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Selected Papers
On the Practice of Educational Communications and Technology
Presented at
The Annual Convention of the Association for Educational Communications and Technology
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Preface

For the thirty-second year, the Research and Theory Division of the Association for Educational Communications and Technology (AECT) is sponsoring the publication of these Proceedings. This is *Volume #2 of the 31st Annual Proceedings of Selected Papers On the Practice of Educational Communications and Technology.* This volume includes papers presented at the national convention of the Association for Educational Communications and Technology held in Louisville, KY. Copies are available online at AECT.ORG. Volumes 1 and 2 are also available through the Educational Resources Clearinghouse (ERIC) system.

This volume contains papers primarily dealing with instruction and training issues. Papers dealing with research and development are contained in the companion volume (Volume #1).

REFEREEING 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 sixty 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.

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Volume 2 – On the Practice of Educational Communications and Technology

PowerPoint and the Pedagogy of Digital Media Technologies

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With the ever-increasing importance of technologies as what orients us in the practical lifeworld, our extensive dependence on them has never been more central or more deserving of sustained critical attention. Indeed, since this dependence forms the very basis of our agency in the technologically mediated lifeworld, developing some understanding of and command over it forms the prerequisite for any subsequent practical project and must accordingly be considered the central concern of contemporary technocultural criticism. (Hansen, 2000, p. 258)

The Internet, iPods, gaming systems and smart phones are changing the way we work, play and interact in the digital age. Similarly new media, Virtual Learning Environments, electronic whiteboards and new software tools are significantly altering processes of teaching and learning in primary, secondary and postsecondary education settings. Few are surprised that in virtually every classroom in schools, training institutions and universities, computers are commonplace. Students supplement textbooks by accessing their assignments and readings online, they wordprocess their course papers, download PowerPoint presentations and class notes, keep in touch via Learning Management System discussion boards and online social networks, all the while texting and twittering on their smart phones. New technological tools are changing how we learn, what we know, and how we understand and live in the world around us. Yet, we have barely begun to grasp the profoundly co-constitutive relationships we share with our digital technologies, relationships that simultaneously open new worlds of possibilities while silently foreclosing others.

My research investigates this over-riding question: How are new media technologies, (re)shaping knowledge[1], altering how it is represented, presented, and subsequently comprehended? The unique issue underlying this inquiry is captured in Marshall McLuhan's notion of the invisible "lines of force" (1964, p. 15) that digital media technologies seem to be exerting in the educational context. To narrow the scope of my investigation I elected to study a now ubiquitous, relatively simple-to-use, software presentation tool: PowerPoint. Using PowerPoint as a touchstone, my research examines how software may extend but also serve to constrain what a student sees, experiences and has access to. In a similar manner, I investigate how teachers are not only aided and "enhanced" by PowerPoint, they are also enmeshed, constrained by and relinquished to the language, imagery, framing, at-handedness, and sensuality of its materiality and design. As Merleau-Ponty observes, "our existence changes with the appropriation of a fresh instrument" (1962, p. 143). We might wonder then, what transformations of perception occur, what translations of action manifest as teachers adopt a "fresh instrument" like PowerPoint in the lived space of the classroom? What is it like for students to learn via PowerPoint presentation? Does PowerPoint affect habits of mind? What is the nature of the vocative appeal digital technologies like PowerPoint seem to exercise in the lived space of the classroom? Can we catch glimpse of the new lifeworlds opened as teachers and students respond to the invitational quality[2] of these new media technologies?

The PowerPoint literature so far

Much of the educational literature on PowerPoint has focused on how-to advice and providing practical exemplars (e.g. Buchholz & Ullman, 2004). Some survey data suggest students have an overall positive attitude towards PowerPoint (Atkins-Sayre, Hopkins, Mohundro, & Sayre, 1998; Apperson, Laws and Scepansky, 2006; Daniels, 1999; Frey & Birnbaum, 2002; Harknett & Cobane, 1997; Kask, 2000; Lowry, 1999; Mantei, 2000; Nowaczyk, Santos, & Patton, 1998; Szabo & Hastings, 2000). Students report PowerPoint is a useful cognitive tool,

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[1] My use of the term knowledge is intended to be inclusive of the passions, skills, attitudes, and emotions that inhere in teachers' knowing.

[2] The "invitational quality" of a thing is very similar to J. J. Gibson's original term "affordance" (now popularized in human-computer interaction and design literature, cf. Donald Norman). Gibson (1979) claimed affordance as "a radical hypothesis, for it implies that the 'values' and 'meanings' of things in the environment can be directly perceived" (p. 127). He credited his coinage of the term to Kurt Lewin's description of the *Aufforderunscharakter* of environments and objects. Lewin (1926) illustrates:

> The beautiful weather, a certain landscape invites one to go for a walk. A staircase entices the two-year old child to climb up and jump down; doors entice one to open and shut them, little crumbs to pick them up, a dog to pet it; the sandbox to play in it; chocolate or a piece of cake to be eaten, etc. (p. 350)

Around that time, American philosopher George Herbert Mead (1934) similarly wrote of armchairs "calling out" for us to sit in them (p. 278-80). Phenomenologically speaking, we often "hear" objects and aspects of the environment as invitations to partake of and participate in the world in particular ways.

especially when the electronic files or slide printouts are made available for review. They describe teachers using presentation software as generally more organized. On the other hand, a recent poll of 4,500 American undergraduates reveals significant student unhappiness with the way technology is being employed in lecture halls, most particularly PowerPoint (Kvavik, Caruso & Morgan, 2004; Young, 2004).

Studies aimed at determining the efficacy of PowerPoint relative to other teaching methods have yielded mixed results. Lowry (1999), Mantei (2000), and Szabo & Hastings (2000) report PowerPoint-enhanced lectures increased levels of academic performance among college students, whereas Daniels (1999), Rankin & Hoaas (2001) report no effect. Kask (2000) found female, but not male, college students achieved better grades in a microeconomics course using PowerPoint. However, Susskind (2005) questions the results of some of these early studies, citing research design flaws. Apperson, Laws and Scepansky (2006), also in an attempt to overcome previous research design flaws, measured student satisfaction and test performance in ten classes across four disciplines. One semester was taught with PowerPoint, one without, with each pair given by the same professor. This study concludes PowerPoint does not impact academic achievement, but does develop an overall positive impression of the professor including likeability, organization, and a host of other "good" teaching behaviors not directly attributable to PowerPoint. Levasseur and Sawyer (2006), offering the most comprehensive review of the educational literature on PowerPoint to-date, similarly conclude that "the majority of studies comparing computer-generated slide-based instruction against other instructional methods have failed to find significant differences in learning outcomes" (p. 116).

Critical analyses of PowerPoint have also been forwarded. Most notably, visual communications expert Edward Tufte (2003) claims PowerPoint supports a cognitive style that is inconsistent with both the development of higher analytical thinking skills and the acquisition of rich narrative and interpretive understanding. Some geography scholars, whose discipline is embedded in visual representation practices, worry PowerPoint is commanding an "epistemological monopoly [that] reinforces the interchangeability of content within the single (re)presentational system" (Crang, 2003, p. 239) and carries unfortunate corporate undertones (Matless, 2003; Rose, 2004). In this way, PowerPoint may prove to be a "killer app" superceding a variety of classroom practices and potentially rendering obsolete valuable, perhaps critical, knowledge forms (Adams, 2006).

Sherry Turkle (2004) suggests productivity software like PowerPoint "constitute a particular aesthetic in educational computing" (p. 101). PowerPoint promotes a particular way of thinking, one that "does not encourage students to make an argument [but rather] to make a point." (p. 101). Digital media researcher Jamie O'Neil (2005) uses Bourriaud's theory of relational aesthetics to examine "how the medium of PowerPoint effects (or affects) the message" (p. 84). His intent is to dislodge the common instrumental, effective view of PowerPoint and install a critical, affective, experiential one. O'Neil concurs with artist David Byrne's claim that PowerPoint "tells you how to think as it helps you accomplish your task" (Byrne, 2003, p. 3) and welcomes the arrival of "critical PowerPoint artworks (or covert interventions) as a mode of resistance to groupthink" (O'Neil, 2005, p. 84).

What does all this mean for educators using PowerPoint in their classrooms? Studies show no significant gains in academic performance. At the same time, there is an appreciable increase in positive feelings towards instructors using PowerPoint. Finally, critical analyses are aligned on this point: PowerPoint tends to encourage a particular way of thinking, a way that may have questionable—or at least limited—merit in academic environments. Meanwhile, we still do not know how students or teachers actually experience PowerPoint mediated lessons and lectures. We are missing what Turkle (2004a) calls "the phenomenology of the digital experience" (p. 102).

Methodology

Mindful of Turkle's suggestion that we may be missing a phenomenology of the digital experience, this is precisely the approach I take for my research methodology. The main focus and aim of phenomenological inquiry is the description of lived experience, that is, the description of phenomena as they present themselves or as they are given in experience. Phenomenology is concerned with how we experience our world *pre-reflectively, pre-verbally* in its lived immediacy; it is the practice of fidelity to lived experience. As well as describing experience, *hermeneutic* phenomenology seeks to draw out the meaning or significance of our practical involvements in the world. Such research formulates questions of the type, "What is this or that human experience like?" It is an attempt to return "to the things themselves" (Husserl, 1911/80, p. 116), and further, to let these things (phenomena) speak for themselves (Heidegger, 1962). Phenomenology is not interested in conceptualizing, theorizing or idealizing experience, but rather in describing and interpreting experience as it is lived.

Phenomenological inquiry explicitly positions the researcher to comprehend information and communication technologies, not as solely objective *or* subjective phenomena, but as *lived*. A central feature of phenomenological method is the gathering of a field of descriptive evidence from which underlying patterns and structures of experience can be drawn (van Manen, 1997). My study addresses three distinct modes of PowerPoint engagement: (1) how PowerPoint presentation is experienced by students; (2) how teachers experience constructing a presentation with PowerPoint; and (3) how teachers experience teaching through PowerPoint presentation.

The phenomenological study involved in-depth interviews with fourteen college students and twelve instructors at two different academic, post-secondary institutions; observation of large university lecture classes where PowerPoint was being employed as a primary means of teaching; and reflection on my own use of PowerPoint as an instructor in post-secondary settings. I used hermeneutic phenomenological methodology to capture the particularities of the PowerPoint experience in the form of lived experience descriptions (LEDs). Methods employed include thematic analysis, linguistic interpretations, honing of exemplary or anecdotal narratives through eidetic reduction. Phenomenological method also requires a systematic scholarly "reading" of relevant philosophical literature and phenomenological studies. Using techniques such as comparing pedagogical styles of classroom discussions and presentations with and without PowerPoint I examine how the experiences of software-mediated presentations are uniquely sponsoring and providing for modes of teaching and learning that are always and inevitably embodied and situated in particular temporal, spatial and relational contexts.

Theoretical Framework

The totality of the immediate environment that we inhabit, our lifeworld, is best described as "a *milieu*—a field of intensive forces, vibrant according to their own inner codes" (Lingis, 2004, p. 278). Ivan Illich (1996) coins the phrase *le milieu technique* to refer to the irresistible embrace of the high technology lifeworlds we find ourselves dwelling in today. The technological milieu is shaping substantially—insinuating itself, habituating us and simultaneously reinterpreting—how we act in and perceive the world. Mark Hansen suggests that new media technologies are "poised on the cusp between phenomenology and materiality" and as such have introduced "a theoretical oscillation that promises to displace the empirical-transcendental divide" (2006, p. 297) that has long structured western thinking.

This research is situated in the midst of this difficult theoretical divide, and attempts to make visible some of the tight intimacies, primordial interminglings, and, at times, acute dependencies teachers and students find themselves living with their educational technologies every day. To this end, this research project draws on four phenomenologically-informed traditions: curriculum and pedagogy studies (e.g. Max van Manen, Iain Thomson), philosophy of technology (e.g. Martin Heidegger, Don Ihde), human environmental aesthetics (e.g. Berleant & Carlson, Pauline von Bonsdorff) and media studies (e.g. Hansen, Marshall McLuhan). For example, in the section below, I frame participants' lived experience descriptions in light of Martin Heidegger's foundational insights about human-technology relations. Heidegger, one of the earliest philosophers of technology, shows that each thing (or place) opens a new world to us, revealing novel structures of experience and meaning; every technology discloses a new horizon of possibilities to us. Human beings are "the be-thinged" (Heidegger, 1971, p. 181), that is, we are prereflectively inhabited, conditioned, and creatively provoked by the things of our world.

In the remaining pages, I provide an excerpt of the final phase of my project, which attempts a phenomenology of university teachers' everyday experiences of PowerPoint.

Inhabiting PowerPoint: constructing a lesson with PowerPoint

The vocative appeal of PowerPoint to the teacher is at once a linguistic gesture: "Click to add title," "• Click to add text". It is also a promisingly familiar and easy-to-use digital environment; a hermeneutic horizon of previous PowerPoint design and teaching experiences; entrance to an architected form intending persuasive presentation; a windowed milieu that the teacher traverses with her eyes upon screen, fingertips on keyboard, hand shuffling a mouse. As Heidegger (1972) tells us, "When we handle a thing, for example, our hand must fit itself to the thing. Use implies a fitting response" (p. 187). Reaching out with anticipation of PowerPoint's promise to help her point powerfully, the teacher orients herself toward her windowed environment; her being is drawn in and gently caught up in the "draft" of PowerPoint, the unique horizon of possibilities it brightly frames for her. She responds fittingly.

> One teacher describes how she constructs a lesson using PowerPoint:
> *I insert an image, add some text, then try them in different positions on the slide. I'm looking for balance. I like using compelling images, with minimal, carefully chosen text for impact. As I work, I do not, cannot separate the composition of slides themselves from the subject matter at hand, the vision of my students, and the appeal I am trying to make. I sit back and look (perhaps trying to see the slide as my students might), then adjust, and adjust things again. I try out different fonts, sample background colors from my images, wanting to give the whole presentation a sense of visual cohesion. I take a certain pleasure and satisfaction in this. I move to Slide Sorter View [where all the slide thumbprints are laid out across the window] to grasp the whole so far, to visualize the general flow of the presentation. From here, I move a few slides to a different place in the sequence to see how that flows, then return to Normal view. I find I am variously engaged with trying to represent the content, the purpose of this teaching presentation, visually, in text, or both, and thinking about, imagining presenting the slides to my class.*[3]

Within the PowerPoint environment or milieu, the teacher's work materializes as an accumulating series of slides. The basic elements of each slide are text, images, color, and animation. She composes, adjusts, tries out new fonts, samples colors, switches "views," plays with order. She is wholly engaged, representing content as slides then imagining their presentation in the immediacy of a classroom with her students. Slides, subject matter, the vision of her students, and her presentational and teacherly intentions intermingle.

In performing this preparatory work, the teacher is sitting in her office with computer, screen, keyboard and mouse; texts and papers litter the desk. Her screen shows numerous windows open: a web browser, email, a Word document, as well as PowerPoint. Occasionally her eyes wander from the screen, and stare thoughtfully out her office window into the distance. She turns back to the PowerPoint window, pulls her keyboard a little closer, nudges her mouse and continues work. Once the teacher is engaged in her preparation work, her office, desk, screen, keyboard and mouse recede into the background. PowerPoint too withdraws from full view, fading to a transparent framework, a sophisticated but peripherally present set of tools that she may variously call upon to perform her presentation design activities in this digital world.

Phenomenologically speaking, we do not usually engage a tool as a discrete, obvious object, that is, in what Heidegger calls its present-at-hand mode (*vorhandenheit*). Rather we tend to encounter a tool through using it, in its handiness (*zuhandenheit*). In this handy encounter, the tool is essentially invisible to us, taken-for-granted. It is, as Sartre says about the everyday experience of our own bodies, passed over in silence—"*passé sous silence*" (Sartre in Bleeker & Mulderij, 2002).

> Consider the example (used by Wittgenstein, Polyani, and Merleau-Ponty) of the blind man's cane. We hand the blind man a cane and ask him to tell us what properties it has. After hefting and feeling it, he tells us that it is light, smooth, about three feet long, and so on; it is occurrent for him. But when the man starts to manipulate the cane, he loses his awareness of the cane itself; he is aware only of the curb (or whatever object the cane touches); or, if all is going well, he is not even aware of that….Precisely when it is most genuinely appropriated equipment becomes transparent. (Dreyfus, 1991, p. 65)

Hammering a nail in the wall to hang a picture, we are focused on the picture-hanging, the project we are engaged in, not on the hammer. When we are writing a scholarly paper or an email, we are barely aware of our typing fingers or the keyboard. Our fingers serve us silently, tapping transparently on the vaguely present keyboard, while we are primarily engaged in the higher-level business at hand: writing thoughtfully. Only when we accidentally hit our finger with the hammer do we suddenly awaken to our throbbing finger and to the hammer as an obvious object. Too, until our fingers know how to type, the keyboard stands as an insurmountable obstacle. But, as Heidegger (1962) describes, "the less we just stare at the [tool], and the more we seize hold of it and use it, the more primordial does our relationship to it become" (p. 98). To be what it is, a tool must recede from visibility.

The work-object or focal project of our instructor is thus not PowerPoint. Her project is the classroom situation she will find herself in a few days hence. As teacher, her primary intention is to creatively assist her students in learning the particular subject matter at-hand. For this purpose, for this subject matter, she has chosen to use PowerPoint. Thus while the presentation software expertly frames and facilitates her activity of planning a lesson, PowerPoint is not the main objective and intention, anymore than canvas and paint palette are the objective and intention of the artist. Nonetheless, we must also notice how the instructor's activity patterns and meaning

[3] The italicized text represents phenomenological research material drawn from interviews conducted with twelve university and college instructors regarding their everyday, "lived" experiences of PowerPoint. Individual participants are identified only as "the teacher", "the instructor", "he" or "she".

structures are also being quietly *in-formed*—conformed, deformed, and reformed—by the architecture of the particular software she finds herself *inhabiting*.

The PowerPoint habit

Another teacher relates simply: "*Sitting down to prepare a PowerPoint, I can't help but think in bullets.*" Parker (2001) humorously notes how PowerPoint seems to promote a certain kind of thinking: "Last week I caught myself planning out (in my head) the slides I would need to explain to my wife why we couldn't afford a vacation this year" (p. 78). As the teacher seizes hold of PowerPoint as a tool of teaching, he or she necessarily begins to think in terms of the form it suggests. At minimum the teacher must think in slides, reconfiguring his or her knowledge in the new 4:3 rectangular landscape delineated by PowerPoint. The software readily assists in this project by inviting the teacher to consider certain formats: to title each slide, to reform subject material as abbreviated, bulleted points.

In PowerPoint, the teacher sees and understands her teaching world in terms of the sphere of possibilities this software discloses to her as she works: slides, menus, animations, Slide Sorter View, Normal View. Her lesson planning world unfolds in the context of a bright, spacious rectangular "window," a bright screened facade framing and containing explicit text and iconic invitations. Ihde (1990) suggests, "technologies, by providing a framework for action,…form intentionalities and inclinations within which use-patterns take dominant shape" (p. 141). *In* PowerPoint, the teacher "does not, cannot separate" the software's possibilities and designs from her own: the aims and inscriptions of the Microsoft programming team and the teacher intentionalities and inclinations intertwine, enmesh and reorient. The teacher's world is translated into new vocabularies and presentation genres, expanding her possibilities of action while simultaneously framing and constraining the world as a screenic succession of 4:3 slides.

Having responded to the vocative appeals of PowerPoint—its invitational qualities or affordances—the teacher enters a mode of human-technology engagement Chesher (in Suchman, 2007) describes as "managed indeterminacy" or *invocation*. "Invocation involves those actions that define the terms of engagement written into the design script or discovered by the participating user" (Suchman, 2007, p. 282). The teacher is now conversationally engaged, enfolded into, and intertwined with PowerPoint. The teacher-technology relational boundaries blur and a hermeneutically rich but "silent" corporeal rapport sets in. What sorts of conversations seem to unfold between teacher and PowerPoint?

Yet another instructor describes a somewhat different approach and concern when creating her PowerPoint slides:

> *Composing this slide, there was a particular aesthetic I was striving for: thoughtful use of color, thematic cohesiveness, consistency between the slides (not sameness!), but also movement, meaningful movement through and among the slides. There is clearly an art to this.*

This teacher is preoccupied with visual appeal and attaining thematic integrity with the subject matter. Movement achieved "through and among" her slides has significance to her. The teacher is trying to be sensitive to the atmospheric quality of the PowerPoint media on her students. This raises the question of how atmosphere is usually anticipated in the planning of a lesson and how the aesthetic of PowerPoint slides may be seen as an evocative tool for establishing a sphere.

"PowerPointing": Teaching by and with PowerPoint

Enter teacher with trolley replete with laptop, mouse and data projector. Untangling the garage-band knot of electrical cords and connector cables, the teacher connects, plugs in, and turns on laptop and projector. This process is sometimes accompanied by palpable anxiety surrounding the stages of equipment hook-up, and worries about self-competence in the face of difficulties or breakdown and the implications of "no PowerPoint" to the fate of the class. The projector hums at last, the slides are cued up, the teacher breathes a quiet sigh of relief.

The simple act of drawing the blinds or switching off the light, darkens perceptibly the hue of the wall, softens the faces of students. The teacher becomes less visible; the projected slide shines brighter. The mood changes, the classroom atmosphere shifts. PowerPoint reconfigures the classroom as a cinematic space: the students settle in as spectators, the teacher as orator, narrates the slides from the side. When the teacher turns to the opening slide, the students are cued to sit back, get comfortable and hopefully enjoy and learn from the PowerPoint presentation with a certain sense of (inter)passivity. A subtle change occurs in the students' attitude and orientation. The large, bright slideshow reminds students they may become a particular kind of audience, "invigorated or drowsy, [but] a generally passive audience that is rarely called upon to really interrogate the images" (Crang, 2003, p. 242). But what does the projected PowerPoint slide evoke for the teacher?

The vocal rhythm of PowerPoint

> *I notice when I turn to begin my PowerPoint, I shift my role slightly—I'm less conversational, more oratorical. PowerPoint locks you into a gait in your speech, a kind of vocal rhythm.*

The teacher with-PowerPoint finds himself standing somewhat differently in relationship to his class: less dialogic, more monologic; less open to interruption and discussion, fastening to a vocal pattern that rhythmically signals oration not conversation. Vocal rhythm may also establish a kind of synchrony with the slide rhythm.

> *The arrival of a new slide is the occasion to take a breath, a momentary pause to look at the slide, allow its meaning to prompt me: a reminder of what to say next, what direction to pursue. But too, I must somehow find connection with what I have just said. Or not. It tells me what comes next. I feel I must press on.*

Like walking and talking with a good friend, footfalls—narrative breaths and slidefalls—find a mutually comfortable rhythm and pace. Here a special kind of pathic relation is hosted, not between teacher and students, but between teacher and projected slides. This human-technology dialogue appears more determined and rigid than the comparably flexible, nuanced relation engaged during the planning and design phase. More specifically, the slides are no longer in the midst of being created and manipulated. In View Show" mode, the teacher cannot change the slides themselves, he can only control the direction of movement between the slides and animation moments—forward, backward—as well as access preset links and buttons. This predicament of being instructionally captivated in a slide set seems too to be a consequence of the teacher planning the lesson with a series of headlines or points, as we saw above.

In the lived moment of the class, as each new slide appears, it "speaks" prereflectively to both students and teachers alike. That is, before we are even aware of it, we have already seen the new slide and begun to read and make sense of it; the teacher finds himself or herself speaking to the slide. When the next slide is summoned, it "speaks" again, and the teacher must now speak to it.

"I am committed to do this PowerPoint"

> *As soon as I clicked to the next slide, I knew immediately it was the wrong thing. Seeing their eyes, I felt: I simply can't go on. It was the same sinking feeling you get realizing the person you are having a conversation with isn't listening to you. I had spent all this time preparing this PowerPoint presentation and then the problem with PowerPoint is you just can't simply jump ahead, be extemporaneous—"just ignore this and this while I find the right slide." I was stuck with my plan.*

This college instructor recalls a time when he suddenly felt that, in the lived context of his class, his choice of using PowerPoint to address a particular topic was misjudged. Of course, any lesson plan or teaching approach can go awry or fall flat. In such moments, the teacher may decide to "stick with the plan" or diverge and improvise. The seasoned teacher usually has a few other "tricks" at-hand. Yet, is there something about PowerPoint that complicates the move to diverge in response to one's felt sensibilities? One teacher describes her PowerPoint dilemma like this:

> *PowerPoint is a finished product. It is hard for me to loose myself from the slides in the context of my class. The story has, so to speak, already been decided.*

But perhaps, the problem is precisely that the story had not been decided. The teacher did not prepare a story but a series of points, stops on the way to some cognitive end point. She goes on to describe the resistance she feels in deviating from the slide set she herself has constructed: "If I answer a question, how will I go back to the slides?" In planning and carefully constructing the lecture beforehand, she tried to imagine her students there before her, tried to anticipate their questions. But now, in the context of her actual class, the world looks different.

> *In the classroom, PowerPoint is a representation of my anticipated presentation—an imagining of what my presentation would be, could be. But in the actual moment of teaching, things are often otherwise. In the midst of teaching, my slides and I sometimes come into conflict with one another. Then I feel fragmented, forced to choose this particular outcome—what is represented up there on the slides—over the felt relation with my students—what seems to present itself to me in the moment. I am committed to do this PowerPoint. I cannot now easily choose to do something else.*

When a teacher uses PowerPoint in her classroom, she commits to the unfolding of a particular form of teaching and learning, a predetermined story wending its reckoned path to a decided conclusion. A PowerPoint presentation prepared beforehand is also an investment, visible proof of preparation and organization in the face of the contingent, indeterminate lifeworld of the classroom. To abandon such obvious evidence of competence may strike as fool-hearty, exposing oneself to an uncertain, unprepared-for future. As Howell (2007) laments

> From the moment I walk into the lecture theatre I feel the pressure from my students to line up my thinking with their PowerPoint notes, without which they seem to be lost. I usually succumb by connecting them to the screen rather than to myself, each other, and the subject matter. In giving precedence to the object of PowerPoint, where the slides take on a language and world of their own,…students may subconsciously be encouraged to zoom out of the teacher's presence in favor of the rectangle on the screen. (p. 139)

The Times-Square-like surround of slick and easy possibilities is so appealing and omnipresent, our inner compass as teachers may be quietly lifted from us and replaced by the veneer of "powerful" solutions. As sociologist Daniel Bell prophetically wrote in the early 1970s, the new "intellectual technologies"—tools that specifically extend our cognitive reach—substitute "algorithms (problem-solving rules) for intuitive judgments" (1973, p. 29). A digital technology is given default proxy for professional knowing.

Ready, set, teach!

> *Not so long ago, I gave a lecture for a PowerPoint-loving colleague of mine who had to be away. Standing before his students, I opened his PowerPoint file on my laptop, the whole system struggling to cope with the gigantic file. While we are waiting, I tell his students that their professor has left me 143 slides to cover today. "That means," I calculate, "one slide every 21 seconds. So we better hurry up and get started!"*

PowerPoint exhibits the tendency toward or certainly the desire to achieve maximum efficiency in teaching. Contemporary technologies are both the product of as well as the increasingly complex scaffold supporting and reifying a particular technological frame of mind, "a mode of revealing," which Heidegger calls "enframing" (*das Gestell*). In today's ubiquitous surround of technologies

> we increasingly think and act in accordance with the world picture [modern technology] provides…The technological mode of revealing is a fixation of things by categorizing them and representing them to ourselves in thought through abstract categories, thus making manageable and capable of being efficiently manipulated—a demand to which the fluid and the ill-defined remains inconveniently resistant….We "enframe" things by turning them into instances—understanding them in terms of the objective properties attributed to members of the category to which they have been allocated. (Bonnett, 2002, p. 234).

This technological way of apprehending things—wherein all things, including human beings, increasingly show up to us as resources to be enhanced and optimized for maximal efficiency—is radically restructuring our daily lives, along with contemporary learning experiences and teaching practices. To put it another way and perhaps a little more forcefully, post-modern technology engenders a totalizing style of practices that, according to Dreyfus and Spinosa (2003) threaten to: "restrict our openness to people and things by driving out all other styles of practice that enable us to be receptive to reality. This threat is not a problem for which we must find a solution but an ontological condition that requires a transformation of our understanding of being. For that, we need to understand technicity as our current mode of revealing things and people" (p. 341).

The demand to "have" the PowerPoint

> *On the first day of class, a student asks, "Will you be making your PowerPoint slides available?" I reply, "I haven't yet read all of Plato's dialogues, nor have I learned yet how to put slides up on the web. Given a choice between taking the time to read another dialogue and putting my PowerPoint files on the web, I think I'd choose the former." At the back of the lecture hall, a young woman snaps her book shut, gathers her things and promptly leaves my classroom.*

The PowerPoint slide deck is a lecture product that students are increasingly expecting to procure from their teacher. In becoming a product, the teacher's work may seem less a matter of developing pedagogic relations and the sharing of understanding, skill and expertise, and more a matter of commodity and consumption. Here the young woman expresses her disgruntlement that the new covenant of entitled student-consumer has been broken. She has nothing to gain from the philosopher in his person, only his PowerPoint. Another example:

> *At a conference recently, where PowerPoint is the norm, I am speaking before a fairly large group. As I begin, I am surprised to notice someone, several rows back, raise their hand as if for a question. But then I see the hand is holding a camera, and it quickly goes back down again. Next slide. The same digital-camera-hand goes up then down, and now, off to my right, some ways back, I see another camera-touting hand shoot up. I feel taken aback. Surely my PowerPoint slides are not so compelling that each slide should warrant photographing. No: I, or rather, my work, is being consumed, commoditized and owned…and all without my consent.*

Borgmann (1984) claims modern technology is decisively separating means from ends. The activities or processes of creating things are progressively being hidden from view and replaced with the more singular activity of procuring end-products or commodities. "What distinguishes a [modern] device is its sharp internal division into a machinery and a commodity procured by that machinery" (p. 33). As a result, some of the practices associated traditionally with creative teaching activities are ostensibly disappearing in the wake of sophisticated technologies.

As illustrated above, the PowerPoint slide deck is essentially a product of a teacher's knowing and thinking in conversation with the PowerPoint software, now inscribed as single framed, sequential snapshots. Thus with PowerPoint, students witness more often the projected knowledge product, and less the teacher's knowing-in-action. Then again, each slide has the potential to trigger the embodied insights of an experienced practitioner in the immediacy of the now. This *punctum* or evocative capacity can "save" a PowerPoint presentation from being merely a product.

Yet it may be that “the ultimate success of teaching actually may rely importantly on the “knowledge” forms that inhere in practical actions, in an embodied thoughtfulness, and in the personal space, mood and relational atmosphere in which teachers find themselves with their students” (van Manen, 1995, p. 48). Thus, a primary concern here is a bypassing of the experiential dimensions of practical knowledge, both in the discipline of the subject as well as in teaching practice. When educators try to capture and translate aspects of their tacit understandings to a series of slides, there is the danger of “short-circuiting” the normally contingent enactments of their ordinary teaching and professional actions. Of course, “shortening the circuit” is precisely what devices of expedience, like PowerPoint, are designed to do: eliminate “unnecessary” sub-steps (via hardware or software solutions) to allow the most efficient path to an end.

Overview of Findings

Our corporeal being—our lived body—is increasingly and intimately enhanced by, enmeshed with and enfolded into new digital technologies. These paratextual[4] machines mediate our lived experience with startling immediacy and complexity, lending us novel sensory worlds, and pre-scribed ways of knowing and doing that are increasingly shared globally. The moniker “digital” is signaling a radical change in our material world, but also in our human selves. Techno-utopian thinkers like Hans Moravec and Ray Kurzweil predict human-technology fusions where the “software” of our minds will one day be uploadable to more durable, faster hardware, thus rendering our “mere jelly” (Moravec, 1988, p. 117) bodies—the “old slow carbon-based neural-computing machinery” (Kurzweil, 1999, p. 129)—obsolete. In the wake of such euphoric claims of transcendence, philosopher N. Katherine Hayles (1999) reminds us that the “human mind without human body is not human mind. More to the point, it doesn’t exist” (p. 246). Our human self is intimately tethered to the possibilities as well as the limits of our flesh-and-blood, human body. Thus, as the “mere jelly” body is gradually being relinquished in these technology turf wars, a new version of human being has been conceived: the post-human, “whose basic capabilities so radically exceed those of present humans as to be no longer human by our current standards” (Bostrom, 2003, p. 5).

What does all this mean for educators employing new media technologies? Foremost, we must begin to discern and “focus on our own embodiment as the material site—the bearer—of technology’s otherwise wholly inhuman impact” (Hansen, 2000, p. 263). Digital technologies are locally deployed “mimetic vehicles” (Benjamin, 1978) that prereflectively shape our embodied agency. “Software quite literally conditions existence” (Thrift, 2005, p. 241) by scaffolding a habituation process that occurs primarily outside of the phenomenal field of subjectivity. One of the difficulties in grasping the mediating influence of software is that its texts do not fit the usual model of representation, wherein humans and objects represent each other via words and images. Instead, software texts concern words *doing* things in particular contexts: the language of the machine has immediate material effects.

Our interactions with software, often via a screen and keyboard/mouse/controller, are direct, sensuous and mimetic. Software “affects our experience first and foremost through its infrastructural role, its import occurs prior to and independently of our production of representations” (Hansen, 2000, p. 4). PowerPoint sponsors a style of thinking and presenting, a normative framework for staging knowledge: headings and bullet points for teachers to “talk to”. This scaffolding of abbreviation, built into the software as default signage, implicitly informs how some teachers visualize and subsequently present their knowledge in the lived space of the classroom. The projected PowerPoint slide presentation, regardless of the kind of knowledge it is serving to frame, exercises a powerful sway over the teacher in the moments of teaching, at times appearing as impenetrable obstacle, rather than a generative support to the teacher desiring to pursue her pedagogical sense of tact. In this way, our lived experience is being radically, prereflectively re-habilitated; our intentional involvements perturbed and re-inscribed via the constraints and dispensations of pre-fabricated digital architectures. We are now well into an era of technological-becoming, our sensible bodies quietly adapting to the inhuman rhythms of an evolving, digitally coded and intensifying mechanosphere.

It is imperative that we attend mindfully to the material, hermeneutic, and existential shifts that are transpiring as our worlds are daily extended, intensified, and complicated by digital technologies. The continued promotion of digital technologies as neutral agents—a foundational belief or “posit” of our current ontological epoch—imperils the normative project of pedagogy by concealing the instrumental constructs they materialize. Rather, these paratextual machines must be recognized as effective and affective *mimetic interventions* that prereflectively shape our being, knowing and doing in the world. Such a view necessarily burdens tomorrow’s

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[4] The term “paratextual” is used by Gerard Genette in his book *Palimpsestes* (1982) to describe “accompanying productions” that bind the text and the reader together. He lists the following as examples of paratexts: “title, subtitle, intertitles; prefaces, postfaces, notices, forewords, etc; marginal, infrapaginal, terminal notes; epigraphs; illustrations; blurbs, book covers, dust jackets, and many other kinds of secondary signals.”

teachers with a renewed sense of professional responsibility, one sensitive to the uncertain ecology of today's classrooms in the wake of digital technology integration, but more importantly, for the well-being of our post-human children living this brave new world.

Finally, this research provides argument, ground, and example of how educational scholars must qualitatively document and critically theorize media technology's "hidden" curriculum, that is, the material effects, activity patterns and meaning structures ICTs are mobilizing at a startling speed in education. Educational technologists have spent much energy in trying to assist teachers to use these new media tools, but through this research I show how we must also concern ourselves with how these tools may be using us.

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Signaling the Keywords or Sentences: An Eye-tracking Study

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Abstract

This study examined whether signaling the relevant keywords or signaling the relevant sentences was more effective on students' performance and what the effects of signaling on reading with the help of eye-movements are. 28 undergraduate students voluntarily participated in the study. 14 students studied the computer-based material in which relevant sentences were signaled and others studied the computer-based material in which relevant keywords were signaled. The results showed that type of signaling does not make any change on the students' performance in retention and transfer scores. Eye-tracking data showed that signaling enhanced the attention, decreased the unnecessary visual search and directed the attention to the relevant information. Hence, it reduced the extraneous cognitive load because of split attention.

Introduction

Advances in the technology during recent years have increased the use of multimedia learning. Multimedia learning environments present the information in textual, graphical and audible forms. According to multimedia principle, "people learn better from words and pictures than from words alone" (p.117) (Fletcher & Tobias, 2005). Mayer and Morena (1999) stated that computer-based multimedia learning environments including pictures and words provide "a potentially powerful venue for improving student understanding." (p.108). However, only using the pictures with words is not enough to enhance the learning. "The case for multimedia learning is based on the idea that instructional messages should be designed in the light of how the human mind works" (Mayer, 2001; p.4). For this reason, instructional designers should be sensitive to cognitive theory of multimedia learning while designing the multimedia instruction.

Cognitive theory of multimedia learning is based on engaging the active cognitive processing for meaningful learning (Ausebel, 1968; Wittrock, 1990 as cited in Mautone & Mayer, 2001). Cognitive theory of multimedia learning has three cognitive science of learning assumptions. People have separate channels for processing visual information (e.g. on-screen text, pictures and graphs) and auditory information (e.g. narration and background sound). The second one is the limited capacity assumption. According to this assumption, people have limited capacity to process information in each channel at one time (Mayer, 2005). This means that people have limited working capacity, whereas the capacity to store knowledge in long-term memory is unlimited. Sweller (2005) stated that instructional designs ignoring the working memory limitation "are likely to be random in their effectiveness". The last assumption is that humans actively engaged in three cognitive processes which are selecting relevant information, organizing this information logically and integrating it with other knowledge (Mautone & Mayer, 2001).

Improper instructional designs, which ignore the human's limited working capacity, result in extraneous cognitive load (Sweller, 2005). Multiple sources of information such as texts, figures or narration are used in multimedia learning environments at the same time. However, processing all of this information simultaneously in working memory results in cognitive load (Sweller & Chadler, 1994). Mayer and Moreno (2001) stated that cognitive load is crucial in multimedia learning environments. Thus, they suggested nine ways to reduce cognitive load in multimedia learning. These solutions are off-loading, segmenting, pretraining, signaling, weeding, aligning words and pictures, eliminating redundancy and synchronizing.

Using both words and figures in multimedia instruction sometimes results in unnecessarily splitting the learners' attention. Learners should be kept information in the text in working memory while searching the referents in the figure. Ayres and Sweller (2005) stated that forcing the learning to engaging in a search in order to locate relevant information, then cognitive sources may be distracted from learning. For this reason, search process increase extraneous cognitive load. Proposed solutions should be based on decreasing the unnecessary search. Integrating texts and diagrams are one of the solutions to overcome this problem (Ayres & Sweller). Evidences have showed that learning is enhanced when related text and pictures are in close proximity in an integrated format rather than separated in space (Moreno & Mayer, 1999). Another proposed solution use using color coding to reduce cognitive load. Kalyuga, Chadler, and Sweller (1999) demonstrated that the learners who studied the color-coded format had lower working memory load and outperformed on a multiple choice test than the learners who studied the conventional format. The reason is reducing the unnecessary visual search.

Because of the unnecessary visual search to find relevant information in the diagram, some processing resources in the mind will be consumed (Kalyuga et al., 1999). For this reason, there will not be enough processing resources in the mind (Sweller, van Merriënboer, & Paas, 1998). As a result of the cognitive load associated with the presentation format of instruction, performance will diminish. To minimize this problem, Mautone and Mayer (2001 suggest signaling, providing cues the people with the efficient and effective way to process the materials.

In this study, we used signaling strategy to reduce the cognitive load caused by the combination of graph and explanatory text. Signaling guide the learner's cognitive processing and help the learner to select the relevant information, organize the information logically and integrates the information with prior knowledge by providing cues (Mautone & Mayer, 2001). Using typographical cues, such as; underlining, capitalization, italics, bold-face and color variations, can be used for signaling (Lorch, Lorch & Klusewitz, 1995).These typographical cues can be used for taking attention to key terms, introducing technical terms, and emphasizing the important information. Lorch (1989) stated that "the simplest way to signal the relevance of information is to distinguish it visually from the body of the text by typographical variation" (p.223).Moreover, headings, titles, enumeration signals (first, second, etc.), arrows, linguistic cues (e.g. lower intonation) and outlines are the other cues for cognitive guide (Mautone & Mayer, 2001).

Previous research studies shows that signaling has an effect on students' learning (Mautone & Mayer, 2001; Lorch et al., 1995). Thus, people learn more deeply when the text is signaled. Mayer (1975) stated that "when the material is presented as text, signaling may include the use of highlighting of words…" (as cited in Mautone & Mayer, 2001). However, Lorch et al. (1995) signaled the target sentences instead of words in their study. Thus, it is not clear which one is more effective.

Mayer (2005) stressed the need of extra studies to determine the signaling effects in a multimedia environment, because previous research studies are based on printed text. Moreover, in this study, eye-tracking data provided fixation duration and fixation count. These are valuable information to learn the cognitive processes of the learner during learning.

Purpose of the Study

This experimental study investigated the signaling effect in multimedia learning environment. In this study, two types of signaling strategy was used to reduce the learners' cognitive load. One of them was signaling the relevant keywords, other one was signaling the relevant sentences. In the literature, there is no consensus about signaling word or signaling sentences in multimedia learning environments. This study aimed to give a clear understanding about whether signaling the relevant keywords or signaling the relevant sentences was more effective. Thus, one of the goals of the experiment was to examine the following questions.

- Do the retention test scores for the participants who study with the multimedia learning material in which relevant keyword are signaled significantly differ from the scores for the participants who study with the multimedia learning material in which relevant sentences are signaled?
- Do the transfer test scores for the participants who study with the multimedia learning material in which relevant keyword are signaled significantly differ from the scores for the participants who study with the multimedia learning material in which relevant sentences are signaled?

Another goal was examining the role of signaling in multimedia learning environments by the help of fixation duration and learners' locus of fixation while studying the material. This study shed on light how signaling affects the learners' reading.

Real-time measures of cognitive processing during multimedia learnin can be obtained from eye movement data such as number of fications, average fixation duration and total gaze duration (Henderson, Brockmole, Castelhano, & Mack, 2007). According to the eye-mind hypothesis , the location of the eye fixation is associated with what the subject is processing at that time and the duration of the fixation shows how long it takes to process that information (Just & Carpenter, 1976).

Eye-tracking data is also beneficial to determine the efficiency of the instructional material in terms of how easy it is to find desired information (Murata & Furukawa, 2005). Number of fixations is smaller when it is easy to locate necessary information (Greene & Rayner, 2001).

Methodology

Participants

28 volunteer (12 Females, 16 Males) 4th grade undergraduate students from the department of Computer Education and Instruction Technology at Middle East Technical University were the participants of this study. 14 students (5 Female, 9 Male) were assigned to the group in which the participants experienced the signaling relevant keywords and 14 of them (7 Female, 7Male) were assigned to the group in which the participants experienced the signaling relevant sentences. Participants were between ages of 21 and 24 (M=22.86, SD=.71). Their Cumulative Grade Point Average (CGPA) were ranged from 1.86 to 3.84 (M=2.86, SD= .51).They did not have prior knowledge about the topic of the material, because the topic of the material was about an imaginary country.

Materials

The materials consisted of an informed consent letter, a retention test, and a transfer test, a computer-based material with signaled relevant keywords, a computer-based material with signaled relevant sentences and two computer-based practice materials.

Informed consent letter was used to inform the participants about the study and to understand whether they participate voluntarily or not. It was one page paper-based material.

Materials that were administered as paper-pencil tests consisted of the retention test and the transfer test, each on 21 cm X 29.7 cm sheets of paper. Participants could complete the materials in their own pace without any time restrictions.

The retention test included five multiple-choice questions. This questionnaire assessed how much information the participants remembered about the population distribution of Patagonya according to the occupational sectors ("service", "farming", "industrial") between 1970 and 2000.

The transfer test consisted of eight open-ended questions. These questions assessed how the participants transfer their knowledge about the population distribution of Patagonya according to the occupational sectors between 1970 and 2000 to other environments. The questions were based on the comparison of the female and male distribution according to the sectors and comparison of the sectoral distribution.

Computer-based practice materials included a graph which was about changing telephone tariffs between 2004 and 2007 and an explanatory text below the graph. It was prepared by the researcher in Macromedia Flash 8. When the participant clicked one of the lines on the graph, the relevant keywords or sentences (based on experimental or control group) was underlined in the explanatory text. This material let the participants become familiar with the computer-based materials in the experiments.

In the computer-based material in which the relevant sentences were signaled, there was a line graph about the population distribution of Patagonya according to the occupational sectors between 1970 and 2000 and an explanatory text below this graph. It was prepared by the researcher in Macromedia Flash 8. To maintain the content validity, sector names were taken from job statistics in the web site of Turkey statistical community. However, the line graph and explanatory text were designed by the researcher. When the participants clicked one of the line on the graph, the relevant sentences were signaled by using typographical cue, underlining.

Computer-based material in which the relevant keywords were signaled was the same with computer-based material in which the relevant sentences were signaled. However, relevant keywords were underlined instead of relevant sentences when participants clicked one of the lines.

Apparatus

Eye movements of the participants were recorded by Tobii 1750 Eye Tracker, integrated in the panels of the monitor. The system had a 50 Hz sampling rate and an accuracy of 0.5°.

Procedure

The experiment was done in the Human-Computer Interaction laboratory. There was a Tobii eye tracker in this lab. It records the participants' eye-movements during the experiment. Each participant was individually taken to this laboratory by an appointment. First of all, the informed consent letter was given to the participants and the researcher told them "Please read this letter and if you accept to participate in this study, please fill it and sign it". After s/he signed it, the aim of the study was explained. Then, the participant used the computer-based practice material to become familiar with the computer-based material. Before conducting the actual experiment material, the automatic eye-tracking calibration of the subjects was done by Tobii's ClearView software. The calibration gives information to the eye tracker of a particular subject's eyes. It is required for "accurate estimation of a subject's gaze point" (Tobii Technology AB, 2006). During the calibration, participants were presented a series of circles and requested to follow the circles by their eyes as the circles move within the screen. After the completion of the calibration process, a calibration plot was shown indicating the quality of the calibration by marking missing or inaccurate calibration points with red squares. If the collected calibration was poor, the calibration process was performed again. Next, participants studied the instructional materials. The participants were assigned to the group randomly. They studied the topic, the population distribution of Patagonya according to the occupational sectors between 1970 and 2000, by using the computer-based material in which the sentences were signaled or the keywords were signaled. There was no time limitation. They finished their study whenever they want. Study time changes from 90 seconds to 416 seconds. Participant's eye movements were recorded by Tobii 1750 Eye Tracker while they studied the instructional material. The Clearview 2.7.1 program provided the duration of eye fixations, and the number of fixations. After finishing studying the instructional materials, each subject was given the retention test and the transfer test in respective order.

Validity, Reliability, and Scoring

In order to enhance the content validity, sector names were taken from job statistics in the web site of Turkey statistical community. The instruments were also pilot-tested with 10 students to evaluate the clarity of the statements and to detect the usability of the computer-based materials. The researcher requested the participants of the piloting group to mark unclear statements and told about their interpretations. Revisions were made on these tests and computer-based instruments in accordance with the feedbacks from the pilot study.

Retention test was assessed by giving1 points for each correct answer. Transfer tests will be assessed by the researcher according to the 4-point scale rubric to minimize the measurement errors resulting from the rater's judgment while scoring the open-ended questions (Penny, Johnson & Gordon, 2000). Another rater independently scored randomly selected transfer tests of 8 subjects. The raters were blind to the group of the answer sheet. Inter-rater reliability which indicates the agreements of the raters was calculated. The intra-class correlation coefficient was .82 indicating a high agreement of among the raters. Scores of the transfer test were converted to percentages.

Data Analysis

The results of retention and transfer tests and eye-movement data were used for data analysis. Independent t-test was conducted to understand whether there was a significant difference between the retention test scores of two groups of participants who study with the computer-based material in which the relevant sentences were signaled or in which the relevant keywords were signaled and whether there was a significant difference between the transfer test scores of two groups of participants who study with the computer-based material in which the relevant sentences are signaled or in which the relevant keywords are signaled.

The material region was divided into different Area of Interests (AOI) according to the occupational sectors, keywords, sentences, graphs and texts. For data analysis, descriptive statistics and separate independent t-tests was used.

Results

Learning Outcomes

Separate independent sample t-test was performed to examine whether signaling the relevant keywords or signaling the relevant sentences differed in retention and transfer tests. The participants who received the signaled relevant sentences material (*M*=58.57, *SD*=29.84) outperformed the participants who received the signaled relevant keywords material (*M*=52.86, *SD*=24.32) on the retention test. However, the effect of groups was not significant on retention, t (26) = .56, p=.58. Moreover, the difference in the transfer scores was not statistically significant between the learners who were administered the signaled relevant sentences material (*M*=13.50, *SD*=6.47) and the learners who were administered the signaled relevant keywords material (*M*=13.43, *SD*=4.78), t *(26*) = .03, *p*=.97.

Eye-Tracking Data

In order to calculate the average fixation duration on signaled sentence and keywords while sentence or keywords was underlined, and average fixation duration and average number of fixations until finding the relevant information, recordings of the participants were firstly divided into time segments by the intervals of the underlined sentences or keywords. An area of interest (AOI) was determined for the relevant sentence and keywords for each time interval. Thus, separate AOIs were created for each sentence and keyword. Finally, the sum of the eye-tracking measure was computed for all corresponding keywords and sentences.

For the participants experienced the signaling relevant sentences, average fixation duration on the signaled sentence while the related sentence was underlined (*M*=118.79 ms, *SD*= 59.18) was very close to the average fixation duration on the keyword (*M*= 116.53 ms, *SD*=66.08). On the other hand, while average fixation duration on the corresponding sentence was 108.10 ms (*SD*=55.90), it was 126.06 ms (*SD*=54.77) on the underlined keyword for the participants who experienced the signaled keywords. These results indicated that signaling increase the fixation duration on the signaled text.

