttest use and Intended future use

	Pretest		Posttest	
	Yes	N (%)	Yes	N (%)
Use Web-based lesson template to adapt general education lessons for students with special needs		0 (0%)		27 (90 %)
Intend to expand the variety of technology used in my future teaching		2 (6 %)		27 (90 %)

*Table 8. Pretest and Posttest Technophobia Scores*

	Pretest		Posttest	
	N	(%)	N	(%)
High technophobia	6	(2%)	2	(.6 %)
Moderate technophobia	13	(4 %)	3	(1%)
No technophobia	11	(3.6%)	25	(8 %)

## Discussion

Technophobia is a major concern in the educational arena. Technophobia has been categorized as the number one reason teachers fail to integrate technology in to the classroom. Utilization of the T-N-T template was investigated as a means to reduce technophobia to a manageable level and thereby allow teachers to integrate technology into the classroom in the form of Web-based instruction.

As a result of incorporating the use of T-N-T participant performance was substantially improved in several areas of concern. Technophobia was reduced in two categories (Moderate and High) with many students reporting moving into the No Technophobia category. Three students, who scored high in technophobia during the pre-test, showed little or no response whatever in the learning curve. The same students did not score well on the pre and post for template effectiveness, efficiency and appeal. This may have been due to attitude, age, or lack of motivation to use computer-based technologies. These students were the oldest in either of the groups.

Average lesson development time decreased from 347 minutes to 55minutes by the ninth lesson. The number of instructional strategies/components included in lessons developed by the participants increased dramatically. This increase is encouraging in that earlier teacher instructional behavior research has indicated that the discriminating factor between novice and expert teachers was that novices who did not start teaching with effective lesson development skills did not acquire them simply as a result of experience (Ayers, 1983; Housner & Griffey, 1994; Medley, 1980).

Functionality of the technical components included in the Web-based lessons developed by the participants went from 0 for many participants to the highest possible post-test score of three. The use of the template made this increase possible; however, the participants could have easily made the components nonfunctional. The fact that so many of the teachers succeeded with the template provides a solution to the findings of McCormack and Jones (1998). They found few educators possessed the required integrative ability to combine the technical knowledge and educational principles to construct effective Web-based educational environments. The template allows teachers to circumvent the necessary learning for technical technology skills while capitalizing on their emergent instructional skills.

## Limitations

The researchers used the one-group pretest-posttest design in this experiment because the special education teachers were expected to provide modifications/adaptations of assignments for students in the general education classroom. The absence of a control group did not pose a serious threat to the internal validity of the experiment, however, because the researchers were able to safely assume that expected pretest-posttest gains due to extraneous factors would be minimal or nonexistent.

## Conclusion

The use of a Web-based lesson template increased the potential for special education teachers to effectively support the inclusion of students with EBD and/or LD in the general education curriculum. As teachers become increasingly more efficient in Web-based lesson design they will transform education. The use of the T-N-T template will promote lessons that are derived from measurable student goals and objectives, activities that are linked to the goals and objectives, and quizzes that assess the stated learning to take place. The results of this study promote the thinking that teachers make selections based upon availability and immediate usefulness instead of applying the concepts or principles on teacher effectiveness (Guskey, Huberman, & Michael, 1995; Lortie, 1975) and will support the use of applications that enhance immediate usefulness and teacher effectiveness. It will also

encourage the use of technology for communication between teacher and students. The Office of Technology Assessment declared that technology was generally used in classrooms for low-level cognitive and instructional tasks (1995). This study refutes the very idea. "We have the potential to do great things with technology in our schools, but it is a potential still largely unrealized" (Riley, 1999, p. 9).

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