Average fixation duration until finding the relevant information in the text after clicking on the line was 764.01 ms (*SD*= 309.69) for the group who experienced the signaling relevant sentences and 867.20 ms (*SD*= 529.48) for the group who experienced the signaling relevant keywords. Moreover, for the participants who experienced in signaled sentences (M= 4.96 , SD= 1.54) made fewer fixation counts until finding the relevant information in the text after clicking on the line than those who experienced in signaled keywords (M= 4.76 , SD= 2.33). However, the differences in average fixation duration and average fixation counts were not statistically significant according to the separate independent t-test results, t (26) = -.61, *p*=.55 and *t (*26) = .26, *p*=.80 respectively. These results showed that signaling the keyword or signaling the sentence did not differ in taking learners' attention to the relevant text according to both their finding time and searching.

In the second part of the data analysis, the material region was divided into two AOIs which were graph and text. Whether there was a difference between fixation duration on text and graph regions was examined according to the frequencies. Average fixation duration on graphs (*M*=124.87 ms, *SD*=63.01) was higher than average fixation duration on text (*M*= 117.86, *SD*= 52.60). This shows that learners made a deep processing on the graph. Percentages of fixations made on the graph and on the text were examined. People made more fixations on the text part (*M*=52.3%, *SD*=17.7%) than on the figure part (*M*=47.7%, *SD*=17.7%). If unnecessary visual search is responsible for cognitive load and consequently for impaired learning in split attention effect, then it is expected that the number of fixations would be smaller and average fixation duration would be longer on the graph part of the material.

To understand how signaling effects on the overall reading, average fixation durations on keywords and sentences were compared according to the frequencies. To conduct this analysis, each keyword and sentence were selected as AOIs. The results showed that learners who experienced the signaling sentences had higher average fixation durations on sentences (M= 112.45, SD= 52.35) than on keywords (M= 105.96, SD= 69.06). On the other hand, learners who experienced the signaling keywords had higher average fixation durations on keywords (M= 126.44, SD= 59.69) than on sentences (M= 116.28, SD= 48.02). These results showed that signaling directs the learners' attention to the signaled text. However, according to independent sample t-test there was not a significant difference in average fixation duration on sentences and average fixation duration on keywords between the groups, $t(26)$= .37, p=.85 and $t(26)$= -.84, p=.41 respectively. This non-significant result might be explained by non-significant difference in their retention and transfer performance.

Discussion & Conclusion

The goal of this study was to investigate whether signaling the relevant keywords or signaling the relevant sentences was more effective on learning and to explore the effects of signaling on reading. The results suggested that there was not a significant difference between the retention and transfer scores of the learners who studied in the signaled sentences material and the learners who studied in the signaled keywords materials. This indicated that type of signaling does not make any change on the students' performance.

The effects of signaling on learners' reading was further explored with the help of eye tracking data. Signaling had three main effects on reading. First, signaling increased readers' attention to the specific information. People who were studying the material in which relevant sentences were signaled had higher average fixation durations on sentences whereas people who were studying the material in which relevant keyword were signaled had higher average fixation durations on keywords while the sentences or keywords were underlined. Moreover, for whole reading process, these results were the same. This showed that learners devote more processing time to underlined text. Second, signaling directed attention of the participants to the relevant information. Both group made little number of fixations and spent less time to find the information after clicking on the line. Third, signaling decreased unnecessary visual search, which was evident from longer average fixation duration and fewer number of fixations on graph.

The effects of the signaling on reading supported the literature by giving clear evidence with eye-movements data. Lorch (1989) summarized the signaling effects as attention, selective case, discriminating important information and comprehension. Mautone and Mayer (2001) suggested that signaling is one of the solutions to reduce the extraneous cognitive load.

Lorch (1989) stated signaling cause enhancing attention to the cued text. Thus, he suggested that reading time must be used to assess the attentional effect of signaling. Lorch et al. conducted a study to understand this effect. They found that reading speed was slower while the participants were reading a signaled text. This means that readers spent more processing time to signaled content than to nonsignaled content.

According to the eye-tracking data, learners' attention on sentences and keywords did not significantly differ. Furthermore, signaling the keyword or signaling the sentence did not differ in taking learners' attention to the relevant text according to both their finding time and searching. Both signaled materials also decreased the visual search because average fixation count on graph was smaller and average fixation duration graph was longer. These non-significant results can be the reason of no significant difference in the students' performance.

Superior performance in signaled materials may be caused by tagging signaled content as important in memory without devoting more processing time to signaled information (Lorch, 1989; Lorch et al., 1995). Thus, in the future study, control group who studied the nonsignaled material can be used. By this way, their performance and their fixation duration will give compared results. Moreover, the sample of this study was 28 undergraduate students. Thus, this study should be replicated with a higher sample size.

In addition to the limitation of sample size, the content of the material was not too long. For these reasons, no significant difference was found. Thus, the content should be longer in further studies.

These results provide the following implications. To minimize the unnecessary search, designers should use the signaling devices in the materials in which both graphs and texts are used. By this way, learners match the related information for matching related information in the pictures that corresponds to the text. Instructional designers should be sensitive to the cognitive theory of multimedia learning while designing multimedia instruction.

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Case Study Analysis: One Researcher's Coding Journey

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Introduction

One of the challenges of carrying out a qualitative research study is to develop coding categories when a priori categories do not exist. A number of sourcebooks describe different data analysis techniques (e.g., (Fraenkel & Wallen, 2006; Merriam, 1998; Miles & Huberman, 1994; Yin, 2003). This article focuses on the coding journey of one researcher, exploring how expert web visual designers carried out the preliminary stages of the visual design for a visual computer interface of an instructional website.

Overview of Study Logistics

This embedded case study (Yin, 2003) was exploratory (Stake, 1995) since it sought to discover a process not yet reflected in visual design research literature. The three participants worked individually. Each of them were presented with a simulation task (Fraenkel & Wallen, 1996) to stimulate the initial visual layout design process.

Redesign Task

The participants had the task of redesigning the visual look and feel for an existing website. In order to ensure authenticity, it was important for this task to reflect an appropriate, real-world design setting. An existing instructional website, entitled "The Great Computer Mystery," was used as the basis of the simulation task. The website included a home page, intermediate navigation pages (one for each of four case-based scenarios or "mysteries"), and a series of content pages for each of the case-based scenarios (see Figure 1).

Figure 1: Example of original "Great Computer Mystery" webpages

The redesign task targeted this website for a number of reasons. First, it was an authentic site, which had been used successfully: undergraduate students used the website in a computers-in-education course for two semesters, and the website won the Kemp Award for innovative instructional design. Second, the site had a very basic visual design. The webpages contained basic WordArt and clipart images created with Microsoft Office. Third, students used this site to work through case-based scenarios called "mysteries." The researcher felt that the "mystery" metaphor also might pique the interest of participants in the study.

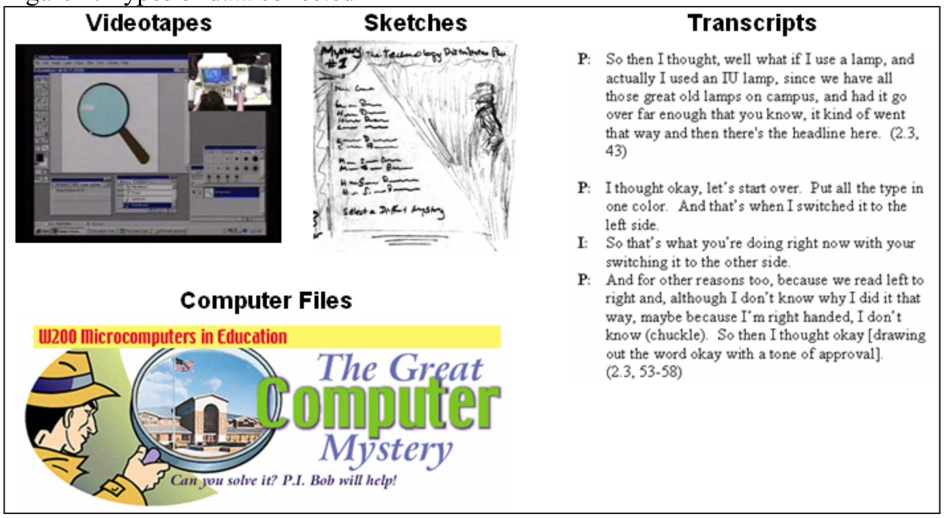
Participants

Three expert web visual designers were selected as participants in this study. Having multiple participants in the study brought richness to the data and allowed for cross-participant triangulation (Lincoln & Guba, 1985). In order to qualify as "experts" for this study (Durrance, 1998; Nonaka, 1991, , 1994; Polyani, 1967; Schon, 1983), participants had to meet the following criteria: (1) more than ten years of experience in graphic design, (2) more than four years of experience creating website look and feels, (3) design products that exemplify a professional level of visual design, and (4) the ability to describe their work in explicit terms.

Data Collection

The data collected included videotapes of the three sessions: the screening interview, the first design and stimulated-recall session, and the second design and stimulated-recall session, In addition to the videotaping, the data also included sketches participants drew during the design sessions, transcripts of the videotapes, and computer files created during the sessions (see Figure 2).

Figure 2: Types of data collected



Data Analysis

The data coding process for this study involved the creation of coding categories, and the application of those coding categories to written transcripts and design actions. The six data coding phases were as follows:

1. Creating Sentence-based Units
2. Carrying out a Card Sort of Statements
3. Coding of All Statements
4. Writing Early Stories
5. Coding Actions
6. Mapping Participant Actions

Creating Sentence-based Units

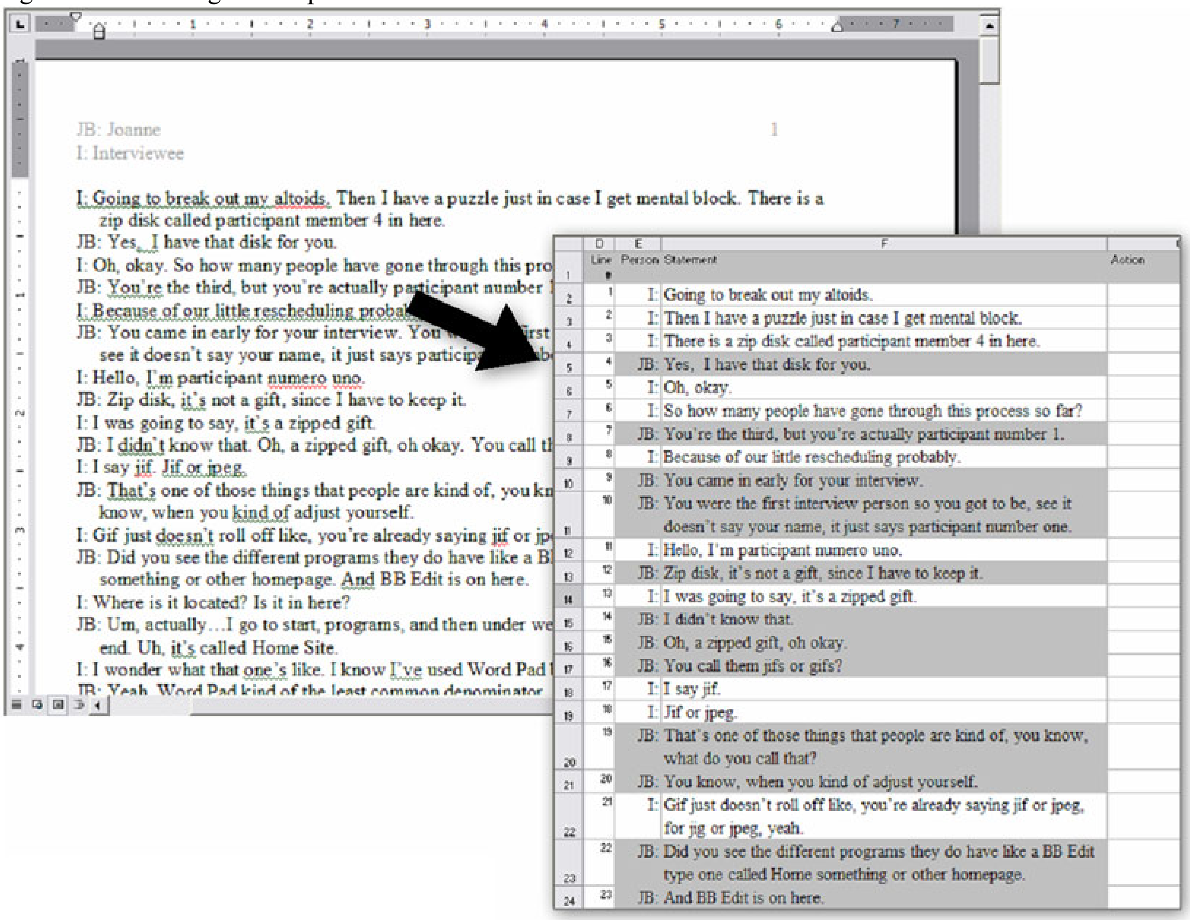
To begin the coding process, the textual data was broken into sentence-based data units. Data units are defined by Merriam (1998) as follows:

> A unit of data is any meaningful (or potentially meaningful) segment of data….A unit of data can be as small as a word a participant uses to describe a feeling or phenomenon, or as large as several pages of field notes describing a particular incident.

According to Lincoln and Guba (1985) a unit must meet two criteria. First, it should be heuristic—that is, the unit should reveal information relevant to the study and stimulate the reader to think beyond the particular bit of information. Second, the unit should be the smallest piece of information about something that can stand by itself—that is, it must be interpretable in the absence of any additional information other than a broad understanding of the context in which the inquiry is carried out.

After reviewing the transcripts for the study, the researcher determined that the smallest heuristic unit size for the data was a sentence unit. Each sentence unit was identified by participant name, session number, and line number (see Figure 3)

Figure 3: Converting transcripts to numbered statements

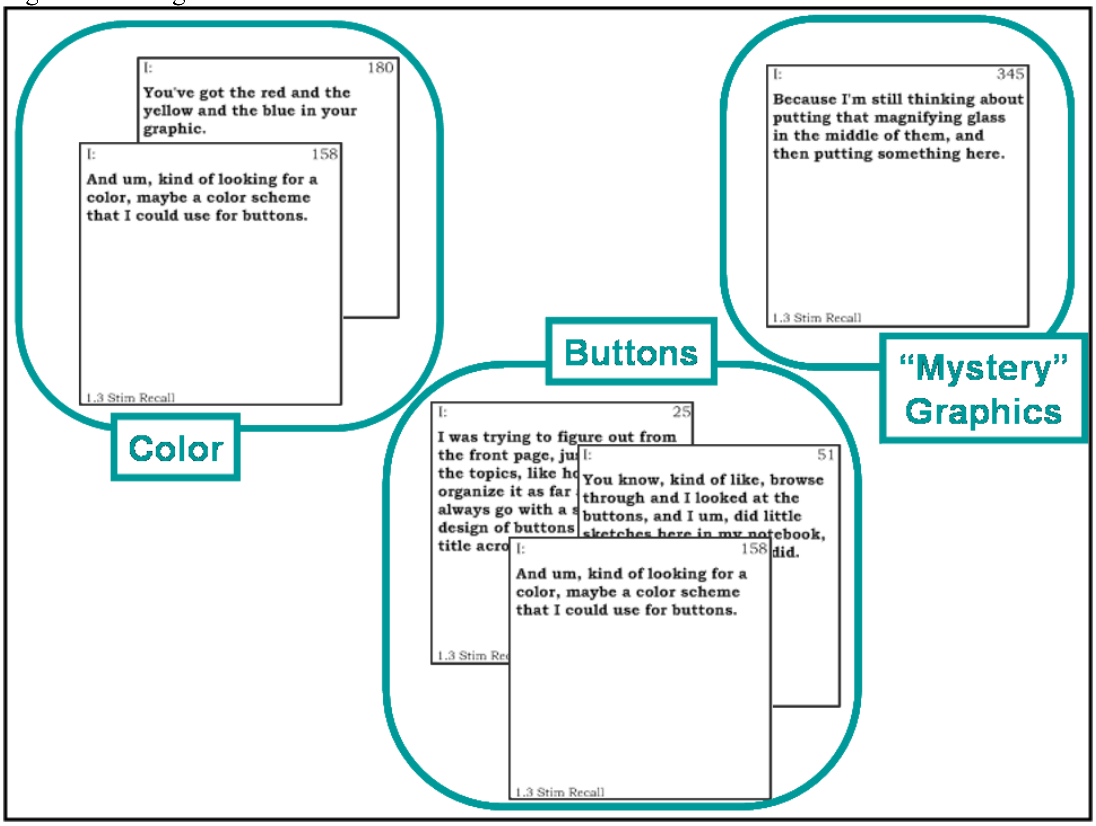


Carrying out a Card Sort of Statements

To begin the data reduction or analysis of the data, it was necessary to develop context-sensitive coding categories (Merriam, 1998; Miles & Huberman, 1994; Schwandt, 1997). Following a card-sort procedure (Merriam, 1998), the researcher printed each statement on a separate 2" x 2.5" card (see Figure 4). The researcher read each individual statement. If that statement had a similar meaning to a previously-read statement, they were clustered together. If not, it was put separately. Sometimes a statement would fit into more than one cluster. In this case, the researcher would write it on a separate card and put a copy of the card in each cluster. Sometimes a statement would shed a new insight to the clusters, and then clusters were adjusted to represent the new meaning structure. The researcher sorted the statements from one transcript using the card-sort procedure. At that point the creation of clusters had reached saturation, meaning there were not any significant changes to the clusters with additional statement coding.

When all cards were sorted into clusters, the researcher selected a category name to represent the meaning of the statements within that cluster (see Figure 4). Sometimes the category name was a word used in the statements themselves. Sometimes the category name was a word that conveyed the meaning of the statements even though it was not directly mentioned.

Figure 4: Sorting statements into clusters

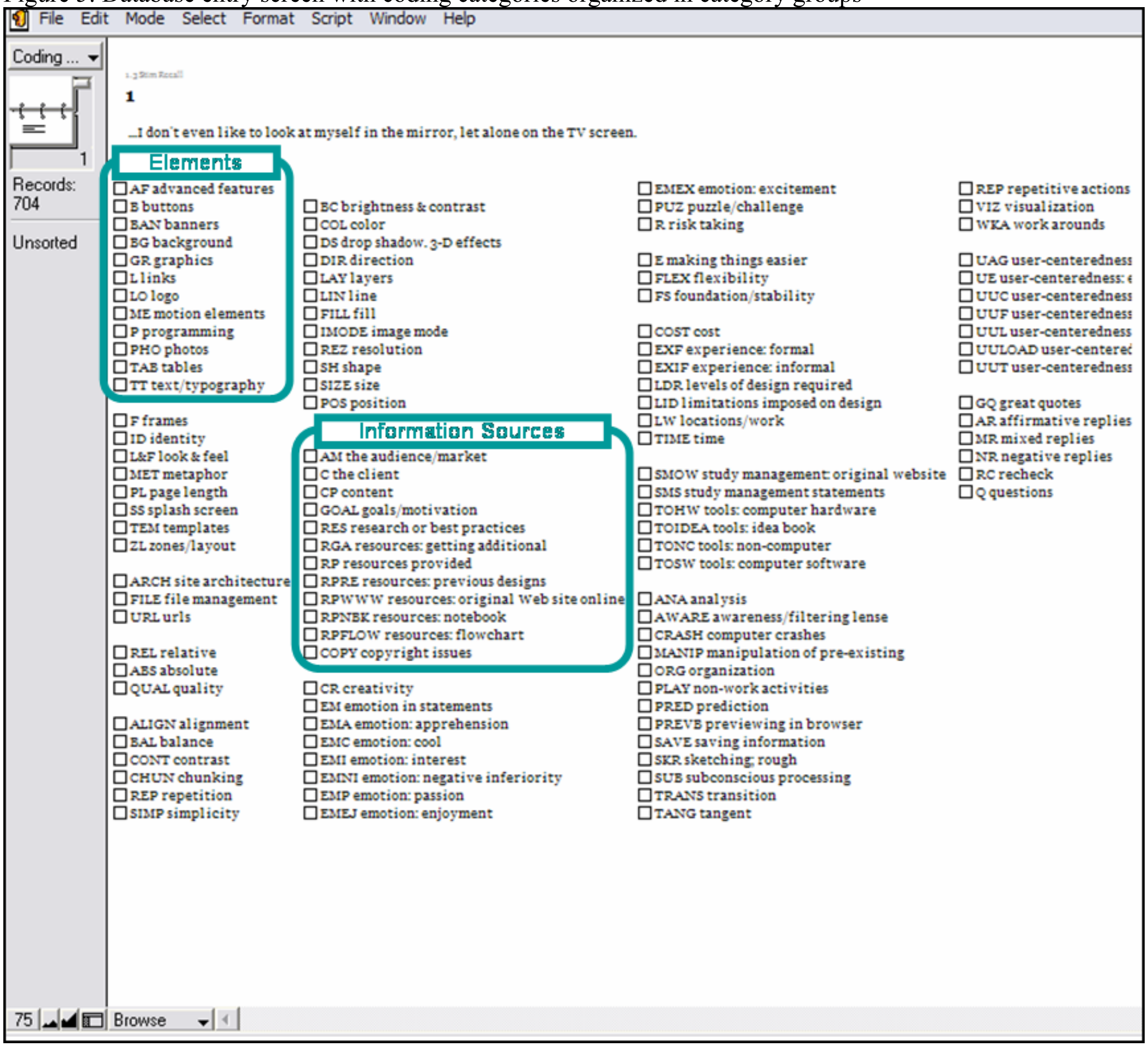


Coding All Statements

The cluster names, resulting from the card sort, became the coding categories for data analysis. For ease of coding, the statements and coding categories were entered into a database (see Figure 5). Two coders, the researcher and an additional person, coded the statements from all the transcripts together. The researcher would read the statement aloud and determine the initial coding category for the statement. Meanwhile, the additional person would check off that code in a coding database and would double check the statement to see if she was in agreement with the researcher's initial choice of code. If the additional person did not agree with the researcher's choice of code, she would discuss the difference of opinion with the researcher, and they would both reach agreement as to the coding of the statement before making it final. The measure of inter-rater reliability for the initial coding categories of statements in the first transcript was 87%. However, there actually was 100% agreement for all final coding of statements due to the nature of the two-coder interaction.

During this data analysis stage, the coding categories were further refined (Miles & Huberman, 1994). When the data from a statement represented a new meaning, a new category was created to portray that meaning. In some cases a category would be split into separate categories that better reflected the nuances of the meanings. In other cases, two or more categories were combined because they had virtually the same meaning. At the end of this process, there were 113 coding categories. These categories were grouped into 13 category groups. This data reduction technique made it much easier to manipulate the data (Miles & Huberman, 1994) and to see the patterns within the 13 groups.

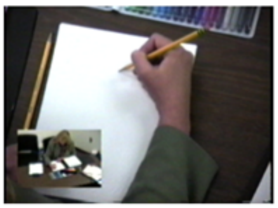
Figure 5: Database entry screen with coding categories organized in category groups



Writing Early Stories

Up to this point in the data analysis process, the researcher had focused on the transcript data containing statements. However, the researcher had not yet analyzed the actual sketches, files, and videotapes. Keeping the categories from the transcript analysis in mind, the researcher began coalescing the different types of data (see Figure 6) and describing the combined data through written stories or vignettes (Miles & Huberman, 1994). This process triangulated the statements with the other types of data (Glesne, 2005; Lincoln & Guba, 1985; Mathison, 1999; Schwandt, 1997) and enabled the researcher to see how the pieces of data fit together. The result was a descriptive chronology that followed the sequence of what the participants did, as well as recording why they made specific decisions within the sequence.

Figure 6: Writing early stories



Video Still Image

P(hyllis): This is where I started.
I(nterviewer): So here you started off your sketch?
P: Sketch, playing with the street light idea, which you...it doesn't really pick up because it's pencil. And then also I had the notebook so I could see what typography had to go on the page, and I just wasn't sure if I could do half a line, say in black, and the other half in white even. (2.3, 31-33)

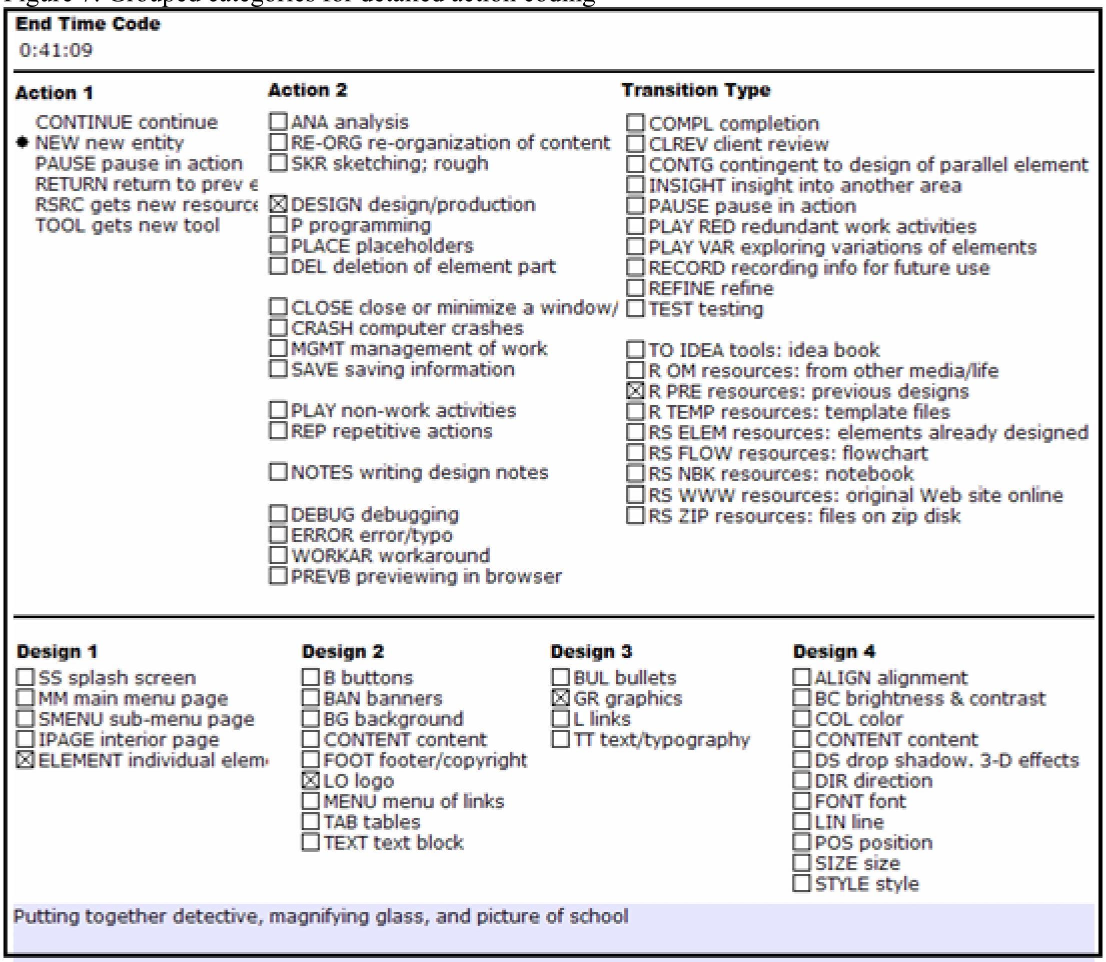
Detail

In order to test the feasibility of the combination of the graphic and text, she did a second sketch of the main menu page of the Web site (see Figure 3) that contained the same elements as the first sketch with one main exception--instead of using a placeholder for the submenu links, Phyllis wrote out the text. Phyllis was still not satisfied with this layout. As she put it, "I've dug myself into a hole here (2.3, 42)." She decided to abandon this layout for two reasons: (1) she felt that the audience would not be comfortable reading text with this type of optical illusion (2.3, 41) and (2) she considered that this treatment of mixed text colors might be limited by Web functionality (2.3, 40; 2.3, 52-53).

Coding Actions

By writing the vignettes, the researcher became aware that the same coding categories used for the transcript statements could also be applied to coding the sketches, files, and videotaped actions. Next, the researcher created a database for the action coding process. The same coding categories were used; however, the category groupings were organized into types of actions and descriptors of the design (see Figure 7). The videotaped actions were coded by time index using this database. This enabled the researcher to find a common ground for coding what initially appeared to be vastly different types of actions.

Figure 7: Grouped categories for detailed action coding



End Time Code
0:41:09

Action 1
CONTINUE continue
• NEW new entity
PAUSE pause in action
RETURN return to prev e
RSRC gets new resourc
TOOL gets new tool

Action 2
☐ ANA analysis
☐ RE-ORG re-organization of content
☐ SKR sketching; rough
[x] DESIGN design/production
☐ P programming
☐ PLACE placeholders
☐ DEL deletion of element part
☐ CLOSE close or minimize a window/
☐ CRASH computer crashes
☐ MGMT management of work
☐ SAVE saving information
☐ PLAY non-work activities
☐ REP repetitive actions
☐ NOTES writing design notes
☐ DEBUG debugging
☐ ERROR error/typo
☐ WORKAR workaround
☐ PREVB previewing in browser

Transition Type
☐ COMPL completion
☐ CLREV client review
☐ CONTG contingent to design of parallel element
☐ INSIGHT insight into another area
☐ PAUSE pause in action
☐ PLAY RED redundant work activities
☐ PLAY VAR exploring variations of elements
☐ RECORD recording info for future use
☐ REFINE refine
☐ TEST testing
☐ TO IDEA tools: idea book
☐ R OM resources: from other media/life
[x] R PRE resources: previous designs
☐ R TEMP resources: template files
☐ RS ELEM resources: elements already designed
☐ RS FLOW resources: flowchart
☐ RS NBK resources: notebook
☐ RS WWW resources: original Web site online
☐ RS ZIP resources: files on zip disk

Design 1
☐ SS splash screen
☐ MM main menu page
☐ SMENU sub-menu page
☐ IPAGE interior page
[x] ELEMENT individual elem

Design 2
☐ B buttons
☐ BAN banners
☐ BG background
☐ CONTENT content
☐ FOOT footer/copyright
[x] LO logo
☐ MENU menu of links
☐ TAB tables
☐ TEXT text block

Design 3
☐ BUL bullets
[x] GR graphics
☐ L links
☐ TT text/typography

Design 4
☐ ALIGN alignment
☐ BC brightness & contrast
☐ COL color
☐ CONTENT content
☐ DS drop shadow. 3-D effects
☐ DIR direction
☐ FONT font
☐ LIN line
☐ POS position
☐ SIZE size
☐ STYLE style

Putting together detective, magnifying glass, and picture of school

Next, the actions were compared using a summary worksheet in MS Excel (see Figure 8). During this coding phase, the researcher identified patterns of similar actions and calculated the duration of these patterned actions and the transitions from one patterned action to another.

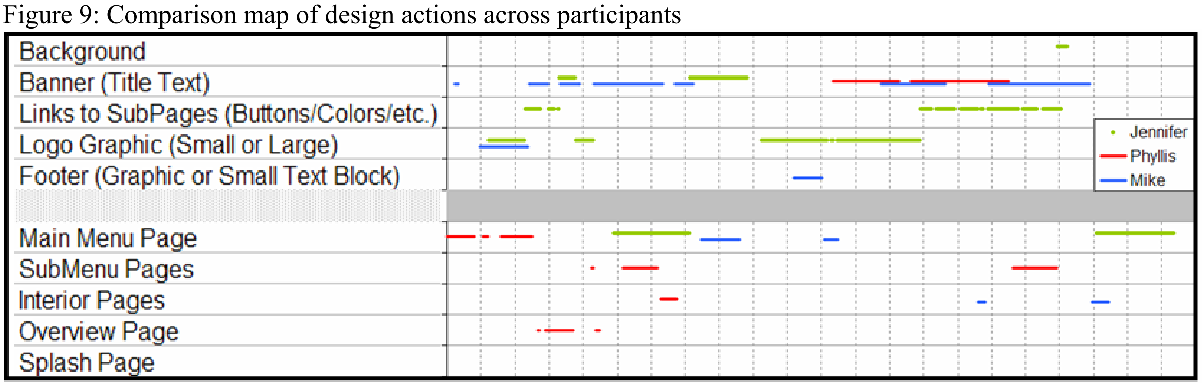
Figure 8: Action summary worksheet

Part.	Session	Start	Finish	Duration	Action 1	Action 2	Design 1	Design 2	Design 3	Design 4	Transitition	Notes
2	2 Actions		0:19:36									
2	3 Actions	0:19:36	0:19:52	0:00:16	NEW new er	DESIGN desi	MM main mer	BAN banners	TT text/typography			
2	2 Actions	0:19:52	0:20:08	0:00:16	CONTINUE c	DESIGN desi	MM main mer	BG backgrou	GR graphics			
2	2 Actions	0:20:08	0:20:18	0:00:10	CONTINUE c	PLACE place	MM main mer	MENU menu	TT text/typography			
2	2 Actions	0:20:18	0:20:27	0:00:09	CONTINUE c	DESIGN desi	MM main mer	BG backgrou	GR graphics			
2	2 Actions	0:20:27	0:20:39	0:00:12	CONTINUE c	PLACE place	MM main mer	BAN banners				
2	2 Actions	0:20:39	0:20:42	0:00:03	CONTINUE c	DESIGN desi	MM main mer	BG backgrou	GR graphics			
				0:01:06								
2	2 Actions	0:20:42	0:21:24	0:00:42	NEW new er	DESIGN desi	MM main mer	BG backgrou	GR graphics		REFINE refin	In this sketch
2	2 Actions	0:21:24	0:21:27	0:00:03	CONTINUE c	PLACE place	MM main mer	FOOT footer/copyright				
2	2 Actions	0:21:27	0:21:36	0:00:09	CONTINUE c	DESIGN desi	MM main mer	BAN banners	TT text/typography			
2	2 Actions	0:21:36	0:22:14	0:00:38	CONTINUE c	DESIGN desi	MM main mer	MENU menu of links			RS NBK reso	She is using
2	2 Actions	0:22:14	0:22:18	0:00:04	PAUSE pause in action							
2	2 Actions	0:22:18	0:22:24	0:00:06	CONTINUE c	DESIGN desi	MM main mer	BG backgrou	GR graphics			
2	2 Actions	0:22:24	0:22:30	0:00:06	PAUSE pause in action							
				0:01:48								
2	2 Actions	0:22:30	0:22:43	0:00:13	NEW new er	DESIGN desi	MM main mer	BG backgrou	GR graphics		PLAY VAR e	In this drawi
2	2 Actions	0:22:43	0:22:52	0:00:09	CONTINUE c	DESIGN desi	MM main mer	BAN banners			RS NBK resources: noteb	
2	2 Actions	0:22:52	0:22:59	0:00:07	CONTINUE c	PLACE place	MM main mer	MENU menu of links				
2	2 Actions	0:22:59	0:23:11	0:00:12	CONTINUE c	DESIGN desi	MM main mer	BG backgrou	GR graphics			
2	2 Actions	0:23:11	0:23:19	0:00:08	CONTINUE c	NOTES writing design notes					RECORD recording info fo	
2	2 Actions	0:23:19	0:23:31	0:00:12	RETURN retu	PLACE place	MM main mer	FOOT footer/copyright			REFINE refin	Note: at first
2	2 Actions	0:23:31	0:23:42	0:00:11	PAUSE pause in action							
				0:01:12								
2	2 Actions	0:23:42	0:24:34	0:00:52	NEW new er	DESIGN desi	ELEMENT ind	BAN banners	TT text/typography		PLAY VAR exploring vari	
2	2 Actions	0:24:34	0:24:42	0:00:08	CONTINUE c	NOTES writing design notes					RECORD recording info fo	
2	2 Actions	0:24:42	0:24:48	0:00:06	PAUSE pause in action							

Mapping Participant Actions

By enumerating durations of different types of actions, it was possible for the researcher to make a comparison map of the actions of the three different participants (see Figure 9). The comparison map reduced hundreds of actions into one visual representation (Miles & Huberman, 1994). This enabled the researcher to identify patterns and cross-participant, leading the petite-generalization and model-making processes.

Figure 9: Comparison map of design actions across participants



Final Thoughts

Overall, the coding process developed for this case study was very detailed. The early stage of carrying out the card sort of statements was time-consuming but necessary given the lack of a priori codes. The use of database and spreadsheet programs allowed the researcher to streamline the coding process, since the data were able to be manipulated in both formats. In addition, the coding categories developed through this analysis process may be used in future studies in the field of visual interface design.

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The Impact of Scaffolds and Self-directedness in Computer-mediated Problem-based Learning

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Introduction

An increased focus on problem solving and teamwork compels educators to engage learners in opportunities for knowledge seeking and collaboration. To achieve these goals, some educators are using constructivist pedagogical designs such as problem-based learning that are based on the assumption that learning is a product of both cognitive and social interactions in problem-solving environments (Evensen & Hmelo, 2000). Problem-based learning (PBL) is a promising instructional approach. However, it has its own share of challenges. When applied to real settings, PBL increases the complexity of the learning task and the cognitive load of students (Land, 2000). Scaffolding is proposed to address these challenges by providing support or imposing additional structure to learning in a PBL environment (Ge & Land, 2004; Pea, 2004).

We are studying the impact of scaffolding along with other relevant individual characteristics in problem-based learning environments through a series of studies. The first study examined the effect of scaffolding and prior knowledge on individual posttest achievement, group project performance, student attitudes, cognitive load, navigation patterns and time in the program (Su, 2007). In this presentation, we will describe the second study in this series.

Scaffolds

In PBL environments, scaffolds are designed to induce learners to think and develop a deep and thorough understanding of the problem while arriving at a solution. One type, called metacognitive scaffolds, support the underlying processes associated with individual learning, providing guidance on how to think during learning. Metacognition can be best explained as thinking about thinking. Land (2000) outlines three metacognitive skills required in open ended learning environments such as PBL – (a) identifying appropriate learning issues, (b) monitoring the effectiveness of learning strategies and (c) monitoring detailed steps in problem-solving while remaining focused on the task. Land (2000) further claims that many students lack these metacognitive skills and that supports should be designed to help them. Metacognitive scaffolds introduced in this study were designed to facilitate learners to plan, monitor, regulate and reflect upon their learning process.

Self-directedness

The role of self-directedness in an individual's learning process has been extensively studied. Though the definition of self-directed learning varies throughout the literature, the most common definition is that of Knowles (1975), who defined self-directed learning as a process in which individuals take the initiative, with or without the help of others, to diagnose their learning needs, formulate learning goals, identify human and material resources for learning, choose and implement appropriate learning strategies, and evaluate learning outcomes. Self-directedness has been shown to be a strong factor in predicting academic achievement (Hsu & Shuie, 2005). Self-directed learning is also an integral part of the PBL instructional approach (Hmelo-Silver, 2004). A new tool was developed to study self-directedness in this study. Prior to the research study, participants were each administered a "Learning Notions and Preferences Survey (LNPS)" which collected data describing an individual's inclination to be engaged in a self-directed study. Responses to this survey were assessed on a five-point Likert-type scale and converted to a score. This score was used to evaluate an individual's self-directedness.

The purpose of this study was to investigate the impact of metacognitive scaffolds and self-directedness on project performance, participant achievement and attitudes within the context of a computer-mediated, collaborative problem-based learning environment. The main research questions addressed in this study were:

1. What is the effect of metacognitive scaffolds on participant achievement and attitude, in a computer-mediated, collaborative problem-based learning environment?
2. What is the relationship between self-directedness and participant achievement and attitudes in a computer-mediated, collaborative problem-based learning environment?

Method

Design & Participants

This study used a pretest-posttest experimental research design. The independent variables were metacognitive scaffolds (absence or presence) and self-directedness. The dependent variables were group project performance, individual posttest achievement, and participant attitudes.

Participants were 39 male and female undergraduate college students enrolled in an educational technology course at a large southwestern university in the United States. The course was offered through the College of Teacher Education and Leadership. Participants received extra course credit for their participation. They were grouped into teams of three and the teams were randomly assigned to one of the two treatment groups (No Metacognitive Scaffolds - NMS or Metacognitive Scaffolds - MS).

Materials

The instructional material used in this study was a web-delivered, hypermedia problem-based instructional program called “All you need is a screwdriver” developed by Su (2007). Central to the program was a PBL project of building a virtual desktop computer achieved through collaborative effort. As is typical of PBL environments, this project was designed as an ill-defined problem. Built into the program were resources for information and guidelines for component selection. Content scaffolds, which included a warm-up sheet, a note taking sheet and a project template were common to both treatment groups and were designed to support participants’ understanding of the content.

Participants in the NMS group received instructional materials with only the content scaffolds. Three metacognitive scaffolds (MS) were available to participants in the MS treatment group in this study: (1) a project planning sheet for each team, (2) a project reflection sheet for each team member, and (3) software cues in the form of pop-ups that urge the participants to reflect on their choices before making a final decision of component selection.

The objective of the project was for project teams to build a virtual computer that could be used for tasks such as doing homework, listening to music, viewing videos, surfing the internet, downloading files and playing 3-D video games within a prescribed budget of $1000. The project did not have a unique answer. A team’s answer could be the solution to the problem as long as the proposed virtual computer configuration met the performance, compatibility and budget requirements.

Data Sources

Five data sources were used in the study. These include a pretest, a posttest, the LNPS score, an attitude survey and a group project score. The test items and scoring rubrics for the pretest, posttest, group project and the attitude survey were borrowed with permission from Su (2007) and modified to meet the needs of the current study by the primary researcher.

Pretest. Prior to completing the instructional materials, a 12-item, computer-based, four-choice, selected response pretest measuring general computer knowledge was administered to the participants. This pretest provided data about the general proficiency and comfort level of participants in the areas of computer components, hardware and connectivity. Each pretest item was worth one point. All pretests were automatically scored by the computer program and the results downloaded to a database.

Posttest. Following the completion of the PBL project, a 20-item, computer-based, four-choice, selected response posttest measuring individual knowledge and skills covered in the instructional program was administered. The test items were generally aligned to the project objectives to establish content validity. Each posttest item was worth one point. All posttests were automatically scored by the computer program and the results were downloaded to a database.

LNPS score. The Learning Notions and Preferences Survey (LNPS) score was based on the responses to a self-reported, 18-item, computer-based instrument developed by the primary researcher. This instrument measured an individual’s inclination to be self-directed Participants responded to questions designed to elicit individual feelings about their capacity of performing a task specifically focusing on their previous experience. The items were rated on a five-point Likert scale with “SA” representing “Strongly agree”; “A” =Agree; “U” = Undecided; “D” = Disagree, and “SD” = Strongly disagree. The response “SA” corresponds to “5 points”; “A” = 4 points; “U” = 3 points; “D” = 2 points, and “SD” = 1 point. The maximum possible LNPS score was 90 and the minimum was 18. This survey was administered at the beginning of the research study before the pretest.

Attitude survey. An attitude survey was developed to measure participants’ reactions to all aspects of the instructional program. The survey was administered immediately after the posttest on the day of the study. It contained 16, five-choice Likert-type (SA-strongly agree, SA-strongly disagree) and two open-ended questions. The survey included questions to elicit participant responses about the characteristics of the instructional program, working in small groups, problem-solving approaches and perception towards scaffolds.

Group project score. The project score was assessed using a scoring rubric. The rubric primarily assessed the accuracy of the answers and the quality of the rationale descriptions. The rubric was designed to consider all aspects of the problem-solving process and provided for the possibility of awarding partial credit for partially correct answers. The total possible score for the project was 55 points. The primary researcher scored all the group projects.

Procedures

The study was conducted in regularly scheduled classrooms with individual computers. On the day of the study, the primary researcher introduced the instructional unit to the participants. Participants were informed about the nature of the study before agreeing to participate and were assured that their participation in the study was entirely voluntary. They were also informed that all individual results were confidential and not available to anyone except the research team, and that any data reported would be aggregated. Participants were notified that they would be working in groups on an online program to build a virtual computer in two hours and that they were not allowed to access any other external site except the online instructional program website during the research study. The regular classroom instructor then told the participants that their full participation in the study would earn them five extra credit points in the course. Initially, the individual, computer-based LNPS survey was administered to all participants. This was immediately followed by the pretest. Subsequently, teams of three were formed based on existing seating in the classroom and the teams were randomly assigned to one of the two treatment groups. Each team was then handed an envelope that contained the study materials corresponding to the assigned treatment group. Participants were then directed to the instructional program website and instructed to begin their work. During this phase of the study, the teams followed the instructions provided on the instructional program website to complete the project. At the conclusion of two hours all program materials were assembled, inserted into the envelope and returned to the primary researcher. The individual computer-based multiple-choice posttest was then administered to each participant. Upon completion of the posttest, individual participants also completed a Likert-type attitude survey.

Data Analysis

SPSS version 17.0 was used for all data analysis. Two major research questions were addressed in this study: 1) What is the effect of metacognitive scaffolds on participant achievement and attitude, in a computer-mediated, collaborative problem-based learning environment, and 2) what is the relationship between self-directedness and participant achievement and attitudes in a computer-mediated, collaborative problem-based learning environment. Table 1 conveys the descriptive statistics associated with each of the independent and dependent variables. The table reports the mean scores and standard deviations of each condition (No Metacognitive Scaffolds - NMS or Metacognitive Scaffolds - MS) on the pretest, LNPS score, posttest and project score. Two separate one-way analyses of covariance (ANCOVAs) were conducted to examine the effect of metacognitive scaffolds and LNPS score on the posttest and project performance, using the pretest score as a covariate, each at alpha = 0.05. Preliminary analyses were conducted to test for the homogeneity of slopes between the covariate (pretest score) and the dependent variable (posttest score or project performance score) across groups (No Metacognitive Scaffolds - NMS or Metacognitive Scaffolds - MS). All means reported in this section were adjusted for the covariate.

Results

Project performance. Unadjusted means and standard deviations for this task are reported in Table 1. The average score for all project teams was 37.99 (SD=5.36) out of a possible score of 55. The mean score for teams in the No Metacognitive scaffolds group (NMS) was 34.37 (SD=3.71) and for teams in the Metacognitive scaffolds Group was 41.61 (SD=4.20)

Table 1: Unadjusted mean scores and standard deviations by treatment type on project score.

Treatment type	Project Score
No Metacognitive Scaffolds (NMS)	
Mean	34.37
SD	3.71
N	23
Metacognitive Scaffolds (MS)	
Mean	41.61
SD	4.20
N	23
Total	
Mean	37.99
SD	5.36
N	46

A preliminary analysis of the homogeneity-of-slopes assumption indicated that the relationship between the covariate (pretest) and the dependable variable (project performance score) did not vary significantly as a function of the independent variable (treatment type), $F(1,42) = 1.03$, $MSE = 16.02$, $p = .32$, partial $\eta^2 = .16$. A one way analysis of covariance (ANCOVA) was conducted to examine the effect of metacognitive scaffolds on project performance using pretest as a covariate. The ANCOVA was significant, $F(1,43) = 35.45$, $MSE = 16.03$, $p <.01$. The strength of the relationship between the metacognitive scaffolds group and the project performance score was very strong as assessed by a partial η^2, with the metacognitive scaffolds factor accounting for 45% of the variance of the project performance score, holding the pretest score constant. The Metacognitive Scaffolds group (MS) had the largest adjusted mean ($M = 41.58$) and the No Metacognitive Scaffolds group had the smallest ($M = 34.40$). Furthermore, a one way analysis of covariance (ANCOVA) conducted to examine the relationship between self-directedness (as measured by the LNPS score) on project performance using pretest as a covariate did not yield a significance difference.

Posttest. Unadjusted means and standard deviations for this task are reported in Table 2. The average score for all individual posttests was 11.37 (SD=3.02) out of a possible score of 20. The mean score for individuals in the No Metacognitive scaffolds group (NMS) was 11.04(SD=3.20) and for individuals in the Metacognitive scaffolds Group was 11.70(SD=2.87).

Table 2: Unadjusted mean scores and standard deviations by treatment type on posttest score.

Treatment type	Posttest score
No Metacognitive Scaffolds(NMS)	
Mean	11.04
SD	3.20
N	23
Metacognitive Scaffolds(MS)	
Mean	11.70
SD	2.87
N	23
Total	
Mean	11.37
SD	3.02
N	46

Posttest performance was analyzed by treatment group and self-directedness score using pretest score as a covariate to determine differences in achievement. The ANCOVA analysis yielded no significant differences either for the treatment group or the self-directedness score on project performance.

Attitudes. Responses to 16 Likert-type items on the computer-based attitude survey were scored on a 5 (strongly agree) to 1 (strongly disagree) basis. The mean attitude scores and standard deviations by treatment group are shown in Table 3. These data indicate that most participants felt that their group distributed their work load fairly among its team members (M = 4.21, SD = .92) and that their group designed the computer using the information obtained from their research in the program (M = 3.82, SD = .76). The data also suggests that the participant groups had enough time to complete the project (M = 3.77, SD = 1.16). However, participant responses were not as positive to the item that asked whether they liked the computer program (M = 2.59, SD = 1.14). Participants also indicated that they would probably not enjoy working on another similar program (M = 2.69, SD = 1.22) and that they were not confident that they would pass the individual test (M = 2.69, SD = 1.10).

The attitude data were analyzed using MANOVA to determine whether there was a significant difference between the mean scores of treatment groups and self-directedness score (LNPS score) on the survey items. No significant effects were found either for the treatment group or for self-directedness.

Approximately 78% of the study participants who completed the Likert-type portion of the attitude survey responded to either one or both of the open-ended questions. When asked what they liked most about the program 18 out of 29 respondents (62%) mentioned that they got to learn more about computers. For example, one respondent stated that "they got to learn how a computer is built and what goes into it." Further, 12 out of 29 respondents (41%) indicated that they enjoyed the group aspect of the program. One responded notes 'I liked that you allowed us to work in groups rather than as individuals. This allowed for us to communicate about different ideas together." When asked how the program could be improved 11 out of 29 respondents (38%) suggested that the length of the program be reduced, 6 respondents (21%) indicated that the program was hard and 5 (17%) respondents expressed that the project required a lot of writing.

Table 3: Attitude scores by treatment group.

Items	Scaffolding		
	NMS	MS	Total
1. I liked the "All you need is a Screwdriver" program.	2.72 (1.11)	2.48 (1.25)	2.59 (1.14)
2. I learned a lot about computer hardware from this program.	3.39 (.85)	3.43 (1.08)	3.41 (.97)
3. The program was well designed.	3.44 (.71)	3.43 (1.08)	3.44 (.91)
4. I would enjoy working on another project like this again.	2.83 (.92)	2.57 (1.43)	2.69 (1.22)
5. I am confident that I passed the individual test at the end of the lesson.	2.78 (.73)	2.62 (1.36)	2.69 (1.10)
6. My group had enough time to complete the project.	3.72 (1.23)	3.81 (1.12)	3.77 (1.16)
7. My group planned how to approach the project before we got started on it.	3.61 (1.04)	3.38 (1.12)	3.49 (1.07)
8. My group distributed our work load fairly among team members.	4.39 (.78)	4.05 (1.02)	4.21 (.92)
9. My group designed the computer using information obtained from our research in the program.	3.89 (.68)	3.76 (.83)	3.82 (.76)

10. Working with my team helped me do well on the individual test at the end of the lesson.	3.50 (.99)	3.33 (.86)	3.41 (.91)
11. The program included enough information and resources to help me do well on the individual test at the end of the lesson.	3.61 (1.04)	3.24 (.10)	3.41 (.97)
12. The program offered enough support to help my team organize our project.	3.72 (.83)	3.43 (1.12)	3.56 (.10)
13. It was easy to find information needed to complete the project.	3.61 (.92)	3.38 (1.12)	3.49 (1.12)
14. The program provided enough support at the beginning to help my team get started on the project.	3.83 (.86)	3.52 (1.03)	3.67 (.96)
15. The program included enough support to help me keep track of information I collected to complete the project.	3.89 (.47)	3.48 (1.08)	3.67 (.87)
16. My group reflected on what we learned from the program.	3.17 (.79)	3.14 (1.11)	3.15 (.96)

Note. Scores are based on a 5-point scale (5 – strongly agree, 1 – strongly disagree).

Discussion

This study examined the effect of metacognitive scaffolds on achievement and attitudes of university undergraduate students. It also explored the relationship between self-directedness (as indicated by the LNPS score) and participant achievement and attitudes. Participants in the metacognitive scaffolds (MS) group scored significantly higher on the group project score than those in the no metacognitive scaffolds (NMS) group.

Group project

The significantly higher group project score for participants in the MS group over those in the NMS group is most likely because of the presence of metacognitive scaffolds. This study incorporated three metacognitive scaffolds: (1) a project planning sheet for each team – to help participants identify how a learning task can be divided into sub-tasks and approached (Quintana, Zhang, & Krajcik, 2005) (2) a project reflection sheet for each member – to encourage participants to summarize the collected information, reflect on, and debrief information they learned after finishing the project and (3) software cues in the form of pop-ups that urge the participants to reflect on their choices before making a final decision of component selection (Su, 2007). These findings are in line with those by Wolf (2000) who reported that students in the metacognitive scaffolds group outperformed those with no metacognitive scaffolds. However, unlike this study, students in Wolf's study did not receive any content scaffolds. The finding that self-directedness (LNPS score) did not yield a significant difference over the no metacognitive scaffolds (NMS) group for group project performance may be due to the high scores of all participants on self-reported LNPS survey (M = 71.6, SD = 6.55) over a total possible score of 90 points.

Posttest

The finding that the metacognitive scaffolds (MS) group did not yield a significant difference over the no metacognitive scaffolds (NMS) group for posttest achievement is inconsistent with the findings of Su (2000). A factor that could have mitigated the potential overall effect of metacognitive scaffolds in this study is the presence of content scaffolds for both the treatment groups. Content scaffolds in this study directed participants to important concepts and rules by asking specific and detailed questions. For example: correctly answering the content scaffold question "What is RPM? How does it affect hard drive performance?" enabled the participant to answer the following posttest item: “Which of the following items correctly describes a hard drive performance?” Answering questions posed by content scaffolds enabled students to acquire specific knowledge which was required on the individual posttest (Su, 2000). The finding that self-directedness (LNPS score) did not yield a significant difference over the no metacognitive scaffolds (NMS) group for posttest performance may be due to the possibility that the LNPS score may not be a powerful enough factor to yield significant difference in posttest achievement scores.

Attitudes

Overall, participants expressed near neutral attitudes towards most features of the program. Respondent scores averaged between 2.6 to 3.7 on a 5-point Likert-type scale (3 = neither agree nor disagree). Survey questions that dealt with group work elicited most favorable responses while questions about the program topic and content were returned neutral responses. An analysis of the participants’ response to the open-ended items of the survey may explain low scores on some of the items. While responding to the open-ended questions, many participants felt that the program was too long. Some felt that the content itself was hard to comprehend and that there was a lot of writing involved. These reasons may have impacted participants’ attitude towards the PBL program. The attitude survey did reveal some positive things about the program. Many enjoyed the new information presented in the program, working in groups and the design of the program. These responses indicate that the PBL module was perceived as both useful and valuable.

Implications and Further Research

As a second part of a series of studies of the impact of scaffolding along with other relevant individual characteristics in problem-based learning environments, we have presented our findings from the study of the impact of metacognitive scaffolds and self-directedness in Computer-mediated Problem-based Learning. We feel that the present study has implications both for educational practice and further research. With regards to practice, the study indicates that the use of metacognitive scaffolds together with content scaffolds is likely to improve group project performance scores. With regards to research, the present study does not provide clear answers to the issue of whether self-directedness might impact achievement when stuents use PBL. Future research should continue to study PBL and scaffolds. Additional studies are required to isolate significant effects of different types of scaffolds and other individual characteristics. As complex PBL environments become mainstream, researchers should continue to investigate factors that ensure participant success.

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Exhuming Cultural Artifacts to Embed and Integrate Deep Adult E-Learning

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Abstract

This study addresses which factors can have a positive influence on adult on-line learners by studying cognitive load, the use of technology and semiotic tools in on-line courses. It incorporates theory and research from multiple disciplines and weaves cultural artifacts into e-learning based on the findings of a survey that looked at which factors worked successfully to transform e-learning into integrated learning for adult learners. The findings may provide important insights into student cognitive load and e-learning that can be extended to other colleges contemplating offering on-line courses and programs.

Purpose of the Study

The purpose for the study was to gather data on students at a private and a public urban university that both had students enrolled in on-line courses and hybrid degree programs in order to assess the cognitive load and quality of learning. The reason for the assessment of cognitive load is because it is the study of the mental processes of learning, memory and problem solving.

> Cognitive load theory (e.g. Sweller, 1988; 1994) is an instructional theory…(that) describes learning structures in terms of an information processing system involving long term memory… Information may only be stored in long term memory after first being attended to, and processed by working memory...The fundamental tenet of cognitive load theory is that the quality of instructional design will be raised if greater consideration is given to the role and limitations, of working memory. (Cooper, 1998, p.1)

The research was conducted to see if the retention rates of students in these courses were higher with the addition of sociocultural tools and artifacts than the courses without these additions. The researchers were also interested to see if the university rate of attrition was less, equal to, or more than the national average of student attritions in on-line programs at other universities in the United States. The intent was to observe which factors could positively influence cognitive load and student retention, particularly in view of the fact that the national average attrition rate of students in on-line courses in 2002 was approximately 40% (Hudson & Shafer, 2005; National Center for Educational Statistics Report, 2002).

The use of interactive multimedia in on-line courses allows the integration of multiple sources of information and tool mediation (Ambron & Hooper, 1990; Cooper, 1998; Crawford, GannonCook, & Rudnicki, 2003; Driscoll, 2000; Nelson, Ketelhut, Clarke, Bowman, & Dede, 2005; Nersessian, 2007; Vygotsky, 1962, 1978, 1981;Wertsch, 1985). However, effective student use of more complex multimedia into course materials (more complex by the fact that the student not only must learn the course materials, but also how to use the course navigation and technology) depends on the way the student processes data and how much cognitive load the student can handle before she or he becomes saturated or overwhelmed with data (Huffman, Goldberg, & Michlin, 2003; Kegan, 1993). If the student, particularly an adult learner (24 years or older), is coming into college after being out of school for a while, a task with two or three simple steps on- and off-line could cause frustration and negative reaction. And it is here that the student must scaffold her or his new course content materials.

The need to study cognitive load in on-line learning, particularly because of the limitations of working memory, must be considered when certain factors, such as the need to know how to use technology and navigate course materials, will remain a challenge for many students new to or uncomfortable (because of learning styles, self-regulation skills, or cultural differences) with on-line learning. However, while there are maximum limits of working memory, there is also evidence that expansion of working memory may be possible (Pavio, 1990; Baddeley, 1992; Basak, n.d.). So, in addition to studying factors that could reduce cognitive load, ways to expand working memory can also be pursued as a means of facilitating on-line learning (Cooper, 1998). By studying what facilitates and frustrates on-line learning, strategies for effective knowledge transfer could reduce cognitive overload and help learners to acquire and assimilate course materials in ways that reinforce learning and course completion (Cooper, 1998).

Background

Adult learners, for the purposes of this study, are defined as students 24 years or older (National Center for Education Statistics, 2002). and mirrors the national average age and demographics of students in on-line courses (most work full-time while attending college) (Berker & Horn, 2004). While a majority of undergraduates in traditional degree programs were younger than 24, one in four students was actually 30 or older, or about 43 percent of undergraduates who were enrolled in 1999-2000 were age 24 or older (Bradburn, Berger, Li, Peter, & Rooney, 2004).

Research on adult-learners in on-line courses indicates that the majority of post-secondary on-line courses have high attrition rates (National Center for Education Statistics, 2002), as high as forty percent or more. While there may be a number of reasons for this high attrition, one of the reasons may be related to cognitive over-load. This study looked at cognitive load, including the learning curves of technology, time management, and new content materials, to see what effect they might have on both student attitudes and retention in on-line courses. It also looked at working memory (WM) limitations (Mayer, 2001, 2005), how those could be minimized, how WM could be expanded, and how there could be “learning consequences for ignoring those limitations” (p.22).

Prior research indicated that while there are maximum limits of working memory, there was also evidence that expansion of working memory might be possible (Bailey, 1999; Basak, n.d.; Birdsong, 1999; Jewitt & Oyama, 2001; Mayer, 2001; Sweller, 1988; 1994).

Methodology

The study was designed to interweave theory, research, practice, and theory development and explore whether there could be inferences as to which factors could influence cognitive load and student retention in online courses. The researchers’ made efforts to actively incorporate methodologies from multiple methodologies, such as experimental research using a Likert-type of survey and developmental research (McKenney & van den Akker, 2005; Richey, Klein, 2007) appreciative inquiry (Preskill, Catsambas, 2006), and action research (Singleton & Straits, 2005). The survey sampled 109 adult learners to analyze data from an electronic survey that was designed to include elements of appreciative inquiry. One of the researchers was also embedded in the online course to document events and activities that occurred during the study.

The study researched adult-learner cognitive load in on-line courses and compared text-based online courses (traditional courses transferred to on-line formats without graphics, metaphors, or multimedia) and graphics and media-enhanced on-line courses (courses designed with embedded semiotics, such graphics and metaphors, or multimedia) to see which had a more positive effect on adult-learner cognitive load and subsequent learner retention. Prior research indicated that the inclusion of multi-media into online courses could enrich student learning (Bailey, 1999; Beggs, 2002; Brooks, 2008; Cobley, Jancz, 1997; Crawford, Gannon-Cook, 2008; Gannon-Cook, 2006; Gannon-Cook, Crawford, 2006, 2007; Greeno & Hall, 1997; Mayer, 2001; Ryan, Hodson-Carlton, & Ali, 2005), the findings of the study supported those findings (Hard & Jamison, 2005). In addition, the study found that the factors of embedded graphics and metaphors, followed by the integration of visual multimedia, such as embedded multi-media *PowerPoints*, or *MP4s*, were more effective than some other multi-media, such as *Wimba* or *Second Life* to lessen cognitive load and best predict student retention for adult learners. The students expressed recognition of simple signs and icons, and acknowledged that these did serve as kind of signposts that continued to point them in an onward direction through the course.

One of the biggest surprises in the researchers’ findings was how much the students seemed to get engaged in telling their own stories. (Narratives were embedded in the modules to function as yet another form of semiotics). The vast majority of students expressed the most satisfaction from reading about and sharing stories and experiences with each other. Both researchers were genuinely surprised that the cultural icons and tools seemed to help the students to stay focused; they seemed to open up a bit more in the modules with the icons and indicate a willingness to communicate more about their lives. They also seemed to stay involved and expanded their online discussions beyond their assignments in many instances with only two students dropping out of the course and those two took incompletes.

Summary

New technologies are often implemented by colleges as a kind of panacea to stay competitive with other universities or as remedies for problems such as attrition. These reasons can be valid, particularly as a competitive tool, but there may be other factors that could provide deep solutions that could both facilitate integration of new technologies seamlessly into the fabric of their learning, and help students weave new content knowledge into their daily lives.

This study was conducted to see how student cognitive load could be minimized and monitored so that new technologies could be integrated seamlessly into learning, instruction and performance. The study provided insights into which factors could help regulate cognitive load for students. Further studies could provide more data on how these factors could reduce student attrition in online courses.

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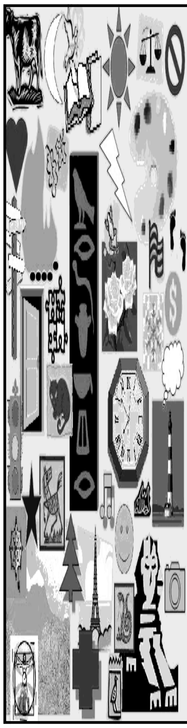
Thank you.
Proposal No. 693 has been submitted.
9/1/09 Proposal accepted.



Exhuming Cultural Artifacts to Embed and Integrate Deep Adult E-Learning

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This study addresses which factors can have a positive influence on adult on-line learners by studying

- cognitive load

- the use of technology, and
- semiotic tools in on-line courses

The Purpose of the Study

- to gather data on students at a private and a public urban university that both had students enrolled in on-line and hybrid degree programs to see what may positively influence the students, help them feel encouraged and nudge them to finish the course.

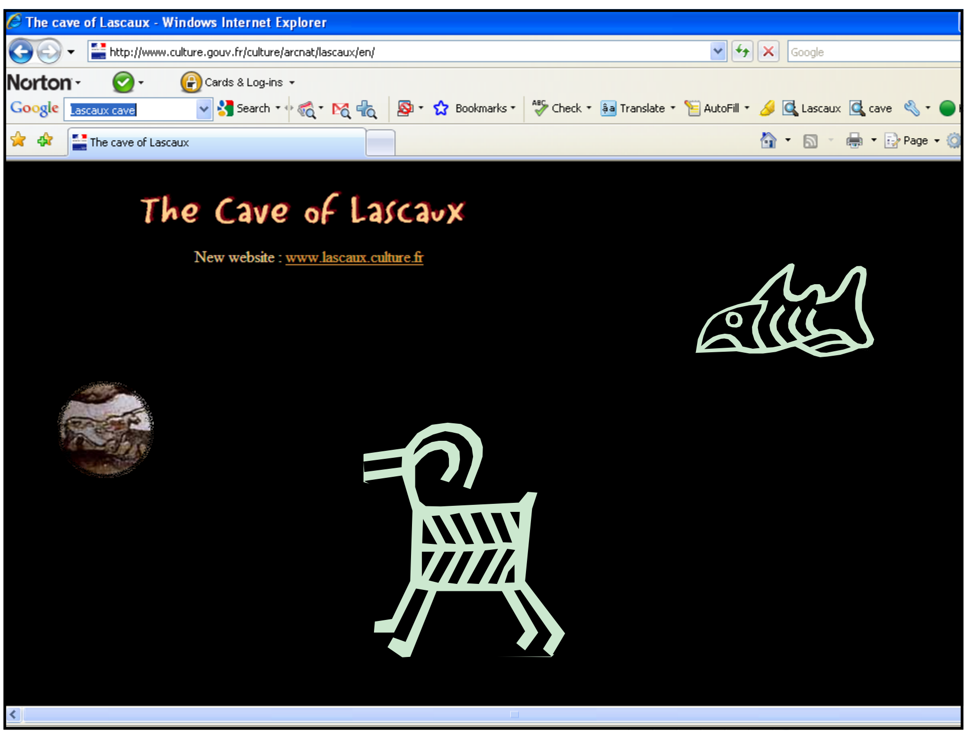
Cognitive load theory

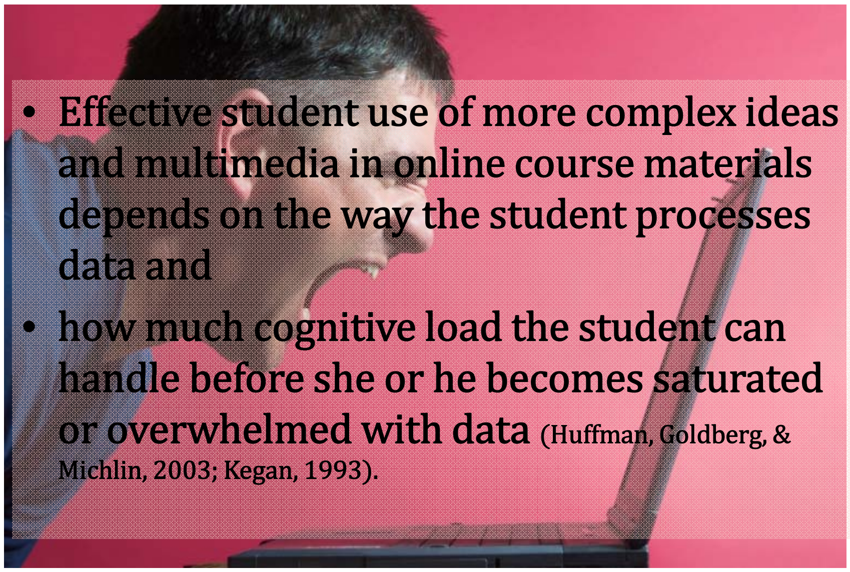
(e.g. Sweller, 1988; 1994)

- Information may only be stored in long term memory after first being attended to, and processed by working memory...

- The fundamental tenet of cognitive load theory is that the quality of instructional design will be raised if greater consideration is given to the role and limitations, of working memory. (Cooper, 1998, p.1)

- The research was conducted to see if the retention rates of students in these programs were higher with the addition of semiotic sociocultural tools and artifacts than the courses without these additions.





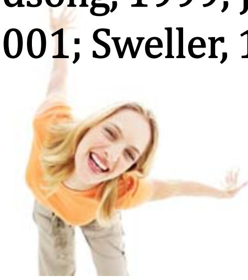
- Effective student use of more complex ideas and multimedia in online course materials depends on the way the student processes data and
- how much cognitive load the student can handle before she or he becomes saturated or overwhelmed with data (Huffman, Goldberg, & Michlin, 2003; Kegan, 1993).

- So, in addition to studying factors that could reduce cognitive load,
- ways to expand working memory can also be pursued as a means of facilitating on-line learning (Cooper, 1998).
- By studying what facilitates and frustrates on-line learning, strategies for effective knowledge transfer could reduce cognitive over-load and
- help learners to acquire and assimilate course materials in ways that reinforce learning and course completion (Cooper, 1998).

- Research on adult-learners in on-line courses indicates that the majority of post-secondary on-line courses have high attrition rates as high as forty percent or more (National Center for Education Statistics, 2002).
- While there may be a number of reasons for this high attrition, one of the reasons could be related to cognitive over-load.

- This study looked at cognitive load, including the learning curves of technology, time management, and trying to learn new content materials, to see what effect they might have on both student attitudes and retention in on-line courses.
- It also looked at working memory (WM) limitations (Mayer, 2001, 2005), and
- how those could be minimized,
- how WM could be expanded, and
- what "learning consequences for ignoring those limitations" might occur (p.22).

- Prior research indicated that while there are maximum limits of working memory, there was also evidence that expansion of working memory might be possible (Bailey, 1999; Basak, n.d.; Birdsong, 1999; Jewitt & Oyama, 2001; Mayer, 2001; Sweller, 1988; 1994).



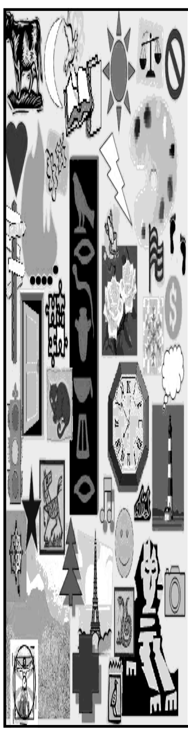
Methodology

- The researchers' made an effort to actively incorporate multiple methodologies, such as
- experimental research using a Likert-type of survey,
- developmental research (McKenney & van den Akker,2005; Richey, Klein, 2007)
- appreciative inquiry (Preskill, Catsam; Singleton & Straits, 2005; Basak, n.d.), and
- action research (Richey, and Klein, 2007).

- The study researched adult-learner cognitive load in on-line courses and compared text-based online courses (traditional courses transferred to on-line formats without graphics, metaphors, or multimedia) and
- graphics and media-enhanced on-line courses (courses designed with embedded semiotics, such graphics and metaphors, or multimedia)
- to see which had a more positive effect on adult-learner cognition.

- Prior research indicated that the inclusion of multi-media into online courses could enrich student learning (Bailey, 1999; Beggs, 2002; Brooks, 2008; Cobley, Jancz, 1997; Crawford, Gannon-Cook, 2008; Gannon-Cook, 2006; Gannon-Cook, Crawford, 2006, 2007; Greeno & Hall, 1997; Mayer, 2001; Ryan, Hodson-Carlton, & Ali, 2005),
- the findings of the study supported those findings,
- cognitive load was reduced and this supported subsequent learner retention.

- In *addition, the study found that the factors of embedded graphics and metaphors, followed by the integration of visual multimedia, such* as embedded multi-media *PowerPoints*, or *MP4s*, was more effective than some other multi-media, such as *Wimba* or *Second Life* to lessen cognitive load and best predict student retention for adult learners.

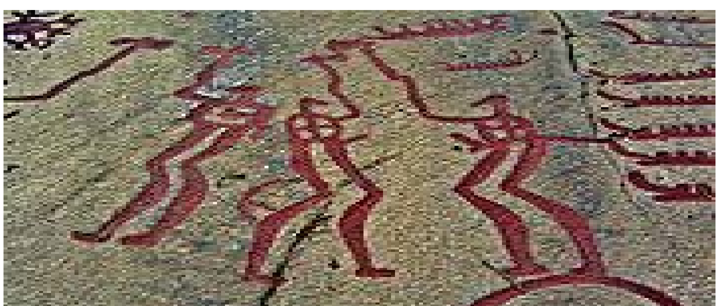


Findings

While newest technologies can be used as a competitive tool, there may be other factors that could provide deep solutions to facilitate integration of new technologies seamlessly into the fabric of their learning and help students weave new content knowledge into their daily lives.

Findings

- This study was conducted to see how student cognitive load could be minimized and monitored so that new technologies could be integrated seamlessly into learning, instruction and performance.
- The study provided insights into which factors could help regulate cognitive load for students.
- Further studies could provide more data on how these factors could reduce student attrition in online courses.



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- New technologies are often implemented by colleges as a kind of panacea to stay competitive with other universities or as remedies for problems such as attrition. These reasons can be valid, particularly as a competitive tool, but
- there may be other factors that could provide deep solutions that could both facilitate integration of new technologies seamlessly into the fabric of their learning, and help students weave new content knowledge into their daily lives.


- The students expressed recognition of simple signs and icons, and acknowledged that these did serve as kind of signposts that continued to point them in an onward direction through the course.

- One of the biggest surprises in their findings was how much the students seemed to get engaged in telling their own stories. (Narratives were embedded to function as yet another form of semiotics).
- The vast majority of students expressed the most satisfaction in reading about and sharing stories and experiences with each other.
- Both researchers were genuinely surprised that the students stayed involved and a larger number than expected remained in the course through its completion.

- but there may be other factors that could provide deep solutions that could both facilitate integration of new technologies seamlessly into the fabric of their learning, and help students weave new content knowledge into their daily lives.

- This study was conducted to see how student cognitive load could be minimized and monitored so that new technologies could be integrated seamlessly into learning, instruction and performance.
- The study provided insights into which factors could help regulate cognitive load for students. Further studies could provide more data on how these factors could reduce student attrition in online courses.

Thank You!

Questions?

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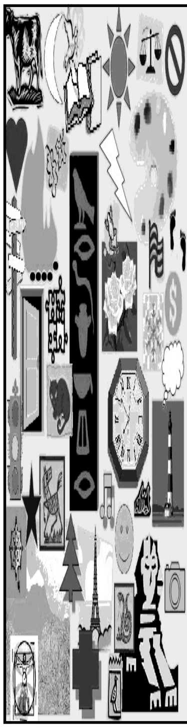

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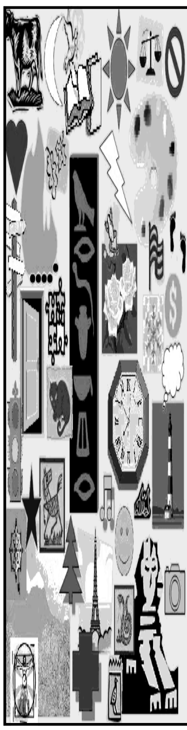

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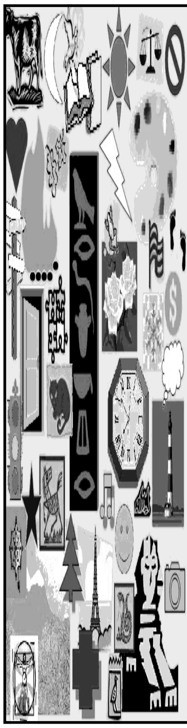

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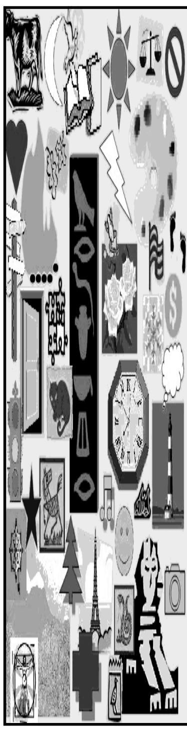

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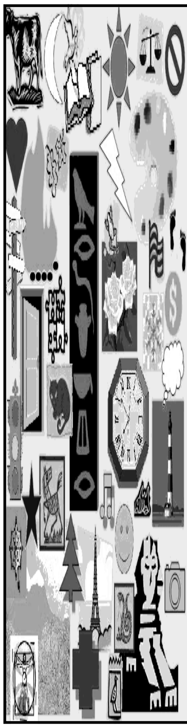

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Faculty Training for Online Teachers in Three Rural Alabama Community Colleges: A Collective Case Study

Robert E. Davis Jr., Ph.D. and Angela D. Benson, Ph.D.

Abstract

Online education is providing community colleges opportunities to reach students through the use of technological advances. These technological advances have allowed faculty to develop new teaching skills and transfer these skills into pedagogical practices in an online environment. The purpose of this study was to examine how the training instructors receive support their teaching classes in an online environment at community colleges. This research study followed a qualitative research design; a collective case study that included administrators who made the decisions for online education, trainers who provided professional development training, and faculty who had taught online classes at community colleges. In response to the overarching question that guided this study, *"How does professional development training influence faculty teaching online at Alabama's rural community colleges?"* this study found that technological skills and familiarity with online education theories and pedagogies facilitated the transfer of pedagogical strategies from the training to their online classes. The study found that when faculty received training incorporating online pedagogical strategies, the online teaching practices taught during the training were transferred to their online classes. This study also made clear that the instructors' interest in online education was a driving force for the establishment of formal professional development training programs at their institutions. The results of this study can inform all community colleges of the need for professional development training, spur innovations in faculty training for online teaching, and encourage further research in the area of training for online teaching and learning.

Introduction

Professional development for community college faculty began to grow in response to the realization that the rapid growth of new community colleges in the early 1960s and 1970s was waning and that people, rather than buildings, programs, and organizational structures, needed attention (O'Banion, 1981; Watts & Hammons, 2002). Hammonds, Wallace, and Watts (1978) identified multiple events that led to professional development at community colleges, including (a) the need for increased effectiveness and efficiency due to competition for limited tax dollars and beginning public demands for accountability, (b) the acknowledgement that the future success of the community college depended on the ability of its personnel to adapt to a constantly changing environment, (c) the development of a technology of instruction with potential for improved instruction unknown to most faculty, (d) an awareness to faculty that they were becoming unable to cope with the needs of the increasing percentages of "high risk" students enrolling in community colleges, (e) a recognition among leaders that change was imperative and they needed to become skilled in planning, implementing, and evaluating change, (f) the increasing influence of court decisions, collective bargaining, and federal regulations on instructional governance, and (g) the occurrence of a relatively high turnover in leadership positions at the midmanagement levels.

Community colleges are continuing to change in response to community and societal changes, and those who lead, teach, and provide support in those colleges will need to continually grow and change as well (Watts & Hammons, 2002). According to Watts and Hammons (2002), "Professional development has provided and will continue to provide the necessary programs to meet growth needs and appears now to be a permanent fixture in community colleges." (p. 8)

The adoption of *online education* practices has produced important changes in education in the last decade, including a growing tendency towards new models of teaching and learning that include a combination of web-based technologies and classroom instruction (Bonk, Kim, & Zeng, 2006; Dziuban, Moskal, & Hartman, 2004; Horizon Report, 2005). This use of web-based systems has led to an increase in the offering of distance education courses by higher education institutions (Lewis, Snow, & Farris, 1999), and has had an impact on classroom education as well (Bates & Poole, 2003; Curtain, 2002; O'Sullivan, 2000; Palloff & Pratt, 2001; Spector & Teja, 2001).

Successful online course experiences for students and instructors depend on the expertise and dedication of a well-prepared online instructor (Ko & Rossen, 1998). New instructors need comprehensive training to ensure a strong start, and continuing support and services throughout their distance education experience to promote maximum quality and satisfaction in the online courses they teach (Lieberman & McNett, 2000). When online instructors are fully equipped with proper technical skills, familiar with the online learning environment, and most importantly, hold a true awareness of effective online pedagogies and teaching strategies, the online learning experiences they create have the highest potential to succeed (Bedore, 1997).

Purpose

Given the evidence that the use of technology provides new opportunities for learning, for collaboration, and for developing learning communities (Cross, 2003; Horizon Report, 2005), there is an impetus for community colleges to encourage faculty to integrate technology in their teaching and learning, The purpose of this study was to examine the training that instructors received in support of their online classes at the community college and to contribute research on professional development training. The results of this study can be used to enhance professional development programs, to develop new strategies for faculty training, and to equip instructors with skills that support pedagogical decisions when integrating new approaches, which include technology.

Theoretical Framework

Transfer of learning is the degree to which an individual transfers the knowledge, skills, and attitudes gained formally or informally to new situations (Baldwin & Ford, 1988; Enos, Kehrhahn, & Bell, 2003). Transfer is a critical element in learning, and it involves complex cognitive processes. Transfer occurs when an individual is faced with a situation or problem and draws from previously acquired knowledge to deal with this new circumstance (Ormrod, 2004; Schunk, 2004).

Training, including professional development training, is useless if it cannot be transferred into performance (Yamnill & McLean, 2001). Training is of little value to organizations (and community colleges) unless it is transferred in some way to performance (Holton, Bates, Seyer, & Carvalho, 1997). Therefore this study used Holton's (1996) transfer of training model as a guiding framework. This model proposes three primary outcomes and three primary inputs of a training intervention. The three primary outputs are: learning, individual performance, and organizational results. The three primary inputs are: motivation to transfer, transfer climate, and transfer design (Holton, 1996).

According to Holton (1996), motivation to transfer comprises four categories: (a) *intervention fulfillment* (e.g., refers to the perception of learning something that has met the trainee's expectations and has fulfilled his/her need for performance-related learning), (b) *learning outcomes* (e.g., the results of learning will have an effect on motivation to transfer, this is also related to the expectancy theory), (c) *job attitudes* (e.g., meaning that a person's commitment and job satisfaction should influence motivation to learn and to transfer to the job), and finally, (d) *payoff* (e.g., one who sees utility in training is more motivated to transfer to the job than one who does not).

Holton's (1996) transfer of training model included "transfer climate" which is defined as the mediating variable between organizational context and a person's job attitudes and work behavior as a result of an individual's perception of their work environment. Thus, even when learning occurs in training, the transfer climate may either support or inhibit the application of learning to the job or the extent to which a person can use learned skills on the job (Mathieu, Tannenbaum, & Salas, 1992).

Holton's (1996) definition of training design can be characterized as the conditions necessary within a training program for facilitating the transfer of training. Training design can be summarized as the characteristics of the learning environment, such as the materials, opportunities to practice, providing feedback, development of learning objectives, and organizational results.

Holton (1996) provided a definition of learning as the achievement of the learning outcome desired in an HRD intervention. For this study "an HRD intervention" means a training program.

Holton (1996) defined this as a change in individual performance as a result of learning being applied on the job.

Holton (1996) defined organizational results as results at the organizational level as a consequence of change in individual performance. Simmons (1999) further expanded organizational results as special measures of the organization that can be taken before and after learning takes place and to help the process of transfer to the workplace.

Research Questions

The overarching question, which this research addresses, is "How does professional development training influence faculty teaching online at Alabama's rural community colleges?" To guide the data collection and analysis, the following sub questions were explored:

1. What professional development training (including follow-up training) is provided to community college teachers preparing to teach online?
2. How do the elements of Holton's Transfer Model influence the application of this professional development training to teaching the online class?

Methods

This study employed a qualitative case study research design; more specifically, the study was designed as a collective case study (Stake, 1995). Case studies are intensive descriptions and analyses of a single unit or bounded system (Merriam, 1998). The bounded system in this case study is the community college with the unit of analysis being the community college staff involved in the delivery of online courses, including instructors, trainers and distance learning coordinators.

Selection of Sites and Participants

Community college criteria and selection. Three Alabama community colleges were selected: Alpha Community College, Beta Community College, and Charlie Community College. The following criteria were used in selecting the community colleges:

1. Offer online learning courses,
2. Distance Learning Coordinator responded to initial email questionnaire,
3. Used fulltime faculty and staff to conduct professional development training,
4. Fulltime faculty who teach both traditional and online courses,
5. Rural Alabama college classification by The Carnegie Foundation for the Advancement of Teaching,
6. Classification as Associate level institutions where all degrees are at the Associate level, and
7. One college each from the classification of small, medium, and large populations based on The Carnegie Foundation for the Advancement of Teaching.

Participant criteria and selection. The researcher selected fourteen participants who were involved in online education delivery including: distance learning coordinator (DLC), trainers (T), and instructors (I) from the three community colleges. The selection criteria used were the following:

- Distance Learning Coordinators: 1) Designated as the distance learning coordinator at the community college, and 2) Job title or duties involve distance learning.
- Trainers: 1) Faculty or staff members of the community college, 2) Conducts training sessions at the college, 3) Job title or duties involve training faculty members, and 4) Referred to researcher by the distance learning coordinators.
- Instructors: 1) Full-time instructors, 2) Experienced in teaching both traditional and online courses, 3) Taught online classes during the fall semester 2008, and 4) Referred to researcher by the distance learning coordinators.

Data Collection

Data were collected via in-depth semi-structured interviews that were informal and interactive with open-ended questions (Merriam, 1998). The researcher took detailed notes and audio taped each interview. After the interview, each recorded interview was transcribed verbatim.

This study included multiple sources and multiple methods of data collection (Merriam, 1998; Miles & Huberman, 1994; Stake, 2000). The methods involved interviews, observations, and study of documents. Specifically, four steps were followed in the data collection process: (a) pilot study in which distance learning coordinators were interviewed, (b) open-ended interviews with instructors and trainers involved in online learning, (c) in-depth study of documents relating to professional development offerings at the participating colleges as well as online teaching materials, (d) summary write-up of each case identifying themes related to research questions, and (e) cross-case analysis of the individual case summaries.

Limitations

Unlike quantitative research studies, the design of qualitative research lacks a consistency, or uniformity, of a prescribed procedure. Therefore, this study was limited in the following ways:

1. This study was restricted to participants teaching online classes in rural Alabama Community Colleges.
2. Due to the sample size and absence of randomization, the sample did not allow for statistical generalizations.
3. The Distance Learning Coordinator at each college selected the participants based on criteria developed by the researcher. Given this, the selection of participants could be biased.

Additionally, the qualitative data gathered by the researcher may be subject to other interpretations thereby reducing the degree of external reliability of the results. Therefore, generalizing the results to other community colleges outside the State of Alabama may not be possible.

Findings

Professional Development Training

All three of the colleges included in the study had established comprehensive professional development training programs at the time of review. There were similarities and differences in the manner in which professional development training was developed and provided to online instructors.

Similarities. The training programs evolved from the instructors who were teaching online classes from the initial startup phase in 2001. These instructors were selected on a volunteer basis and basically had no training provided to them. They learned how to teach online classes through on-the-job training or by "trial and error." Since training had not been provided these instructors formed informal committees where they would meet and provide each other with successes and failures of online education they had learned from experience. At all three colleges the informal committees were recognized by administrators, which eventually led to the professional development training programs being established for distance education. Another avenue many of the instructors utilized for training purposes were their participation in graduate courses. Instructors were pursuing advanced degrees from universities, which were tailored to online education. In fact, many of the classes they had to complete for these degrees were taught in an online environment.

Participants at Charlie Community College suggested there had been external influences on decisions made at their college. Charlie was in the process of updating their learning management system when a State-level committee was formed to standardize the learning management system for all community colleges. However, this committee has been inactivated, thereby placing Charlie Community College in limbo as to which direction the college should proceed in obtaining a learning management system. Even though this influence was not mentioned at the other two colleges, they are part of the same organization, the Alabama Community College System, so the same observations apply to them as well.

Online instructors at all three colleges participating in the study understood that distance education was a new shift in teaching methods based on economic factors and that students wanted this type of learning. Therefore, each instructor volunteered to teach online classes and found creative ways to obtain the training they needed to do so.

Differences. Alpha State utilized contracted Blackboard personnel for their professional development training, which was provided once a year during the fall semester. At the time of this study, this was different from Beta and Charlie State, in that neither of these schools had established Divisions within their colleges that provided training sessions year round.

Also, there were differences in the manner in which follow-up training was provided. While Alpha State had two instructional designers who provided the majority of follow-up training in one-to-one mode, Beta and Charlie State incorporated the professional development training sessions into their training websites. These websites allowed instructors to refresh their training knowledge by accessing the training site anytime they needed. Of course, there were also personnel within the training divisions who would provide face-to-face help to any instructor that requested assistance.

Another difference in the training programs was that Beta State required all instructors to participate in professional development training for distance education whether they taught online classes or not. This requirement was to allow all instructors to become familiar with the online process. Further, Alpha State required all division chairs and associate deans to attend distance education professional development training also.

Transfer of training

The Holton Transfer of Training Model captured the professional development of the community college participants in this study. This model proposed three primary inputs: motivation to transfer, transfer conditions (environment), and transfer design and three primary outcomes of training interventions: learning, individual performance, and organizational results (Holton, 1996).

Motivation. Motivation to transfer is defined as an individuals' desire to use knowledge and skills on-the-job. Instructors were motivated by training they received on the pedagogy and the valuable practical experience of having been an online student while enrolled in graduate school. At all three colleges, instructors who had taken graduate courses concentrating on how to teach in an online environment understood online education was changing the role of teaching and that it was very important for them to adapt to this change. Because of this knowledge, instructors teaching online at Alpha motivated newer online instructors by conducting small workshops on the methodology of teaching in an online environment. At Beta Community College instructors were given the opportunity to use "virtual hours" to teach their online classes from home. Another motivating factor prevalent at all three colleges was the use of a cohort system where instructors teaching online classes would informally meet and share their thoughts and ideas on how to better their online classes.

Transfer design. Transfer design is defined as the conditions necessary within a training program for facilitating the transfer of training. All three colleges provided training to their online instructors in a real life work environment. All the colleges provided training in a face-to-face environment. Beta and Charlie went one step further by recording and posting face-to-face training sessions to their training website. Factors in the training design that allowed transfer of knowledge were administration support of online classes and the use of instructional designers as training personnel. The workplace atmosphere was an environment that allowed faculty to maintain a positive attitude towards online education even when training on this subject was not available. Because of this attitude teachers at all three colleges volunteered to teach online classes, developed and delivered small workshops to help and encourage faculty teaching online, and conducted informal meetings to discuss ideas on ways to better their online classes.

Transfer climate. Transfer climate is defined as the mediating variable between organizational context and a person's job attitudes and work behavior as a result of an individual's perception of their work environment. The colleges provided online instructors with a positive climate for transferring their knowledge to their online classes. All three colleges provided instructors a web-based system for use when teaching both their online and traditional classroom. All three colleges had established formal Distance Education Committees and had strong administration support. The committees, with the support of administration, developed a vision for distance education at their colleges. In addition, at Alpha instructional designers had been appointed, while Beta and Charlie had incorporated training sessions into a training website. This website allowed new instructors the opportunity to participate in the previous training sessions and allowed present instructors the opportunity for refresher training.

Learning and Individual Performance. Learning is defined as the desired outcome of a training program. Individual performance is defined as a change in individual performance as a result of learning being applied on the job. There were several factors present that contributed to administrations desired learning goal for online teachers to strengthen their online classes through training focused on distance education. Instructors at all three colleges converted their traditional classroom into a format to be taught in an online environment. One of the tools the online instructor's utilized at all three colleges, which they learned about during professional development training, was the discussion board. All instructors incorporated student discussions when introducing course materials in the online class, used a questions forum and email to address students ongoing questions, and gave tests to determine students' understanding of the course materials. Alpha established testing centers where all online students were required to take their tests, Beta and Charlie instructors gave timed tests, but Charlie instructors require students to take finals on campus.

Organizational results. Organizational results are defined as changes that occur at the organizational level as a consequence of a change in individuals. This study did not explicitly explore organizational results but some overall observations can be made. Initially there was no training offered when online classes began at the colleges so one organizational change outcome was the formation of some form of training to guide and direct teachers toward when teaching online. At one college, training was initiated in the form of Blackboard training sessions provided via contractual agreements with Blackboard personnel. Also, this college required all division chairs and associate deans to attend this training. All the colleges in the study had developed policies and procedures for the distance education programs that they provided in a Distance Education Faculty Manual. In addition, technology offices were established at the colleges and staffed with qualified individuals in charge of conducting training sessions on distance education matters. All three colleges provided face-to-face training sessions and at two of the colleges, the training material used was posted on their college online education websites.

Discussion

Although previous studies have suggested that professional development training provide pedagogical strategies for online teaching in the classroom, there were no studies, which explored this topic in Alabama Community Colleges. The results of this study were consistent with previous researchers' suggestions (Henning, 2000; Simpson & Head, 2000) indicating that professional development training was a major issue on faculty's ability to design and teach online courses.

This study identified several factors that contribute to professional development training that help faculty teach online. These factors include: administration support (transfer climate), technology staff support (transfer climate, transfer design), training curriculum (transfer design), and motivation to transfer.

Administration Support (Transfer Climate)

The administration's support is a major key to offering professional development training to online teachers. Even though, as this study showed, teachers will obtain training through other avenues, it is essential to provide training through the college. The attitudes of the teachers toward online teaching are directly tied to how they perceive they are supported by administration. Administration was supportive at all three colleges. In fact, training would not have been established at the three colleges had it not been for the support of administration.

Technology Staff Support (Transfer Climate, Transfer Design)

The role of the technology staff is another major key to offering professional development training to online teachers. The colleges included in the study had well-organized technology staffs eager to help instructors increase their knowledge of online teaching strategies. These individuals developed and provided training to all instructors at the colleges and provided software suggestions to enable instructors to enhance their online classes.

Training Curriculum (Transfer Design)

All three colleges had spent countless planning hours configuring their training program for online instructors. Alpha State utilized yearly training sessions and instructional designers to teach the proper techniques of online teaching. Beta Community College and Charlie Community College utilized multiple training sessions offered each semester (summer excluded) in computer labs. In addition they captured each training session and posted them to the college websites. Doing this provided instructors a mechanism to review the sessions whenever they felt they needed follow-up training. Directors of Training at Beta and Charlie Community College corresponded with each other on a regular basis to share successes and hardships and learn from each others' programs.

Motivation to Transfer

All the participants volunteered to teach online classes and came to understand the importance of the online education program at their college. They understood this was a new form of education desired by students and wanted to become a part of the first to teach online classes at their college. Faculty also sought training experiences when their colleges offered none.

Summary

This study found that faculties were not provided training during the initial start-up phase of online education because the community college administrators assumed teachers would know how to teach in the new environment. They soon found out that training and assistance were much desired by their online instructors. This study suggested that since their institution did not offer training, these faculty members obtained training through other means. As a result these faculty members were instrumental in helping the institutions establish formal training programs.

Additionally, this study, like other recent research on training (Fenby, 2006), suggested training should take place in an online learning environment to give the faculty training in the pedagogy and experience of having been an online learner. This study suggested training provided faculty with the readiness to teach online classes. The training provided familiarity with technology and with the pedagogy of using course content and context in an online environment.

Implications for Practice

The study identified factors that facilitated the effect professional development training had on faculty at Alabama's rural community colleges in the development of online classes. These findings also have implications for the practice for community colleges offering or planning to offer online classes.

Faculty Professional Development Training Curriculum

Faculty training for online teaching should include modules on pedagogical strategies in addition to modules on the mechanics and application of online tools. Training which was focused entirely on the mechanics of the application of software tools and did not provide information on the pedagogical strategies fails to provide faculty with the knowledge needed to teach online (Palloff and Pratt, 1999). Consistent with previous research, this study found that online teaching should focus on pedagogy (Bates, 2000; Bates & Poole, 2003; Boettcher & Conrad, 1999; Palloff & Pratt, 2001; Spector & Teja, 2001) and how technologies can provide alternate ways of knowledge and uses of information as they taught and prepared their first online class (Fenby, 2006).

Follow-Up Training/Instruction

Follow-up instruction should be provided to increase the likelihood that faculty will apply what they learn during training in their online class. Training that does not allow for follow-up instruction does not provide faculty a mechanism to refresh and reiterate the pedagogical strategies learned in the initial training. Follow-up instruction activities identified in this study included: (a) training captured by video or audio taped and put on the college website, and (b) one on one sessions by the instructional designers, as needed.

Support System For Faculty Teaching Online

Establish a community of online teachers—whether face-to-face or online. Faculty members who had taught online classes after participating in professional development training for online teaching needed to be given opportunities to reflect on their online teaching experiences. This helped them produce changes in their teaching methods. Informal learning from their colleagues, as this study showed, played an important role as a motivator for reflection and exploration of new ideas. The colleges studied provided avenues to facilitate and encourage opportunities for faculty reflection and sharing of teaching methods. These initiatives enhanced transfer and ultimately increased faculty interest in integrating online technologies.

Training for All

Require all instructors not teaching online classes to have exposure to the online software and to use online tools for some aspect of their class. Also, administrators should be required to attend this training to ensure they have first-hand knowledge of the online classroom experience. This knowledge will allow administrators who are appointed to state-level or local level committees dealing with online teaching to have some personal knowledge of the subject.

Staffing of Training Effort

Require training personnel to have exposure in either actual online teaching or extensive professional development training in the proper techniques of teaching in an online environment. The training staff should have first-hand knowledge of teaching in an online environment. Also, require the use of instructional designers to strengthen training programs. These individuals should have prior experience teaching in an online environment or have had extensive training in the area of online education. Administrators should consider appointing instructional designers from the pool of instructors who are teaching online classes at their college since they would have the necessary experience and also be familiar to the faculty.

Organizational Structure for Distance Education

Administrators should strongly consider establishing the training programs for online education as a separate division of the college with a separate Dean, Director of Technology, Distance Learning Coordinator, and training personnel. This Division should maintain a separate funding line to ensure accountability of funding and student learning outcomes. Since teaching in an online environment requires additional and special technological resources a separate division would make the program more managable. Also, this will broadcast the college's commitment to online distance education and allow the college to maintain a separate strategic plan, resulting in a stronger distance education program.

Delivery of Training

Provide training in an environment that realistically represents the online classes at the colleges. One recommendation is to establish training centers on campus where not only faculty, but students, can receive training on the proper techniques for teaching and learning of an online class. Training personnel should deliver face-to-face instruction to faculty members and provide follow-up training via the web or instructional designers. Capturing the actual face-to-face training and posting it to a training website where instructors can access anytime would provide a tremendous amount of training hours to faculty. Establish a separate instructor and student training module for the delivery of follow-up training.

Vision Sharing

Reinstate or establish State-level committees to provide oversight and vision sharing to all community colleges within the State. This committee would provide an avenue for sharing distance education procedures among community colleges. Ensure the committee members selected to represent the respective community college have first-hand knowledge on teaching in an online environment.

Reflective Commentary

As the researcher, I was surprised to find the three colleges reviewed had established comprehensive professional development training programs. Based on my personal experience in the education field I had initially thought there would be some training provided for distance education instructors but not to the extent that these findings revealed. It was exciting to see in practice things discussed while taking instructional technology courses. For example, one class I completed had revealed the importance of instructional designers in developing and sustaining online classes. I was actually permitted to see this in action when I collected data from Alpha State. This reinforced the importance of the role instructional designers have on training curriculum for online instructors. Another key training ingredient that I enjoyed was the training websites developed at Beta and Charlie State. This reinforced my understanding of the importance of internet websites in providing instructors with immediate training or in other words, training "just in time."

Recommendations for Further Research

There are still elements that remain unexplored dealing with professional development training in Alabama's rural community colleges. Some items that need further study are:

1. Include a larger number of participants to lend additional validity to the initial findings of this research.
    a. Include adjunct faculty who teach online classes.
    b. Include faculty who have not taught online classes.
    c. Include additional community colleges.
    d. Compare community colleges within an urban/suburban and/or another sector.

2. Include participants at the State-level to determine:
    a. What policies and procedures are being reviewed and/or developed to standardize online education within The Alabama Community College System.
    b. Whether state-wide committees of distance education should be reactivated and include representatives from colleges who have experience in an online environment.
3. Perform a quantitative approach and use a statistical survey across all community colleges.

Conclusion

In response to the overarching question that guided this study, "*How does professional development training influence faculty teaching online at Alabama's rural community colleges?*" this study found that technological skills and familiarity with online education theories and pedagogies facilitated the transfer of pedagogical strategies from the training to their online classes. The study found that when faculty received training incorporating online pedagogical strategies, the online teaching practices taught during the training were transferred to their online classes. This study also made clear that the instructors' interest in online education was a driving force for the establishment of formal professional development training programs at their institution. Results from this study have the potential to inform innovations in faculty training for online teaching and to encourage further research in this growing area.

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On measuring attrition: An examination U.S. virtual school trial period and course completion policies

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Abstract: Variations in the policies used by virtual schools in relation to course enrollment trial periods and course completion impact the comparability of attrition statistics. Based on the responses of 86 of the 159 U.S. virtual schools we contacted, approximately 70% had trial periods that varied from one day to 185 days. Course completion definitions also varied considerably from remaining in the course irrespective of the final grade to receiving an A- in the course. We recommend virtual schools adopt consistent measures for calculating student attrition to allow meaningful comparisons between virtual schools and also between virtual schools and brick-and-mortar schools.

There has been a rapid proliferation of virtual schools throughout the United States. In 2008, 44 states had significant K-12 online activity (Watson, Gemin, and Ryan 2008), up from 21 states just three years earlier (Watson and Kalmon 2005). One challenge to such rapid growth has been adopting common metrics across virtual schools to measure quality. Currently, no common metrics exist to calculate course completion rates (Pape, Revenaugh, Watson, and Wicks 2006; Smith, Clark, and Blomeyer 2005, Watson and Ryan 2006). Unfortunately, completion rates are a key indicator commonly used to measure the quality of virtual schools (Blomeyer and Dawson 2005). The absence of a common metric for measuring course completion rates makes it difficult to draw comparisons on student retention and attrition among virtual schools.

Several factors affect course completion rates. While many are directly related to the student and the learning environment (Rice 2006), administrative policies unique to virtual schools can also affect course completion rates. Policies that determine when and how students are counted in the official course completion rates can affect the outcome measure (Roblyer 2006). The purpose of this study was to explore the policy variations in how U.S. virtual schools calculated completion rates. Specifically, this study sought to answer the following research questions.

1. What are the trial period policies for US virtual schools?
    a. How much variability exists across different types of virtual schools and regions of the country?
2. How do US virtual schools define course completions?
    a. How much variability exists across different types of virtual schools and regions of the country?

Review of Literature

In virtual school settings, student attrition is believed to be a significant problem (Carr 2000; Rice 2006). It is estimated that attrition rates range between 12%-40% (Lary 2002) and in some cases may even be as high as 50% (Rice 2006). These estimates vary greatly due to differences in the age of the program, method and amount of funding, instructional quality, teacher staffing, technical support, and the diversity of the student body (Roblyer 2006). Another contributing factor is the lack of a commonly accepted metric for calculating student attrition. While most virtual schools calculate student attrition, no common criteria exist on when a student is officially enrolled and what constitutes a course completion (Pape et al. 2006; Smith et al. 2005). Simply put, a student counted as completing a course in one virtual school may be considered a non-completer in another (Watson and Ryan 2006). Varying metrics make it impossible to compare attrition rates between virtual schools, and also make it difficult to compare attrition rates between virtual schools and brick-and-mortar schools.

While attrition rates may be high, the seriousness of the problem might be masked by the policies adopted to determine when and how students are counted. Many schools utilize a trial period wherein students can withdraw from a course with no penalty and not be counted as officially being enrolled (Watson et al. 2008). Long trial periods can act as a sifting mechanism when weaker students drop out, masking attrition rates for lower performing students (Barbour and Reeves 2009; McLeod, Hughes, Brown, Choi, and Maeda 2005). Virtual schools with generous trial periods would be able to report high retention rates because students who were struggling would have dropped out before the virtual school began counting them. In their 1999-2000 evaluation, Bigbie and McCarroll (2000) reported that FLVS had a 73.6% completion rate. However when taking into account students who dropped out during the 28-day trial period, the completion rate fell to 53.5%. This problem has also been well documented in comparative studies examining student performance of virtual school students compared to brick-and-mortar students (Ballas and Belyk 2000; Cavanaugh, Gillan, Bosnick, Hess, and Scott 2005). Retention figures across virtual schools vary since institutions begin counting students at different points in time and this prevents meaningful comparisons between virtual schools and brick-and-mortar schools. For example, in their study examining students' algebraic understanding McLeod et al. (2005) found that virtual school students performed better than their classroom counterparts, but speculated the reason was due to the high dropout rate in virtual school courses. They believed the result of the attrition was that many low-achieving virtual school students had already removed themselves from the sample prior to the assessment. This is only one of many possible examples.

Similarly, the definition of a course completion can also affect retention rates (Pape et al. 2006; Roblyer 2006). A school that defines course completion as a student receiving a grade (i.e., A-F) will have a higher retention rate than a school that defines a course completion as a student receiving a passing grade (i.e., D- or better). Again, these variations make it difficult to compare retention rates and weaken the value of the outcome metric.

While numerous researchers have called for standardizing performance measures across virtual schools (Smith et al. 2005; Pape et al. 2006; Watson and Ryan 2006, Watson et al. 2008), there is limited research examining the extent of variation that exists in trial period policies and course completion definitions. Pape et al. (2006) conducted a small study comparing several outcome measures used at three virtual schools: Virtual High School Global Consortium, Illinois Virtual High School, and Connections Academy. Two of the three schools had trial periods of three and five weeks. There were also differences in course completion definitions across the schools. Watson and Ryan (2007) also surveyed 32 virtual schools to analyze trial period and course completion policies to determine how completion rates were calculated among virtual schools. They found that about two-thirds of the schools had trial periods of varying lengths and the same amount required students to receive a passing grade in order to be counted as a course completion. A major limitation of both Pape et al. (2006) and Watson and Ryan's (2007) was the sample size of 3 and 32 respectively. In addition, neither study examined whether there was a relationship between the policies adopted and the geographical region or type of virtual school. Beyond these two studies, we were unable to locate other studies examining trial period policies and course completion definitions across US virtual schools. This study sought to fill this gap in this body of research on K-12 online learning.

Methodology

We surveyed schools using a combination of methods including e-mail, fax, and telephone (see Appendix A for a copy of this survey). To guide our study, we used Clark's (2001) definition of a virtual school as "a state approved and/or regionally accredited school that offers secondary credit courses through distance learning methods that include Internet-based delivery" (p .i). Schools included in the sample were located using a variety of sources, as no comprehensive list existed. We included all of the state-led schools listed in the *Keeping Pace with K-12 Online Learning: A Review of State Level Policy and Practice* report (Watson and Ryan 2007) and those listed on North America Council for Online Learning's (NACOL) *Online Learning National Clearinghouse for Online Programs* (see http://www.edgateway.net/cs/nacol/print/docs/437) as of November 2007. The accuracy of NACOL's list was questionable, as we found contact information dated, listings for schools that had closed, and course content vendors listed as schools. The combined lists yielded 159 schools, all of which met Clark's (2001) definition of a virtual school. Virtual schools were categorized using the taxonomy outlined in Cavanaugh, Barbour, and Clark (2008) and grouped in the geographic regions listed in Watson and Ryan's (2007). Table 1 describes the schools sampled based on school type and geographical region.

Table 1. Demographic characteristics of schools sampled

Characteristics	Sample Size	% of Sample
School type		
Cyber Charter	34	21.1
For Profit	9	5.6
Multi-district / Consortium	11	6.8
Private	21	13.0
Single-district	49	30.4
State – led	24	14.9
University – led	11	6.8
Total	159	100
Region		
Central States	41	25.5
Northeastern States	18	11.2
Southeastern States	33	20.5
Western States	67	41.6
Total	159	100

Single-district and cyber charter schools accounted for over half of the schools sampled compared to for-profit schools that accounted for the smallest portion of the sample. Although Northeastern states had a high number of students and brick and mortar schools, they had fewer virtual schools and online learning programs compared to other regions in the U.S.. Many states in the Northeastern region participated in Virtual High School, a large virtual school consortium, which draws students from 500 high schools in 28 states and 35 countries (Watson et al. 2008). In Massachusetts, for example, 100 high schools (30%) had students attending the Virtual High School. Moreover, it was also not surprising that the bulk of virtual schools sampled were from Western states, which have larger rural populations. Traditionally, distance education was used by rural school districts as a means to provide students with access to college preparatory courses and qualified teachers otherwise inaccessible (Smith et al. 2005). Thus, the sample was reasonably representative of the K-12 online learning landscape.

Our data collection methods consisted of surveys that were sent initially by electronic mail on two occasions, then once by fax, and finally once by phone. We analyzed the data using *SPSS* statistical software. Trial period lengths were measured by days. Data for course completion policies were collected qualitatively. We analyzed the responses and clustered course completion statements into three broad themes. Within each of these themes there was further differentiation, which we maintained in our quantitative coding. Data were examined using basic descriptive statistics, one-way ANOVAs, and cross tabulations. There were some limitations to the nature of the data we collected. Six schools identified trial period lengths that varied based on the length of the semester. Summer semesters typically had shorter trial periods than winter and spring semesters. In these cases, we coded the schools with the longer trial period of winter and spring semesters. Finally, one school reported it had an "indefinite" trial period. In this instance, we used the length of the school year for brick-and-mortar schools in the same school district to determine the trial period length.

Results and Discussion

Of the 159 sampled, 86 schools responded to the survey. The response rate was 54.1% and varied based on school type and region. Table 2 indicates respondents based on school type and geographical location.

Table 2. Frequency count of respondents based on school type and geographical region

Demographic Characteristics	Respondents	% of Respondents
School type		
Cyber Charter	16	18.6
For Profit	1	1.2
Multi District / Consortium	7	8.1
Private	12	14.0
Single District	26	30.2
State – led	16	18.6
University – led	8	9.3
Total	86	100
Region		
Central States	23	26.7
Northeastern States	8	9.3
Southeastern States	19	22.1
Western States	36	41.9
Total	86	100

Single district virtual schools had the highest response rate and accounted for one third of the respondents. Western state schools accounted for almost 42% of the respondents, as was expected. While Central and Southeastern states were nearly evenly split, accounting for approximately half of the respondents. Northeastern states had a lower than expected response rate. This was likely due to the fact that so many schools and districts in this region were members of Virtual High School.

To determine the representativeness of the respondents, Table 3 details the proportion of actual respondents, proportion in the original sample, and the difference between these two proportions by geographical region.

Table 3. Regional differences in respondents and total sample

Region	% of Actual Respondents	% Sampled	% Difference
Central States	26.7	25.5	1.2
Northeastern States	9.3	11.2	-1.9
Southeastern States	22.1	20.5	1.6
Western States	41.9	41.6	.3

The difference between the two proportions was small. Consequently, the study's findings were regionally representative of the K-12 online learning landscape in the U.S..

Question 1: Trial period policies

Trial periods were a fairly common practice, with 68.6% of schools having a policy. This finding was supported by a much smaller study surveying 32 virtual schools, which found that about two thirds of the programs surveyed had trial period policies (Watson and Ryan 2007). There were subtle variations in the prevalence of trial period policies based on the type of virtual school and geographical location. For example, all but one state-led school had a trial period of some length. Private and cyber charter schools were almost evenly split on the presence or absence of trial periods. Regionally, Northeastern states were least likely to have trial periods with only 28.6% compared to Southeastern states where 83.3% had trial period policies. Approximately 70% of Western and Central States had trial period policies.

There was significant variation in the lengths of trial period policies reported. Trial period length ranged from as little as one day to as long as 185 days. The mean number of days was 25.22 days, while the median was 15 and the mode was 14. Table 4 reports the frequency counts of the different trial period lengths.

Table 4. Frequency of trial period length by days

Days	*n*	%
1	2	3.4
3	1	1.7
7	5	8.6
8	1	1.7
10	4	6.9
14	12	20.7
15	4	6.9
20	1	1.7
21	6	10.3
28	7	12.1
30	9	15.5
35	2	3.4
60	1	1.7
180	1	1.7
185	1	1.7
Total Count	58	100%

Fourteen-day trial periods were the most common mode and when combined with 15-day trial periods accounted for 27.6% of the trial period policies. The next most frequent were 28- and 30-day trial periods, which accounted for another 27.6% of the sample. Thus, approximately two and four week trial periods accounted for over half of the trial periods. This finding was supported by a smaller study surveying 32 virtual schools which identified two and four week trial periods as the most commonly reported (Watson and Ryan 2007). While several researchers have identified the need for consensus on common metrics such as course completion rates for quality assurance and comparison purposes (Pape et al. 2006; Watson and Ryan 2006; Watson et al. 2008), no one has proposed what that consensus would look like. Findings from this study and Watson and Ryan's (2007) indicate that if accrediting bodies, policymakers, or virtual school coalitions were to attempt to standardize trial period lengths to enable comparisons, two or four week policies would likely meet less resistance than other trial period lengths based on their prevalence. There were several anomalies in trial periods presented by the data. There were two extreme outliers of 180 days and 185 days. When the descriptive statistics were calculated excluding these outliers, the adjusted mean was significantly smaller, at 19.61 days.

Two schools were excluded from the data set. West Virginia Virtual School had a unique trial period policy in that the course provider determined it. In other words, West Virginia Virtual School served as a broker for a variety of contracted course providers, each of which might have had different trial period policies. Grigg's University and International Academy, a private virtual school, had a trial period policy where a student could withdraw at anytime so long as they had not started the course. These policies further illustrated the variety in trial period policies.

It is interesting to note what drives administrators in determining their trial period policies. Though not the focus of our study, one school administrator revealed that her school's trial period recently changed from two weeks to four weeks to match the trial period length of another major virtual school. This was done in an effort boost the school's completion rates to make them appear on par with a rival institution. This logic may explain why schools cluster around trial period lengths of two and four weeks. Virtual schools may be adopting the trial period policy of their nearest competitor in an effort to attract or retain students. Literature in regional policy diffusion has identified three primary reasons for policy diffusion across states: competition, convenience, and policy communities (Cohen-Vogel, Ingle, Levine, and Spence 2008). Economic (Dye 1990) and normative (McLendon 2003) competition where one adopts a policy to gain advantage over another state, to avoid disadvantage of another state, or to conform/keep pace with other states provides a plausible explanation for interstate policy adoption. Another factor playing into policy adoption may be convenience. Neighboring states or institutions may adopt another's policy due to incomplete information, time constraints, or its appearance as a sound model (Cohen-Vogel, et al. 2008). Lastly, policies can be adopted as a result of an influential, community network with common values (Mintrom and Vergari 1998). Future research could investigate the driving forces behind trial period policy length and adoption.

University, private, state-led, and consortium schools had on average longer trial periods than other types of virtual schools with mean lengths of 30.5, 21.6, 21.13, and 19.6 days respectively. In contrast, cyber charter and single-district schools had 16.78- and 15.5-day periods. However, a one-way ANOVA indicated that there was no statistically significant difference between trial period lengths and virtual school type. There were also differences in the trial period lengths for schools located in different geographical areas. Northeastern and Western region states tended to have slightly longer trial periods. However, a one-way ANOVA indicated that differences between trial length and geographical region were not statistically significant at p=.05.

In summary, there was a wide range of trial period policy practices among virtual schools. These differences were not dependent on the type of virtual school, nor its geographical location. These findings compound the difficulty policy makers, schools, prospective students, and parents face when comparing completion rates to and between virtual schools and brick-and-mortar schools.

Question 2: Course Completion Definitions

All but two of the 86 schools provided qualitative definitions of a completion. These ranged from "remaining in the course regardless of the grade" to passing the course with an A- or better. Responses fell into three main categories: (1) completion of the course within the allotted time frame regardless of the grade received, (2) completion of the course within an allotted time frame with a passing grade, and (3) deferring judgment to the brick and mortar school the student physically attends. Within these main categories there were several more refined definitions. Table 5 illustrates the range of definitions as well as the frequency counts of each.

Table 5. Frequency count of course completion definitions

Definitions	***n***	**% of sample**
Final grade is irrelevant		
Remaining in the course for its duration regardless of the final grade received	16	19.0
Completing of all or the majority of the coursework and/or exam within the allotted timeframe regardless of the final grade received	11	13.0
Mastery of material (not defined as grade or percentage)	1	1.2
Final grade is determining factor		
Passing the course	37	44.0
Passing the course and passing the final	2	2.3
Completing four quarters with 60% or better	2	2.3
Passing the course with a D/64% or better	1	1.2
Passing the course with a C-/70% or better	6	7.1
Passing the course with a B-/80% or better	4	4.8
Passing the course with an A-/90% or better	1	1.2
Deferred judgment		
Brick and mortar school the student attends defines a course completion	3	3.6
Total	84	100%

Thirty-three percent defined a course completion as completing a course regardless of the grade received. In contrast, 62.9% used a more stringent definition of a passing grade to indicate a completion. This finding was consistent by Watson and Ryan's 2007 survey of 32 schools. Similarly, they found that roughly 66% of the schools defined a course completion as receiving a passing grade.

Some schools had unique factors contributing to how and whether to calculate course completions. While they had internal policies that govern completion calculations, many deferred judgment to the student's brick-and-mortar school. Other schools did not calculate course completion rates, particularly if the program was only for full-time students, as was the case with one full-time charter school surveyed.

To examine the relationship between course completion definitions and school type and geographical location, we ran a cross tabulation and Chi Square Test for Independence with p=.05. This test indicated no significant relationships between course completion policies and types of virtual schools or the geographical location of the schools.

The wide variation in how schools defined a course completion has significant implications. First, as with trial period lengths, idiosyncratic policies make it difficult for lawmakers, researchers, parents, and students to make meaningful comparisons among virtual school attrition/retention rates (Watson and Ryan 2006). If all other variables influencing student academic success were equal, schools with less stringent definitions of a course completion would have lower attrition rates than virtual schools with more stringent definitions of a completion. Thus, attrition rates could be manipulated by factors unrelated to student learning. Second, if course completion rates were an indicator of the success and health of a course, then counting failing students in this statistic was illogical and counterproductive. A third of schools in our study, and in Watson and Ryan's (2007) smaller study, counted students as successfully completing a course regardless of the grade or effort students put forth. Consequently, a student could sign up, never officially withdraw, mentally check out after the first week, and ultimately contribute to a higher course completion rate. Such a practice pollutes the metric rendering it useless as an indicator of the quality of the course, teaching, and/or instruction.

Conclusions and Implications

In summary, our study examined the variation in trial period and course completion policies—two policy factors that affect course completion rates. We found that trial periods were a fairly common practice among virtual schools and varied in length. We also found that the majority of schools defined a successful course completion as passing the course, though there was wide variation in what percentage constituted a "passing grade." Consequently, it was impossible to compare completion rates of one virtual school to another. In order to make course completion rates a meaningful measure a standardized method for calculating this metric needs to be established and adopted throughout the K-12 online learning community.

There are several implications that arose from this study. The variation in trial period length and course completion definitions gave weight to earlier calls to standardize course completion metrics (Smith et al. 2005; Pape et al. 2006; Watson and Ryan 2007). Though schools can have their internal policies for calculating course completions, for statistical and reporting purposes, all virtual schools should be required to start counting students at the same time and in the same manner. Ideally, when and how students are counted ought to be similar to how brick and mortar schools calculate course completions, thus allowing parents, prospective students, researchers, and legislators the ability to compare virtual school attrition rates with other virtual school and with brick-and-mortar school completion rates.

Since there was no statistically significant difference in trial period and course completion policies by geographical location and only state-wide supplemental virtual schools were unique in completion definitions, regional accrediting bodies ought to be able to agree on a single, nationwide trial period length and course completion definition to facilitate meaningful comparisons. To reinstitute course completion rates a quality indicator, virtual schools should abandon the practice of including failing students. Accrediting bodies or legislatures could mandate this change in practice. Unless virtual schools were required to this, there would be no incentives for schools to change.

Future research should examine students who are withdrawing from virtual school programs during this trial period and how they compares to the types of students who remain in the course beyond the trial period. This would be a meaningful research question, as it speaks to the question of which students online learning is actually serving. Findings from such research could help guide practitioners in developing instructional supports to assist those students who struggle in these online learning environments.

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Appendix A

1. Does your virtual school allow students to register for a class and drop that class without being counted in the official attrition statistics?
2. If you answered yes to question 1, how long do students have in this "trial period"?
3. How does you virtual school define a completion?

Transforming School Organizations into Dynamic Organisms

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Abstract

The study examined a professional development framework that resulted in improved student achievement and capacity building for systemic instructional improvement. Using a data-driven professional development plan, teachers' received intensive training on a Course Management System (CMS), administrative follow-up, technical support, self-evaluated products, and extrinsic motivation to practice and continue to self-develop materials. This year long, extrinsically rewarded job-embedded aspect resulted in the continuity of implementation and resulting impact on student achievement. The progression from a half-loop professional development model to a double-loop cycle demonstrated an often seen process whereby a self-organizing system, guided by research can become more than the project directors intentionally planned or expected.

Introduction

This paper presents a model for systemic transformation in schools, based on the concept that current school systems do not dynamically adjust to the needs of our current information-rich society. This model is based partly on Alan Bain's (2007) Self-Organizing Schools Model and research. Self-organizing dynamical systems are discussed as one solution, in particular Bain's Model. A project is presented that demonstrated the use of a CMS Course Management System (CMS) to facilitate positive distributed change through the implementation of self-directed learning supplements and social networking approaches across partnering districts. This demonstrated one vehicle for assisting schools in developing self-organizing schools through professional development networks.

Background

School organizations primarily exist today as self-sustaining structures driven by pre-existing structures and processes that meet the political and legislative needs of the local (LEA) and state educational agencies (SEA). This model was developed at the turn of the 19th Century to meet the needs of a growing, global industrialized society (Watson & Reigeluth, 2008). Just as the nine-month schedule of American schools was set by the needs of primarily agrarian society, the economic needs of the early 1900's required a uniform product: the factory worker, who could follow simple directions, achieved a minimal skill set in the three R's, and who was essentially interchangeable with another worker. The current world in which today's students find themselves also requires certain prerequisite skills. But it requires the ability to dynamically adapt to an ever-changing flow of new information that is developed, shared, and modified through social networking tools. Whether schools have begun to develop classes without walls, dynamic informational systems and knowledge management tools have started tearing those walls down in virtual space. Given the wide accessibility and usage of such technologies among school-age children, schools must transform from static systems to dynamic organisms than can adapt to a quickly transforming world; a world with growing opportunities for students to find, share, and distribute information with a wide range of students, teachers, and content experts living in a dynamical, virtual knowledge space. In order to adapt to such a world, schools allow emergent qualities and capabilities to thrive and develop among students and teachers and administrators embrace such change.

Bain (2007) reported such emergent qualities only thrive in a self-organizing system. From 1992-2003, Bain conducted a program to develop and sustain a self-organizing school reform project. The basic tenets were that such a sustainable system needed: simple rules, a design that is embedded in the process of the school, the use of emergent feedback that is bottom-up, has similarity of scale at all levels throughout the system by using various teams distributed throughout, and uses dispersed control rather than centralized. In Bain's model, the technology for cooperative learning and knowledge management is adopted and scaled up through distributed teams that self-organized at different levels of scale. Emergent feedback eventually scales up to lead to district-level professional development changes allow enterprise level adoption. The self-organizing school project reported impressive results on SAT-I scores. The effect size for overall performance improvement was .58 and .70 for students with learning disabilities. This is considerably large than found with most comprehensive school reform programs. Part of the difference with such a model may be attributed a more transformational change than just tweaking the system.

Bartunek and Moch (1987) referred to change that just tweaks the existing systems structure as 1st Order Change. Substantial reformation of the system is 2nd Order Change. An actual systemic transformation of the systems is a 3rd Order Change that must be sustainable and builds change management into the transformed system.

Professional Development

Professional development can have many direct and indirect effects on teachers. For example, Wenglinsky (2002) pointed out that professional development (PD) directly affected the classroom practices of the teachers. The biggest challenge Guskey (2003) and Killion (2002) reported that classroom teachers did not integrate new training into their instructional bag of tricks. This has been one of the noted weaknesses in dollars and time spent on in-service teacher professional development.

Technology integration in PD has had limited research. Holum and Gahala (2001) suggested that

1. Professional development must be on-going,
2. Faculty must have access to technology tools, and
3. Professional development should focus on how to use technology tools in ways that are relevant to the teacher.

Teachers need to have frequent opportunities to practice using new technology at a level appropriate for them (Cook & Fine, 1997), and relevant to the content that they teach. A one-shot professional development workshop on technology innovations has limited chances of transferring to the classroom if there is limited or delayed opportunity to practice those skills in classroom.

Often teachers learn new technology in isolation or with tutoring with a technology mentor. There tends not to be a true community of support for technology integration. What community exists usually does not extend past the school building or the district. Adoption of technology for teaching is also often top-down. As Buckingham (2007) stated,

> As we have seen, there are many 'local' reasons why technology has failed to transform learning in the manner that many of its advocates have envisaged. Yet perhaps the overriding one is to do with the centralized, top-down nature of the innovation itself (p. 64).

This top-down enforcing of technology innovations maintained a static structure and environment that perpetuates its form and processes. What was viewed as needed was a more dynamical process that involved more stakeholders, created a more adaptive, organic system that processes feedback from many stakeholders at varying levels of organization structure. This leads to a more responsive system where participants reacted to their environment (stakeholders, external policies and regulations, economy, and a rapidly changing technology-infused landscape). Such two-way feedback also encouraged more of a sense of ownership within the participants. They became shareholders and change agents within this educational organism that could extend and interact with other educators outside the limits of the school or even the district.

The professional development model used workshop and post-workshop activities that helped educators in rural, Midwestern secondary schools to design, create, and use online course materials and alternative online strategies for delivering content that encourages student collaboration and participation. The model followed the theoretical frameworks focused on the professional development research and Vygotsky's (1978) zone of proximal development and a combination of parts of other research on professional development (Guskey, 2003; Fullan, 1996; Galloway, n.d.; Killion, 2002).

Traditional professional development models represented combinations of half-loop activities. These included such administrator-planned non-productive activities as having external expert train teachers in a single all day or half-day event formats. Administration checked event as being completed and the teachers trained. There was minimal regard for follow-up or sustainability. Typically the building principal did not even participate in the training, therefore could not have followed-up, even if he or she had wanted to. A fundamental belief of the traditional model of professional development was that training was not really a means to an end, but a way to occupy state mandated teacher in-service trainings. There was also not an expectation for teachers, once trained, to use their training. The system did not encourage implementation. The illustration of a half-loop model was shown in Figure 1.

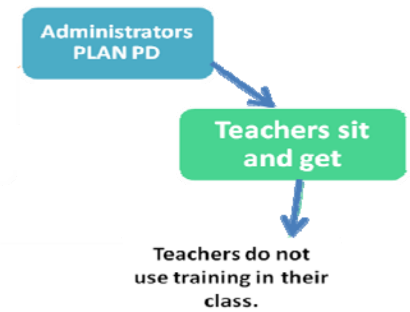

Figure 1. Traditional professional development on technology.

As the research on K-12 public school professional development represented new ideas on effective methodologies, some districts began to implement a single loop system (see Figure 2). In this top down model, administrators continued to determine the needs of the teachers in their buildings or district and trained teachers through the use of external experts. The training continued to be a sit and get experience but administrators completed differing degrees of follow-up. Administrators would complete observational feedback and provide instructional support. As a result of the principal's follow-up activities, teachers used the strategy(s) or skill(s) acquired from the training. The implementation was not sustained over time but dissipated when then the follow-up activities were discontinued. Principals did not complete the loop because of a belief in their significance to the outcome but rather because it was expected of them. Walk-through observations and or other supportive activities were also influenced by the *recency effect* (Glanzer & Cunitz, 1966). That which was the most recent training experience would receive administrative attention and support. The farther from the date of the training event, the less time administrator's spent on providing teachers' follow-up support. Once short-lived attention had been given to follow-up and teachers were observed using their training, principals were ready for teachers to receive additional training. In many cases the next phase of training may not relate or build on to the previous training. Teachers were vague in their understanding of any relationship and the loop repeated itself.

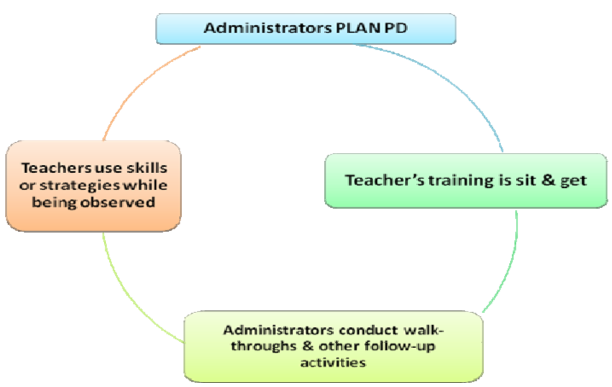

Figure 2. Considered progressive professional development model.

The results of these models were wasted resources, no positive impact on student achievement; increased frustrations by teachers wanting to see better uses of their time and limited resources; and disconnects between administration, training, research, and the teachers. The study focused on creating a single loop that would improve student achievement and increase the likelihood that teachers would sustain their newly acquired skills.

Methods

The research question asked the following questions: How can districts get teachers to utilize the knowledge and skills acquired from in-district professional development on a course management system? Teachers from seven different districts developed course supplements to be implemented through a course management system (CMS). Aspects of the model included: (a) Math and science teachers were paid small stipends to complete 3 eight-hour training on the CMS. (b) Administrators were trained in observational and feedback strategies. They were also shown examples of high quality online courses. (c) Teachers were given a rubric for self-evaluation on the components of the course materials they created. (d) On-going technical support was offered between training sessions. (e) It was the realization that teacher's needed incentives to continue their practice and implementation past the point of external accountability, that supported the pay for product incentive opportunities. To reinforce the development of independence with the CMS teachers were offered an additional small stipend for each instructional unit created. This gave teachers an incentive to practice until two things happened: they became somewhat proficient with their skills using their software and they

The CMS training was part of a continuous improvement framework model. Teachers from different districts came to together to learn CMS and social networking tools to develop innovative activities to supplement their courses. The participants then shared these supplements with fellow teachers from other districts who provide feedback and gained insights on how they might apply the demonstrated strategies to their own school systems and content areas. They thus became agents of change for their own districts.

As progressive districts began to calculate the real dollar expenditures related to teacher training, federal grant programs expected scientifically-evidenced based instruction, and academic accountability was becoming as visible as athletic accountability, districts began looking for more effective professional development models. Research supported the following process (see Figure 3):

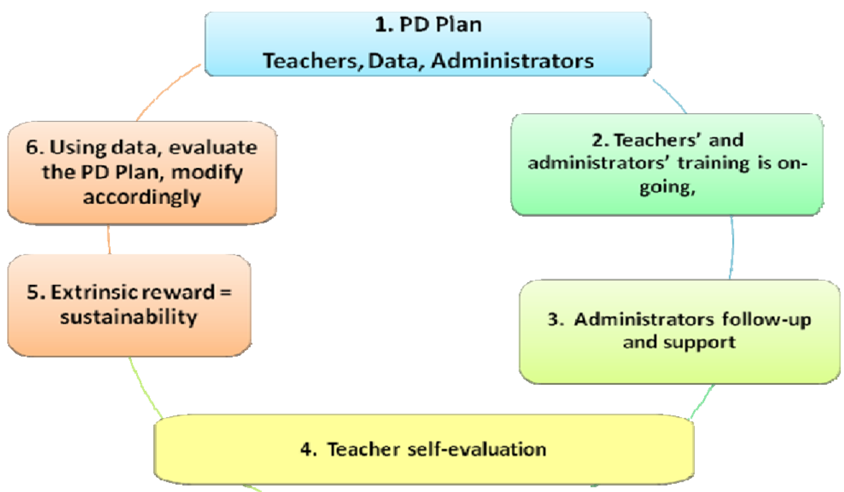

Figure 3. Single-Loop Professional Development Framework.

Step 1. All teachers were invited to input ideas into the development of the professional development plan. They were asked what they wanted and what they needed to tie their instruction to the 21st century. Teachers identified a need for extensive training on online course management systems. Although they were not clear about the exact what, they were certain that in order to become 21st teachers their students needed to access structured lessons – using multi-media, self-assessments, application based studies, and much more. The teachers also insisted that their principals have some understanding of the technology hardware and software being used AND that they understood how to evaluate their instruction. These needs were then aligned to the district test data and other data sets to determine a professional development plan. Teachers determined the training schedule and the feedback loops.

Step 2. It was important to the project that teachers did not miss instructional time with their students. The trainings were scheduled over time, after school, weekends, and summer. The training was conducted by an external expert in both the technology required and effective instructional design. The principals received training focused on effective math and science instruction, as well as training in the criteria for online course evaluation systems.

Step 3. Teachers were trained in the CMS software. Training protocol used chunking. Small pieces of required knowledge and skills were shared, practiced, and implemented. As teacher confidence grew, smaller chunks were grouped into larger projects. Teacher modeling lessons, observing lessons/evaluating materials, team-teaching/creating materials,

Step 4. – Teachers and administrators were trained in the CMS online performance-based rubric. This instrument, adapted from the Illinois Online Network (2007)'s Quality Online Course Initiative Rubric, gave a baseline for quality expectations. Teachers were grateful for concrete expectations and examples of excellence. As one teacher stated,

> We usually find out we have done something wrong afterwards – knowing expectations upfront and having something concrete by which to self-evaluate really helped me structure stronger supplemental materials. It was also important knowing that others would be evaluating my work.

Step 5. Once teachers were trained they were offered an extrinsic incentive for continued practice. Teachers were paid $300 for each additional unit of supplemental materials created. These were not single lesson but comprehensively supporting an entire unit. This was done to support on-going practice and performance. Teachers shared their products with each other – creating a learning community.

Step 6. Student data &/or performances, teacher self-reflections, and rubrics were used to determine effectiveness .

Schools involved in the grants-sponsored program reported improvement in their district's state achievement test scores. Positive gain scores were reported in math, science, and reading test scores for Latino and special education students at the participating schools. The utilization of technology to foster collaboration between the teachers and within their classes should be acknowledged as having a partial responsibility (Hemphill & McCaw, 2009). An unexpected result of the new framework was the development of a double-loop system. Loop one included the project framework and loop two resulted from the teacher behaviors of the extrinsically motivated teachers (see Figure 4).

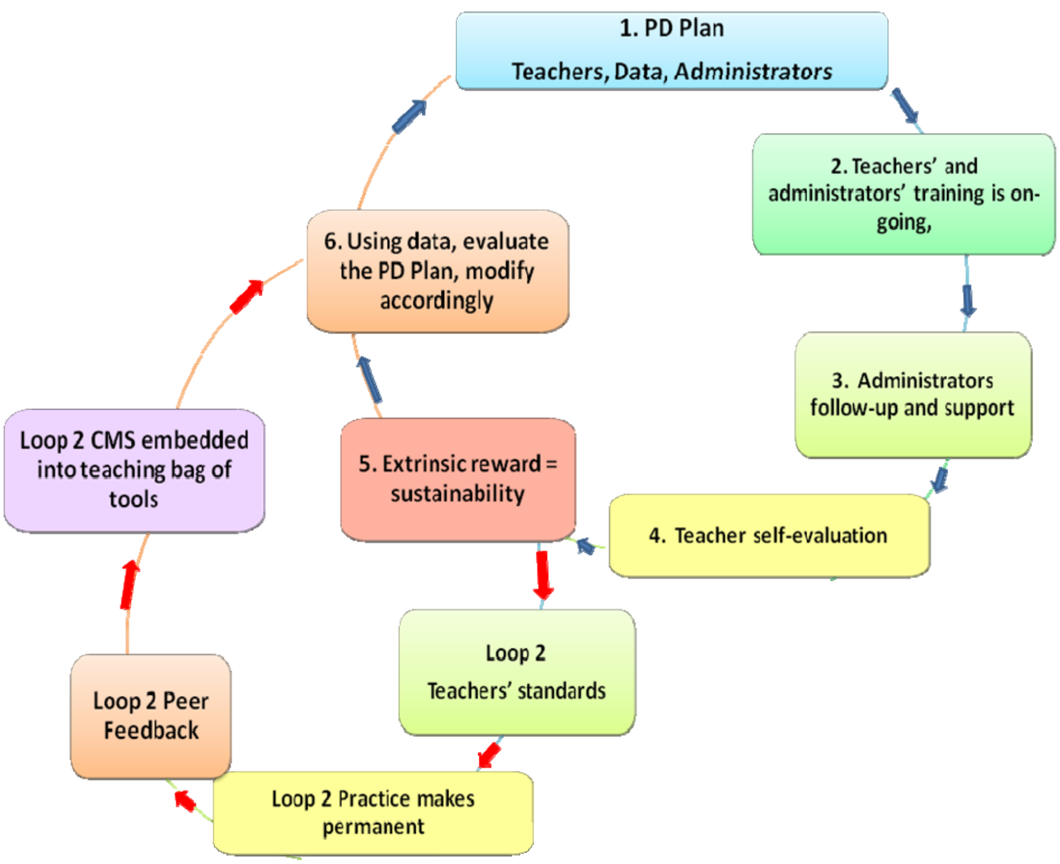

Figure 4. Double-Loop Professional Development Model (McCaw Model).

Over time, those teachers extrinsically motivated by small stipends were found to sustain over time the knowledge and skills used within the CMS until they became embedded within their bag of instructional tools. Teachers then used their own data to modify, improve, and update existing materials; while continuing to create new ones. These new ones were not a result of extrinsic rewards but the intrinsic ones identified with excellence in teaching.

Often in research outcomes can be surprising. This was found to be true in this project. As the system self-organized it evolved. All of the previous steps applied but outcomes of the extrinsic rewards became the fulcrum point for energizing newer deeper levels of self-analysis, communications with peers, greater integrity to standards of excellence, growing willingness to mentor each other and to listen to the voices of their students. Each of the subsequent parts has the potential for extending the life cycle of the model. In Loop 2 as the Feedback process grows it could potentially become its own loop – sustaining the process with energies experienced with experimentation and subsequent success.

The $300 stipend for each completed unit seemed to give enough impetus to the system for it to become an extension Loop. Teachers felt obligated to complete what they had started – less for the money than for the desire to finish what they had started. The stipend tied their feelings of obligation to something more concrete than time. The money seemed to also play a role in justifying their sense of being appreciated and supported rather than simply expected to become better. All of the teachers admitted that the stipend did not cover the enormity of time that was involved in the creation of each unit. Another aspect that created energy was the concreteness by which their projects were to be evaluated. The rubric explicitly identified traits and expectations for excellence in creating and teaching an online course. The specificity gave them a clear path to follow. This path and the stipend created a venue within which they created quality course supplements. With each lesson and then unit teachers became more confident. With confidence came increased speed in design and implementation. As more of their courses used the supplemental materials student feedback increased. Teachers reported that students were commenting on the materials, surprised by the variety of tools, opportunities for practice assessments, and related materials to the subject area. One teacher shared that some of her students were impressed that there were teachers finally teaching for their generation – using technology not just lecture, blackboards, and paper pencil. The teacher literally shined as she shared her student's perceptions of her. With practice and permanency came the point where teachers were automatically engaging with the CMS as a co-teacher. The practices, knowledge, and skills had become embedded into their bag of instructional tools. The teacher and the tools were felt to be one in the same.

Findings and Conclusions

Findings can be reported at three levels: student achievement, continuation of teachers using the CMS, and effectiveness of the model in reflecting the processes used. Student achievement was shown to have gradual but systemic improvements. For example, percentage of all junior status students at the participating high school that met the state benchmark on the publicly accessible American College Test (ACT) math data: 2005 as 18.7%, 2006 as 20%, 2007 as 26% and 2008 as 29%. Although there were other interventions incorporated into the overall school improvement processes, the use of the CMS was also found to increase over time. Increases were also found at the middle schools, grades sixth through eighth, especially with minority students.

This association between the use of technology and student achievement was supported by the findings from a meta-analysis review by Smith, Clark, and Blomeyer (2005) of research in technology integration. The study demonstrated an effective process for conducting and sustaining the professional development of teachers when creating online course supplements. The findings add to, and are supported by the body of research on professional development and technology implementation in the schools. In a time of limited resources there is an increased need for cost-effective, evidence-based, and implementable training modules for educators. The study presented in this paper is an early contributor for meeting such demands and also illustrates the potential using course management systems and eventually learning management systems (Reigeluth, et al., 2008).

An additional conclusion related to the theories behind self-organizing systems. It is viewed as impossible to predict the outcomes of healthy research-based systems. It is not the limitations of systems but the system's limitations that minimize their impact. The study provided evidence of these assumptions. Once the organism was allowed to grow from a half-loop into a single loop and supported with extrinsic rewards for teachers and intrinsic rewards for administration, the single loop became more. Teachers focused on establishing their own standards, elevated their levels of sharing ideas and strategies, and listened to many voices for improvements. Including in some cases the voice of the student.

While the modest project presented in this paper was not a full implementation of some form of a self-organizing school system, it does demonstrate the effectiveness and impact of early technology adapters as change agents in the use of new knowledge management tools and social networking tools to transform schools into a form that more closely represents the world students will succeed and flourish in tomorrow. It hopefully illustrates a way to introduce and distribute the tools and processes that will facilitate a level-three change that will transform schools from a static top-down structure to one that is self-organizing and dynamic.

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Examining the Effects of Teaching Presence on Student Satisfaction in Fully Online Learning Environments

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Descriptors: Teaching Presence; Student Satisfaction Online

Abstract

This study examined the relationship between teaching presence as defined by the Community of Inquiry model and student satisfaction. The participant group of 22 graduate students represented a convenience sample from four fully online college courses. Much has been written about the positive impact of social presence on student interaction and satisfaction in online courses, but recent research is focusing on the importance of teaching presence and its role in online learning environments. The teaching presence construct represents instructional design and course organization, facilitated discourse, and direct instruction. A correlational analysis found a significant positive relationship between teaching presence and student satisfaction, while no significant relationship was found between previous online course experience and teaching presence. T-test provided evidence that age has a significant effect on student perception of teaching presence,

Introduction

In recent years, as researchers investigate student learning in online environments, the phenomenon of online presence has emerged. Online presence refers to one's ability, whether student or instructor, to project their human nature into an otherwise computer mediated environment, void of the visual and verbal cues found in the traditional classroom. "In an online course, the simplest definition of presence refers to a student's sense of being in and belonging in a course and the ability to interact with other students and an instructor although physical contact is not available" (Picciano, 2002, p. 22).

The concept of presence in online learning environments can be further examined when several elements essential to educational transactions in the online environment are included. These elements are 1) cognitive presence, 2) social presence, and 3) teaching presence (Garrison, Anderson, & Archer, 2000). Garrison et al. (2000) define cognitive presence as the extent to which participants are able to construct meaning through sustained communication. Categories for cognitive presence include triggering events, exploration, integration, and resolution. Shea, Pickett, and Pelz (2003), elaborate the term by adding that it is achieved in concert with satisfactory social presence and effective teaching presence. Examples of cognitive presence include student questions, expressions of confusion, problem solving, and evidence of students making connections and building new knowledge.

Kehrwald (2008) defines social presence as "… the means by which online participants inhabit virtual spaces and indicate not only their presence in the online environment but also their availability and willingness to engage in the communicative exchanges which constitute learning activity in these environments" (p. 94). Garrison et al. (2000) describe social presence as the ability to project oneself as a real person (one's full personality) both socially and emotionally in the online environment. The original categories of social presence, as defined by Garrison and Arbaugh (2007) are affective expression, open communication, and group cohesion. They also suggest that activities which cultivate social presence can enhance the learner's satisfaction with the Internet as an educational delivery medium. Social presence can be recognized by the use of emoticons to express oneself, idioms, more informal and familiar language, and evidence of students helping each other in a supportive manner.

Teaching presence as defined by Anderson, Rourke, Garrison, and Archer (2001) is "…the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes" (p. 5). Based on this definition, the authors distill three components or elements of teaching presence: instructional design and organization, facilitating discourse, and direct instruction. Examples of teaching presence are the instructor clarifying areas of confusion, correcting misinformation appearing in discussion postings, moving the discussion along and keeping it on topic, and encouraging students to participate online. Teaching presence focuses on the tasks and processes of teaching online; it is not the affective projection of the instructor's self, or personality into the virtual learning environment per se. This is referred to by some as teacher social presence, where the instructor works to develop and nurture a sense in the students that there are real people who care about them and their learning in the virtual environment (Wise, Chang, Duffy, & del Valle, 2004, p. 249).

However, Garrison, Anderson, and Archer (2000) acknowledge that for additional progress to be made in understanding the three components of teaching presence, more precise and valid indicators associated with each of them are necessary. Shea, Picket, and Pelz (2003), address this by providing the necessary depth to these elements with the addition of sub-categories or indicators as depicted in table 1.

Table 1

Subcategories or indicators of the main elements of teaching presence

INSTRUCTIONAL DESIGN AND ORGANIZATION	**FACILITATING DISCOURSE**	**DIRECT INSTRUCTION**
Setting curriculum	Identifying areas of agreement and disagreement	Presenting content and question
Designing methods	Seeking to reach consensus and understanding	Focusing the discussion
Establishing time parameters	Encouraging, acknowledging, and reinforcing students' contributions	Summarizing the discussion
Utilizing the medium effectively	Setting the climate for learning	Confirming understanding
Establishing netiquette	Drawing in participants and prompting discussion	Diagnosing misperceptions
	Assessing the efficacy of the process	Injecting knowledge from diverse sources
		Responding to technical concerns

Using the indicators and their subcategories from table 1, Shea, Swan, Li and Pickett (2003) developed a Teaching Presence Scale (TPS) to tease apart the aspects of teaching presence from social presence and cognitive presence. A study using this scale was conducted to further examine the relationship between students' perception of teaching presence and their satisfaction in fully online learning environments. The purpose of this research was to examine the indicators (elements) of teaching presence as they relate to student satisfaction in the hope of increasing instructor awareness about the importance of teaching presence and to guide faculty development initiatives. A closer examination of the three elements of teaching presence can help faculty design, facilitate, and instruct more effectively in the online environment.

Instructional Design and Course Organization

Before students ever enter an online class, faculty and instructors must prepare the structure or bones of the course in advance. Anderson et. al. (2001) describe the course design and organization element of teaching presence as the planning and creation of the structure, process, interaction, and evaluation aspects of the online class. Shea, Swan, Li and Pickett (2005) offer that setting the curriculum, utilizing the medium effectively, and establishing netiquette are also parts of effective online course design and organization. Whether using a learning management tool such as BlackBoard or WebCT or an open source system such as Moodle, thoughtfully planning the course design and organization are critical aspects of providing a satisfactory online learning experience.

According to Anderson (2004), the design and organization of a course offers instructors the first opportunity to develop their teaching presence. The design of an online course provides the framework from which students access all content, including the syllabus, discussion questions, commentary, mini lectures, the gradebook, images, audio and video files, and dialogs with other students and the instructor. Having a sense of the courses' grand design, learning objectives, and the related activities, reassures students that they can participate effectively online and achieve the learning objectives. Ensuring that students can quickly find the critical information they need to get started in the class reinforces their confidence that they can be successful in the online environment. Therefore, how this content is structured and made accessible informs a student's first impression of the online course as well as first impressions of the instructor.

In this respect, keeping content consistent, accessible and clearly labeled becomes a key component of teaching presence. Swan (2001) found in her research that the "greater the consistency among course modules, the more satisfied students were, the more they thought they learned, and the more interaction they thought they had with their instructors" (p. 318). Research by Henry and Meadows (2008) also supports this idea.

> In an online course, students need to be able to find everything they need to be successful learners and how to do so easily. Even in well-organized courses it is not uncommon to find out, part way through the course, that one or more students have not found some of the essential information (Henry & Meadows, 2008, p. 10).

Providing timelines, organizational guidelines, clear expectations for student work and activities also support sound instructional design and course organization elements. Instilling teaching presence is also accomplished by explaining or modeling for students what appropriate responses look like from an etiquette or online professionalism perspective.

Facilitated Discourse

The second element of teaching presence, facilitated discourse, "… is the means by which learners develop their own thought processes, through the necessity of articulating them to others" (Anderson, 2004, p. 280). According to Shea, Swan, Li and Pickett (2005) the instructor task of facilitating discourse is necessary to maintain learner engagement and refers to a focused and sustained deliberation that differentiates it from a discussion. The authors characterize facilitated discourse by including such instructor tasks as identifying areas of agreement and disagreement in discussion postings, helping students understand and reach consensus, reinforcing and encouraging student contributions, setting the climate for learning, drawing in participants and assessing the efficacy of the process. The authors also found that a strong and active presence of the instructor, guiding the discourse, is related to both students' sense of connectedness and learning. Facilitated discourse goes beyond the social aspects of making contact online. It offers a deeper, richer, student to instructor interaction relative to the content at hand, and it is distinct from the instructor participating in a chat room or informal blog with students.

Appropriate facilitation is demonstrated when the instructor makes an overt effort to build trust and transparency, engage all students in online discussions, and model exemplar discussion postings and participation. Building trust online is key to creating a safe and open learning environment, one in which learners are free to explore, share and create knowledge. Trust allows for risk-taking, a necessary component in learning, while promoting sharing and mutual learning. Within the element of teaching presence, the instructor can also model expected and appropriate online discussion participation by posting her own thoughts or ideas about a particular topic and conclude by adding additional open ended questions to encourage further discourse. Trust is further demonstrated when students are asked to lead or moderate and facilitate the discussions postings.

Other aspects of effective discourse facilitation include providing prompt feedback to student questions and postings, and using student names in communications. Posting positive remarks when students demonstrate understanding or reach consensus are also effective discourse facilitation strategies. Pointing out areas of disagreement or misconceptions may pique student interest and create cognitive dissonance, thereby stimulating others to participate. Being involved in student discussions and communications on a regular basis supports teaching presence. As Swan (2001) found in her empirical study, student perceptions of interaction with their instructors were highly correlated with both satisfaction and perceived learning.

Direct Instruction

Instructors and faculty demonstrate direct instruction when they provide intellectual and scholarly direction for the course, sharing their knowledge as content experts with students. As Anderson et. al. explain (2001), the teacher as subject matter expert "is expected to provide direct instruction by interjecting comments, referring students to information resources, and organizing activities that allow the students to construct the content in their own minds and personal contexts" (p. 9). Direct instruction communicates and sets the intellectual climate for the course, modeling the qualities of a scholar, including integrity and sensitivity (Anderson, 2004). In content rich units the instructor can present herself by including her personal reflections on content issues, providing relevant anecdotes and examples, and offering insights into being successful in an online learning environment.

Shea et. al. (2003) found that instructor behaviors for facilitating discourse and direct instruction correlated highly with satisfaction and learning, supporting the notion that the instructor is expected to be the subject matter expert and is expected to share that knowledge in the learning environment in the form of direct instruction. Swan, Richardson, Ice, Garrison, Cleveland-Innes, and Arbaugh (2008) state, "Instructor responsibilities are to facilitate reflection and discourse by presenting content, using various means of assessment, and feedback" (p. 3). By providing thoughtful, prompt, direct instruction, faculty can enhance their teaching presence in the online environment.

This study addressed the following research questions:

1. What is the relationship between teaching presence as defined by the elements of instructional design and organization, discourse facilitation, and direct instruction, and student satisfaction in a fully online college course?
2. What is the effect of age on student perception of teaching presence?

3. What is the relationship of the number of online classes a student has taken and their perception of teaching presence?

Methodology

Participants

Participants represented a convenience sample of under graduate and graduate college students enrolled in four online classes during the first six-week session of summer semester 2009. All four classes were taught by full time PhD faculty. Twenty one students from a total of 71 students (30%) elected to participant in the online survey. These fully online classes are part of the teacher preparation and educational technology curriculum at a university located in the southwestern region of the United States.

The survey used in this research was adapted from the validated Teaching Presence Scale (TPS) from Shea, Swan, Li, and Pickett (2005), with slight modifications; questions addressing the other two components of the Community of Inquiry construct (social presence and cognitive presence) were omitted and four open ended questions regarding student perceptions of teaching presence were added.

Materials

The survey instrument was an electronic questionnaire that consisted of 17 Likert measured items which corresponded to the three elements of teaching presence as defined by the Garrison et al. (2000) model. The survey opened with two questions directed toward learning more about the participant group: their age range and how many previous online courses they had taken. The 17 items were evaluated using a 5 point scale with 1 for strongly disagree through 5 for strongly agree. Included were two additional Likert scale questions designed to measure overall student satisfaction with the course using the same 5 point scale. The survey concluded with four open ended questions designed to elicit student opinions about course organization and instructor involvement

Procedure

During the fifth week of the six-week summer session, a hyperlink to the online survey along with a letter of consent was posted in each of the four online classes being studied. Students agreed to participate by clicking the survey link which took them to the informed consent letter and then into the actual survey. Students had one week to complete the survey during which two reminder emails were sent. All emails were sent through the university's course management system. Participation was voluntary and survey data was collected anonymously by the survey provider. The survey was closed at the end of the sixth week.

Data Analysis

Two correlation computations using Pearson's *r* were performed to answer the research questions addressing student satisfaction and previous online course experience with teaching presence. Correlation designs are used to determine the extent to which two or more variables are related among a single group of people, in this case the participant group of 22 students taking online courses. In correlational research there is no attempt to manipulate the variables or to prove cause and effect. A t-test was performed in order to examine the effect of age on students' perception of teaching presence. All statistical calculations were completed using SPSS statistical software.

Results

The Pearson product moment correlation for the mean teaching presence score and the mean satisfaction score was statistically significant at $r\ (18) = .719$, $p < .001$, $N = 19$. The evidence suggests a significant positive relationship between students' perception of teaching presence and their satisfaction with the class.

Another Pearson product moment correlation was performed to answer research question three regarding the relationship of previous online courses taken and student perception of teaching presence. Evidence from these calculations suggests a small negative relationship between the number of online classes taken previously and the mean teaching presence score; $r\ (18) = -.382$, $p = .107$, $N = 22$. There is not a significant relationship between the number of online classes previously taken and the mean teaching presence score.

A one sample t-test was performed to determine if age has an effect on student perception of teaching presence. This resulted in $t(21) = 9.253$, $p < .0001$, $N = 22$, thereby suggesting that age had a significant effect on the mean teaching presence score (M = 4.1053, $SD = .49006$).

Teaching Presence Open Ended Questions

When asked what they liked most about the online course organization, five student comments expressed appreciation for the clear directions regarding how to complete their assignments as well as explicit due date information. Four student comments expressed appreciation for the examples the instructor provided which helped them better complete their assignments. One participant wrote, "I liked that the assignments came with directions as well as examples. I also liked that for the most part the directions were very clear. The teacher was also prompt when posting assignments and available to email and responded in a timely and friendly manor [*sic*]."

When asked what they liked least about how the course was organized, students reported difficulties with the group work, such as communicating with their group and not being able to view the completed work of other groups (eight comments). Other students commented that they wanted more interaction from the online instructor (three comments). For example, "The instructor didn't really do any teaching. All he/she did was provide feedback on the materials we created."

Students responding to the question about what the instructor did to support their learning, said overwhelmingly they appreciated the prompt feedback and quick email responses (14 comments). Secondly, they said the clear examples provided helped them to learn (9 comments).One participant commented, "He/she provided great examples of [the] expectations for the course, and most of the time the directions were clear and precise."

The final question asked what the instructor could have done to support their learning. A few students said they would like the instructor to be more engaged with the class and "to teach more" (2 comments) while others said they wanted to see the work produced by other groups (2 comments).

Discussion

Because there is a strong positive relationship between teaching presence and student satisfaction, one can make a case for building and facilitating fully online courses based on the criteria of effective instructional design and course organization, facilitated discussion, and direct instruction. The results of this study support previous research (Swan & Shih, 2005; Shea, Pickett, & Pelz, 2003; Swan, 2001) demonstrating that student-teacher interaction and teaching presence were strongly related to student satisfaction and perceived learning.

The instructional design and course organization element of teaching presence represents the structure, processes, interactions, and evaluation of the online course, tending to students' needs regarding instructional design and organization means providing clear navigation paths within the course, providing clear instructions about how to participate in the online learning activities, as well as effectively communicating timelines, due dates, and expectations around polite and professional course participation (group norms or netiquette).

Facilitating discourse requires the instructor to participate actively in student dialogs and discussion postings by raising questions, making observations and contributing 'expert' commentary that move the online conversation along. Previous research (Shea, Swan, Li, & Pickett, 2005; Shea, Pickett, & Pelz, 2003) found that evidence of a strong and active presence from the instructor, one where she actively guides the discourse, was related to students' sense of learning.

Direct instruction which involves content presentation, such as PowerPoint slides, mini lectures in the form of short audio files, or text-based commentary highlighting salient points, as well as providing other sources of information (e.g. links to other online resources) also represents an important component of teaching presence. Explanatory feedback, delivered in a timely and constructive manner, along with the correction of misunderstandings, are additional ways faculty can enhance and support student satisfaction in the online learning environment. These combined elements when evidenced in an online class, underpin a successful and satisfactory learning experience for students as the positive correlation between teaching presence and student satisfaction found in this study suggests.

As indicated by the results regarding the effect of age on the perception of teaching presence, there is a significant effect. In this study, the majority of students were between the ages of 17 -28 (54.54%), with only two in the class over the age of 40. These results may indicate that the younger online students have a greater need to experience teaching presence in order for them to stay engaged, motivated and satisfied in the online environment. Also the direction, feedback, facilitated discourse, and clear course design provide by teaching presence may be more welcomed by younger, less experienced online learners.

When investigating the relationship of teaching presence and previous online course experience, the results suggests that there is no effect. This may be because students who have taken online classes previously are already familiar with the general processes, procedures, and expectations found in online course work and therefore do not have a need for teaching presence. It is also possible that because of their previous online experiences, these students are accustomed to teaching presence elements in online classes and take those elements for granted, or they have become proficient at being an online learner even if teaching presence elements are lacking.

As Shea, Swan, Li, and Pickett (2005) found, students reported higher levels of teaching presence, learning, and satisfaction in courses where the instructors had been previously trained in how to establish effective teaching presence. The results of this study support a call for instructor and faculty professional development initiatives around building online learning environments grounded in effective instructional design and clear course organization, facilitated and meaningful discourse, and concise direct instruction; elements which enhance student engagement and satisfaction.

Limitations

Unfortunately, the number of survey participants was small compared to the number of students invited to participate in the survey. This limits the generalizability of the results to a larger population. Additionally, this study did not review the specific course organization and design, facilitated discourse, and direct instruction found in each of the classes surveyed. More specific details, examples, and evidence of teaching presence within the online courses surveyed may better inform the results and implications for improving teaching presence.

Areas for Future Research

Research questions generally beget more research questions and this study is no exception. This study did not address the effect of teaching presence on learning, and it did not examine the relationship between teacher social presence and teaching presence although the two are closely related. Other areas for investigation include observing teachers who have high teaching presence scores and capturing how they facilitate online, the types of activities they offer students, and how they plan and structure their online courses.

More recent studies (Arbaugh, 2007; Shea & Bidjerano, 2008) have examined teaching presence as just two factors or elements: directed facilitation and instructional design and organization. Shea and Bidjerano (2008) recommend making a clearer distinction among the factors defining direct instruction by adding such characteristics as the instructor's ability to provide valuable analogies, useful illustrations, and present helpful examples (p. 552). Therefore, future studies on teaching presence may need to include a more comprehensive and revised description of the direct instruction element.

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Appendix A: Survey Instrument

Survey Questions:

1. Choose your age range.
   17-22
   23-28
   29-34
   Over 35

2. Choose which best represents your previous online course experience.
   This is my first online course.
   I have taken 1 online course.
   I have taken 2 or more online courses.

Instructional Design and Organization	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. The instructor clearly communicated important course topics.	1	2	3	4	5
2. The instructor for this course clearly communicated important course goals.	1	2	3	4	5
3. The instructor provided clear instructions on how to participate in course learning activities.	1	2	3	4	5
4. The instructor clearly communicated important due dates and time frames for learning activities.	1	2	3	4	5
Facilitating Discourse	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5. The instructor for this course was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	1	2	3	4	5
6. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	1	2	3	4	5
7. The instructor helped to keep course participants engaged and participating in productive dialog.	1	2	3	4	5
8. The instructor helped keep course participants on task in a way that helped me to learn.	1	2	3	4	5
9. The instructor encouraged course participants to explore new concepts in this course.	1	2	3	4	5
10. Instructor actions reinforced the development of a sense of community among course participants.	1	2	3	4	5
Direct Instruction	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
11. The instructor provided useful illustrations that helped make the course content more understandable to me. .	1	2	3	4	5
12. The instructor presented helpful examples that allowed me to better understand the content of the course.	1	2	3	4	5
13. The instructor provided explanations or demonstrations to help me better understand the content of the course.	1	2	3	4	5
14. The instructor provided feedback to the class	1	2	3	4	5

during the discussions or other activities that helped us learn.					
15. The instructor asked for feedback on how this course could be improved.	1	2	3	4	5
Overall Satisfaction	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
16. Overall, I am very satisfied with this course.	1	2	3	4	5
17. Overall, this course is meeting my learning needs.	1	2	3	4	5

Open ended questions

1. What did you like most about the way this course was setup and organized in Blackboard?
2. What did you like least about the way this course was setup and organized in Blackboard?
3. What are some things this instructor did to support your learning in the online environment?
4. What are some thing this instructor could have done to support your learning in the online environment?

Assessment of Knowledge: Do Graphical Notes and Texts Represent Different Things?

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Abstract

One essential question concerning the assessment of knowledge and mental models is that as to which methodology should be used. The main objective of our study is to track learners' progression while using graphical and language-based externalization techniques. Specifically, we compare the similarities and differences of the graphically and textually elicited knowledge structures and their semantics. Our results reveal that graphical notes and texts re-represent different things. This supports our newly introduced model of *information density* vs. *emphasis* – from the different types of notation, we expect different types of information structures.

Introduction

Over the past decades, various researchers have contributed to the further development of the theoretical foundation of mental models (Al-Diban, 2002; Dinter, 1993; Gentner & Stevens, 1983; Johnson-Laird, 1989; Norman, 1983; Spector, Dennen, & Koszalka, 2006) and also to their application in instruction (Anzai & Yokoyama, 1984; Ifenthaler, Pirnay-Dummer, & Spector, 2008; Mayer, 1989; Seel, 1995, 2003). However, there are still a number of important unanswered questions concerning the assessment of mental models (Ifenthaler, 2008a; Ifenthaler & Seel, 2005; Seel, 1999).

One essential question concerning the assessment of knowledge and mental models is that as to which methodology should be used. Many authors consider concept maps to be an adequate format of externalization for analyzing complex knowledge structures (Jonassen & Cho, 2008; Novak, 1998). Concept maps seem preferable to classical knowledge tests such as multiple choice tests for the purpose of representing linked knowledge by means of network-like visualization. On the other hand, there are strong arguments indicating that natural language representations are a good basis for assessing knowledge and mental models (Ifenthaler, 2008a; Pirnay-Dummer & Spector, 2008).

The main objective of our study is to track learners' progression while using graphical and language-based externalization techniques and compare the strengths and weaknesses of these assessment methods. Specifically, we will compare the similarities and differences of the graphically and textually elicited knowledge structures and their semantics. First, we will focus on learning and the role of internalization and externalization of knowledge structures. In the next section, we will introduce the design of our research study, followed by a brief overview of the applied graphical and language-based methodologies for the assessment and analysis of knowledge representations. Then we will present our results and discuss our findings. Finally, we will suggest a guideline for selecting a suitable methodology for different research demands and practical applications.

Learning and the Role of Representations

The theory of mental models has been the foundation for both facilitating and assessing learning (e.g. Ifenthaler, 2008a; Seel, 2003). Both areas of application are very close on a theoretical level because a mental model is a symbolic information processing construct. They are very closely related on the practical level, because in model-based learning and instruction, learning and assessment lead to the same design (Ifenthaler, Masduki, & Seel, 2009). However, on the methodological level, assessment and learning differ due to differences between the *internalization* and *externalization* functions (Ifenthaler, in press).

Internalization

When we think of learning goals we think of internalization of features or properties of the learning environment. In many cases a learning environment is focused on a text, and the learner has a (limited) amount of time to spend with the text. In an ideal case, the learning environment is such that it facilitates the learner's reconstruction (representation) of the environment, which exemplifies his or her real environment either symbolically (with text), through icons (pictures), or enactively – of course all of them with nuances.

Externalization

In assessment the mapping procedure is reversed. Learners have different options for externalization at their disposal using language (spoken and written) and graphical notes (abbreviations) of various commonly known (mind mapping, concept mapping) or idiosyncratic formats. Of course formal representations are also possible, but they are very rarely used in common learning tasks. Sometimes we ignore the fact that externalization itself influences the learning outcome, not to mention the fact that the high demand for assessment also contributes to learning. Several new assessment methodologies have been developed in order to gain knowledge about what the learner does know rather than finding out what he or she doesn't know – as is often the case in classical testing. The most important and most widespread sources for the assessment of what the learner knows are (1) text which the learner produces and (2) the learner's graphical notes.

In this study we look at two specific sources of externalized knowledge: text and graphical notes. Text that learners produce in assignments, such as work in class or homework, is an important source of their thought. The text can come from any task, from statements, comments, and online discussions to learning diaries and essays. In addition, learners can be asked to share their knowledge by using concept mapping techniques, in which they describe their ideas about a topic in graphical form (see Ifenthaler, 2008b; Novak, 1998).

Different Approaches for Aggregation

Both kinds of representation are used in everyday situations. Which is chosen depends on the purpose of the externalization. If the learner is just taking notes for himself, he may leave out significant parts of the knowledge and use the notes as a memory aid in order to retrieve knowledge more quickly (e.g. Ifenthaler, 2008a). Due to new developments, both modes of externalization can be quantitatively compared to the externalized thought of experts (Ifenthaler, 2008b; Johnson, Ifenthaler, Pirnay-Dummer, & Spector, 2009; Pirnay-Dummer, 2007).

In order to be compared, knowledge has to be aggregated (condensed) to the most important and most relevant re-representation model. Knowledge is usually widely connected and associated. When the learner takes graphical notes as part of an assessment, he or she tries to aggregate the knowledge by him or her before the analysis – but almost nothing is known about the inter-rater aggregation stability within this process. When computer-linguistic methodology is used to aggregate the re-representation models from written or even spoken text, this will by definition raise the objectivity of the aggregation. The aggregation functions are always known down to the algorithmic level before they can be implemented into computer programs. However, the fact that learners implicitly tag the information which is most important to them may result in a loss of objectivity.

Whereas classical methodologies are used to let the learner (or expert) aggregate his or her knowledge graphically for analysis, natural language-oriented methodologies like T-MITOCAR (**T**ext Model Inspection Trace of Concepts and Relations) use the text itself to generate the graph (Pirnay-Dummer, Ifenthaler, & Johnson, 2008). T-MITOCAR can elicit, visualize, analyze, and compare knowledge structures of groups and individuals within a specific subject domain on the basis of natural language. It can easily interface with other automated analysis tools, e.g. with the SMD Technology (Ifenthaler, 2008b), or HIMATT (Highly Integrated Model Assessment Technology and Tools; Pirnay-Dummer, Ifenthaler, & Spector, 2009).

Different Approaches for Aggregation

However, it makes a great difference for the type and format of the representation whether the learner constructs the notes only for himself (e.g. for later remembering) or for somebody else's understanding. If he constructs an externalization for himself, he may leave important things out which are obvious to him or use notations which are idiosyncratic to his understanding. If the goal is to inform somebody else using the notes, more care has to be put into notation standards and also more information generally has to be provided. Thus confronted with assessment situations, the learner will need to know that somebody else will have to make sense out of his notes. But this again shifts the intentionally inconspicuous assessment, in which the learner is not distracted by the assessment, to a more obvious situation in which the learner knows that he is being assessed. In most practical cases, the assessment may therefore be hidden in a learning task where, e.g., a case is presented in such way that it requires the information of other (existing or virtual) persons on the subject domain.

Different Approaches for Aggregation

From the different types of notation, we expect different types of information structures. When the learner conducts the aggregation (into the graph), he will have much more control over what is to be specifically emphasized. But if the learner writes the externalization into a text, the output will obviously have a higher information density and the emphasis will be more syntactically hidden in the text. On the other hand, a stronger emphasis on the individual learners' aggregation will lead to more diversity in the actual re-representations, which will lower both the objectivity and the reliability of the assessment (see Figure 1).

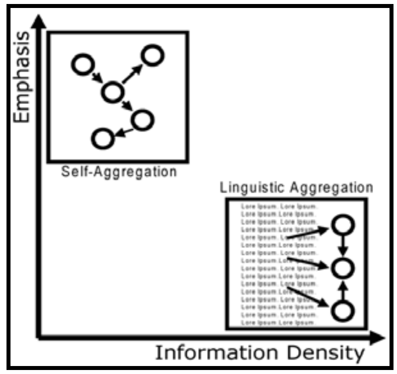

Figure 1: Assumptions on density and emphasis for different aggregation methods

Research Questions and Hypotheses

To gain more information about the differences between self-aggregation and linguistic aggregation we conducted a cross-methodology study. The research goal was to show the differences and similarities between these very different assessment techniques. This will make it possible to provide a guideline for determining which methodology is best for various research questions and practical applications. Differences in internal coherence and cross validity are therefore of key interest in this investigation.

The following set of hypotheses was tested in our experimental study. In order to understand the strengths and weaknesses of the methodologies, we first need to know how good the internal consistencies within each methodology are and how much they differ. Based on the different kinds of aggregations we expect the internal consistency to be different between the methodologies:

$H_{1.1}$: The graphical model representations and the textual model representations have different errors of variance.

$H_{1.0}$: The graphical model representations and the textual model representations have the same errors of variance.

As described above, we took both texts and concept maps from the subjects. We took the concept map after the subject had written the text. The text was aggregated using HIMATT (Pirnay-Dummer et al., 2009). Due to the close assessment and the short time between writing and concept mapping we expected a close match between the structural and semantic indices for both methods (a description of all of the applied indices will be provided in the following section):

$H_{2.1}$: The indices of the graphical model representations and the indices from the text-based model representations correlate significantly with $r > .7$.

$H_{2.0}$: The indices of the graphical model representations and the indices from the text-based model representations correlate with $r \leq .7$.

Method

Participants

Forty-seven students (31 female and 16 male) from a European University participated in the study. Their average age was 25.7 years (*SD* = 1.7). All students were attending an introductory course on *research methods*.

Materials

Data were collected through graphical and text-based representations. For the graphical representations we used the software *CmapTools* (Cañas et al., 2004). According to Novak (1998), a concept map is a graphical two-dimensional representation of communicated knowledge and its underlying structure. A concept map consists of *concepts* (graph theory: vertices) and *relations* (graph theory: edges). Research studies on the application of *CmapTools* indicate a wide acceptance of the software (e.g. Coffey et al., 2003; Derbentseva, Safayeni, & Cañas, 2004). The text-based representations are tracked with HIMATT (Highly Integrated Model Assessment Technology and Tools; Pirnay-Dummer et al., 2009). HIMATT tracks the association of concepts from a text directly to a graph, using a heuristic to do so. Texts contain model structures. Closer relations tend to be presented closer within a text. This does not necessarily work within single sentences, since syntax is more expressive and complex. But with texts which contain 350 or more words, associative networks can be generated as graphs from text and the heuristic becomes highly stable. The re-representation process is carried out automatically in multiple computer-linguistic stages (Pirnay-Dummer & Ifenthaler, in press).

Procedure

The study was realized as a design experiment. It took place in a research methods course and consisted of (1) a 60 minute introductory phase, (2) a phase of learning with five learning tasks, and (3) a phase for assessing the final task performance. In the first phase, the participants were introduced to using the *CmapTools* software (see Cañas et al., 2004) and writing text-based explanations of the phenomenon in question. Additionally, the instructor collected demographic data and delivered documentation on concept maps and text production, including examples. The second phase lasted several weeks. In this phase, the participants were asked to create an open concept map and a text-based explanation relating to their understanding of research skills. In total, five identical task explanations had to be uploaded at a specified date and time during the course. In the last phase, the final task performance was measured through (1) five written assignments, (2) a written exam, and (3) a written research proposal. The score of the final learning outcome was rated between 0 and 100 points.

After uploading the concept maps and text-based representations, the instructor gave the students brief feedback to notify them that their assignments had been successfully uploaded and that they should carry on with their studies in the course. As we used open concept maps in our research study, the subjects were not limited to specific words while annotating the concepts and relations.

Analysis

To analyze the participants' concept maps and texts, we used the seven core measures implemented in HIMATT (Pirnay-Dummer & Ifenthaler, in press; Pirnay-Dummer et al., 2009). Figure 2 shows the seven similarity measures of HIMATT, which include four structural indicators and three semantic indicators. The similarity indicators range from 0 (no similarity) to 1 (complete similarity) for better in-between comparability. Matrices of multiple representations can be compared simultaneously. Reliability indices exist for the single instruments integrated into HIMATT. They range from r=.79 to r=.94 and are tested for the semantic and structural measures separately and across different knowledge domains (see Pirnay-Dummer et al., 2009). Validity measures are also reported separately for the structural and semantic indices. Convergent validity lies between r=.71 and r=.91 for semantic comparison indices and between r=.48 and .79 for structural comparison indices (see Pirnay-Dummer et al., 2009).

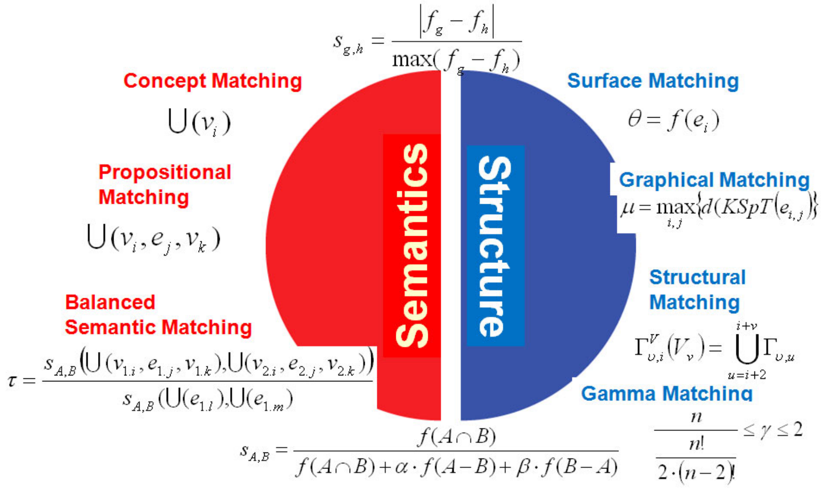

Figure 2: HIMATT structural and semantic measures

These seven measures are defined as follows (see Ifenthaler, 2008b; Pirnay-Dummer, 2007; Pirnay-Dummer & Ifenthaler, in press; Pirnay-Dummer et al., 2009):

Surface Matching (R): The surface measure (Ifenthaler, 2008b) compares the number of vertices within two graphs. It is a simple and easy way to calculate values for surface complexity.

Graphical Matching (G): The graphical matching (Ifenthaler, 2008b) compares the diameters of the spanning trees of the graphs, which is an indicator for the range of conceptual knowledge. It corresponds to structural matching as it is also a measure for structural complexity only.

Gamma Matching (D): The gamma or density of vertices (Pirnay-Dummer, 2007) describes the quotient of terms per vertex within a graph. Since both graphs which connect every term with each other term (everything with everything) and graphs which only connect pairs of terms can be considered weak models, a medium density is expected for most good working models.

Structural Matching (S): The structural matching (Pirnay-Dummer, 2007) compares the complete structures of two graphs without regard to their content. This measure is necessary for all hypotheses which make assumptions about general features of structure (e.g. assumptions which state that expert knowledge is structured differently from novice knowledge).

Concept Matching (C): Concept matching (Pirnay-Dummer, 2007) compares the sets of concepts (vertices) within a graph to determine the use of terms. This measure is especially important for different groups which operate in the same domain (e.g. using the same textbook). It determines differences in language use between the models.

Propositional Matching (P): The propositional matching (Ifenthaler, 2008b) value compares only fully identical propositions between two graphs. It is a good measure for quantifying semantic similarity between two graphs.

Balanced Propositional Matching (B): The balanced propositional matching index (Pirnay-Dummer & Ifenthaler, in press) is the quotient of propositional matching and concept matching. Especially when both indices are being interpreted, balanced propositional matching should be preferred over propositional matching. Propositional matching necessarily has its maximum in the value of concept matching. In order to balance this dependency of both indices, the balanced propositional matching index should be used instead of the concept and propositional matching.

Results

In testing our first research question, we wanted to understand the strengths and weaknesses of the applied methodologies (graphical and text re-representations). Therefore, we tested how good the internal consistencies within each methodology were and how much they differed. For our second research question, we tested the match between the structural and semantic indices for both methodologies.

Consistency

For both methodologies (graphical and text re-representations), the consistency was tested for all seven HIMATT measures (structural and semantic measures). As shown in Table 1, all structural errors and all semantic errors of variance are alike are alike except for the *density of vertices* measure. Based on this derivation, we keep the null hypothesis for the consistency: The graphical re-representations and the text-based re-representations have the same errors of variance.

Table 1: Consistency of graphical and text re-representations of structural and semantic indices

		R	G	D	S	C	P	B
graphical re-representation	*M*	.77	.79	.90	.82	.58	.46	.61
	EV	.21	.20	.12	.17	.32	.38	.36
	α	.44	.44	.48	.45	.37	.31	.38
textual re-representation	*M*	.77	.83	.81	.79	.71	.63	.74
	EV	.26	.22	.22	.22	.32	.39	.36
	α	.44	.46	.45	.45	.42	.39	.43

Note. *M* = mean; *EV* = error of variance; α = internal consistency; R = surface matching; G = graphical matching; D = gamma matching; S = structural matching; C = concept matching; P = propositional matching; B = balanced propositional matching

However, we found a difference between graphical and text-based re-representations (see Table 2). The text-based re-representations are by far more concise on the semantic level (concept matching, propositional matching, balanced propositional matching). Additionally, the text-based re-representations are significantly more complex than the graphical re-representations (graphical matching). Otherwise, the graphical re-representations are by far more concise concerning their density of vertices (gamma matching). Further, we found no significant differences between the text-based and graphical re-representations for the measures surface matching and structural matching (see Table 2).

Table 2:	Student t-Test; paired samples of similarity measures (graphical & text-based re-representation)			
Measure	*t*	*df*	*p*	*d*
surface matching	.080	187	.936	-
graphical matching	2.181	187	.030	.196
gamma matching	-5.348	187	<.01	.486
structural matching	-1.513	187	.132	-
concept matching	4.797	187	<.01	.380
propositional matching	5.294	187	<.01	.433
balanced propositional matching	4.156	187	<.01	.349

Note. *d* = effect size

Validity

Following the second hypothesis, we tested correlatives between graphical and text-based re-representations (see Table 3). Although all αs *and* means of similarities are statistically significant, the overall similarities are by far not sufficient to accept the alternative hypothesis. We therefore keep the null hypothesis: The indices of the graphical model representations and the indices from the text-based model re-representations correlate with $r \leq .7$. This means that text re-representations and graphical re-representations are attached to different constructs and therefore measure different things.

Table 3:	Correlatives of graphical and textual re-representations of structural and semantic indices						
	R	G	D	S	C	P	B
M	.41	.53	.64	.63	.10	.01	.06
EV	.24	.23	.23	.15	.09	.03	.13
α	.29	.35	.39	.39	.09	.01	.05

Note. *M* = mean; *EV* = error of variance; α = internal consistency; R = surface matching; G = graphical matching; D = gamma matching; S = structural matching; C = concept matching; P = propositional matching; B = balanced propositional matching

Discussion

The focus of our study was to compare the similarities and differences of the graphically and textually elicited knowledge structures and their semantics. Participants were asked to externalize their knowledge about the domain of research methods with two different elicitation methodologies – concept mapping and written text.

For our analysis and comparisons of the externalized knowledge structures, we used the seven measures from the HIMATT toolset (Pirnay-Dummer & Ifenthaler, in press; Pirnay-Dummer et al., 2009). The automated quantitative analysis generated structural and semantic measures. The structural indicators were *surface*, *graphical*, *gamma*, and *structural matching*. The semantic indicators were *concept*, *propositional*, and *balanced propositional matching*. With the help of these indicators, we were able to precisely describe and track changes in students' representations and compare the graphically and textually elicited knowledge.

The fact that graphical notes and texts re-represent different things (even when used in the same task with the same participants) does not necessarily lead to the conclusion that either assessment is obsolete. In fact, it supports the model of *information density* vs. *emphasis* introduced above (see Figure 1). Further studies will have to be conducted to strengthen the theorem that re-representation values have different dimensions. But the results clearly show that concept mapping techniques and systematic text analysis can not be used as complements, e.g. in mixed-method attempts to triangulate theoretical constructs which are hard or impossible to observe directly.

The graphical re-representation is structurally more concise, while the text-based re-representation is better on the semantic measures. At first sight, this may be contra-intuitive when we think about *emphasis*, because graphical re-representations have less semantic consistency. However, this should in fact be expected: While the whole model is constructed (*information density*) and little *emphasis* is conveyed in the textual re-representations, the graphical re-representations are idiosyncratic notes which happen to have a similar structure. Accordingly, there are two ways to interpret the similarities on the structural level:

1. Concept maps are better for rebuilding a concise structure.

2. Concept maps always have similar structures because their users only apply a certain range of structural patterns and therefore constrain themselves to the available patterns.

The interpretations will have to be tested in a future study in which we will compare graphical structures from similar tasks but on completely different subject domains. If the structures turn out to be non-selective for any content or knowledge type, then we would have to favor the latter interpretation. If they are selective, the first interpretation has to be favored.

The greater semantic similarities of the text re-representations are consistent with the model of *information density* vs. *emphasis*. Since the texts have a higher information density they contain more information and therefore more semantic terms match. Maybe the differences are a matter of objectivity – an assumption which can not be tested with the data at hand. This still leaves details about the differences between the aggregations open for investigation.

Our future work will concentrate on larger experiments allowing us to analyze and compare graphical and text-based re-representations on completely different subject domains. These studies will help to strengthen the theorem that re-representation values have different dimensions, introduced in this study as *information density* vs. *emphasis*.

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Effects of Self-Explanation in Science Learning and its Relationship with Self-Reported Level of Prior Knowledge: A Study in Introductory Chemistry.

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Abstract

This exploratory study presents the results of the use of self-explanation strategies to increase learners' performance with application on basic chemistry problems. The results of this randomized experiment confirm prior findings: learners can benefit from using self-explanation strategies, and the mediation effect between prior knowledge and self-explanation is suggestive of a synergic effect for learning. From an instructional design perspective, self-explanation can be adapted for effective tutoring sessions, review sessions, or short transfer problems, in both face-to-face and distance learning contexts.

Introduction

At the most fundamental level, when learning, to comprehend the material assigned students need to relate the new ideas to knowledge they already possess and to use that knowledge to form their own understanding and synthesize new knowledge. With many students struggling with concepts they encounter, especially when they are in their freshmen year, their instructors' attempts to help these students often relies on threads of coherent reasoning constructed based on answers instructors received from them. Nevertheless, for objective reasons, an instructor is rarely available at the precise moment when a student needs help understanding a concept or working through a theory. Therefore, to ensure success, students need to employ a wide range of learning and reasoning strategies and rely on these strategies' capabilities to help them make sense of the material they study.

In this context, from the toolbox students have at their disposal, this study looked at self-explanation (e.g. Chi, Bassok, Lewis, Reinmann, & Glaser, 1989) as a possible strategy to support learners' conceptual understanding and learning. Its objective was to find if this strategy could be used successfully to support learning in an introductory chemistry course in science education. Based on prior research findings (e.g. Bielaczyc, Pirolli, & Brown, 1995) which suggests a link between the effectiveness of this strategy and the domain-general and specific knowledge the learner has, this study looked at the effect prior knowledge, as reported by the learner, had on self-explanation strategies effectiveness. In addition, because this experiment was conducted online, using web-based technologies, its success suggests the potential of such strategies to be implemented in distance learning.

Self-Explanation

The term self-explanation or self-generated explanation (Chi, et al., 1989) refers to the explanation a learner generates on his or her own as opposed to the explanations provided by an external source (instructor, book, etc.). This is a domain independent strategy that can be used across domains and age groups with the capability to provide significant improvements in learners' performance. Being a domain independent strategy, one important characteristic of self-explanation is that strategies based on it are reusable. That is, it provides these strategies with the capability of adaptability from one context to another and, more importantly, from one domain to another.

Self-explanations are thought to be more effective than explanations provided by other sources because (a) they require students to actively elaborate their prior knowledge, thus triggering more constructive learning processes, (b) they are usually very well targeted to the learner's specific problem, and (c) they are available at the precise time and place of the learner's need. Reported gains in science education attributed to the use of self-explanation strategies are overwhelming, with self-explainers sometimes performing twice as well as the non-self-explainers (Kastens & Liben, 2007).

The effect of self-explanations has been investigated by numerous researchers on subjects in a variety of conditions and tasks. For example, Chi & Bassok (1989) studied its influence on problem solving in physics while Pirolli & Recker (1994) looked at computer programming. Lin & Lehmann (1999) looked at experimental design while Kastens & Liben (2007) looked a map reading activities. Existing research documents the effectiveness of self-explanation based strategies across a variety of conditions. For example, Didirejean & Causinille-Marmeche (1997) studied its effectiveness when self-explanations are spoken aloud compared to when they just happen in one's head and Aleven & Koedinger (2002) looked at it from the perspective of written versus typed expression media. It has also been documented that self-explanation based strategies help with (Aleven & Koedinger, 2002) and without (Chi, et al., 1989; Chi, De Leeuw, Chiu, & Lavancher, 1994) feedback on the correctness of the explanation.

From a theoretical perspective, self-explanation was studied in the context of gap-filling (Chi & Bassok, 1989; Lin & Lehmann, 1999; VanLehn, Jones, & Chi, 1992), mental model revision (DeLeeuw & Chi, 2003), conflict detection and resolution during knowledge integration (Chi, et al., 1994), thought organization (Lin &

Lehmann, 1999), and error detection and self-correction (Kastens & Liben, 2007). By construct, scholars have looked at schema formation and case-based reasoning (Didierjean & Cauzinille-Marmèche, 1997), analogical enhancement (Reinmann & Neubert, 2000), visual/verbal integration (Aleven & Koedinger, 2002), construction of new knowledge (Chi, et al., 1989; DeLeeuw & Chi, 2003; Wong & Lawson, 2002), connection of principles to action (Lin & Lehmann, 1999), and situational model building (Kintsch, 1994).

Looking at self-explanation as a domain independent strategy, Nathan et al. (1994) found that it works better for conceptual reasoning while providing only marginal advantage for procedural contexts. He also noted a decrease in performance when cognitive load is significant, situation that suggests the existence of a competition for cognitive resources. Bielaczyc et al. (1995) show that self-explanation is a strategy most high-performance students use, for example, when linking current concepts with prior knowledge. In his studies, the effectiveness of the strategy depends on the learners' domain-general and domain-specific knowledge, the comprehensiveness of the problem being studies, as well as the state of the students' evolving understanding. It has also been found that either guiding (e.g. Bielaczyc, et al., 1995) or prompting (Chi, et al., 1994) people to self-explain improves performance.

For example, one area where self-explanation strategies can be successfully used is in tutoring. While some studies on self-explanation show that most learners do not spontaneously use self-explanation strategies (Conati & VanLehn, 2000) other studies suggest that learners seem to start self-explaining more when they are guided or prompted to do so (Bielaczyc, et al., 1995). Therefore one can consider that self-explanations strategies can be used to increase the effectiveness of tutoring or review sessions for problem solving through more intense conceptual engagement of the students. As an example, Chi (1996) uses successfully strategies involving self-explanation in tutoring students to solve mechanics problems. In this case, the tutor's actions that prompted for the co-construction of knowledge (which includes self-explanation) proved to be the most beneficial in achieving deep learning, capable of overcoming misconceptions. That is, providing the tutees with support and opportunities to successfully construct answers on their own.

The use of self-explanation strategies proved to be beneficial in online environments as well. One of the attempts in using an online environment to scaffold the use of self-explanation was undertaken by Atkinson and his colleagues (2003) who, in solving problems about probabilities, asked learners, aside from solving the problem, to specify the principle that applies to the particular problem they were working on. In this case a surprisingly simple procedure, prompt the participant to choose the principle underlying the problem, produced medium to strong effects on both near and far transfer.

These are only two examples of how self-explanation has been used successfully to improve learners' performance. As one can see, the interventions used in both cases are simple, nothing out of ordinary. What is important for success is the way they are used to support the learners' effective use of self-explanation strategies. Our research was developed to target the same characteristics. We used prompt questions to elicit self-explanation at different stages in the learner's path toward the solution. The challenge was to find how to construct these questions and how to time them to produce the expected effect, self-explanation, and not give away the solution to the problem.

Instructional Context

Incoming students often face difficulties in moving from learning strategies they used in high school to strategies that are effective for learning in college. These difficulties are more apparent in engineering and science programs where abstract knowledge and the skills needed to master them are critical to academic success. Among these difficulties, one major challenge students engaged in these transition processes face is their ability to build and successfully use deep reasoning skills. In the long run failure to address this challenge at institutional level results in poor student retention, which, in turn, contributes to a decrease in the attractiveness of engineering and science programs. To address this challenge, a Midwestern engineering college offers incoming students the option to enroll in a three-week summer program focused on the transition from high school to college instruction. This program is an excellent opportunity for incoming students to learn about coursework expectations in Mathematics, Chemistry, and English, as well as about campus life and community involvement. Continuously increasing enrollment in this summer program proves its positive impact for incoming students. In addition, the program provides incoming students with the opportunity to earn three hours course credit toward their academic degree.

The focus of this study was the introductory chemistry module of the summer program presented above. In this module the students were engaged in a comprehensive study of the general principles of chemistry.

This module emphasizes chemical nomenclature, periodicity of elements, chemical reactions and reaction stoichiometry, chemical bonding, and possible applications. During this module students took pop quizzes, work on homework assignments, take formal examination, and get grades for their performance. Participation in this research provided the students with the opportunity to earn extra points toward their final grade. While this group of future engineering students was expected to have a certain level of prior knowledge in chemistry, to ensure equal opportunities for similar training and prior knowledge, this study was conducted at the end of the chemistry track.

Research Questions

The primary objective in this study was to find to what degree the use of self-explanation strategies improves students' performance in basic chemistry problem solving. With prior knowledge singled out as affecting the effectiveness of self-explanation based strategies, a secondary goal in this research was to in which way prior knowledge, as reported by the students, affects self-explanation effectiveness. That is, the exploratory research questions were:

(1) Does the use of self-explanation strategies increase learners' performance in solving basic chemistry problems?
(2) How does the use of self-explanation strategies relate to the learners' perception of their own prior knowledge of the domain?

Methods and Methodologies

Participants

A group of 80 incoming freshmen students enrolled in an intensive summer preparatory program were asked to solve a short chemistry problem and to answer a few demographics questions. At the time of the study all students were exposed to the chemistry track of the summer program, allowing them to address the task. Participation was voluntary and rewarded with extra points toward their chemistry section grade. A number of 52 students completed all required tasks. No outliers were found and normality was a strong assumption for the group (one-sample Kolmogorov-Smirnov shows $p > .05$ for all continuous variables).

Research design and procedure

A two-group between subjects completely randomized experimental design was used (e.g. Keppel, 1991). That is, each participant was randomly assigned to only one of the two experimental groups, control or treatment. The experiment was delivered using a web-based research instrument designed and developed by the researchers together with a subject matter expert (SME), the instructor of the chemistry module. The application performed the random assignment of the participants on one of the two research conditions, control or treatment. Because once assigned to a group some students did not complete the entire set of tasks, the 52 students included in the final set were composed of 29 students assigned to the control group and 23 students assigned to the treatment group.

The participants in both groups were asked to solve a short chemistry problem using the following scenario:

Adrenaline, also referred to as epinephrine, is a sympathomimetic monoamine that is produced by the adrenal gland. This stress hormone, when secreted into the bloodstream, rapidly prepares the body for action in emergency situations. It increases heart rate and stroke volume, dilates the pupils, and constricts arterioles in the skin and gastrointestinal tract while dilating arterioles in skeletal muscles. It elevates the blood sugar level by increasing catabolism of glycogen to glucose in the liver, and at the same time begins the breakdown of lipids in fat cells.

The students in the control group were asked to answer the following assessment question:

Given that adrenaline contains 3 oxygen moles, 13 hydrogen moles, 9 carbon moles, and 1 nitrogen mole, which is its chemical formula?

In contrast, the students in the treatment group were asked, before presenting them with the opportunity to answer the main assessment question, to answer the following three guiding questions:

(1) What type of chemical compound is adrenaline?
(2) How does belonging to this type of chemical compounds influence the way chemical formulae are written?
(3) *How do you write the formula for this type of compound?*

These guiding questions, developed in collaboration with the subject matter expert, aimed at engaging students in self-explanation behavior. The nature of these questions emulated the causal structures an expert would activate when answering the main question.

In the next step, the participants in both the control and treatment groups were asked to indicate how confident they are in the correctness of their answer for the main assessment question and then to estimate their own level of chemistry knowledge. Finally, the participants were asked several questions related to their individual learning characteristics and to provide demographic information.

Dependent variables

Two categories of measures were used in this study. The first category included measures of students' performance and the associated confidence that the answer they provided was correct. The performance was measured as a binary outcome 0 = wrong answer/1 = correct answer. In addition participants' confidence in the accuracy of the answer was generated as a continuous variable, varying from 0 for low confidence to 100 for high confidence. To account for the complexity of students' performance the binary outcome was complemented with an adjusted performance variable computed as follows:

*Adjusted performance = (-1) * Confidence for wrong answer+ 100 and*

Adjusted performance = Confidence for the correct answer + 100

The resulted dependent variable named adjusted performance, ranges from (0) for wrong answer with high confidence that the answer is right to (200) for correct answer with high confidence that the answer is right.

The second group of dependent variables was deployed to test if there is a significant difference between the control and treatment group in terms of individual characteristics associated with learning in this program. The two dependent variables in this second group were motivation and academic efficacy, and were adapted from Midgley et al. (1998; 2000). These constructs used a five point Likert scale and the final value resulted as a mean of the items in each scale. The value of these variables varied from 1 for low to 5 for high values of the respective construct.

Independent variables

The first independent variable was the group to which the participants belonged, a categorical variable with two levels based on allocated experimental condition, control and respectively treatment. The second independent variable, self-reported familiarity with the field of chemistry, was collected as a continuous variable varying from 0 for low familiarity to 100 for high familiarity with the field of chemistry. This second independent variable collected to test if prior knowledge behaves as a moderator, as suggested by the existing research literature (Bielaczyc, et al., 1995) where prior knowledge is viewed as an important ingredient for effectiveness of self-explanation strategies. Table 1 summarizes the statistical characteristics of continuous variables used in this study.

Table 1

Means, Standard Deviations, and Pearson Correlations for continuous variables

	M	SD	1	2	3	4
1. Adjusted performance	111.22	73.75	-	.29*	.29*	.01
2. Academic Efficacy	4.12	.58		-	.52**	.14
3. Motivation Goal Orientation	3.93	.64			-	-.02
4. Self-reported knowledge	44.78	27.01				-

Note: *p < .05; **p < .01

Results and Interpretation

One-way ANOVA with one between-groups factor was used to test the homogeneity of the two experimental groups. No statistically significant differences were found between students' learning characteristics in the two experimental groups as measured by academic efficacy, $F(1,49) = 1.16$, $p = .29$, motivation goal orientation, $F(1,49) = .63$, $p = .43$, and self-reported knowledge of chemistry, $F(1,50) = 2.54$, $p = .12$. Therefore, the two groups randomly created for this experiment had similar learning characteristics.

To analyze if the use of self-explanation strategies increased learners' performance on basic chemistry problems we first use a chi-square test with binary performance as dependent variable. We found that significantly more students in the treatment group (using self-explanation strategies) answered correctly to the chemistry problem when compared to students in the control group, χ^2 (1, N=52) = 6.32, $p < .05$.

Linear regression was used to analyze how the use of self-explanation strategies relates to the learners' perception of their own prior knowledge of the domain. The adjusted score was the dependent variable, self-explanation treatment was the categorical variable treated as dummy variable with 1 for the treatment group and 0 for the control group, while the self-reported knowledge of chemistry was the moderating variable. The focus was on the moderating effect self-reported knowledge of chemistry might have on the relationship between the adjusted score and the self-explanation treatment. The reason for choosing the adjusted score for the dependent variable in this analysis was its ability to enhance the value of a binary right/wrong answer to account for the students' confidence in the validity of the provided answer and by this means, reflect the strength of their mental model.

The bivariate correlations revealed one significant predictor for the adjusted score, the treatment ($r = 0.37$) significant at $p < 0.05$. In a first step the adjusted score was then regressed on the treatment and the self-reported chemistry knowledge. The resulted equation accounted for 15% of the variance in the final exam score, $F(2,49) = 4.16$, $p < 0.05$. Only treatment displayed a significant beta weight of $\beta = .39$ ($p < .05$).

In a second step, the interaction between the treatment and the self-reported chemistry knowledge score was introduced as predictor mean centered values for self-reported chemistry knowledge were used in the analysis. In this second step, the interaction term between attendance behavior and homework explained a significant increase in final exam score, $\Delta R^2 = 0.16$, $F(1,48) = 11.06$, $p < 0.05$. Thus, the self-reported chemistry knowledge was a significant moderator of the relationship between treatment and adjusted score (Table 2).

Table 2
Summary of Regression Analysis

Predictor	Beta Weights	
	Beta	*t*
Treatment (A)	.41	3.35**
Self-reported knowledge (B)	-.26	-1.59
A * B	.54	3.33**
Model Summary	$R^2 = 0.31$, $p < 0.01$	

Note: N = 52. **p < .01

The unstandardized simple slope of adjusted score for the treatment group was + 1.55, and the unstandardized simple slope for the control group was - 0.71 (Aiken & West, 1991). The simple slope analysis indicated that the positive slope for the treatment group was statistically significant, $t(48) = 3.01 > t_{cr}(40) = 2.707$, $p < 0.01$, while the negative slope of the control group was not statistically significant (Figure 1).

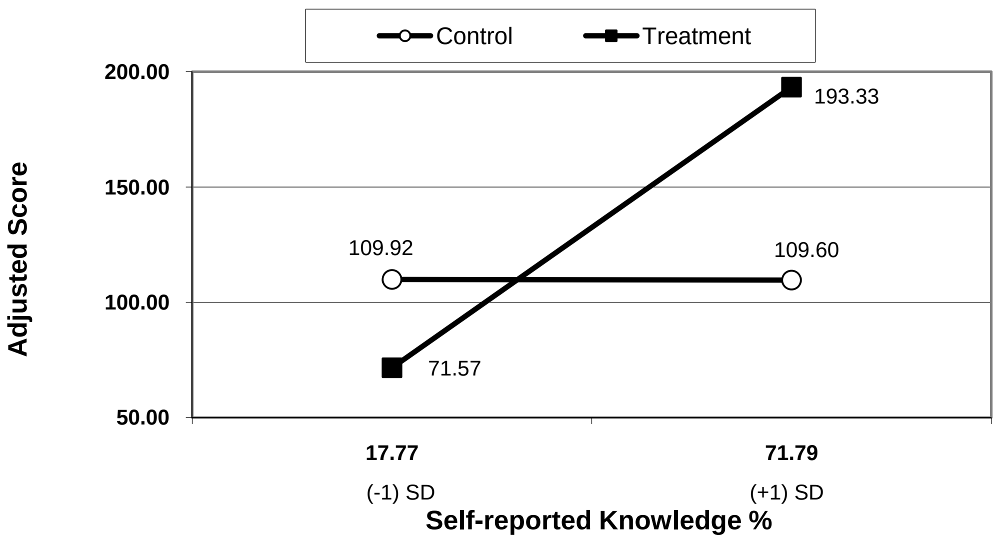

Figure 1. Moderating effect of self-reported prior knowledge on the use of self-explanation strategies

Discussions and Implications

The results of this study confirms, on one hand, that learners can benefit from using self-explanation strategies in learning chemistry and, on the other hand, the mediation effect of prior knowledge on the outcomes of using self-explanation based strategies is suggestive for a synergic effect on the subjects' ability to solve chemistry problems. The interaction between prior knowledge and the use of self-explanation based strategies seems to be two-folded. On one side, the higher the self-reported knowledge is, the more powerful the effect of self-explanation strategy is, in agreement with the behavior suggested by prior research. Also, using strategies based on self-explanation tends to help students make better use of their prior knowledge of the domain in their current activities by "forcing" them to consider it when working on current tasks. On the other side, for these strategies to be effective, a certain level of prior knowledge (threshold) seems to be needed. That is, if prior knowledge is too low, the strategy seems to be acting in the opposite direction, effectively diminishing student performance in solving chemistry problems. Present research was not designed to study prior knowledge but only to account for it. It is for future research to investigate the nature and threshold level of prior knowledge that makes self-explanation based strategies effective.

From a developmental perspective, these findings suggest that a layered deployment of self-explanation based elicitation strategies has the potential to increase the effectiveness of the knowledge construction processes. Its purpose should be to provide students with this tool and to train them in using it. That is, the first stage could consist of constant use of self-explanation elicitation questions to train the students in using these strategies, followed by a second stage, where the use of these questions would be faded out allowing students to further adapt the use of these strategies to their own needs and characteristics.

From an instructional design perspective this strategy can be adapted to increase the effectiveness of tutoring and review sessions or short transfer problems through more intense cognitive engagement of the students during the various learning activities. The fact that this experiment was conducted entirely using web-based technologies can be an indication that methodologies based on self-explanation elicitation strategies could be readily embeddable in online learning environments.

As for the future, research should look for example at how various characteristics of the elicitation questions, such as focus, atomicity, concept vs. process targeting, etc. influence learners' performance. For example, in science and engineering, where the question asking strategy is frequently used in classroom-based activities, future research could look at the effect of generic vs. specific prompt questions or at how timing of the questions could affect the strategy's effectiveness.

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Analysis of peer-scaffolding patterns in four phases of problem-solving in web-based instruction

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Introduction

Problem-solving is regarded as one of the most important competency in everyday life and many professional contexts. Thus, in recent years, there has been an increased emphasis on improving students' problem-solving abilities (Phye, 2001). One of the most effective approaches for students to enhance their problem-solving abilities is the utilization of web-based environments that allow them to provide peer-scaffoldings to solve a given set of problems. Web-based environments allow learners to develop their problem-solving abilities, build knowledge, and interact with peers through a web-based learning system (Chou, & Tsai, 2002; Lee, 2004). On the web, students may liberally join discussions to get information related to problem-solving, or provide peers with support.

It is difficult for learners to solve problems successfully without an instructor's or peer's support in a web-based environment. This is because some obstacles, such as the learner's feeling of isolation and the still of communication remain (Sharma & Hannafin, 2007). To overcome these obstacles, scaffolding may play an important role, as experts provide support in these environments and are involved in giving appropriate help.

Although several studies have been conducted on the various scaffoldings in problem-solving situations, it is really hard to find out the researches on peer-scaffoldings which can support to the learners' problem solving processes. It is therefore important to understand peer-scaffolding patterns for collaborative problem-solving in web-based instruction environments. The purposes of this study are to explore the types of peer-scaffolding that occur during the problem-solving processes in web-based instruction, as well as to identify what patterns of peer-scaffolding for problem-solving are used to effectively solve problems from the early phase to the last phase.

Theoretical Background

A. Concepts and types of scaffoldings

The concept of scaffolding originated in Vygotsky's socio-cultural theory. Vygotsky (1978) described learning that occurs in the zone of proximal development (ZPD) –the space in which a child can do something, such as complete a task or attain a specific goal with an expert's or more capable peer's support.

During the last decade, there have been several studies on various scaffolding types, such as explanation, feedback, direction maintenance, demonstration, and modeling (Bull, Shuler, Overton, Kimabll, Boykin, & Griffin, 1999; Roehler, & Caltlon, 1997; Woods, Bruner, & Ross, 1976). These types of scaffolding have been found effective in fostering problem comprehension, problem-solving, and reflective thinking. In addition, many researchers emphasize how scaffolding can be used in various ways, such as providing explanations or cues and inviting student participation (Hogan & Pressley, 1997; Kim, 1997; Winnips, & McLoughlin, 2000).

B. Four phases of problem-solving

According to many scholars, like Gagné (1985), and Smith and Ragan (1999), students generally go through similar problem-solving processes regardless of a problem's characteristics. Newell and Simon (1972) explained that the general problem-solver specifies two sets of problem-solving processes: understanding processes and searching processes. Gick (1986) synthesized various other problem-solving models and proposed a simplified model of the problem-solving process: constructing a problem representation, searching for solutions, implementing, and monitoring solutions. Noh and colleagues (2001) proposed that the four stages of the problem-solving strategy are understanding, planning, solving, and checking while investigating the influences of an instructional method related to problem-solving. Ge and Land (2003) studied the effects of question prompts and peer interactions in scaffolding learners' problem-solving processes. In their study, they divided problem-solving into four processes: problem representation, developing solutions, making justification for generating or selecting solutions, and monitoring and evaluating the problem space and solutions. Considering those phases of problem-solving processes that all researchers suggested, the process can be categorized into four phases: understanding, planning, solving, and reviewing.

C. Relationships between scaffolding and problem-solving

Scaffolding has been found effective in fostering problem-solving (Scardamalia, Bereiter, & Steinbach, 1984). Hogan and Pressley (1997) emphasize that scaffoldings are needed for students to build powerful thinking strategies for learner inquiries or solving a problem. Choi and colleagues (2005) report that, through scaffolded instruction, learners take more responsibility for their own learning and become more independent learners. In other words, learners' responsibility and independence, both necessary for successful problem-solving, can be built up by providing scaffolding. Scaffolding is definitely necessary for students to solve problems successfully because scaffolding helps learners to understand the relationships between what they already knew and the new information needed to solve a problem.

Methods

A. Participants

Six participants were involved in solving the given problems as a group. Solving these problems, they shared peer-scaffoldings collaboratively. All of the participants had worked in middle-, upper-, and higher-positions in different fields of administrative divisions, such as research affairs, student affairs, and academic affairs at the three universities in Seoul, Korea. In addition, they had worked for more than 10 years in their professional fields. The age range of the six participations, four males and two females, was 40 to 50.

B. Problems as a learning task

Participants worked collaboratively in a group and were required to solve problems in a learning task. Problems in the learning task were: (1) to identify topics that will be helpful for solving problems that they may come across in their working fields, (2) to search for data and information that is related to problem solving, and (3) to delineate the results of the problem-solving process in an approximately 50-page report.

C. Course setting

This course consisted of 15 weeks of a ‘advanced leadership training program’, in the spring semester of 2008. They were instructed to collaboratively solve the given problems as a learning task with their peers. This study was conducted in a web-based environment. The participants had to discuss, in an online community, at least 15 hours over the 15 week period in order to solve the problems as a learning task.

D. Procedures of research and data analysis

Data from collaborative on-line discussions were collected through the website for the peer-scaffolding analysis. The website was run in a cyber teaching learning class. There were two steps in analyzing the data, as two steps will be discussed below.

1. Four phases of problem-solving for analyzing the data

The four phases of problem-solving as shown in Table 1 are understanding, planning, solving, and reviewing. Problem-solving activities in each phase are presented in Table 1. Data were classified into the four phases of problem-solving accordingly.

<Table 1> Four phases of problem-solving and problem-solving activities in each phase

Four phases of Problem-solving	Problem-solving activities
Understanding	□find the given information and goal □confirm the topic to write the report
Planning	□identify additional knowledge to solve the problems □select and organize the contents □discover strategies to write the report
Solving	□collect the information to write the report □write the report collaboratively
Reviewing	□check the solving processes □review the things to learn □reflect on the appropriateness of solutions

2. Coding scheme to analyze peer-scaffoldings according to the four phases of problem-solving

In order to analyze the patterns of peer-scaffolding during the collaborative problem-solving activities, a coding scheme for analyzing peer-scaffoldings was developed and elaborated. To verify the coding scheme, the tool that Jang (2005) applied in her study was revised and applied in the present study. Using this tool, the coding scheme for analyzing the peer-scaffoldings in Table 2 was validated by experts (1 professor and 3 doctoral candidates) in the instructional psychology field. These experts verified the coding scheme by using a 5 point Likert scale (5=Fully verified, 1=no verified) to rate explicability, usability, validity, comprehensibility, and generality with respect to dimensions of peer-scaffolding, types of peer-scaffolding, definitions of peer-scaffolding, and examples of peer-scaffolding. The results of experts’ verification were shown the average points of 3.92 out of 5.0. This result confirms that the coding scheme for analyzing peer-scaffoldings is fairy valid.

< Table 2 > Coding scheme for analyzing the peer-scaffoldings

Dimensions of peer-scaffolding	Types of peer-scaffolding	Definition of peer-scaffolding	Examples
Strategy	maintaining direction	Statements about maintaining attention on a goal by requesting clarification.	For completing this task, why don't we consider not only public control universities, but also private control universities as the best case?
	assigning role-taking	Statement about something to do to solve problem or task	For gathering meaningful information or materials, we need to assign individual roles. I'd like to suggest that Mrs.Jang search on this part because Mrs.Jang is an expert on this.
Content	offering cue	Statements related to problem area to focus on completing the tasks.	When I was a graduate student in Japan, I carried out a survey similar to this study. That survey may be helpful for our task. So I attached the survey report with reference to our work.
	Offering opinion	Statements describing one's thoughts, such as alternative plans to facilitate problem-solving, or tactics to discover a solution.	According to my opinion on administrative services to faculty and students in universities, the professionalism of the staff is a critical factor, I think.
	offering explanation	Statements adjusted to fit the learner's enhancing understanding about what is being learned, why and when it is used, and how it is used.	I think it would be better to understand ERIC, which is explained in the blue ocean strategies. ERIC stands for Eliminate, Reduce, Increase,and Create. Eliminate means that consumers are….
	offering feedback	Statements of evaluation of peers' work and pointing out the distinction between the learner's performance and the ideal.	After reading the current survey, we need to add content related to staff promotion to what we're about to write.
Affection	offering praise	Statements that are about encouragement or inspiring peers to further effort, and comments on peers' good work.	Mrs. Jang! ERIC is really important content for completing the task. You provided such appropriate contents to solve this problem. Thank you!!
	Inviting participation	Statements that asked learners to join in problem-solving activities.	Mrs. Jang, I want to get your opinion. Please read the contents of the attached file and give me your opinion or feedback.

Two coders analyzed independently peer-scaffolding messages with reference to the coding scheme validated by experts. The inter-rater reliability between the two coders was calculated for 75% of the data. The inter-coder reliability (agreement) in each analysis was 73%.

Results and Discussion

A. The number of peer-scaffolding messages, and ratio according to problem-solving phases

According to our coding scheme, we analyzed all the messages that were discussed among peers in the online community. The total number of messages from learners was 77 postings on the bulletin board. More specifically, the number of initiating messages was 36, and the number of reply messages was 41. Most messages consisted of approximately 10-20 sentences. In the content analysis, the unit of analysis was the semantic unit. Each message segment was analyzed in light of the eight scaffolding coding scheme categories (See Table 3).

<Table 3> The numbers of peer-scaffolding messages and ratio by problem-solving phases

Dimension	Scaffolding types \ Problem-solving phases	Understanding phase	Planning phase	Solving phase	Reviewing phase	Total(%)
strategy	maintaining direction	6	1	6	1	**14 (8)**
	assigning role-taking	0	3	8	5	**16 (9)**
	sub total	**6**	**4**	**14**	**6**	**30 (18)**
content	offering cue	4	3	21	0	**28 (16)**
	offering opinion	7	0	9	0	**16 (9)**
	offering explanation	8	1	8	6	**23 (14)**
	offering feedback	8	0	1	2	**11 (6)**
	sub total	**27**	**4**	**39**	**8**	**78 (46)**
affection	offering praise	5	2	15	13	**35 (20)**
	inviting participation	9	3	13	2	**27 (16)**
	sub total	**14**	**5**	**28**	**15**	**62 (36)**
Total (%)		**47(28)**	**13(7)**	**81(48)**	**29(17)**	**170(100)**

With respect to the problem-solving phases, the number of peer-scaffoldings was 47 (28%) in the understanding phase, 13 (7%) in the planning phase, 81 (48%) in the solving phase, and 29 (17%) in the reviewing phase. In addition, in terms of peer-scaffolding dimensions, the number of peer-scaffoldings was 30 (18%) in the strategy dimension, 78 (46%) in the content dimension, and 62 (36%) in the affection dimension, respectively (See Table 3).

B. Patterns of peer-scaffoldings in each dimension of the four phases of problem-solving

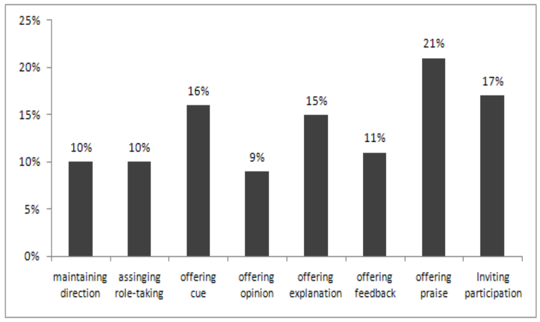
All the messages were analyzed to reveal the patterns of peer-scaffoldings in each dimension of the four phases of problem-solving. As shown in Figure 1, peer-scaffoldings in the content dimension represented a higher ratio of peer-scaffoldings in the understanding phase and solving phases than did those in the strategy dimension or affection dimension. Further, a chi-square analysis on peer-scaffolding patters according to these dimensions demonstrated that there was a statistically non-significant difference between the strategy, content, and affection dimensions ($\chi^2 = 8.805$, $p>.05$) (see Tables 4, 5).

More specifically, peer-scaffoldings in the strategy dimension were 18% of all peer-scaffoldings across all three dimensions. The strategy dimension includes the 'maintaining direction' scaffolding and the 'assigning role-taking' scaffolding (see Figure 1). The reason for this pattern is that the participants tended to keep the strategies that they had in their mind as the most effective and efficient strategies. This means that even though they know various strategies, they use more familiar strategies when solving a problem without considering the context. In addition, they could easily have had similar ideas when they made plans to find a solution because all of the participants had similar work experiences in the administrative field.

The peer-scaffoldings in the content dimension were 46% of all peer-scaffoldings across all three dimensions, and content dimension includes the four peer-scaffoldings of 'offering cue,' 'offering opinion,' 'offering explanation,' and 'offering feedback' (see Figure 1). This result suggests that participants have sufficient expert knowledge related to problem-solving, especially as participants were sufficiently experienced for a long time in their professional job areas.

The peer-scaffoldings in the affection dimension accounted for 36% of all peer-scaffoldings across all three dimensions, and the affection dimension includes the 'offering praise' and 'inviting participation' scaffoldings. This result shows that participants recognized that peer-scaffoldings in the affection dimension were more important than scaffoldings in the strategy dimensions.

Comparing the eight types of scaffoldings, however, we see that the number of messages in the 'offering praise' scaffolding was the highest among all types of scaffolding. This implies that adults consider a permissive atmosphere to be an important factor for successfully solving problems (see Figure 1).



<Figure 1> Distribution of peer-scaffoldings in all problem-solving processes

<Table 4> Dimension * problem-solving phase Cross-tabulation

			problem-solving phase				Total
			Under-standing	Planning	Solving	Reviewing	
Dimension	Strategy	Message No.	6	4	14	6	30
		%within	20.0	13.8	46.7	20.0	100.0
		% within phase	12.8	30.8	17.3	20.7	17.6
		% of total	3.5	2.4	8.2	3.5	17.6
	Content	Message No.	27	4	39	8	78
		%within dimension	34.6	5.1	50.0	10.3	100.0
		% within phase	57.4	30.8	48.1	27.6	45.9
		% of total	15.9	2.4	22.9	4.7	45.9
	Affection	Message No.	14	5	28	15	62
		%within dimension	22.6	8.1	45.2	24.2	100.0
		% within phase	29.8	38.5	34.6	51.7	36.5
		% of total	8.2	2.9	16.5	8.8	36.5
Total		Message No.	47	13	81	29	170
		%within dimension	27.6	7.6	47.6	17.1	100.0
		% within phase	100.0	100.0	100.0	100.0	100.0
		% of total	27.6	7.6	47.6	17.1	100.0%

<Table 5> $\chi 2$ test on the patterns of peer-scaffolding according to dimensions

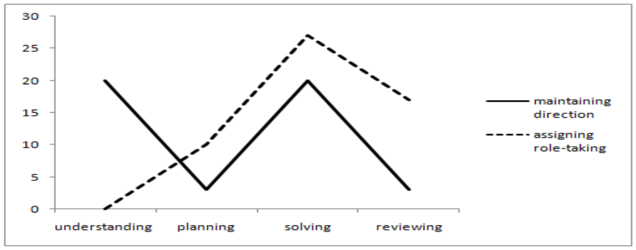
	value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.805[a]	6	.185
Likelihood Ratio	8.795	6	.185
N of Valid Cases	170		

a. Cells (16.7%) have expected counted less than 5. The minimum expected counted is 2.29.

C. Patterns of peer-scaffolding according to each peer-scaffolding dimension

1. Patterns of peer-scaffoldings in the strategy dimension

A chi-square test on patterns of peer-scaffolding by strategy dimension demonstrated that there was a statistically significant difference between the strategy, content, and affection dimensions (χ^2= 9,863, p<.05) (see Tables 6, 7). Despite the statistical significance of these results, it should be careful about accepting the significance, as 9 out of 16 cells had expected counts under five. More specifically, considering the patterns of peer-scaffolding in the strategy dimension (see Figure 2), the 'maintaining direction' scaffolding represents a higher ratio than the 'assigning role-taking' scaffolding in the understanding phase. This result suggests that participants discussed 'what learner should think of completing the task,' and 'what goals and directions are needed to solve the problem.' After understanding problems as a task, the 'assigning role-taking' scaffolding was higher frequency scaffolding than 'maintaining direction' scaffolding from the planning phase to the reviewing phase. The reason is that, after understanding the problems, it was crucial for participants to commit to roles for problem-solving and become involved in the problem-solving activities.



<Figure 2> Patterns of peer-scaffoldings in strategy dimension

<Table 6> strategy * problem-solving phase Cross-tabulation

			problem-solving phase				Total
			Under-Standing	Planning	solving	reviewing	
strategy	maintaining direction	Message No.	6	1	6	1	14
		%within	42.9	7.1	42.9	7.1	100.0
		% within	100.0	25.0	42.9	16.7	46.7
		% of total	20.0	3.3	20.0	3.3	46.7
	assigning role-taking	Message No.	0	3	8	5	16
		%within	.0	18.8	50.0	31.3	400.0
		% within	.0	75.0	57.1	83.3	53.3
		% of total	.0	10.0	26.7	16.7	53.3
Total		Message No.	6	4	14	6	30
		%within dimension	20.0	13.3	46.7	20.0	100.0
		% within phase	100.0	100.0	100.0	100.0	100.0
		% of total	20.0	13.3	46.7	20.0	100.0

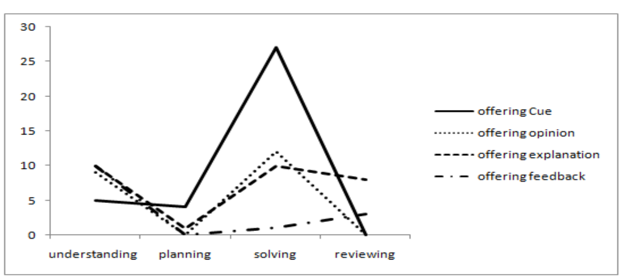
<Table 7> χ2 test on the patterns of peer-scaffolding in the strategy dimension

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.863[a]	3	.020
Likelihood Ratio	12.429	3	.006
N of Valid Cases	30		

a. 6Cells (75.0%) have expected counted less than 5. The minimum expected counted is 1.87.

2. Patterns of peer-scaffolding in the content dimension

A chi-square test on the patterns of peer-scaffolding in the content dimension showed that there was a statistically significant difference among the ‘offering cue’, ‘offering opinion’, ‘offering explanation’, and ‘offering feedback’ (χ^2 = 30.639, p<.05) (see Table 8, 9). Again, despite the statistical significance of this result, it should be careful in accepting this, as 9 of 16 cells had expected counts lower than five. More specifically, the ‘offering cue’ scaffolding represents a higher ratio than do the other peer-scaffoldings in the planning phase and in the solving phase, as participants recognized that their peers had high levels of problem-solving abilities and had accumulated prior knowledge (See Figure 3). This result means that cues provided by adults facilitated learners’ active problem-solving.



<Figure 3> Patterns of peer-scaffoldings in the content dimension

<Table 8> content * problem-solving phase Cross-tabulation

			problem-solving phase				total
			Under-standing	Planning	solving	reviewing	
content	offering cue	Message No.	4	3	21	0	28
		%within	14.3	10.7	75.0	.0	100.0
		% within phase	14.8	75.0	53.8	.0	35.9
		% of total	5.1	3.8	26.9	.0	35.9
	offering explanation	Message No.	8	1	8	6	23
		%within	34.8	4.3	34.8	26.1	100.0
		% within phase	29.6	25.0	20.5	75.0	29.5
		% of total	10.3	1.3	10.3	7.7	29.5
	offering feedback	Message No.	8	0	1	2	11
		%within	72.7	.0	9.1	18.2	100.0
		% within phase	29.6	.0	2.6	25.0	14.1
		% of total	10.3	.0	1.3	2.6	14.1
	offering opinion	Message No.	7	.	9	0	16
		%within	43.8	.0	56.3	.0	100.0
		% within phase	25.9	.0	23.1	.0	20.5
		% of total	9.0	.0	11.5	.0	20.5
Total		Message No.	27	4	39	8	78
		%within dimension	34.6	5.1	50.0	10.3	100.0
		% within phase	100.0	100.0	100.0	100.0	100.0
		% of total	34.6	5.1	50.0	10.3	100.0

<Table 9> $\chi2$ test on the patterns of peer-scaffoldings in the content dimension

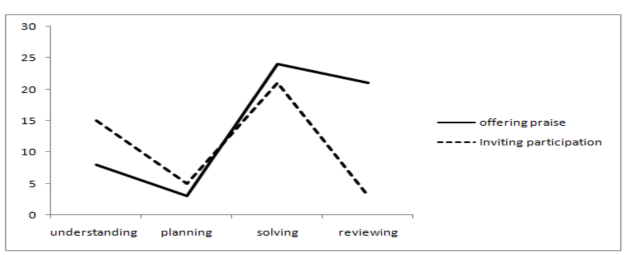
	value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.639[a]	9	.000
Likelihood Ratio	35.671	9	.000
N of Valid Cases	78		

a. 9 Cells (56.3%) have expected counted less than 5. The minimum expected counted is .56.

3. Patterns of peer-scaffolding in the affection dimension

A chi-square test on patterns of peer-scaffolding in the affection dimension demonstrated a statistically significant difference between the 'offering praise' scaffolding and the 'inviting participant' scaffolding ($\chi^2 = 8.664$, $p < .05$) (see Tables 10, 11). More specifically, the 'inviting participation' scaffolding represented a higher ratio than did the 'offering praise' scaffolding in the understanding phase.

The understanding phase is an early part of the problem solving process, and participants are not yet intimate friends each other in this early phase. Accordingly, participants did not actively interact with their peers to solve the problems. So, in the understanding phase, they provided 'inviting participation' scaffolding more than 'offering praise' scaffolding. On the other hand, in the later reviewing phase, the 'offering praise' scaffolding represented a higher ratio than did the 'inviting participation' scaffolding (see Figure 4). The reason is that when participants reviewed the problem-solving process, they were more likely to offer praise to peers so that they were able to actively engage in problem-solving and complete the task.



<Figure 4> Patterns of peer-scaffolding in the affection dimension

<Table 10> affection * problem-solving phase Cross-tabulation

			problem-solving phase				total
			Under-standing	Planning	solving	reviewing	
Affection	inviting Participation	Count	9	3	13	2	27
		%within	33.3%	11.1%	48.1%	7.4%	100.0%
		% within phase	64.3%	60.0%	46.4%	13.3%	43.5%
		% of total	14.5%	4.8%	21.0%	3.2%	43.5%
	offering Praise	Count	5	2	15	13	35
		%within	14.3%	5.7%	42.9%	37.1%	100.0%
		% within phase	35.7%	40.0%	53.6%	86.7%	56.5%
		% of total	8.1%	3.2%	24.2%	21.0%	56.5%
Total		Count	14	5	28	15	62
		%within dimension	22.6%	8.1%	45.2%	24.2%	100.0%
		% within phase	100.0%	100.0%	100.0%	100.0%	100.0%
		% of total	22.6%	8.1%	45.2%	24.2%	100.0%

<Table 11> χ2 test on the patterns of peer-scaffolding in the affection dimension

	value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.664[a]	3	.034
Likelihood Ratio	9.482	3	.024
N of Valid Cases	62		

a. 2 Cells (25.0%) have expected counted less than 5. The minimum expected counted is 2.18.

Conclusion and Implications

Various peer-scaffoldings are critical elements for effective problem-solving. But little research exists on what patterns and types of peer-scaffolding are practiced during group problem- solving, and what types of peer-scaffolding occur during the four problem-solving phases.

The purposes of this study were to analyze the types of peer-scaffolding messages during on-line problem-solving, and to investigate patterns of peer-scaffolding as effective problem-solving strategies in the four phases of problem-solving.

The major findings of this study on the patterns of peer-scaffolding are as follows: First, peer-scaffoldings in the strategy dimension accounted for only 18% of all peer-scaffoldings across all three dimensions. According to the chi-square value, this resulted from a statistically significant difference though it should be careful to interpret this result given expected counts under five messages in the chi-square test. More specifically, considering patterns of peer-scaffolding in the strategy dimension, the ‘maintaining direction’ scaffolding represented a higher ratio than did the ‘assigning role-taking’ scaffolding in the understanding phase. After understanding phase, the ‘assigning role-taking’ scaffolding was higher frequency scaffolding than ‘maintaining direction’ scaffolding from the planning phase to the reviewing phase. In this sense, instructor needs to encourage learners to use various strategies that they have to keep a direction in understanding phase. And after understanding phase, instructor should guide for students to assign role to team members appropriately.

The chi-square analysis on the pattern of peer-scaffolding in the content dimension was significant different among the ‘strategy’ dimension, ‘content’ dimension, and ‘affection’ dimension. But it should be interpreted with caution since the number of messages was under five. Despite this caution, this result implies that it is important to check the extent of the learners’ prior knowledge and adapt the problems’ difficulty level accordingly. In this sense, tutors should encourage adult learners to make use of prior knowledge in the problem-solving process. More concretely, considering patterns of peer-scaffolding in the content dimension, the ‘offering cue’ scaffolding was a higher proportion here than were other peer-scaffoldings in the solving phase. This result implies that, when instructor provides scaffolding to learners, instructor should provide the ‘offering cue’ scaffolding instead of the ‘offering explanation’ or the ‘offering feedback’ scaffoldings in the planning phase and in the solving phase. In addition, the ‘offering cue’ scaffolding should be considered a critical factor in designing problem-solving instruction.

Third, in the affection dimension, the ‘inviting participation’ scaffolding represented a higher ratio than did other peer-scaffoldings in the understanding phase. On the other hand, in the reviewing phase, the ‘offering praise’ scaffolding represented a higher ratio than the ‘inviting participation' scaffolding. These results imply that, when instructors provide peer-scaffoldings in affection dimension, which are ‘offering praise’ scaffolding and ‘inviting participation’ scaffolding, they should consider the phase of problem solving carefully. In other words, instructor needs to guide for learner to invite others’ participation in understanding phase and to offer praise to others in reviewing phase.

In addition, comparing all different types of scaffoldings, the 'offering praise' scaffolding is the highest ratio among all types of peer-scaffoldings. This result implies that, when we design collaborative problem-solving instruction in a web-based environment, it must be considered the 'offering praise' scaffolding as critical component. In addition, instructors should be guided to offer more praise to their adult learners appropriately.

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Using CTL-based Online Discussion Strategies to facilitate Higher Level Learning

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Background

Online discussion has become a major instructional component of face-to-face, online and blended instruction. It has been found to enhance students' learning by supporting social learning (Wells, 1992), mindfulness and reflection (Hiltz, 1994; Poole, 2000), and idea sharing and collaborative thinking (Ruberg, Moore, & Taylor, 1996). Scholars have reported student perceived learning to be correlated with the use of online discussion (Picciano, 1998, Jiang & Ting, 2000). Yet, lack of higher level learning (Bloom, 1956) in online discussion has been a drawback reported in many studies focusing on the effectiveness of this strategy (Garrison, Anderson, & Archer, 2001, Gunawardena, Lowe, & Anderson, 1997; Schellens & Vackle, 2005; Sing & Khine, 2006). Given the complexity of today's instructional and training tasks, the latest strategies used in face-to-face or online instruction should be designed to bring about all levels of learning.

Participating meaningfully in an online discussion is a complex cognitive task. In the conventional online discussion format currently used in higher education, learners are provided with a discussion topic and some participation rubrics before they are immersed in the assigned discussion task. They are then expected to apply the participation rules, read and respond to other participants' postings, figure out the interrelationships of materials being posted, deal with different styles in which the materials are presented, and finally cope with the technological problems that may arise during the discussion. Learners experience great amount of extraneous load within these activities, as well as germane and intrinsic cognitive load (Chandler & Seweller, 1991; Sweller, van Merrienboer, & Paas, 1998) presented by the instructional content of the discussion. Learners not only face new elements of information (e.g., the concepts, their theoretical framework, and identified information from other resources) that they need to learn, they also have to deal with the interactions among these new elements throughout the enumerated activities. Furthermore, as a result of encouraging participation in online discussion (Ruberg, Moore, & Taylor, 1996), a large number of postings are created by students in the same class. Ideally, individuals should read each other's posting, comment or reflect on them, and provide each other with responses. The cognitive resources needed in the process is far beyond the capacity of human working memory (Miller, 1956).

In the present study we investigated the effectiveness of several cognitive load theory (CLT)-based strategies in facilitating higher level learning in online discussion. These strategies have been designed to reduce learners' cognitive load in order to improve their learning performance. We applied these strategies in an online discussion and contrasted the outcomes with a conventional online discussion strategy. Following is a description of the online learning environment and the discussion tasks.

Online Learning Environment

An online course on Stress and Resilience in Families and Children was used in this experimental study. The course provided undergraduate majors in Family & Child Sciences with an introduction to family-based theories about the responses of children, adults, and families to stress. It examined ways of applying those theories to understanding the process of coping with stress and ways for professionals to intervene to help families in distress. The course objective was for the students to learn the techniques of working with families and children dealing with distress and supporting them in resolving the disruptions they were experiencing.

The Family Distress Model (FDM) was grounded in research on social support and family problem solving (Cornille & Boroto, 1992). Families, based on this model, will cope with distress, depending on whether the stressor is a crisis or "just a problem", following a predictable set of steps. The Family Outreach Model (FOM) was developed to identify specific strategies that persons can use to be supportive and effective when they form working relationships with families during times of distress (Cornille, Meyer, Mullis, Mullis, & Boroto 2008; Nalls, Mullis, Cornille, Mullis, & Jeter, 2009). This model grew out of the Family Distress Model and research about common factors of helping relationships (Hubble, Duncan, & Miller, 2002). In particular, the FOM links the stages of coping of families with the various styles and quality of helping relationships, suggesting the most effective style of helping relationship for each of the five stages, and strategies for using those specific styles.

For this experiment, we selected the topic of Working Professionally with Families in Distress. This topic was on the course agenda for the week of 13 of a 16 week semester and focused on students understanding how persons who work with families in a professional capacity, such as teachers or health care providers, can develop effective helping relationships with children and their families. During this week, the participants learned how the Family Outreach Model and Family Distress Model could be used to help both the child and their family deal with problems if the students selected career paths such as teaching, counseling, or social work. The discussion topic used for this week was designed based on the content and purposes of the discussion:

> *When you think about your profession after you complete your education, what phase of the Family Distress Model best describes what the families you will encounter will be experiencing? What are the similarities between your expectations and others in this discussion? Using the framework provided by the Family Outreach Model, describe how you might work most effectively with families in that phase. In reading other participants' thoughts, share with one another how your expectations are similar and different from theirs?*

Students participated in group discussions that were organized around one of four strategies.

Discussion Strategies

Strategy 1. Example-based postings

The use of example posting aims at reducing the intrinsic cognitive load of the discussion task and the mental effort required for searching of appropriate steps to fulfill the task. In a complex learning situation, the learners need to understand abstract relationships of the concepts and how the abstract concepts fit with the schemas they already have. They need to process the relationships among the elements and be able to process multiple elements as one (Sweller & Chandler, 1994). Based on the findings of numerous research conducted on the effectiveness of worked-out examples (i.e. Van Gog, 2006; Darabi, Nelson, and Palanki, 2007; Darabi, Sikorski, Nelson, and Palanki, 2006), we argue that an example-based posting that demonstrates what the learner is expected to do, reduces the intrinsic cognitive load involved in performing the task and frees the working memory capacity for higher cognitive activities, such as extracting new relations (analysis) and constructing new ideas (synthesis) (Bloom, 1956).

Generally, an example posting helps students to understand the abstract concepts and relationships embedded in complex learning tasks by illustrating what those concepts and relationships mean in a specific situation. It also demonstrates the processes of how the learning task could be fulfilled, including how to analyze the elements of a situation, form new ideas, and how to make judgment base on certain criteria. Consequently, the learners' attention is directed to the relations between relevant materials and relevant steps, which is similar to what a worked example (Sweller & Cooper, 1985, van Merrienboer & Sweller, 2005) would do. We contend that example postings reduce cognitive load by reducing irrelevant tasks, thus make the working memory available for activities fostering higher level learning.

Strategy 2. Filtering messages

Filtering message is a strategy that allows posting relevant messages together rather than scattering them around in a discussion board. Most of the discussion boards currently in use display messages under threads. It is very common that not all the messages contribute to the discussion threads. Often time a student will find only several of classmates' postings make sense and he or she would not need all the information to form a good understanding of what is being discussed. In fact the non-relevant postings, we argue, may be distractive and thus causing extraneous mental load learners. By using filtering messages strategy, a user will be able to choose only the relevant messages to be displayed on his current screen. The messages irrelevant to current task will not be deleted and can be retrieved later for other tasks. By doing so, learner's cognitive resource is concentrating on holding and processing relevant elements rather than irrelevant ones.

Strategy 3. Limited number of postings on each page

This strategy limits the number of postings on each page of discussion board to 7 ± 2 (Miller (1956). The popular online discussion boards nowadays (e.g., BlackBorad, WebCT Vista, and Moodle) display more than 20 messages on each page by default. If all of the 20 messages provide new information, they will obviously exceed learner's working-memory capacity and thus leave no extra cognitive capacity for processing abstract relationships of the 20 messages. Facing this cognitive overload, we argue, learners are not likely to achieve higher level learning. The design of limiting number of postings on each page of the discussion board is to break the new information into smaller chunks that hold no more than 7 ± 2 elements. So that students are able to preprocess the limited pieces of information before they move on to next chunk.

Strategy 4. Combination Strategy

This strategy combines the above three strategies of example posting, filtering messages, and limiting number of posting on each page. The messages are related to the current topic and include new ideas (no irrelevant messages) and there are no more than 7 ± 2 messages on each page. Using this strategy, the users should presumably be able to reduce the cognitive capacity needed for understanding the discussion task and save the cognitive resource for searching of appropriate problem solving processes. The users' attention should be focused on relevant elements because irrelevant messages are filtered out and the number of message is limited to less than 9 including example posting.

Research Questions and Hypotheses

Our research questions are: (1) Does each of the CLT-based online discussion strategies reduce cognitive load placed on learners compared to conventional discussion board? Which is the most effective? (2) Does each of the CLT-based online discussion strategies enhance higher level learning compared to conventional discussion board? Which is the most effective? (3) Does each of the CLT-based online discussion strategies enhance students' performance on quiz? (4) Which discussion strategy is the most efficient in terms of mental effort invested and learning outcome?

Assuming that cognitive overload is one reason for lack of higher level learning in online discussion, these strategies were designed to reduce cognitive load and therefore assist them with processing discussion content more efficiently for achieving higher level learning. Given the principles of CLT, We hypothesized that compared to the conventional method of online discussion, each of the proposed discussion strategies will result in: (1) a decrease in learners' cognitive load; and (2) an increase in the amount of higher level learning.

Method

Participants

Fifty nine undergraduate students enrolled in an online class in a large university in southeastern United States participated in the study. Six were eliminated from the study (reasons stated in the next session). The course offered an online discussion topic each week and students received credits for participation in online discussions. The majority of the participants were in majors related to family studies. Only two were from outside of the College of Human Sciences. All the participants were considered to have the similar pre-knowledge level of the subject. All of the participants were in at least the 3rd year in their program. As to experience of online discussion tools, nine out of 53 had not taken any online class before. Considering that all the participants had used online discussion for the 12 weeks before this study was conducted, we expected them to be equally experienced in using online discussion board.

Procedures of the study

The students were randomly assigned to one of five discussion groups: Example posting group, Filtered postings group, Limited number of postings group, Combination group, or Conventional group. All groups used the same discussion topic but different discussion strategies. Participants had access only to their assigned discussion group and were not able to see other groups' discussion.

Before the project began, it was approved by the Institutional Review Board for human subjects. Students gave their consent to participate in this study. They were asked to: (1) participate in the discussion at least once during week 13; (2) report their mental effort level right after they posted their postings for that week's discussion; and (3) take a quiz at the end of the week. Six of the 59 students were excluded from the analysis because each of them had missed at least one of the tasks. Other than completion of a course assignment, no additional incentives were provided.

Five groups

Example postings group: This group used a discussion forum with example postings. Two postings were presented to the group together with the discussion topic. The first example posting presented a profession and described a family with which this profession might work. It analyzed the situation of the family using the FDM model and listed possible operations suggested by FOM model for working with the same family. The second posting, described another family that a different profession might encounter and referred to the characteristics of family described in posting 1. It derives the abstract relationships between the conditions of the two families, and evaluated how posting 1 handled the situation. The participants in this group could construct their postings by referring to the scenarios provided in the two example postings and other participants' postings.

Filtered postings group: Participants in this group used a discussion strategy that only allows displaying information relevant to the discussion topic. The irrelevant postings were eliminated. Because none of the currently in use discussion boards has the function that allows the users to filter messages, we used a simulation for this group. We filtered and posted 10 messages in a simulated discussion board. Each actual participant saw 10 messages that seemed posted by 7 other students. Each participant saw the filtered content, but they could not see each other's postings. This ensured that the information each participant saw was identical.

Limited number of postings group: For this group we used a discussion forum that had limited number of postings on each page. In order to provide the same condition for participants in this group, a simulated discussion forum that contained pre-constructed postings by "fake" students were used. There were 14 discussion postings displayed in two pages (7 postings and the discussion topic on page 1 and 7 postings and a reminder messages on page 2). A note on Page 2 instructed participants how to go back to page 1 and how to link to the mental effort measure. This simulated a discussion board that contained no more than 9 messages on each page. Participants were expected to read the messages on page 1 and process them before they move onto page 2.

Combination group: For this group a combination of the three strategies (example posting + filtered message + limited number of message) was used. In addition to the discussion topic, 9 messages were displayed for these participants. The messages were carefully constructed by the researchers (including the instructor of the course) to discuss a new aspect of the discussion topic. Two of the 9 messages were example postings.

Conventional group: As our control group, participants used a conventional discussion board strategy. They were presented with the discussion topic at the beginning of the week. Participants could see each other's posting and were expected to read other's messages to find the similarities and differences and develop their own reflection on the topic.

Measures

Higher Level Learning

Content analysis of the discussion postings was used to measure levels of learning. Bloom's (1956) six levels of learning were used as coding categories. They are knowledge, comprehension, application, analysis, synthesis, and evaluation, from low level to high level. To conduct content analysis, each posting was divided into meaning units so that each unit was coded into only one category. The primary author coded all the units according to the categories. A second coder was trained and asked to code a sample of postings (three postings) randomly selected from the data. There was 100% agreement between the coders.

The following formula was used to calculate the percentage of higher level learning (PHL) for each posting. This percentage is the ratio of sum of the units coded as three higher levels of learning over the total number of units for all of six levels of learning. The higher the PHL value, the more percentage of higher level learning presented in a posting.

$$\text{PHL}=\frac{N(analysis)+N(synthesis)+N(evaluation)}{N(all)}$$

Mental effort level

Participants were requested to report the level of mental effort they invested in composing a discussion message. Mental effort is measured using 9-scale instrument developed by Paas, Van Merrienboer, and Adam (1994). 9 is the highest level of mental effort, 1 is the lowest level of mental effort.

Quiz score

All the participants took an online quiz at the end of Week 13. The quiz was designed to test the students' knowledge and understanding of the content discussed during this week. It consisted of 10 multiple choice questions. The participants' score on this quiz was calculated as part of their final scores of the course.

Instructional efficiency

In order to identify which instructional condition is the most efficient in terms of less demand on mental effort and greater learning outcome, instructional efficiency (E) is calculated based on the formula suggested by Paas and van Merrienboer (1993). Mental effort level is standardized and denoted as Z(ME). Standardized score of higher level learning (Z(P)) was derived at by using the learners percentage of higher level learning as their performance scores and then instructional efficiency for each strategy was calculated using the following formula:

$$E=\frac{Z(P)-Z(ME)}{\sqrt{2}}$$

Results

Strategies and mental effort

A calculation of mean mental effort reported by participants in each group revealed that the participants using the conventional strategy reported the highest mental effort level (M=7.14, SD=0.900). Compared to the conventional strategy group, the lowest mental effort exerted on the discussion of the topic was reported by the participants using the filtered posting strategy (M=5.75, SD=1.422). This was 19.5% lower mental effort than that of the conventional group. This was followed by the group using combination of the three strategies that reported 13.45% lower mental effort (M=6.18, SD=0.87). The group provided with limited number of postings on each page experienced medium level of mental effort (M=6.30, SD=1.337) and the participants in example posting strategy reported the least decrease in their mental effort (M=6.54, SD=1.05)

Higher level learning

The results of content analysis of the discussion postings with regard to higher level learning shows that participants in control group using the conventional strategy of discussion posting indicated the smallest proportion of higher level learning (38.1%). Learners in limited number of posting strategy indicated the highest proportion of higher level learning (72.5%). Participants in example, filtered, and combination strategy groups displayed better percentages (64%, 58.0%, and 48.3%, respectively) of higher level learning compared to the participants using the conventional strategy.

A One-way ANOVA test of group differences indicated significant difference between limited and conventional groups at .05 level (t=2.50, p=0.03). A significant difference was also found between example and conventional group at .10 level (t=1.78, p=0.10). According to the results of this examination, although participants in filtered and combination strategies outperformed conventional group, the differences were not significant.

The analysis of learners' performance on the quiz showed no difference across strategies. The quiz scores were found to be are positively skewed, with the range between 0 and 100 (100 is the highest possible score), mean of 74.3. The mean scores for participants in different strategies were as follows: Example group (M=65.4, SD=25.0), filtered group (M=77.5, SD=12.2), limited group (M=76.0, SD=12.7), combination group (M=77.3, SD=28.0), and finally the conventional group (M=74.3, SD=15.7).

Instructional efficiency

The analysis of the instructional efficiency data for each strategy, calculated according to the formula discussed earlier, indicated that the conventional discussion board was the least efficient (E=-.89). The filtered messages strategy was found to have the highest efficiency score (E=0.35) followed by the limited number of postings strategy (E=0.32). No instructional efficiency for example postings strategy was indicated (E=0.00). The combination strategy showed the lowest instructional efficiency (-.1094) among interventions right next to the conventional discussion strategy. A one-way ANOVA test of differences indicates that all of the four experimental conditions had significantly higher instructional efficiency comparing to conventional condition at .05 level.

Discussion

The results of this study clearly indicated that learners in conventional discussion group faced a heavy cognitive load placed by discussion task. Presumably the learners in online discussion processed part of the task and failed to perceive the latent relations and constructs of the materials which we contend was the reason for not achieving a higher level learning. Compared to the conventional group, participants in experimental groups reported lower level of mental effort indicating the success of our discussion strategies in reducing learners' cognitive load. The example postings strategy provided users with connections between their existing schema produced by their prior knowledge and new abstract concepts and relations. Moreover, example postings, we contend demonstrated processes for performing the task which directed the learners' attention to latent relations and relevant solutions. Similarly, filtered message strategy saved the cognitive resources needed to integrate relevant elements usually scattered around in discussion board. Limited number of posting strategy on each page broke the learning materials into several chunks of smaller size limited to working memory capacity to avoid overload.

We expected that the strategy of combining the three experimental strategies would reduce cognitive load at least as much of the most successful individual discussion strategy. The results showed the combination condition reduced cognitive load by 13.45%, second to our more successful strategy, filtered message strategy (19.5%). Then the question became why the filtered messages strategy, when combined with other strategies, lost some of its impact in reducing the cognitive load while we expected more than when it was offered individually. One can argue that the fact that this successful strategy was combined with two others (example and filtered strategies) might have created a redundancy effect of strategies which lead to their combined lower effectiveness. They seemingly placed heavier cognitive load because (1) each of the two example postings, and each of the seven filtered messages contributed new information which participants might have perceived important for the task and (2) example postings were different from other messages in nature since they included instructor comments requiring more cognitive capacity. Compared example postings group, combination group had more elements to handle and compared to groups using filtered messages and limited number of messages, the combination group needed to handle messages different in nature.

Another area of examination in this study was the impact of these strategies on the learners' acquisition of higher level learning. Our content analysis results indicated higher scores for our discussion strategies in terms of this acquisition when compared with the conventional discussion method. Learners using the example postings and limited number of postings strategies demonstrated significant gains over their counterparts in conventional group. The filtered messages group had smaller gain. The group using the combination of the three strategies produced the least improvement in acquisition of higher level learning.

Test scores have been regarded as measurements of performance. But no difference has been found in quiz score across groups in this study. Quiz score was not a good measurement in this situation because the online multiple-choice quiz tested students' lower level learning skills: recall of facts, understanding and ability to apply learned theory in given scenarios. Higher level learning was not the outcome for measure in the quiz, also higher level learning was not easy to be measured in multiple-choice quiz.

We also examined the instructional efficiency for the experimental strategies used in this investigation. According to the results of our analysis, we found our experimental conditions to be significantly more efficient than conventional discussion board at .05 level. These findings indicated that the discussion boards embedded with each of the four strategies will enhance students' learning with a lower level of mental effort.

To sum up the findings of this study, we propose that the experimental strategies used in this study, compared to the more conventional method of online discussion, are more effective in terms of enhancing students' gain in higher level learning. Because they were purposefully designed according to the CLT principles, they require less mental effort in part of learners using these strategies in their discussion of the online topics. Consequently, the strategies were found to be instructionally efficient in this learning environment.

These findings have some implications for designing and developing instruction and training materials. Designers should make an effort to reduce learners' cognitive load through the use of innovative strategies so that provide the learners with the opportunities for better performance. It seems that freeing some of the learner's mental capacity from extraneous load, usually imposed by not desirable instruction, will result in higher achievements of learning. It also appears that as a result of this cognitive capacity that is freed by appropriate instructional strategy, the learners will have a chance for integrating, synthesizing, and evaluating the new information which lead to the higher level learning.

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An Investigation and Comparison of Students' and Instructors' Perspectives of ICT Use in Higher Education

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Abstract

Recognizing perspectives of the members of university ensure success of ICT implementation. This study aims to compare and define some issues related to ICT use and expectations of students and instructors. 1282 undergraduate students and 211 instructors were participated in the study. Results showed that instructors have low expectancy while students have a higher expectancy related to bringing of ICT in education. Students want both in-class and online technologies while instructors believe the crucial need of in-class technology use. According to the instructors, technology use is less because of the technical deficiencies and lack of time, while the students argue that lack of knowledge of instructors cause less technology use in education.

Introduction

Today most of the universities develop some strategy plans and prepare investments for technology integration. On the other hand, almost all of them have some problems to convince all university members to use these technologies. According to Straub, Keil and Brenner (1997), ICT use is not only shaped by technical situations but also it is shaped by the nature of social environment, organizational dynamics and economical and psychological issues. Social pressure is one of the crucial issues while developing an acceptance model because this is a good motivation to encourage to use innovations (Anandarajan, Igbaria & Anakwe, 2002).Thus, in this study looking from two different perspectives, instructors and students, seemed important to understand whether both instructors and students have same language and whether students' expectations shape the instructors' use of technology. Researchers also proposed to look both students' and instructors' perspective to understand how they interact with each other in terms of technology use. Especially, this survey study is important to reveal the students' expectations from instructors and instructors' views on these expectations.

Higher education is significantly affected by the information and communication technologies. Technology use and integration is precious and return of this investment turns back in the long run. Therefore, this decision needs to be made with a careful planning (Mumtaz, 2000). Planning should begin with the awareness and readiness of users of technology and the view of all stakeholders should be considered. Instructors' and students' attitudes and motivations toward these technologies and their usage play a critical role to diffuse these technologies into educational settings. Understanding their attitudes and the reasons of avoidance provide us to present solutions. For this reason, opinions and expectations of these active users who use these technologies is very important. Effective technology integration can be provided if the technology is indeed available, if people are aware of it and if people are motivated (Perkins, 1985). The purpose of the study was to investigate the current situation of ICT use, opinions and future expectations in terms of integrating ICT in higher education from the students' and instructors point of view.

This study will be helpful for people who work on technology integration in higher education. In higher education it is not enough to take the opinions and expectations of faculties. Students' opinions are also crucial, because they are the ones who are directly affected by the use of technologies. They might also provide a technology integration suggestions if they really aware of benefits of technology. Looking from two perspectives will point out that total awareness of technology use in education. This study might also provide some findings related to conflict between instructors and students in technology use about the ways of effective technology use for to motivate students and to increase the effectiveness of instruction. Therefore, this study might provide new insights to see conflicts in technology integration and insights related how technology integration should be planned by considering each component of the system.

Method

The sample of the study consisted of 1282 students (639 males and 643 females) enrolling at Middle East Technical University (METU) and 211 instructors (119 females and 92 males) working at METU. Students were at least 1st grade attending a common course from the Modern Languages Department. Ratio of the students from the Faculty of Engineering was 48.1%, 18.3% from Faculty of Art and Sciences, 14.4% from Faculty of Economic and Administrative Sciences, 11.8% from Faculty of Education, 5.2% from Faculty of Architecture and 0.7% from graduate programs. The distribution of students' faculties represents the actual ratios of the students' profile at METU. Most of the students (84.5%) had been at METU for at least three years. This showed that students were knowledgeable at least about using Internet and computer technologies which is used generally at METU.
Within 211 faculties, 52 of them were professors, 38 were associate professors, 31 were assistant professors, 15 were lecturers and 69 were research assistants. The faculties' working period at METU ranged from 5 to 32 years. They have been using computers for 28 years on average. Their computer use per week was 30 hours on average, while their internet use was 11 hours per week.

Data were collected with two questionnaires which were different for students and for instructors. This questionnaire consists of close-ended and open-ended questions. It is divided into three sections. Students' questionnaire consists of 5 demographic questions. Second section includes 7 questions about technology use in education from students' points of view. These questions also have open-ended part to write their opinions. Last section covers 2 open-ended questions about the deficiencies in instructional technology use from students' points of view and their suggestions for modern campus.

Instructors' questionnaire consists of three main parts. First part includes gender, title, age and department, the time that instructors have been working at METU, weekly computer and Internet use related 6 demographic questions. The second part consists of 13 questions focusing on the current situation of the use of instructional technologies in courses, including questions targeting on whether the instructors are using web-based instructional tools, the frequencies of instructors' using instructional technologies in the courses, whether the instructors are thinking that they are using instructional technologies effectively, if there any technologies that they would like to use in their courses but could not use, whether Internet and computer use have a positive impact on the education given at METU, whether they are aware of and using Smart Classes at METU. The third and the last part of the questionnaire consisting of three open-ended questions, focuses on the future expectations of the instructors, the encouragements, support from the university for integrating instructional technology into education, and the technologies they would like to use in their courses in the future.

Results

Results of this study was presented in the parts of current situation for technology use, deficiencies in both perspectives, expectations from technology use and expectations from future. Students and instructors differ in terms of expectations and students have more positive views and expectations from technology. However it was observed that students do not like totally online classes. Both instructors and students mostly preferred to in-class technologies to comprehend content easily, however very few students' stated that technology makes courses attractive. Instructors also agree with students about technology improve quality of instruction. 40.2% of students expected regular handouts, 16.4% of them expected PowerPoint presentations with projectors, 56.6% of them stated they expected a rich learning environment with simulations and animations, and 45.4% of them wanted video related the topic. Some students stated that they hate presentations which instructors read just like a book. They also expected specialist people related to topics, active participation, discussion environment and more practice. To provide active learning, 45.4% of students expected Internet based communication tools which provide effective communication with instructor, and most of students (75.5%) stated that they wanted a course web site they easily find lecture notes and additional resources. LMS (NETclass) used by METU also demanded by 21.8% of students, because it can provide most of web applications students demanded. However, students expected full online courses rather less than students wanted other kind of educational opportunities, 10.7% of students stated they wanted online courses. Most of instructors stated that they use technology effectively by 54.9%.

84% of them answered the open ended question; "why technology use is important for your department?". About 24% of them stated that visual materials and tools provide easy presentation, 20% of them stated that their course requires technology and 13% of them thought that it provides time management. "Other" parts, of open ended questions revealed that if the instructors can follow developments in the world, courses become more attractive, students learn effectively and interaction increases by means of technologies. On the other hand, the students argued that instructors tend to use traditional methods. According to the students, most of the instructors use blackboard in classroom by 78.6%, and namely hard copy by 52.3%, overhead-projector 65.6%, computer-Internet by 29.3% and a few video by 6.6%. Students accepted that instructors use computers in classroom but they also stated that use of computers and projectors is limited to presenting the text based content. This situation shows that although there is a rapid change in technologies, traditional habits in instruction is difficult to change. On the other hand, most of instructors argued that they use technology effectively; however some of them reported that they sometimes have problems with hardware, lack of support personnel, and lack of training about education and technology integration into their course content.

Most of the students (90.5%) use the Internet (90.5%),computers (79.8%), hard copy material (72%), communication tools like chat-forum- instant messaging (34.2%), cell-phone (19.5%) and sound-recorder (4.7%) for educational purposes. Most of them thought that online courses are limited with online resources and assignments in the university learning management system. Students who stressed the inadequate knowledge of instructors about technology integration commented on the open-ended part of the deficiency question. In addition to faculties' lack of knowledge, students stated that faculties do not want to use technologies even if required conditions are available. Other deficiencies related with technology use by faculties are that faculties find technology use difficult, tell the lecture as reading texts from presentation, use technology ineffectively, do not spend time for technology integration, and they are unwillingness to use technology.

Both students and instructors were asked what they would like to see as technology in classrooms with open ended questions. First five preferences of students are access of online course content (13.8%), access of video and sound recording of courses (6.8%), online elective courses (5.7%), improvement of technological infrastructure (4.8%) and more course-related technologies like physical experiment settings (4.3%). On the other hand, instructors' choices are a bit different from students. 58 of instructors answered this question and ratios were calculated in accordance with number of 58. Instructors stated that if they had a chance, they would like to use smart boards in their classroom by 27.5%. Smartboards are becoming common at METU, however most of them do not use them. Other preferences of instructors are namely computers (31.0%), projectors (24.1%), Internet technologies (13.8%) and software like modeling or simulating (12.1%). Considering the departments of the students and instructors, it is obvious that engineering departments need to use simulation and modeling. These results implied that instructors are in need of in-class technologies. On the other hand, students would like to reach course content anytime everywhere, thus they want mobilized course content mostly.

Most of instructors (21.4%) stated that technology use is limited because of the insufficient hardware. 12.7% of them also stated that the time limit in their classes is the reason for insufficient technology use. Other reasons they stressed are crowded classrooms (11.8%), lack of knowledge about technology use, lack of knowledge of integration with technology and course content, and insufficiency of software (9.1%). Open ended-questions also supported these findings, instructors stated that they have problem with inaccessibility of hardware, lack of support personnel and lack of training about education and technology integration. According to the findings from student questionnaires, open ended-questions also revealed similar results. They stressed the biggest deficiencies in technology use is insufficient computer related hardware (10.5%), inadequate laboratory conditions (7.6%), lack of Internet tools use (7.4%) and lack of instructors knowledge about technology (7.2%).

Conclusions

In developed countries interest in use of technology in classroom has shifted to effective use of these technologies. However in Turkey, we still need more technology integration. Especially students have a big prejudice about online courses (Inal, Karakus & Cagiltay, 2007). The study showed that students want to have online access to course content, while they are not willing to take online courses. Therefore, new studies should investigate how students' and instructors' perspectives can change in favor of online education and underlying reasons of this hesitation. They want to be active in classrooms and to develop a warm relationship with instructors by means of online communication tools. Classroom and laboratory conditions and technology fluency of instructors are seen two major obstacles for technology integration. Results suggested that instructors should be trained about how to use the Internet and multimedia technologies effectively in their courses. Using technology should not be meant as teacher-centered instruction but as students suggested, technologies should be used to make students active. Communication tools should be provided by university to provide student-instructor interaction, thus this active participation can be achieved.

Students expect quick feedback, timely answers about course context, and effective guidance of facilitator, broad content, more social interaction and communication opportunities for online education (Inal, Karakus & Cagiltay, 2007). These expectations also consistent with Langenberg and Spicer (2001)'s investigation that instructors are turning to "knowledgeable mentor" and "learning facilitator" in education. Lack of meeting these expectations might cause the students' disagreement with online education opportunities providing a high quality for university education like in this study. Therefore, universities should improve the quality of online courses by considering students' expectations. This study's results also improve this finding by its results that students prefer online opportunities to communicate with instructors and to reach course materials easily more than online course opportunities.

This study presented a current situation of technology use in perspective of students and instructors in the one of the most leading university in Turkey. Study results showed that both students and instructors are willing to use in-class technologies related to subject matter while they hesitate to use online technologies totally. METU, as a modern university, can minimize the deficiencies, pitfalls and problems, and support the expectations with a carefully strategy plans. This study might be helpful for planning these strategies by presenting the current situation of technology use from instructor's perspectives.

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The Impact of Text Messaging on the Community of Inquiry in Online Courses

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Abstract

As more students become comfortable with sending and receiving text messages, text messaging is emerging as a tool educators are using for multiple purposes in both face-to-face and online courses. This research study investigated the impact of using text messages to convey course information for six online courses, taught by one instructor, as measured by the Community of Inquiry survey instrument. Text messages communicated course information, including reminders of assignment due dates, notification that assignments have been graded, and short feedback on discussion postings. Students completed a Community of Inquiry (COI) survey and a survey on their reaction to using text messages in the course. Overall results indicate that students reacted positively to receiving text messages. COI survey results indicated, however, that there were no significant differences between students who received text messages and students who did not receive text messages in their perception of social presence, cognitive presence, and teaching presence as represented by the COI framework. This lack of significance may be partially attributable to the instructor's extensive prior experience and success in online teaching.

Introduction

The current trend in research regarding cell phone usage in higher education appears to privilege its use as a learning tool or instructional delivery device. In the research, two terms associated with cell phone use are used interchangeably, namely, text messaging and Short Messaging Service (SMS). Both of these terms refer to the ability to send and receive short text messages on a cellular device. A third term, instant messaging (IM), is also found in this body of literature. Instant messaging refers to conversational and immediate text communication between two people. IM communication can occur between two computers, two phones, or a computer and a phone.

Mobile technologies, especially cellular phones, are intriguing to educators because these technologies are small, relatively inexpensive, and ubiquitous—almost every student has a cell phone. As Markett, Sánchez, Weber, and Tangney (2005) note, mobile phones "require no technology training, and are not intimidating" (p. 282), therefore their use is often seen as low risk and low cost. However, the use of cell phones in education is often contentious. Some educators support the idea of exploring educational uses of cell phones (Kolb, 2007), while other educators stress the potential problems that cell phones can introduce in educational settings (Allen, 2007). One often mentioned potential problem with cell phones is the ability of students to text each other information related to tests. For example, in a nationwide survey (Obringer & Coffey, 2007), 80% of the high school principals that completed the survey indicated that they felt text messaging is a problem, or a potential problem, during tests and examinations. Those who argue in favor of using cell phones point to the potential positive aspects of text messaging, including the ability to help students learn course content, help people change their behavior, and help build a stronger community of learners in online courses.

In the area of learning course content, learning vocabulary is a common focus of text messaging research. Researchers such as Lu (2008) examined the effectiveness of Short Messaging Service (SMS) on second language acquisitions, while Cavus and Ibrahim (2009) used SMS to support the learning of new technical English language words. In another study, Thonton and Houser (2005) found Japanese students learned significantly more vocabulary when they received vocabulary lessons via text messages on their phones compared to students who received the same information in a paper format. Goh and Hooper (2007) explored the use of SMS crossword puzzles as a means to engage students and to promote interaction through learning activities, and Uzunboylu, Cavus and Ercag (2009) used SMS combined with student photographs to portray local environmental blights thereby increasing students' environmental awareness. Text messaging has also been studied in the context of changing behavior patterns.

In a study by Riley, Obermayer, and Jean-Mary (2008), student smokers were aided in a smoking cessation intervention through the use of a combination of text messages and web-based resources. The outcome indicated positive results in the number of study participants who quit smoking and those participants who continued to smoke reported reduced smoking rates. Another example of the use of text messaging in relation to health behaviors is a study by Gerber, Stolley, Thompson, Sharp, and Fitzgibbon (2009). In this study, healthy eating and activity tips, expressions of encouragement, and general health text messages were sent three times a week to participants who had already undergone a weight reduction program. These messages were designed to encourage continued healthy behaviors. In a review of fourteen studies of text messages used to support changes in health behavior, Fjeldsoe, Marshall, and Miller (2009) found thirteen of those studies showed positive behavior changes, especially when messages were tailored to a specific situation.

While these aforementioned studies are all very worthwhile endeavors, there is a gap in the research regarding the use of cell phone text messaging as a tool for learning course content or affecting behavior and using text messaging for building a community of inquiry and promoting interaction in online courses.

Although there are many opportunities for students and the instructor to interact in an online environment, text messaging provides a means of contacting students about the course in a way that does not necessitate them being online and takes advantage of the ubiquity of cell phones on today's college campuses. Additionally, research has pointed to the importance of creating a Community of Inquiry (COI) in the online environment (Anderson, 2004; Garrison, Anderson, & Archer, 2000; Garrison & Arbaugh, 2007; Swan, 2001). A COI as defined by Garrison et al. (2000) refers to the environment created by teachers and students where meaningful learning is defined by the elements of cognitive presence, social presence, and teaching presence.

Cognitive presence (Garrison et al., 2000) is defined as the extent to which participants are able to construct meaning through sustained communication. Categories for cognitive presence include triggering events, exploration, integration, and resolution. Shea, Pickett, and Pelz, (2003) elaborate the term by adding that it is achieved in concert with satisfactory social presence and effective teaching presence. Examples of cognitive presence include student questions, expressions of confusion and indictors of students making connections and building new knowledge.

Kehrwald (2008) defines social presence as "… the means by which online participants inhabit virtual spaces and indicate not only their presence in the online environment but also their availability and willingness to engage in the communicative exchanges which constitute learning activity in these environments" (p. 94). Garrison et al. (2000) describe social presence as the ability to project oneself as a real person (one's full personality) both socially and emotionally in the online environment. The original categories of social presence, as defined by Garrison and Arbaugh (2007) are affective expression, open communication, and group cohesion. Social presence can be identified by the use of emoticons to express oneself, idioms and more informal and familiar language, and evidence of students helping each other out in a collaborative manner. Garrison and Arbaugh also suggest that activities which cultivate social presence can enhance the learner's satisfaction with the Internet as an educational delivery medium and to that we add that the use of SMS also supports student satisfaction.

Teaching presence as defined by Anderson, Rourke, Garrison, and Archer (2001) is "…the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes" (p. 5). Based on this definition, the authors distill three components or elements of teaching presence: instructional design and organization, facilitating discourse, and direct instruction. Examples of teaching presence are the instructor resolving misunderstandings and correcting misinformation that appears in discussion postings, moving the discussion along in a timely manner, keeping the discussions relevant and on track, as well as encouraging students to participate online and share their thoughts and ideas.

Due to the widespread use and support of the COI framework for defining attributes of effective online learning (Garrison & Arbaugh, 2007), the COI instrument was selected as the tool to measure student perception of teaching presence, social presence, and cognitive presence in this study.

Research questions

This research project investigated the impact of text messages on student perception of the sense of community of inquiry and student reaction to receiving cell phone text messages conveying course information and in online courses. The specific research questions were:

- Does the use of text messaging in online courses increase student perception of the community of inquiry?
- What is student reaction to receiving text messages related to course content?

Methodology

Participants in this study were students in six graduate-level courses, taught online by the first author, at a large Midwestern university during two consecutive academic semesters. Students were solicited to participate in the study during face-to-face orientation sessions and also via email. Since the study entails the use of a cellular phone and text messages, some students were unable or unwilling to participate due to a number of reasons, including not owning a cellular phone, not having unlimited text messaging, or simply not wanting to receive text messages. All students who volunteered for the study signed a consent form. Students in the study were randomly assigned to one of two groups. One group received text messages throughout the semester; the other group did not receive text messages. To avoid inundating students with text messages, the consent form indicated that students would receive no more than two text messages per week. A total of 52 students signed up for the study.

Students in the study supplied a cellular phone number to the instructor and indicated the types of messages they wanted to receive. There were five options for types of messages students could receive: 1) reminders of due dates for assignments; 2) important vocabulary; 3) short feedback on discussion postings; 4) notification that an assignment had been graded; and 5) course related teasers (e.g., quality web sites related to course content, links to online videos related to course content, relevant research articles). All students elected to receive text messages to remind them of due dates for assignments and to be notified when an assignment had been graded. The other options were chosen less frequently. Approximately half of the students elected to receive all five types of messages. There was no limit regarding how many of the five types of messages the students could choose to receive.

Procedures

At the beginning of each semester, the first author entered student-supplied cellular phone numbers into her cellular phone, along with the student's name. During the first week of class, the instructor sent a text message to each student to insure that text messages were received. Throughout each semester, a one or more of the five types of text messages were sent to students. The most frequently sent messages had to do with due date reminders and notification that assignments had been graded.

The instructor typed and sent all text messages through her cell phone rather than using an online text messaging service. While this approach added time and complexity to the process, the instructor felt it was important to keep student cellular phone numbers private and to control when text messages were sent.

Due date reminders were sent approximately two days before assignments were due, but were only sent to students who had not yet submitted the assignment, therefore even if a student was participating in the study, that did not mean the student would receive a particular text message. A typical reminder was, "Just a reminder that your project 3 is due by Wednesday, Feb 25 by 11:00 pm."

In order to take advantage of the immediate nature of text messages, text messages to alert students that projects had been graded were sent within minutes of a grade being posted in the online grade book. A typical text message alerting a student that a project had been graded was, "I've graded your tool project. Excellent! You earned the max # of points." Since the instructor wanted students to access the course management system to review detailed feedback, the text message only indicated that the project had been graded and the number of points earned.

An example of a discussion posting text message was, "I enjoyed reading your posting about mobile learning. I can see from your post that you have given the use of mobile technologies serious thought and consideration. It will be interesting to learn about the results of your trial of using text messaging with your students." For vocabulary, one of the terms defined through a text message was *cloud computing*. The text message to define *cloud computing* was lengthy and time-consuming to enter. An example of a teaser was a text message about a new technology, *siftables*. The text message of the teaser was, "Check out this video on siftables. Looks pretty cool. http://siftables.com" At the end of the semester, all students who participated in the study were asked to complete the validated Community of Inquiry survey instrument (Arbaugh, Cleveland-Innes, Diaz, Garrison, Ice, Richardson, & Swan, 2008; Shea, Swan, Li, & Pickett, 2005) and those who received text messages were asked to complete the Cell Phone Text Messaging Survey.

The COI survey consists of 37 Likert scale items with a score of 1 representing strongly disagree, 2 disagree, 3 neutral, 4 agree and 5 representing strongly agree. Additional multiple choice questions included were: 1) What grade do you expect to receive in this course? 2) Gender 3) Age Group 4) Did you receive text messages during this course? 5) How many online course have you taken?

The Cell Phone Text Messaging Survey is designed to measure student reactions to and impressions of the cell phone text message strategy. This survey consisted of 13 Likert scale questions with two open ended questions soliciting additional comments about receiving text messages and ways to improve text message usage within the course.

Results

A one-way ANOVA was computed to compare the Community of Inquiry survey score across the two levels of cell phone text messaging. The dependent variable was the score from the COI survey and the independent variable was the cell phone text message, received yes or no.

Table 1
ANOVA Results of Community of Inquiry Score by cell phone text message

ANOVA

COI

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	560.784	1	560.784	2.623	.114
Within Groups	7911.882	37	213.835		
Total	8472.667	38			

There was not a significant effect of cell phone text messaging on the COI score at the $p < .05$ level for the conditions $F(1,37) = 2.623$, $p = .114$, n = 39. R Squared = .066 (Adjusted R Squared = .041), therefore only 6.6% of the variability in the COI score is explained by the cell phone text messages.

Cell Phone Text Messaging Survey

The Cell Phone Text Messaging Survey is based on similar surveys found in the literature. There were fifteen items in the survey instrument, thirteen Likert-scale items and two open-ended items. Only students who had received text messages completed the survey. A total of 24 students completed the survey. Although students were reminded at least twice to complete the survey, not all students who received text messages completed it. Table 2 contains results in percentages.

Descriptive statistics indicate that the majority of students agreed or strongly agreed that text messages were a good way to receive course information (95.2%), that receiving text messages were useful (91.3%), and that receiving text messages was fun (95.2%). Over eighty percent of the students (82.6%) indicated that it is normal for them to receive text messages, and even though the majority of students did not think that receiving text messages was annoying, there were students (13%) who thought receiving text messages was annoying at times. A majority of students did log into the course management system shortly after receiving a text message (82.6%) and they were either neutral about (30.4%) or liked (69.6%) being able to determine the types of messages they received. Similar results were obtained when students were asked about their satisfaction with the number of text messages they received. Thirty percent were neutral about the number of messages received, while 69.6% agreed or strongly agreed that the number of messages received was about right.

Over half of the students indicated they did not text back (52.5%) to the instructor and only 13% of the results indicated that a text message to the instructor was initiated at least once during the semester. Less than 10% of students thought that the text messages did *not* help them stay up-to-date with the course, a little over one-quarter of students were neutral on this item (26.1%), but the majority (65.2%) either agreed or strongly agreed that receiving text messages did help them stay up-to-date. Just over ninety percent of the students (91.3%) felt that text messaging can serve a useful purpose in education and over eighty percent (82.6%) felt that receiving text messages was a positive aspect of the course.

Table 2
Cell Phone Text Messaging Results

Survey items					
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Receiving text messages on my cell phone is a good way to communicate course information.	0.0%	0.0%	4.3%	34.8%	60.9%
I received course information that was useful to me through text messages on my phone.	4.3%	4.3%	0.0%	34.8%	56.5%
I tended to login to Vista within several hours of receiving a text message.	8.7%	8.7%	26.1%	26.1%	56.5%
Receiving text messages was a fun way to get course information.	0.0%	0.0%	4.3%	34.8%	60.9%
Receiving text messages was annoying at times.	60.9%	13.0%	13.0%	8.7%	4.3%
I frequently texted back to the instructor after receiving a text message from her.	34.8%	17.4%	21.7%	8.7%	17.4%
I constantly use my cell phone, so receiving text messages is normal for me.	4.3%	4.3%	8.7%	26.1%	56.5%
I liked being able to determine the types of text messages I would receive.	0.0%	0.0%	30.4%	34.8%	34.8%
I received just about the right number of text messages from my instructor per week.	0.0%	0.0%	30.4%	34.8%	34.8%
I initiated text messages to my instructor at least once during the semester.	52.5%	21.7%	13.0%	8.7%	4.3%
Receiving text messages helped me stay up-to-date with this course.	0.0%	8.7%	26.1%	17.4%	47.8%
Text messages may serve a useful purpose in an educational setting	0.0%	4.3%	4.3%	30.4%	60.9%
Receiving text messages was a positive aspect of the course	0.0%	0.0%	17.4%	21.7%	60.9%

Students who provided responses to the open-ended questions were positive about receiving text messages. Examples of statements include:

> *"The text messages about links to different technology (siftables) was really engaging. It helped [me] to stay engaged in what we were working on."*
>
> *"I loved receiving text messages with course info and grades! It was never annoying."*
> *"It was very rewarding to receive a positive text message like, 'Good job on your journal.'"*
> *"The text messaging kept me on track and I felt connected to the teacher for the course. The feedback was very beneficial and I'm so thankful that I was able to participate. This was my first experience with online course work and the texting helped me feel in touch. [The instructor] does an awesome job with keeping online learners actively engaged!"*

Although few suggestions were offered for how to improve the use of text messages in the online classes, one student recommended that the first message be an introductory message that clearly identifies that the message is from the instructor. Another student recommended that "other professors should use this technique to communicate."

Discussion

This study was undertaken to investigate the effect of cell phone text messages on student perception of the effectiveness of the learning environment they experienced in online courses, as measured by the Community of Inquiry framework. The researchers sought information to inform how the use of text messages in online courses could enhance the online learning experience. While the results of the COI survey did not show significant differences between students who received text messages and students who did not receive text messages, there were, nevertheless, important and noteworthy results.

First, the instructor found that texting students contributed to a stronger feeling of connectedness to those students. In much the same way that students appreciate interaction from an instructor, many instructors are pleased when students engage in both formal and informal modes of communication with them. Even though only a few students sent text messages back to the instructor, those who did opened up additional lines of communication and reinforced the use of text messages and the notion that text messages can be a positive aspect of an online learning experience.

Second, the use of text messaging appeared to encourage students to log into the course management system (over 80% of students indicated they logged in shortly after receiving a text message). Since much of the work of online courses takes place within a course management system (e.g., online discussions, emails, course announcements, submission of assignments), when students log in on a frequent and regular basis, they may be more successful in meeting course goals, feel more connected, and be less prone to drop out since they are more apt to be up-to-date on course expectations, requirements, and announcements.

Third, students were positive about receiving text messages. As results from the Cell Phone Text Messaging Survey indicate, students thought that communicating course information via text messages was a good idea as well as a useful one. Giving students choice and control over the types of messages they received was also seen as positive by students.

Several aspects of this research proved challenging and should be considered in similar studies of this nature. When the study first begins, the instructor should clearly indicate whether he or she is open to receiving text messages from students. Students were unsure as to whether they were to text back to the instructor or initiate text messages to the instructor. Informing students that they were welcome to send text messages to the instructor may have further enhanced communication about course content as well as increasing the students' perceptions of social presence. As one student noted, "I guess I didn't realize that texting back was an option. If I had been more aware of that I would have definitely sent back information."

The process of composing and sending text messages is another area warranting careful thought and planning to better control the level of complexity in sending text messages. The instructor compiled a list of students participating in the study along with the types of text messages these students elected to receive. In order to send reminders of due dates, for example, the instructor had to refer to the list to determine if a particular student was to receive a text message, verify which type of text message they were to receive, insure that the student had not already turned in the assignment to be graded (early), compose the text message, and finally send it. The instructor also discovered that providing feedback on discussion postings via cell phone text messages was extremely time consuming, since to be most effective, the instructor felt the text message needed to be customized to a student's specific posting. In addition, these text messages were fairly lengthy. For these reasons, only a few text messages were sent providing feedback on discussion postings. An option for future consideration is the use of pre-written posting responses that would be, of necessity, more general in nature, but could nevertheless convey the instructor's assessment of the overall quality of the posting.

Two types of the five text messages provided were problematic; text messages for vocabulary and text messages for course content teasers. Since vocabulary is addressed in this instructor's courses through targeted terminology assignments, there were not many additional vocabulary terms that students needed to learn. And, with the high level of activity in online courses, the instructor struggled with what types of teasers to send, as well as when these types of messages are best sent.

In addition to the above challenges, there are several limitations in this study worth noting. First, this study was conducted across several online classes taught by the same instructor. Participants in this study were very satisfied with the instructor, rating her 4.8 on a scale of 5.0. Secondly, students rated their overall satisfaction with the course as 4.66, and they rated their learning 4.56 out of 5.0. Because of their satisfaction with the course, their learning, and the instructor, the findings of no significance in this study appear logical. The instructor has many years of experience in teaching online and is well versed in effective online teaching strategies. Because of these high average scores regarding student satisfaction, it is possible that the addition of cell phone text messaging did not significantly add to students' perception of a community of inquiry because teaching presence, social presence, and cognitive presence were already established. The authors encourage further investigation into the effect of cell phone text messaging on student perceptions of a community of inquiry across a variety of instructors and with a larger sample size.

Convenience sampling was used, from which the cell phone participants were randomly assigned to participate in the study; however non-probability sampling limits the generalizability of the results to other similar populations, and introduces sampling bias into the study. It is also important to note that participants in the study were limited to those who had cell phones and who were willing to incur possible additional fees associated with text messaging.

Conclusion

As instructors continue to explore ways to enhance online learning experiences, text messaging may be one technique worth further investigation. In this study, mean scores on the COI instrument indicated that student perception of the components that comprise the Community of Inquiry framework were high. Students were also highly positive toward the use of text messages, as reflected in the Cell Phone Text Messaging Survey. Student comments further support the positive reaction to the use of text messaging to convey course information. As one student stated, "I would just continue with it."

Future studies may want to limit the types of text messages students can receive to two or three, rather than five; include larger sample sizes and multiple instructors; and investigate the use of online text messaging services. Additionally, other frameworks for investigating the educational and social effects of instructor initiated, course relevant, cell phone text messaging should be considered.

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Online, Face-to-Face, and Hybrid Learning: Which Model Takes the Most Time?

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Abstract

This article compared the actual amount of time that graduate students enrolled in three different learning delivery models spent completing assignments. It was hypothesized that graduate students enrolled in online classes would spend more time in class preparation than students enrolled in either face-to-face or hybrid classes. Participants in the study consisted of 10 online students, 10 face-to-face classroom students, and 27 hybrid classroom students. While the course content was the same for all participants, the difference among the three groups was the delivery model. Data gathered through surveys were analyzed by ANOVA in order to measure whether or not there were significant differences between the group means. The online students reported that significantly more time was required to complete their work than did students in the hybrid group.

Technology is changing the way that teachers teach and students learn. The Internet allows students to connect, collaborate, and engage the world (Tapscott, 2009). Garrison and Vaughan (2008) point out that universities and colleges must keep up with these changes in order to make learning relevant and engaging for today's student. Another challenge facing colleges and universities is the shift in demographics. According to Ausburn (2004), part-time adult learners are the new majority in higher education, comprising over 50% of the postsecondary student population. Robinson and Hullinger (2008) posit that the advent of the Internet and the Web has brought sweeping transformation to higher education and has facilitated learning environments for online classes. Ausburn also notes that nontraditional working adults, age 26 and older, comprise the largest group for online learning. These students often work full-time and cannot commit to traditional classroom based instruction that follows a rigid schedule. In order to accommodate these students, many universities and colleges are offering adult students greater numbers and varieties of online classes (Ausburn, 2004). Online classes are taught mostly on the Web while hybrid classes combine the traditional face-to-face class meetings with online course sessions. A class is web-enhanced if its traditional classroom course uses the Web to enhance the course's content (Shelly, Cashman, Gunter, & Gunter, 2008). The Sloan Consortium, a nonprofit group devoted to integrating online learning into mainstream higher education, reported that 4 million students in the United States took at least one online course in 2007 ("Tech Smart," 2009). Just three years earlier, the reported enrollment for online courses was 2.3 million. According to Hughes and Hagie (2005), there is no evidence that enrollment rates in online courses will slow.

The emergence of online education, brought about by the advent of the Internet (Robinson & Hullinger, 2008) and its subsequent growth, has been driven by student demand (Tabatabaei, Schrottner, & Reichgelt, 2006). In online classes, students and instructors do not see each other face-to-face, but interact through technology assisted components such as e-mail and discussion boards. Course content can also be conveyed through video, photographic, and/or audio arrangements (Hughes & Hagie, 2005). Online education is flexible in that it is available 7 days per week, 24 hours per day in an asynchronous environment (Osman, 2005). To be successful in the cyber schoolhouse, students must possess basic technology skills and access to the Internet.

Need for the Study

While studies have investigated whether or not online learning is as effective as face-to-face learning in achieving learning outcomes (Robinson & Hullinger, 2008), a search of the literature revealed no studies that compared the actual time spent on assignments among the three delivery models: online, face-to-face, and hybrid learning environments.

Review of the Literature

Online learning solves the problem of working professionals, single parents, military personnel and those in rural areas who cannot enroll in traditional higher education classes due to their schedules and physical location. While traditional face-to-face classes have a set time and place, the online classroom is available 24 hours per day (Mentzer, Cryan, & Teclehaimanot, 2007). Many studies have been conducted comparing online and face-to-face classrooms (McCray, 2000; Mentzer et al.,2007). Keegan (as cited in Simonson, Smaldino, Albright & Zvacek, 2000) states that the online learner and the local learner in the face-to-face classroom should have experiences which are of equal value even though these experiences might be quite different. While research supports (Dennis et al., 2006) that student learning is equal in online and face-to-face classes, it has been noted that students in online classrooms are less satisfied with their learning experiences (Mentzer et al., 2007). Miller, Rainer, and Corley (as cited in Mentzer, et al., 2007) found that online students reported that the negative aspects of an online class included procrastination, poor attendance, and a sense of isolation.

Other researchers suggest that online students may be of a different “ilk” than students who enroll in a face-to-face class (Daughenbaugh, Surrey & Istam as cited in Mentzer et al., 2007). Students who enroll in online classes may have other obligations in addition to attending school, a factor that could result in their achieving lower grades. A second factor could be that online students who succeed in the cyber classroom view online education as advantageous due to its greater flexibility and convenience (Tabatabaei, Schrottner, & Reichgelt, 2006).

Mentzer, Cryan, and Teclehaimanot (2007) compared learning outcomes and student perceptions of and satisfaction with two sections of the same course. Students were randomly assigned to either an online or a traditional face-to-face class, taught by the same instructor. While test performance was equivalent for the two groups, over-all grades were higher in the traditional face-to-face class due to the many incomplete assignments in the online class. In addition, students in the face-to-face class rated the course statistically higher than students in the online class. The researchers concluded that the encounter with the instructor resulted in greater motivation for the students in the face-to-face class.

Online learning demands that students make a hefty time commitment as well as take more responsibility for their own learning (Simonson, Smaldino, Albright, & Zvacek, 2000). In one study (Bambara, Harbour, Davies, & Athey, 2009) students reported that their online classes required more time than traditional face-to-face classes because they had to teach themselves rather than relying on the teacher for instruction. Moreover, some reported that online classes required more time and effort than they had planned to invest in preparing, organizing, and managing their resources.

Face-to-Face Classrooms

Traditional education can be defined as education that “takes place at the same time in the same place” (Simonson, Smaldino, Albright, & Zvacek, 2000, p. 7). The practice of teaching adults in face-to-face classrooms has its roots in antiquity and could be said to have begun with philosophers and religious leaders such as Socrates, Plato, and Jesus. Socrates used a dialectical question-and-answer approach that is now called the Socratic method (Ozmon & Craver, 1999). Although Socrates left no written record of his methods, Plato, his disciple, illustrated the Socratic method through many written dialogues which scholars today refer to as Platonic philosophy. To use the Socratic dialectic effectively, students needed training, experience, and maturity (Ozmon & Craver, 1999). Jesus, too, was a master of the Socratic question-and-answer technique (Price, 1946). This traditional face-to-face learning environment provides a synchronous mode of communication which fosters student engagement and motivation as well as immediate feedback from instructors (Dennis et al., 2006).

Online Classrooms

Online classes, obviously, are not rooted in antiquity. Rather, the online classroom has evolved from the concept of distance education which occurs when “the learner is physically separated from the teacher” (Rumble as quoted in Simonson et al., 2000, p. 7). The earliest distance education dates to 1833 when a Swedish newspaper offered a correspondence course in composition. This new educational phenomenon, the correspondence course, spread first to England and then to Germany before finally arriving in Boston in 1873. When the University of Chicago was founded in 1890, a university extension was created with correspondence study as one of its five divisions (Simonson et al., 2000). The next innovation in distance learning came in the form of audio recordings for the blind. During the 1920s, technology expanded to include radio, and by the 1930s some universities were experimenting with television, although it was not until 1951 that the first university courses via television were offered for college credit at Western Reserve University (Simonson et al., 2000). As satellite technology became more sophisticated in the 1960s and more cost effective in the 1980s, instructional television spread to such remote areas as Appalachia and Alaska. The development of fiber-optic communication systems in the late 1980s and the early 1990s allowed communication via television to become two-way, with high-quality audio and video systems (Simonson et al., 2000). Distance education as we know it today is a result of computer mediated communication made possible through the Internet. Today, hundreds of courses are offered totally online, with students never meeting the instructor in person.

Online education requires students to possess basic technology skills as well as access to the Internet. The flexibility of online learning allows learners to study at their convenience because the online classroom is available 24 hours a day, 7 days per week in an asynchronous environment (Osman, 2005).

Hybrid Classrooms

Since learning is a social practice (Knights, 1993), the communal dimension of learning should not be undervalued. Knights points out that groups can exert a powerful influence to advance learning. According to London and Sessa (2006), a group can be defined as "two or more people who interact with each other to perform a task" (p. 304). The outcome of learning in groups can be multiple perspectives and idea-sharing. One disadvantage that online learners note (Rovai & Jordan, 2004) is that online learning is often a solitary experience. Many online learners miss the personal interaction with peers and instructors (Bambara et al., 2009). Hybrid classes could be the solution to the problem. Hybrid classes represent the thoughtful integration of face-to-face and online learning delivery models that blend the strengths of each into a "unique learning experience congruent with the context and intended educational purpose" (Garrison & Vaughan, 2008, p. 5). Hybrid learning is any "combination of self-paced, instructor-led, distance, and classroom delivery with various digital and print form factors" (Bonk & Graham, 2006, p. 97). It could be that hybrid classrooms may offer today's student the best of both worlds. Just as hybrid cars combine electricity and gasoline to produce a more efficient mode of transportation, hybrid classrooms combine traditional face-to-face classroom instruction and technology-assisted instructional techniques with the goal of creating a more efficient learning environment that increases student engagement. Students in a hybrid classroom have the advantage of personal contact with the instructor as well as the flexibility of online delivery. Garrison and Vaughan (2008) posit that education is "best experienced in a community of inquiry" (p. 26). Rovai and Jordan (2004) found that students in hybrid courses experienced "stronger feelings of community" (p. 10) than did students in either face-to-face or online classes. Hybrid education is the new buzz word in education circles—especially in higher education circles. Hybrid courses are changing the way instruction is delivered and the way that students learn (Ausburn, 2004; Buzzetto-More & Sweat-Guy, 2006; McCray, 2000; Reynard, 2007). The modern teaching and learning environment demands new teaching and learning strategies (Rovai & Jordan, 2004). Rovai and Jordan also note that a discussion that is started in a face-to-face class can be extended to an online discussion that permits time for reflection.

Purpose of the Study

The purpose of this study was to compare the actual amount of time graduate students enrolled in face-to-face, online, and hybrid classes spend on assignments in order to determine which delivery model is the most efficient.

Hypotheses

This study was designed to allow the researcher to test the following hypotheses.

Research Hypothesis I: Graduate students enrolled in an online course will spend more time in class participation than graduate students enrolled in a traditional face-to-face classroom.

Research Hypothesis II: Graduate students enrolled in an online course will spend more time in class participation than graduate students enrolled in a hybrid course.

Null Hypothesis: There will be no difference in the amount of time spent in class participation of graduate students in an online class when compared with graduate students in a traditional face-to-face class.

Research Question

What is the difference in the time spent preparing assignments for graduate students enrolled in an online class when compared with graduate students enrolled in a traditional face-to-face class or a hybrid class?

Theoretical Framework of the Study

The theoretical framework for this study, andragogy, is a learning theory that focuses on process (Knowles, Holton, & Swanson, 1998), making it especially pertinent to instruction that integrates technology into the learning process. Knowles et al point out four characteristics of adult learners that should inform the design of instruction that incorporates technology. First, because adults have a deep need to know why they should learn something before they invest their time and energy, instructors should explain the purpose of technology in the instructional design. Next, instructors should consider the interests of the learners because adults learn best those things they must know in order to perform tasks that are relevant to them. Third, the instructor should find out the background experiences of the learners in order to give them choices based on those prior experiences. Finally, since adults are self-directing and dislike having decisions imposed on them, instructors should allow adult learners to figure things out for themselves. Instructors, in short, should become facilitators rather than directors of learning.

Methods

Participants

Participants in this study consisted of 10 female students enrolled in an online class, 6 female and 4 male students enrolled in a face-to-face class, and 21 female and 6 male students enrolled in a hybrid learning class. Participants, ranging in age from 23-57, were teachers pursuing a master's degree in education. The instructor was the same for the three classes. The course, a graduate course in the social and philosophical foundations of education, consisted of the same course content for all participants. The difference among the three groups was the delivery model.

Instrumentation

The survey instrument, the *Time Measurement Inventory,* was created by the researcher, pilot tested by 18 students in a graduate research class, and revised based on feedback from the participants in the pilot test. Participants gave 100% approval for the revised instrument. The following questions were analyzed by ANOVA to determine statistical differences.

1. How long did it take you to interview the retired teacher?
   a. 15-30 minutes
   b. 31-45 minutes
   c. 46-60 minutes
   d. 61-75 minutes
   e. More than 75 minutes
2. How long did it take you to write your biography?
   a. 1 hour or less
   b. 1 hour - 1 ½ hours
   c. 1 ½ hours - 2 hours
   d. 2 hours - 2 ½ hours
   e. More than 2 ½ hours
3. How long did it take you to read two biographies written by students, write, and post your response to the biographies?
   a. 15-30 minutes
   b. 31-45 minutes
   c. 46-60 minutes
   d. 61-75 minutes
   e. More than 75 minutes
4. To what degree was the value of this assignment to you in understanding the social and philosophical views of a previous era?
   a. Very valuable
   b. Valuable
   c. Somewhat valuable
   d. Very little value
   e. No value
5. How often do you work on your online assignments?
   a. Weekly
   b. Every fourth day
   c. Every other day
   d. Daily

Data Collection

Data were collected through a quantitative/qualitative survey administered upon the completion of a specific assignment. Of the 13 online students, 10 returned the survey. Of the 10 students in the face-to-face class, 10 students returned the survey. Of the 27 students in the hybrid class, 27 returned the survey. To protect the anonymity of the online students, participants e-mailed their surveys to a coworker of the researcher who removed any identification from the e-mails. When all surveys were returned, the coworker placed the surveys in a plain envelope before giving them to the researcher. The face-to-face and hybrid surveys were administered by a student in the class (after the researcher left the room) who placed the surveys in a plain envelope before giving them to the researcher. While the assignment was basically the same for the three groups (interview a retired teacher and compose a biography of the teacher according to guidelines provided), the reporting format of the biography was tailored to the classroom delivery model. The survey instrument, the *Time Measurement Inventory,* was designed to determine the actual amount of time students spent completing the assignment and to measure the value of the assignment to the student.

Data Analysis

Quantitative data gathered through surveys were analyzed by ANOVA in order to measure whether or not there were significant differences (Creswell, 2008) among the group means. Since there were more than two groups, t-tests were performed to determine the specific pairwise differences in the event of a significant ANOVA f-test.

Global type 1 error was controlled at the □ = 0.05 level. Responses to open-ended questions were analyzed according to like themes (Miles & Huberman, 1994).

Results

The results for questions 1 – 4 were not statistically significant, although these results are accompanied by weak power. It is possible, therefore, that a re-test of questions 1 – 4 with a larger data set would provide either significant results or increased statistical power for null effects.

There was, however, a significant mean difference (□ = 0.05) for question 5. Specifically, the online students reported that significantly more time was required to complete their work (mean = 4.0) than students in the blended group (mean = 2.2). There were no data available for the face-to-face students for question 5. A Levene's Test for Equality of Variance failed to reject the assumption of equal variance at a level of □ = 0.05, which supports the assumption of equality of variance for ANOVA. Table 1 reports the results of the ANOVA test for question 5.

	N	stdev	mean
Hybrid instruction	27	1.43	2.2
Online instruction	10	1.05	4.0
Face-to-face instruction			n/a

Table 1: ANOVA for Q5

Discussion

Results of data analysis support the benefits of hybrid classes as far as the time spent on class preparation. Of the 27 students in the hybrid class, 20 expressed that they preferred the hybrid classroom, 4 indicated that they preferred the face-to-face classroom, while the remaining 3 expressed a preference for online learning. While the reasons varied somewhat, students preferring face-to-face classes all reported that they preferred face-to-face classes because of the personal interaction with teachers and other students. Of those in the hybrid classes who preferred the online delivery model, all three students noted that in online classes they could work at their own pace. Two mentioned the savings in gas, and one noted that online classes left more time for family. One student who expressed a preference for online classes did note that online classes took more time. The majority of the students (20) in the hybrid class preferred the hybrid mode of delivery. Most noted that they preferred the hybrid classroom because they could meet with the instructor and their fellow students (more personal) yet have time to work independently as well, giving them more time to spend with family. Several also commented that the hybrid class offered more flexibility in scheduling and more freedom to work "on my own."

Limitations

Limitations of this study include a small sample size (47 total participants) and a limited population (graduate students). Replication of this study with a larger sample is recommended as a larger sample size could offer increased statistical power. Future studies could include undergraduate classes as well as graduate classes. This research could be further extended by including a wider range of online instructional strategies that would facilitate diverse learning needs and learning preferences.

Conclusions

The distinguishing feature of this study is its focus on the actual time students in face-to-face, online and hybrid classes spend in class preparation. Findings from this study will provide students with a guide to help them choose the most efficient delivery model for their particular academic needs. Furthermore, this study contributes to the emerging knowledge base regarding the effectiveness of the hybrid classroom. This study can facilitate faculty in designing courses that meet the diverse needs of adult learners who are nontraditional in that they often work full-time and have family obligations in addition to pursuing higher education (Ausburn, 2004).

As with any new paradigm that promises to be the wave of the future, it is important to determine whether or not the marriage of these two teaching models (traditional face-to-face classrooms and online classrooms) maximizes student engagement and fosters student learning in such a manner that the newly created third model is, indeed, a new learning model and not simply "more of the same" in a new package. Ausburn (2004) points out that hybrid learning is an effective alternative approach because it can combine the best features of each model—the flexibility of the 24/7 online classroom, so valuable to many working adults, with the rapport, interaction, and support among participants in the face-to-face classroom. Garrison and Vaughan (2008) note that hybrid learning is actually a "fundamental redesign and the consideration of new approaches to learning" (p. 26). They further stress the importance of integrating the real and virtual communities, pointing out that "face-to-face verbal and online text communication are distinct and have the enormous potential to complement each other" (p. 27). Thus, the nature of the educational experience can be transformed through the use of direct and mediated communication which can come as a result of the rethinking of the educational approach (Garrison & Vaughan, 2008). The face-to-face classroom is collaborative. Discussions that begin in the classroom can be extended in the online classroom because the online classroom allows time for reflection and consideration of that discussion, thus giving each participant the opportunity to provide a teaching presence (Garrison & Vaughan, 2008). In the words of one student who preferred the hybrid classroom, "It is the best of both worlds."

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Using Asynchronous Online Discussions in Blended Courses: Comparing Impacts Across Courses in Three Content Areas

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Abstract: Asynchronous online discussions are common in online and blended courses. This study examined the impact of online discussions in blended undergraduate courses in three disciplines: educational technology, engineering, and English education. Results showed that students from all courses were comfortable using online discussions and saw them as a way to express opinions and learn course content. However, differences in the outcomes for three groups suggest that certain online discussion strategies are more useful than others.

Introduction

Online and blended forms of learning are expanding rapidly in U. S. higher education. The sixth annual Sloan Consortium national survey of online learning in the U. S. (Allen & Seaman, 2008) found that over 3.9 million college and university students, about 20% of all higher education students, took at least one online course in the fall of 2007. Online learning enrollments in 2007 grew 12.9% compared to the previous year, a rate far in excess of the growth of the overall higher education student population. Blended or hybrid courses, those that combine elements of traditional face-to-face learning with elements of online learning, are also growing in popularity and are offered in proportions similar to fully online courses (Allen, Seaman, & Garrett, 2007).

Although many instructional strategies can be employed to foster student learning online (cf. Bonk & Zhang, 2008), one of the most widely used instructional approaches is the asynchronous online discussion. Asynchronous online discussions have been an integral part of many computer-mediated courses since the inception of this form of teaching and learning (Harasim, 1990; Hiltz & Turoff, 1993). In online courses, asynchronous discussions replace in-class discussions, while in blended or hybrid courses they can extend face-to-face discussions and provide another way for students to interact with each other and with the content. Today, numerous tools for conducting online discussions are available including those built into commonly used course management systems such as Blackboard, Angel, and Moodle. Although asynchronous online discussions are commonplace, relatively little has been written about their use in different disciplinary contexts. This study examined the use and perceived impact of online discussions in blended undergraduate courses in three different disciplines: educational technology, engineering, and English education.

Background

Developing group interaction and problem-solving skills is a goal in both education and the corporate world (Dundis & Benson, 2003). In corporations, employees must be able to communicate and solve problems within a team context. In education, standards (cf. *National Science Education Standards*, National Research Council, 1996) call for teachers to develop communities of learners, nurture collaboration among students, and structure and facilitate formal and informal discussions to promote student learning. *Rising Above the Gathering Storm*, the oft-cited report from the National Academies (2007), suggests that in order to create an environment and culture that support innovation in the U.S., our organizations must value social factors including "collaboration, communication, the treatment of multiple viewpoints" and utilize technological factors such as "access to high-speed computing and communications" (p. 417).

Asynchronous online discussions are one way to utilize computer-mediated communication to promote student collaboration and learning in the educational process. In online courses, asynchronous discussions serve as a stand-in for the dialogue and interchange typical of most face-to-face courses. In blended or hybrid courses, online discussions can extend face-to-face discussions beyond the confines of the classroom to increase students' engagement with the content and with one another. Students tend to respond positively to the asynchronous discussion format because it allows them to participate at their convenience, gives them time to think about and consider points made by peers before responding, and keeps a written record of all contributions for review and reflection (Tiene, 2000). Students perceive online discussion to be more egalitarian than traditional classroom discussions (Harasim, 1990), and online discussions create a sense of social presence that helps to create community online (Gunawardena & Zittle, 1997; Rourke, Anderson, Garrison & Archer, 2001). According to Palloff and Pratt (1999), "The learning community is the vehicle through which learning occurs online. It is the relationships and interactions among people through which knowledge is generated" (p. 15).

This emphasis on a community of learners in the educational process mirrors the workplace where teaming, collaborative problem solving, and group inquiry, often conducted virtually, are becoming the norm. As technical workplaces have become increasingly computer-centered, virtual collaboration through computer networking has become an essential skill for success in the 21st century (Bourne, Harris, & Mayadas, 2005; Johnson, Suriya, Yoon, Berrett, & LaFleur, 2002). Online discussions have the potential to assist students in the construction of knowledge and serve as a scaffold that allows for multiple perspectives, negotiation of meaning, and an understanding of knowledge gaps a learner may possess (Haavind, 2006). A meta-analysis of the effects of distance education compared to classroom instruction found that students using media that supported asynchronous discussion in distance education significantly outperformed students in the traditional classroom (Lou, Bernard, & Abrami, 2006).

However, there are still many questions about the use of online discussions. For one thing, the use and efficacy of online discussions may differ across disciplinary contexts. This study, part of a larger project on the use of peer feedback in online discussions, investigated students' perceptions of the use of online discussions as part of hybrid/blended courses and their effect on students' motivational orientations and use of learning strategies in three different disciplinary contexts: educational technology, engineering, and English education.

Methods

This study was conducted in the fall of 2008 at a large Midwestern university. Participants were students enrolled in three undergraduate courses: an introductory educational technology course, an engineering digital systems design course, and an English education methods course. The courses were required for students in their respective disciplines. Students in the educational technology course were mostly freshmen and sophomores, and, on average, their prior experience with online discussions was limited (40% had no prior experience and another 29% had only one prior experience in a course with online discussions). Similarly, the engineering students were mostly sophomores with limited prior experience (36% had no prior experience and another 31% had only one prior experience). In contrast, the English education students were seniors nearing the end of a teacher preparation program with more experience using online discussions (78% had participated in three or more courses that had used online discussions).

The students in each course engaged in three online discussions related to course content as part of a blended approach that supplemented regular course activities during a 16-week semester. The educational technology and engineering courses each had face-to-face lecture and laboratory components; students' laboratory sections served as the grouping for the online discussions. In the English education course, the entire class participated in the online discussions as a supplement to regular face-to-face class meetings and discussions. Students in the educational technology course participated in discussions on learning theories, millennial students, and plagiarism. Students in the engineering course participated in discussions focused on homework problems on course concepts and exam preparation strategies. Students in the English education course participated in discussions on teacher identity, teaching literature, and action research. All online discussions were hosted in the discussion forum of Blackboard Vista.

To assess students' perceptions of the online discussions, at the end of the semester, students in all three courses were asked to complete an online survey that included questions about perceptions of the online discussions and their perceived impact. Completed surveys were received from students in the educational technology course (n=219), the electrical engineering course (n=103), and the English education course (n=18). Closed and open-ended items assessed students' comfort and confidence using the online discussions, advantages and limitations, and effects of the online discussions. Results of closed-ended items were tabulated, and outcomes for the three courses were compared to identify any differences in the responses of the three groups of students. Open-ended survey responses were analyzed using a simple pattern-seeking method to gather qualitative responses that were used for triangulation of the quantitative results. To assess participating students' motivational orientations and use of learning strategies, the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991) was administered on a pretest-posttest basis at the beginning and end of each course. Completed questionnaires were received from students in the educational technology course (n=172), the electrical engineering course (n=93), and the English education course (n=20). The MSLQ subscale scores were tabulated and pretest-posttest scores were compared within groups to look for evidence of changes.

Results and Discussion

Students' Perceptions of Online Discussions

End-of-semester survey items were used to examine students' perceptions of the online discussions in each of the three classes. Table 1 presents the means and standards deviations for end-of-semester survey items dealing with comfort and confidence related to participating in the online discussions, collaboration/teamwork, and feedback from peers and instructors. Items were assessed on a 5-point Likert-like scale, from 1-low to 5-high, except for the collaboration/teamwork items, which were based on a 4-point scale. Means were calculated for each item.

Table 1

Comparison of Online Discussion Survey Means from the Three Courses

Survey Item	**Ed Tech Mean (SD)** (n=219)	**Engineering Mean (SD)** (n=103)	**English Ed Mean (SD)** (n=18)
Comfort/Confidence			
Comfort using online discussion tool	3.80 (1.06)	3.32 (1.21)	4.39 (0.85)
Comfort contributing to online discussions	3.72 (1.07)	3.12 (1.11)	4.28 (0.75)
Comfort commenting on others' contributions	3.59 (1.11)	2.96 (1.06)	3.94 (1.00)
Confidence in ability to contribute relevant ideas	3.84 (0.97)	3.16 (1.14)	4.28 (0.83)
Confidence in ability to benefit from discussions	3.41 (1.05)	3.15 (1.14)	3.00 (0.91)
Collaboration/Teamwork†			
Level of collaboration with peers as a result of online discussions	3.11 (0.72)	3.35 (0.79)	2.94 (1.06)
Feeling of teamwork among peers	2.86 (0.83)	2.88 (0.86)	2.72 (0.96)
Feedback			
Usefulness of feedback received from peers	3.18 (0.87)	3.21 (0.75)	2.78 (1.00)
Helpfulness of TAs' participation in online discussions	3.36 (1.02)	3.06 (1.36)	2.11 (1.32)

† Collaboration/Teamwork items used a 4-point scale; all other categories used a 5-point scale

Results related to comfort with and confidence in using the online discussions suggest that students in all three classes were relatively comfortable participating in the online discussions. Means for "Comfort using online discussion tool" were above 3 (neutral) for all three classes. The English education students had the highest comfort mean, which is not a surprise given that these students were mainly seniors who were more experienced with online discussions and were more familiar with their classmates than students in the other two classes. Means for "Comfort contributing to online discussions" and "Comfort commenting on others' contributions" were also above 3 for the educational technology and English education students; however, means for the engineering students were close to 3 (neutral), suggesting that these students were somewhat less comfortable contributing to the discussions and commenting on others' discussion posting. This may be related to the nature of the engineering class, which was not particularly discussion-oriented, and the online discussions in that class, which focused mainly on solving problems related to digital circuit design. The technical nature of these online discussions may have led students to be less comfortable making comments and less confident in their own contributions. Indeed, a similar response pattern is seen for "Confidence in ability to contribute relevant ideas" where the engineering students rated their confidence lower than students from the other two classes. On the final comfort/confidence item, "Confidence in ability to benefit from discussions," the educational technology students demonstrated the highest level of confidence, while students in the other two classes gave more neutral responses, on average. The relatively lower means on this item, particularly for the engineering and English education students, suggest that students were uncertain about the value of the online discussions.

Students in all three classes tended to give positive ratings to the effects of the online discussion on their "Level of collaboration with peers as a result of online discussions" and "Feeling of teamwork among peers." Mean scores clustered around 3 on a 4-point scale (Table 1). This suggests that the students in all three classes perceived the online discussions as promoting collaboration with peers. The engineering students gave the most positive responses to these items. This is consistent with findings in a previous project semester (Lehman, Richardson, Ertmer, Newby, & Campbell, 2009) and may reflect the collaborative problem-solving culture in engineering. In the engineering course, students were used to working together to solve homework problems, and the online discussions helped to facilitate this process which may have contributed to a greater sense of collaboration and teamwork resulting from the online discussions among the engineering students.

For the "Usefulness of feedback received from peers" and "Helpfulness of TAs' participation in online discussions" items, mean scores for both the educational technology students and engineering students were above 3 on a 5-point scale, indicating somewhat positive responses. However, the means for the English education students were less than 3 indicating somewhat negative responses. These differences in response patterns likely reflect how the discussions were used in each course. In the educational technology course, students participated in well-structured discussions in which peers made contributions and teaching assistants (TAs) were active discussion facilitators. Not surprisingly, students rated instructor participation the highest in this course. In the engineering course, discussions were mostly peer-driven with occasional TA involvement to clarify a problem solution, for example. In the English education class, only the course instructor was involved; there were no TAs. As a consequence, students in the English education class gave the lowest rating to helpfulness of TA participation.

Student Perceptions of Outcomes

Students responded to survey items about the outcomes of participation in the online discussions including the perceived effect on their learning, attitudes toward peer learning, whether they had become better acquainted with classmates, and met with classmates outside of class. Results are shown in Table 2.

Table 2
Frequencies of Responses Related to Learning Outcomes by Course

Learning Outcome	Ed Tech Students (n=219)			Engineering Students (n=103)			English Ed Students (n=18)		
Perceived differences in learning	Yes 34.7%	No 36.5%	Unsure 28.8%	Yes 32.0%	No 46.6%	Unsure 21.4%	Yes 11.1%	No 72.2%	Unsure 16.7%
Attitudes toward peer learning	Pos 45.2%	Neg 20.6%	Neut 34.3%	Pos 37.9%	Neg 11.6%	Neut 50.5%	Pos 33.3%	Neg 11.1%	Neut 55.6%
Better acquainted with classmates	Yes 18.7%	No 68.0%	Unsure 13.2%	Yes 14.6%	No 69.9%	Unsure 15.5%	Yes 33.3%	No 61.1%	Unsure 5.6%
Met with classmates outside class	Yes 18.9%	No 81.1%		Yes 40.8%	No 59.2%		Yes 66.7%	No 33.3%	

A minority of students from all three courses (34.7% of educational technology students, 32.0% of engineering students, and 11.1% of English education students) felt that the online discussions made a difference in their learning. This is consistent with the responses to the "Confidence in ability to benefit from discussions" item reported above (see Table 1). Although some students perceived a learning value in the online discussions, more students did not or were neutral. However, a greater proportion of students reported a positive attitude toward peer learning (45.2% of the educational technology students, 37.9% of the engineering students, and 33.3% of the English education students). This is consistent with the "Level of collaboration with peers as a result of online discussions" item responses reported above (see Table 1). Relatively few of the students in any of the classes felt that they became better acquainted with their classmates through the online discussions. However, two-thirds of the English education students and two-fifths of the engineering students met classmates outside of class compared with less than one-fifth of the educational technology students. This is likely not so much the influence of the online discussions as it is a reflection of the cohesiveness of the students, in the case of the small English education class, or an outgrowth of the collaborative problem-solving culture in engineering, in the case of the engineering class where students often worked together on homework and to prepare for examinations.

Motivation and Learning Strategy Outcomes

To assess whether the online discussions might influence students' motivational orientations and use of learning strategies, we employed a pre- and post-test administration of the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991). Results are shown in Table 3. For most of the subscales of the MSLQ, students' motivational orientations and use of learning strategies tended to show little change or declines from beginning to end of semester.

Students in the English education class showed the least changes from pre- to post-administration of the MSLQ. These students increased significantly on only one subscale, self-efficacy. Students in the engineering course showed declines on a number of the MSLQ subscales. The educational technology students showed a mixture of gains and declines on various subscales. Notable gains were observed in self-efficacy, intrinsic motivation, and peer learning. The MSLQ changes observed probably do reflect characteristics of the individual courses. For example, the gain in self-efficacy in the English education course makes sense when one considers that this was a methods course that was preparing students for their student teaching experience. The educational technology course had a popular group project that may have contributed to students' gains in self-efficacy, intrinsic motivation, and peer learning. The declines on several scales in the engineering course may be a function of the fact that this was a difficult beginning-level digital electronics course. However, it is doubtful whether any of these shifts can be attributed to the influence of the online discussions, which were only a small part of each of these three courses. In addition, the MSLQ post-administration occurred at the end of the semester, quite a while after completion of the online discussions. Thus, it seems likely that these results are confounded and so not particularly meaningful in assessing the impact of the online discussions.

Table 3
MSLQ Pre- and Post-Test Results by Course

	MSLQ Scale	n	Pretest Mean (SD)	Posttest Mean (SD)	Paired Samples t-value
Ed Tech	intrinsic motivation	172	4.69 (0.91)	4.91 (0.89)	3.12 **
	extrinsic motivation	172	5.59 (0.91)	5.44 (1.06)	-1.72
	task value	172	5.13 (0.97)	5.15 (1.01)	0.16
	control beliefs	172	5.21 (0.95)	5.34 (0.93)	1.66
	self-efficacy	172	5.24 (1.02)	5.84 (0.91)	7.09 ***
	test anxiety	172	4.12 (1.19)	3.85 (1.36)	-2.93 **
	rehearsal	172	4.40 (0.99)	4.42 (1.30)	0.17
	elaboration	172	4.72 (0.93)	4.54 (1.12)	-1.89
	organization	172	4.24 (1.08)	4.19 (1.38)	-0.46
	critical thinking	172	4.02 (1.00)	4.22 (1.23)	2.14 *
	self-regulation	172	4.24 (0.80)	4.32 (0.90)	1.21
	time study	172	5.11 (0.87)	4.55 (0.88)	-7.78 ***
	effort regulation	172	5.01 (1.10)	4.78 (0.96)	-3.02 **
	peer learning	172	3.01 (1.10)	3.72 (1.52)	6.24 ***
	help seeking	172	4.14 (1.10)	4.18 (1.09)	0.41
Engineering	intrinsic motivation	93	5.30 (1.02)	4.94 (1.16)	-3.39 **
	extrinsic motivation	93	5.72 (0.94)	5.31 (1.14)	-4.12 ***
	task value	93	5.73 (1.01)	5.25 (1.25)	-4.12 ***
	control beliefs	93	5.75 (0.88)	5.34 (1.09)	-3.60 **
	self-efficacy	93	5.64 (0.90)	5.05 (1.09)	-4.78 ***
	test anxiety	93	3.97 (1.34)	4.08 (1.27)	0.98
	rehearsal	93	4.27 (1.30)	4.28 (1.31)	0.08
	elaboration	93	4.99 (1.06)	4.81 (1.02)	-1.68
	organization	93	4.46 (1.36)	4.35 (1.33)	-0.73
	critical thinking	93	4.54 (1.38)	4.46 (1.22)	-0.56
	self-regulation	93	4.47 (0.88)	4.43 (0.84)	-0.50
	time study	93	5.01 (0.84)	4.51 (1.06)	-4.78 ***
	effort regulation	93	5.23 (0.98)	4.68 (1.04)	-5.45 ***
	peer learning	93	4.12 (1.34)	3.92 (1.41)	-1.44
	help seeking	93	4.21 (1.32)	3.91 (1.34)	-2.28
English Ed	intrinsic motivation	20	5.35 (0.87)	5.68 (0.80)	1.64
	extrinsic motivation	20	4.79 (0.96)	4.96 (1.02)	0.92
	task value	20	6.29 (0.63)	6.08 (1.00)	-1.07
	control beliefs	20	5.28 (0.86)	5.61 (0.94)	1.31
	self-efficacy	20	6.22 (0.67)	6.57 (0.52)	2.36 *
	test anxiety	20	3.38 (1.50)	3.10 (1.41)	-1.18
	rehearsal	20	3.93 (1.40)	3.58 (1.68)	-1.27
	elaboration	20	5.07 (1.02)	4.82 (1.19)	-0.85
	organization	20	3.63 (1.27)	3.43 (1.33)	-0.68
	critical thinking	20	4.56 (0.91)	4.55 (1.06)	-0.06
	self-regulation	20	4.41 (0.67)	4.34 (0.97)	-0.34
	time study	20	5.48 (0.84)	5.43 (1.14)	-0.37
	effort regulation	20	5.71 (0.97)	5.74 (0.91)	0.16
	peer learning	20	3.37 (1.19)	3.43 (1.87)	0.19
	help seeking	20	4.66 (0.84)	4.66 (1.12)	0.00

* $p < .05$, ** $p < .01$, *** $p < .001$

Advantages and Limitations

Students also responded to survey items that addressed the perceived advantages and limitations with respect to the online discussions. These are summarized in Table 4, which shows the percentages of students who identified specific advantages and limitations. Students could select more than one response, so percentages total to more than 100%.

The most commonly cited advantage for both the educational technology and English education students was that the online discussions “Made it easier to express opinions and to participate in class discussions.” More than 60% of the educational technology students and more than 70% of the English education students identified this as an advantage. This is not a surprise given that discussion is a common instructional method in education, and online discussions allow all students in the class to readily participate. For the engineering students, the most commonly cited advantage was that the online discussions “Helped me understand the content better.” More than half of the engineering students, as well as about half of the educational technology students, identified this as an advantage. The engineering course used the online discussions as a way for students to collaboratively work on homework problems and exam preparation strategies, and so it is not unexpected that the students would perceive advantages in learning the content. In the case of the educational technology course, the online discussions focused on several important topics in the course and so many of these students also perceived that the discussions were beneficial for learning course content. More than a third of both the educational technology and engineering students also cited “Motivated me to study the course materials or other related topics/content” as an advantage, whereas half of the English education students cited, “Helped me get better acquainted with my classmates.”

The limitation most commonly cited by all three groups of students was that “It was hard to remember to do it.” Nearly half of educational technology and engineering students and almost three-quarters of the English education students cited this as a limitation. Many of the students in these classes had relatively little prior experience with online discussions and were unaccustomed to this type of class participation, so it was easy for them to forget about this outside-of-class-time commitment. In hybrid or blended courses such as these, online discussions are an “extra” rather than an essential means of communication, so students may not perceive them as really important. Students also felt that “It took too much time;” this limitation was cited by about a quarter of the students in each of the classes. Both the educational technology and engineering students had some uncertainty about what to post and who was right/correct. These students, who were focused on content learning, seemed to be more concerned about being correct and knowing what was correct, something that was not always clear in the give and take of the online discussions. For the English education students, and to some extent the educational technology students, another limitation was that “It was hard deciding what score to give my peers;” this response was a result of the use of a peer feedback tool in the online discussions. Students were unfamiliar with the process of giving feedback to their peers, and so they were uncertain what they should do.

Students elaborated on the advantages and limitations of the online discussion in their responses to open-ended questions on the survey. Getting to learn from and share ideas with peers was a common theme among students who perceived the discussions as advantageous. As one educational technology student stated, “We don't get a chance to really discuss issues in class so this was a way for me to see what my classmates really thought.” Another educational technology student noted, “It helped me also understand what my other classmates were thinking and that made me see where I was in the class and could compare my thoughts with their thoughts.” An engineering student made a similar comment, saying, “I can see that there could be an advantage in being able to discuss a certain topic with classmates you would otherwise not speak to in lecture.” For the educational technology and engineering courses, where large lectures made in-class participation difficult, the online discussions offered a convenient alternative way to share ideas with classmates. This was less of an advantage for the English education course, which was small and composed of a group of students that already knew one another fairly well. However, even one of the English education students commented that the online discussions, “Gave me an extra chance to get out my thoughts and ideas, or to elaborate on things we discussed in class.”

However, a number of the students felt that the online discussions added little to their learning. One educational technology student commented, “I don't really think I have noticed any difference in my learning. I have always been a hands-on learner, and I actually prefer a face-to-face discussion over an online one. We spend too much time in front of a computer as it is.” Another educational technology student said, “These discussions were interesting and something new, but I don't think they really changed anything about the way I learn.” An engineering student noted that many students participated just because they were required to, saying, “I really do not think that online discussions are really that helpful as far as learning goes because a lot of times people just get on, which is usually kind of a pain, and write just to write rather than something meaningful.” An English education student commented, “I found that the online post was a restatement of what I learned in class and not a continuation or expansion of my ideas.” So, for many of these students, the online discussions did not add enough value to what their classes already offered.

Table 4
Percentages of Students from Each Course Citing Online Discussion Advantages and Limitations

Advantages and Limitations	**Ed Tech Students** (n=219)	**Engineering Students** (n=103)	**English Ed Students** (n=18)
Advantages			
Helped me understand the content better	50.2%	52.4%	11.1%
Motivated me to study the course materials or other related topics/content	44.3%	34.0%	11.1%
Motivated me to spend time studying course materials *consistently* throughout the course (rather than cramming for the exam)	32.0%	26.2%	5.5%
Made it easier to express opinions and to participate in class discussions	61.2%	41.7%	72.2%
Helped me get better acquainted with my classmates	18.7%	14.6%	50.0%
Other	7.7%	13.6%	16.7%
Limitations			
It took too much time	25.1%	22.3%	27.8%
It was hard to remember to do it	47.5%	48.5%	72.2%
It was hard to ask questions or get help	16.4%	18.4%	5.5%
I was unsure about *how* to post	7.3%	7.8%	0.0%
I was unsure about *what* to post	26.9%	48.5%	11.1%
I didn’t know how to respond to others’ postings	28.3%	14.6%	27.8%
I didn’t know who was right/correct	25.6%	40.8%	5.5%
It was hard deciding what score to give my peers	28.8%	9.7%	44.4%
Other	10.5%	12.6%	11.1%

As a final assessment of what students thought of the online discussions, a survey item asked if they were the instructor of the course would they continue the use of the online discussions as is, continue use but with changes, or discontinue use? Results from this item are shown in Table 5. Only a minority of students, less than one-fourth of the English education students and less than one-fifth of the educational technology and engineering students, would not continue using online discussions. Thus, a clear majority of the students would favor continuing the use of the online discussions either as used in the course or with changes (e.g., increasing or decreasing the number of discussions). This suggests the students did see value in this instructional approach.

Table 5
Student responses from the three courses concerning continuation of online discussions in course

	Ed Tech students (n=219)	Engineering students (n=103)	English Ed students (n=18)
Continue as is	41.1%	27.2%	47.1%
Continue with changes	42.0%	54.3%	29.4%
Do not continue	16.9%	18.5%	23.5%

Implications and Conclusions

Online and blended forms of learning are becoming increasingly important in higher education, and, as a result, there is increasing interest in the use of asynchronous online discussions. This study examined the use of online discussions and students' perception of their impact in three undergraduate blended courses in different disciplines. Results suggest that there is potential value in online discussions, but there are differences in the utility of online discussions across different content areas and challenges in implementing them effectively in undergraduate blended course environments.

The findings of this study showed that even students who are relatively inexperienced with online discussions can, over the course of a single semester, become relatively comfortable with this approach and confident in their ability to participate in online discussions as part of blended courses. However, the actual learning outcomes from participation in online discussions in blended courses and the value that students place on them are less obvious. Many students did seem to appreciate the value of online discussions for providing an avenue for expressing opinions and learning from peers. This may be of particular value for larger courses, such as two of the three in this study, where large lecture sessions limit the ability of students to participate in class. Many students also perceived value of the online discussions for helping them to learn course content. This was particularly true in the engineering and educational technology courses, which had a greater focus on content learning. However, many of the students did not see these benefits.

While previous research has suggested that students are satisfied with asynchronous online discussions and benefit from them (Johnson, 2006), only a minority of students in this study perceived a direct effect on their learning. Whereas the use of asynchronous discussions has been found to lead to performance benefits relative to traditional classrooms for distance education contexts (Lou, et al., 2006), it may be more challenging to use asynchronous online discussions effectively in blended learning courses for undergraduates where online discussions are not essential for student-to-student interaction.

The challenge for instructors of blended courses who wish to use online discussions is to find ways to maximize the perceived relevance and/or value of the discussions. According to Xie, Debacker, and Ferguson (2006), when students perceive online discussions as relevant, interesting, and enjoyable their value increases. In this study, the engineering students put the highest value of the online discussions on content learning. This result certainly reflects the way that the discussions were used in the engineering course (e.g., to help students with content problems and for exam preparation) as well as the culture in engineering which puts a premium on problem-solving and getting the right answer. On the other hand, the English education and educational technology students in this study rated the ability to express opinions and participate most highly, and this is consistent with the nature of these disciplines. Achieving concordance between purposes of the online discussion and the goals of the course obviously is important. So, instructors of blended courses should seek to use online discussions in ways that fit the discipline and content.

Other differences among the courses in this study also suggest important considerations for integrating online discussions. For example, in the educational technology course TAs were active discussion facilitators, and students in that course rated this aspect more highly than students in the other courses. According to Talient-Runnels, et al. (2006), instructor participation and scaffolding is important for effective learning from online discussions. So, efforts to use online discussions in blended courses should give consideration to how the discussions are facilitated for best effect.

For all of the courses, the biggest drawback cited by students was that they had difficulty remembering to participate in the online discussions. This is a particularly revealing finding that highlights an important difference between fully online and blended courses. In fully online courses, online discussions are typically the central vehicle for student-to-student and student-to-instructor communication. However, in blended courses, online discussions are an added form of communication that supplements or complements face-to-face interactions. For many of the students in this study, online discussions were perceived as an "extra" rather than as something integral to the course and their learning. The challenge for instructors is to develop ways of utilizing online discussions in blended courses that take advantage of the unique features of the approach so that students will not perceive it as just one more thing to do. With effective design and implementation, asynchronous online discussions may be an effective tool for promoting student learning and collaboration in blended course environments.

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A Study of an Integrated Instructional Model in a Collegiate Course for the Creative Problem Solving with an Online Support System

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Abstract

This study examines the possibilities of an integrated instructional model in a collegiate course using the Creative Problem Solving(CPS) with an online support system. An integrated instructional model in a collegiate course was developed to enhance the creativity of college students. The principles and guidelines of the model were analyzed by the formative research methodology. General design principles were identified by reviewing the literature, and the theoretical components for the model were extracted. Finally, specific guidelines from those design principles and the theoretical components were developed. For this study, the e-Learning contents to explain the major characteristics and thinking tools of the Creative Problem Solving and an online support system which can guide the CPS process were developed. The online support system includes such convergent and divergent thinking tools as brainstorming, attribute list, hits, PMI, and evaluation matrix. Those guidelines were implemented into a college-level course with 33 students in 'A' university. The number of the final interviewees was 10. The participants' responses to the course satisfaction survey and interviews were analyzed to investigate the strengths, weaknesses, and improvements of the model. The strengths include 'providing the blended learning environments', 'implementing a team project', and 'utilizing the CPS support system'. The weaknesses and improvements include 'making participants select appropriate thinking tools for the CPS', 'explaining the CPS process in details', 'proposing a flexible and appropriate schedule for problem solving', and 'evaluating the final product from the perspective of creativity. Further studies are suggested to develop an optimal instructional model using the repetitive formative research methodology and to examine the effects of the instructional model by conducting an empirical study are suggested.

Introduction

Courses to enhance creativity have recently appeared as relatively new subjects in the college environments. Most studies of creativity up to now have focused on the young students ranging from kindergarten to junior high school. However, college students, who would be facing the complex problem-solving situations in their careers, need to have better creative skills. Regarding the creativity, the Creative Problem Solving(CPS) is one of the most frequently referred conceptual models. CPS is understood as a structured methodology for enhancing the creative thinking of the individuals and teams. The CPS model emphasizes a balance between the divergent and the convergent thinking in every step of the problem solving process, and could be deliberately applied to solve the open-ended problems(Puccio, Murdock & Mance , 2005).

Among the various CPS models that have emerged through several decades of studies, this study was based on the CPS version proposed by Treffinger and his colleagues(2000). Their model consists of eight stages: 'Appraising tasks', 'Designing process', 'Constructing opportunities', 'Exploring data', 'Framing problems', 'Generating ideas', 'Developing solutions', and 'Building acceptance (Treffinger, Isaksen, & Dorval, 2000).

The purpose of this study is to develop an integrated instructional model in a college course using the Creative Problem Solving with an online support system. The formative research methodology is used to improve the principles and guidelines of the model. A model was developed by the following three steps: finding out general principles from reviewing the relevant literature; extracting the theoretical components for the model by categorizing general principles; and finally, developing a set of specific guidelines for each principle from the viewpoint of these theoretical components.

Theoretical Background

Creative Problem Solving

Creative Problem Solving is a model to solve problems in the problematic circumstances by the repetitive use of divergent and convergent thinking(Lee & Lee, 2007). In every phase within the CPS model, the divergent and convergent thinking are used in the process of problem solving. The balance between these two kinds of thinking in every step of the problem solving process is a critical factor for the Creative Problem Solving. Studies had been conducted from different definitions for creativity and problem solving. Recently, however, researchers have put more emphasis on studying creativity from the perspective of problem solving.

CPS has emerged through the past several decades of work. The descriptions Osborn(1963) proposed have become the fundamentals of CPS. The Osborn-Parnes model is the five-stage revision of Osborn's initial framework that Parnes(1977) developed by using an experimental study. The five stages are fact-finding, problem-finding, idea-finding, solution-finding, and acceptance-finding. Isaksen and Treffinger(1985) added the sixth stage: mess-finding. They broadened the scope of the fact-finding stage and renamed it as data-finding. Through the studies in the 1980s and 1990s, the process and structure of CPS have been developed in details.

The referred CPS models include Osborn-Parnes' model(Parnes, 1977), Isaksen & Treffinger's model(Isaksen & Treffinger, 1985; Treffinger et al., 2000), and Puccio, Murdock & Mance's model(Puccio et al., 2005).

Among these models, one of the most frequently referred conceptual model is the Isaksen and Treffinger's model, a revision of Osborn-Parnes' model. Treffinger and his colleagues(2000) suggested a CPS model with four components, which can be classified into two major categories: *a management component and a process component*. The management component consists of 'Planning Your Approach', containing two stages of 'Appraising Tasks' and 'Designing Process'. This management component serves as an operating system to guide the application of the three process components, 'Understanding the Challenge', 'Generating Ideas', and 'Preparing for Action'. These process components are composed of six specific stages, during which creative and critical thinking abilities are used in harmony. The followings are those six stages: 'Constructing Opportunities', 'Exploring Data', 'Framing Problems', 'Generating Ideas', 'Developing Solutions', and 'Building Acceptance' (Treffinger et al., 2000).

The most outstanding characteristic of CPS is the repetitive use of divergent and convergent thinking(Puccio et al, 2005). Divergent thinking is operated to detect and identify the problem. It facilitates generating various creative solutions in the process of CPS(Lee & Lee, 2007). Convergent thinking is a skill to determine the solutions by focusing on many possible ideas deliberately and explicitly, and evaluating them with the logical, critical, analytic, and synthetic viewpoints(Kim, 2008). Therefore, for the successful application of CPS, it is critical to use both thinking skills appropriately and flexibly(Firertien, 1982). There are many techniques that can be applied within the stages of CPS to enhance the divergent and convergent thinking skills(Kim, 2008; Lee & Lee, 2007). Kim(2008) classified various thinking tools into the divergent and convergent thinking tools. For instance, brainstorming, forced connection method, morphological analysis, Osborn's checklist, attribute listing, and SCAMPER are classified as the divergent thinking tools. On the other hand, the convergent thinking tools include hits, highlighting, reverse brainstorming, evaluation matrix, paired comparison analysis, ALU(Advantage, Limitation, and Unique Qualities), and PMI(Plus, Minus, and Interesting).

Teaching Creativity

Courses for creativity have been mostly focused on the CPS model with young students of primary and secondary school education, ranging from kindergartens to junior high schools. However, college students who would have to solve the complex problems in their workplace are in greater need for the creative skills. The studies of college courses designed to enhance creativity have focused on developing courses rather than investigating to develop specific models. Creativity courses for college students in Korea could be classified into two kinds: one is a 'teaching creativity course', with its main goal as teaching creativity itself; the other is a 'creativity-integrated course', in which the topics of the course are also taught while the students are involved in the creative problem solving process.

Regarding the 'teaching creativity course', Park(2004) taught creativity in his liberal-arts course of 'Understanding and Enhancement of Creativity', and reported that the course was effective in general. Jeong(2003) designed a 'Developing Creativity' program for a liberal-arts course to examine the effects of a creativity program and the leaning styles, such as an individual and cooperative learning. The results demonstrated the improvement of students' creativity and effectiveness of cooperative learning. On the other hand, as an 'creativity-integrated course', Baek and his colleagues(2006) implemented an 'Imaginative Design Engineering' course to measure and develop the creativity of the college students majoring in engineering. The study found that the TTCT(Torrance Tests of Creative Thinking) score of the participants has increased.

Recently, more attentions are held to the blended learning environments for the creative problem solving, where both online and face-to-face learning modes are included(Graham, 2006). Lee and Lee(2007) developed a blended instructional model for the Creative Problem Solving and integrated an online and face-to-face learning environment in the formation of a 'Blended instructional model for creative problem solving'. In this study, they tried to enhance the Creative Problem Solving skills based on the premise that the online modes offer a learning environment for the divergent thinking. Students in this study would be allowed to generate their own ideas without any limitations. On the other hand, the offline modes provide a learning environment for the convergent thinking, where students' analytic, integrated, and coherent communications are required to come up with some creative solutions. The researchers developed the blending principles by analyzing CPS models and reviewing the literature about the blended learning.

Most previous studies on creativity have been focused on young students. Moreover, those are mostly about teaching creativity course in a classroom setting. Those studies have not focused much on the creativity-integrated courses for college students with an online support system in a blended learning environment. Therefore, this research aims to develop the principles and guidelines for an integrated instructional model in a college course using the Creative Problem Solving with an online support system.

Methods

An instructional model was developed by following the three steps: discerning the general principles from reviewing the relevant literature; extracting theoretical components for the model by categorizing those general principles; and finally, developing a set of specific guidelines for each principle from the viewpoint of these theoretical components. The instructional model also included such components as e-Learning contents and an online support system.

The online support system was developed based on the CPS model proposed by Treffinger and his colleagues(2000). The system guides the CPS process and provides convergent and divergent thinking tools such as brainstorming, attribute list, hits, PMI, and evaluation matrix. Each stage within the system provides one divergent thinking tool that facilitates generating ideas and two convergent thinking tools. The first convergent tool is used for decision-making to select important ideas from a various ideas generated. Finally, one can choose the best idea with the help of the second convergent tool provided. The online support system also allows students to write the reflective journals. This offers them opportunities to reflect on their learning activities while experiencing the online CPS process.

A college-level course was developed and implemented to examine the strengths and the weaknesses of the model and to suggest the improvements of the model by the formative research methodology. Research site was an undergraduate course in 'A' university. A total of 33 students participated, while the number of the final interviewees was 10. The participants' responses to the course satisfaction survey and the interviews were analyzed to investigate the strengths, weaknesses, and recommendations for the improvement of the model.

Results

Six General Design Principles

Reviewing the relevant literature led to identify six general design principles for an integrated instructional model in a college course using the Creative Problem Solving with an online support system.

Provide a blended learning environment

The CPS model emphasizes the balance between divergent and convergent thinking in every step of the process to solve open-ended problems. Lee & Lee(2007) suggested that an online environment is effective for divergent thinking, while a classroom environment is effective for convergent thinking.

This study, however, argued that the convergent thinking could also be effective in an online environment if the appropriate supportive systems were implemented. It is possible to design an online environment where both the divergent and convergent thinking can be exercised, and students can discuss their additional ideas with their team members in a classroom environment.

Make students work on a team project

Cooperative learning is effective for creative thinking. Choe(1998) maintained that a personal relationship is the crucial factor for the creative outcomes. He also mentioned that peers could be a new stimulus for producing the creative outcomes. Jeong(2003) stated that the cooperative learning can enhance not only the interpersonal communications and the critical thinking abilities, but also the creativity thinking skills.

Provide an authentic task

Creativity courses for the college students should be operated in the appropriate and relevant field where students usually work(Choe, 1998). In a domain-specific perspective of creativity, creativity in some specific fields is considered inconsistent with the ones in other fields. In short, creativity can be relatively independent(Han, 2000). Therefore, creativity courses should offer some authentic tasks that provide students with some opportunities to experience their own fields.

Provide an online support system for the Creative Problem Solving

Lee & Lee(2007) suggested an online support system for the divergent thinking, and Lee et al.(2007) identified that an online support system in the Creative Problem Solving process is effective. This study includes designing of the environmental supports, not only for the divergent thinking but also for the convergent thinking, and managing the whole processes of CPS.

Provide appropriate guidance for the Creative Problem Solving and class management

Since students are not familiar with CPS as their teaching-learning model, appropriate introduction of CPS, creative thinking tools, proper guidance, and feedback should be provided. Also, this principle includes the e-Learning contents being developed to explicate the major characteristics and thinking tools of the Creative Problem Solving, and the tutors' supportive roles for students. .

Make students write reflective journals

For a teaching creativity, many researchers stated that the internal motivations, such as devotion, satisfaction, and interest, are the fundamental factors to help produce creativity(Amabile, 1996). While they were writing journals, students can reflect on their process of the problem solving, and consequently, their internal motivations may be promoted

Theoretical Components for the Model

Three theoretical components for the model were extracted by categorizing the general design principles. The first is pertinent to the environment where the learning occurs, and it includes the classroom environment and online environment. The second is related to the processes of instructions. There are four phases: a preparatory phase, a preliminary implementing phase, an implementing phase, and an evaluation phase. The last theoretical component would be the process components of CPS, such as 'Understanding the Challenge', 'Generating Ideas', and 'Preparing for Action'. Figure 1 delineates three theoretical components for the instructional model.

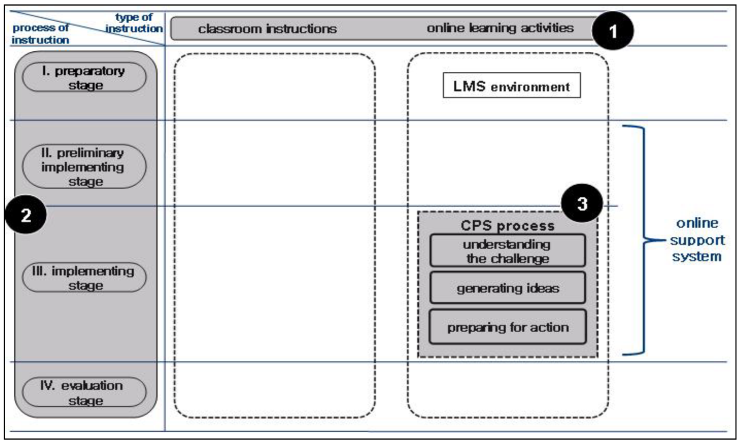

Figure 1. Three theoretical components for the instructional model

Specific Design Guidelines

A set of guidelines were suggested from the general design principles and theoretical components. Figure 2 visualizes the specific design guidelines of the integrated instructional model.

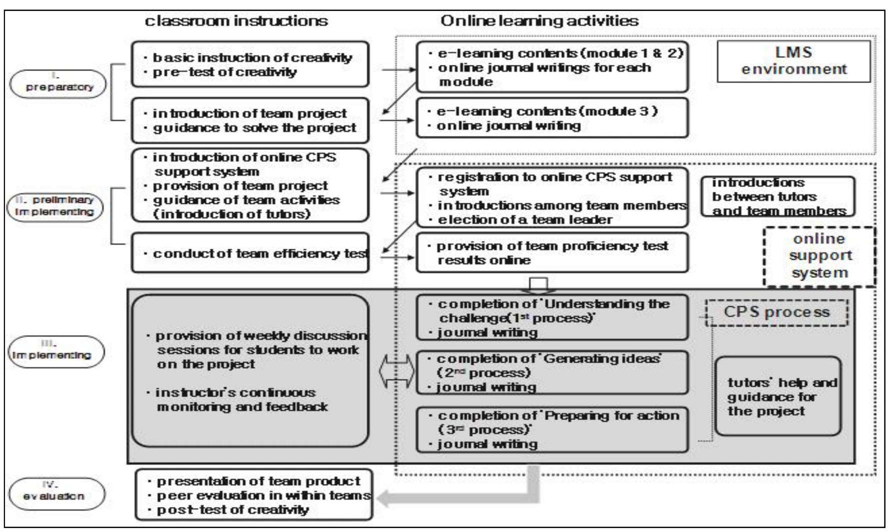

Figure 2. The integrated instructional model in a collegiate course for CPS with online Support system

In the preparatory phase, the course guidance is introduced by the instructor in the classroom and students learn about creativity through e-Learning contents that include the concept of creativity, the CPS models, and thinking tools/techniques for processes of CPS. After learning through the contents, students are supposed to write their online reflective journals.

In the preliminary implementing phase, the instructor offers the guidance for a project. Students are divided into four teams of seven to eight members each. The students are obligated to register via online support system, and the instructor demonstrates how to work on a project. After a team efficiency test is administered, the test result is reported to members to guide individual activities for the project.

In the implementing phase, students work on a team project with the direction of their instructor and tutor. In this stage, opportunities for the team discussions and instructor's feedback are offered in the classroom, and students complete each stage of CPS using the convergent and divergent thinking tools embedded in the online support system. Figure 3 shows the processes of CPS including the sub-processes, the contents of classroom instructions, and the types of thinking tools offered to the students.

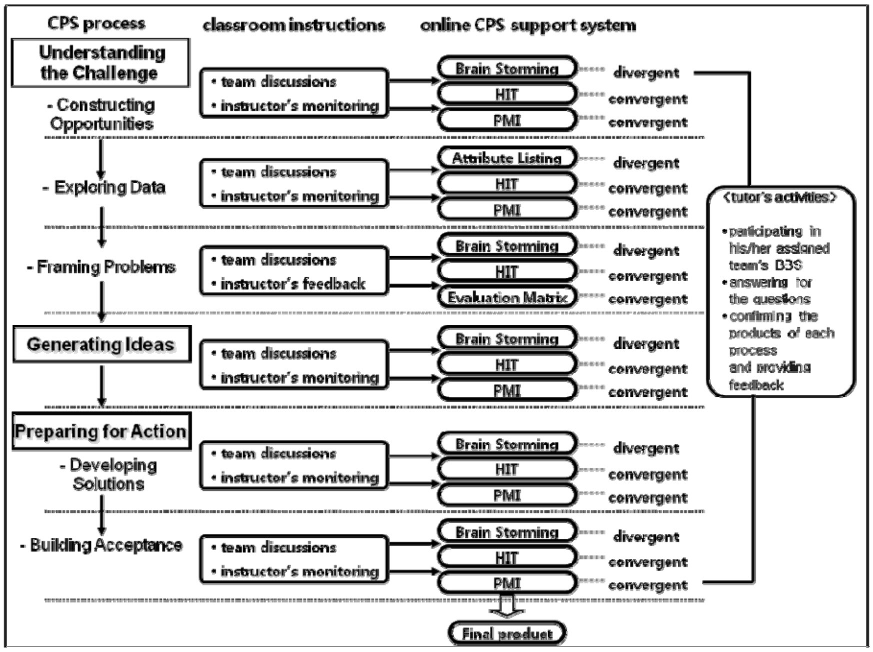

Figure 3. The integration of classroom instructions and an online support system based on CPS process

In the phase 1, 'Understanding the Challenge', there are three stages. In the first stage of 'Constructing Opportunities' students are experiencing the convergent and divergent thinking activities using the online tools, such as brainstorming, attribute listing, hits, PMI, and evaluation matrix. Brainstorming is one of the most popular divergent thinking tools through which students may generate diverse ideas. It encourages them to produce various types of ideas they have in mind without any limitations or hesitations. Students are asked not to judge the others' ideas upon their ideas. Attribute listing is one divergent thinking tool that helps a student to list and analyze all the attributes in an object, or a task of a problem faced. Then, students concentrate on one or a couple of attributes. Finally, they change or modify those in order to come up with the alternative solutions by making their thinking deeper and more expanded. 'HITs' is a convergent tool used to reduce the number of proposed ideas. It allows students to put a check sign next to the more seemingly prospective ideas. It is useful when they need to identify the more important, interesting, and challenging ideas. PMI stands for Plus, Minus, and Interesting. It forces students to concentrate solely on one idea and analyze its strength and weakness, along with its interesting aspects. Evaluation matrix helps students to select the most appropriate solution by evaluating the alternative ideas that they generate based on the assigned criteria. In the second stage of 'Exploring Data', students use the attribute listing as well as hits and PMI. In the last stage of 'Framing Problems', brainstorming, hits, and evaluation matrix are provided for students' thinking processes.

In the phase 2, 'Generating Ideas', brainstorming, HITs, and PMI can be used by students, and in the phase 3, 'Preparing for Action', brainstorming, hits, and PMI are offered for the stages of 'Developing Solutions' and 'Building Acceptance'.

Throughout the entire stages, advices of the tutors are available for each team. They can provide the feedbacks on the students' output.

In the evaluation phase, the final output is presented and evaluated, and a peer evaluation for the participation level is conducted.

General Responses to the Model

The interviews were conducted with ten students and the participants' responses were analyzed to examine the strengths, weaknesses, and improvements of the model.

Selected responses for the strengths are as follows: *Providing blended learning environments, implementing a team project, and utilizing the CPS support system.* Some responses for the weaknesses are as follows: *Lack of integration between online and offline learning environment, improper schedule for the program solving processes, and complexities of the CPS system.* The improvements are as follows: *Seamless integration between online and offline environments and rescheduling the process of the CPS projects.* Table 1. shows more details for the strengths, weaknesses, and improvements of the model.

Table 1. Strengths, weaknesses, and improvements of the model

	Students' responses	Frequency
Strengths	Providing the blended learning environments	6
	Implementing a team project	9
	Utilizing the CPS support system	10
	Providing the e-learning modules	3
	Providing learning resources in the LMS	3
	Providing the tutors' feedback	6
Weaknesses	Lack of integration between online and offline learning environments	6
	Improper schedule for the problem solving processes	10
	Limitations of the CPS system; complexness, inflexibility, and the lack of explanation about terminology	10
	The number of team members	2
	Lack of the tutors' feedback or help for the products of each CPS step and explanations for the new concepts	4
	Improper criteria for evaluating the final products	2
Improvements	Seamless integration between online and offline learning environments	8
	Rescheduling the process of the CPS projects	6
	Providing a variety of thinking tools	3
	Resetting the criteria for evaluating	2

(Number of participants: 10)

Responses of Respective Design Principles

Most interviewees responded that each design principle facilitated the process of creative problem solving. However, some weaknesses and improvements for each design principle existed as well. Students' responses for each design principles are listed in Table 2.

Table 2. Responses of respective design principles

Design principles	Students' responses		
	Strengths(Frequency)	Weaknesses(Frequency)	Improvements(Frequency)
Provide a blended learning environment	It was helpful for the process of creative problem solving. (4)	Offline activities were not helpful. (2)	Instructor's instant feedback on the online activities is needed. (1)
Make students work on a team project	Helpful for the process of creative problem solving. (7)		4-5 students are appropriate for one team. (2)
Provide an authentic task	An authentic task for the project was helpful for the process of creative problem solving. (3)		It is needed to provide a task for creative problem solving easy and interest. (1)
Provide an online support system for Creative Problem Solving	CPS system was helpful for the process of creative problem solving. (8)	CPS system rather disturbed the creative thinking. (1)	The improvement in function of each thinking tool is needed. (10)
Provide an appropriate guidance for the Creative Problem Solving and the class management	E-learning contents were helpful for the process of creative problem solving. (10)	There were some difficulties to understand the CPS model in e-learning contents. (7)	The terminologies used in CPS model should be easy to understand. (5)
Make students write reflective journals	Writing reflective journals was helpful. (5)	Writing reflective journals in every step was not helpful. (1)	The numbers of writing reflective journals should be reduced. (2)

(Number of participants: 10)

Conclusion

Traditional studies on creativity have put more emphasis on the primary and secondary school students' creativity. For creativity education in a collegiate level, 'teaching creativity' as a liberal arts course has been provided (Jeong, 2003; Park, 2004). On the other hand, a study of a 'creativity-integrated course' with a subject matter has been explored as well(Baek et al., 2006). Recent studies about the online support system and the blended learning pertinent to creativity have provided us with some new perspectives on how to teach the creativity skills to college students.

This study focuses on figuring out how creativity would be taught in a collegiate setting. Although researchers have recently paid attention to the significance of creativity, few studies discuss the integrated instructional models in a college level course for the Creative Problem Solving using an online support system. This study identified the general design principles and the specific design guidelines for an integrated instructional model in a college course using CPS with an online support system. The instructional model was developed by the following three steps: discerning the general principles from reviewing the relevant literature; extracting the theoretical components for the model by categorizing the general principles; and finally, developing a set of specific guidelines for each principle based on these theoretical components. The instructional model includes the e-Learning contents and an online support system.

Using the formative research methodology, the strengths, weaknesses, and improvements of the model were analyzed. The strengths included 'providing the blended learning environments', 'implementing a team project', and 'utilizing the CPS support system'. Some weaknesses and improvements involved 'making participants to select the appropriate thinking tools for CPS', 'explaining the CPS process in details', 'proposing a flexible and appropriate schedule for the problem solving', and 'evaluating the final product from the perspective of creativity.

Through this study, major directions for the improvements of the model were suggested. Further studies are expected in the following areas: to improve the principles and guidelines of the model by using the repetitive formative research methodology and to examine the effect of the instructional model by conducting an empirical study.

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Research-based Guidelines for K-12 Science Teachers to Use Blogs

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Introduction

The interest in new media for teaching and learning has highlighted the potential of innovative application in web-based learning environment. This interest has focused on blogs recently. A small number of educational uses of blogs have surfaced. This research describes how blogging could facilitate reflection and discussion in general, categorizes how blogs have been used in K-12 science classroom into blogging as a content delivery tool, blogging as a reflective tool, and blogging as a collaborative tool. At the end, guidelines are provided for K-12 science teachers to use blogs to form an online science education community.

Background

Blogs

Weblogs were first named and described in 1997 by Jorn Barger (Blood, 2000) and then shortened to *blogs* by Peter Merholz in1999. Blogging is the act of creating and maintaining a blog. A blogger is someone who maintains a blog, while the blogosphere refers to the interconnected, interlinked and constantly self-referential community of blogs and bloggers.

Blogs are one of hottest issues on the web, with many enterprises investing a lot of manpower and finance to improve functionalities of blogs which contain text, audio, and video files that archived on a Web page for easy access. According to blog tracking site Technorati's latest research into the explosion of personal publishing sites, the blogosphere is doubling in size every five and a half months. On average, a new blog is born every second. 13.7 million bloggers are still posting 3 months after their blogs are created.

Ease of access and use

Free blog services are available on the Internet, such as WordPress.com and Blogger.com, make blogging user-friendly for both Macintosh and Windows users. It takes less than five minutes to set up a blog. With a few clicks, the teacher and students can configure blog sites. Once blogs are configured, the teacher and students can upload text, photos, audio and video files.

The maintenance of a blog requires minimal web-page development skills; web sites exist which allow anyone to create a personal blog by adding text entries and images to a selected template, the developing blog being hosted and archived by the web site and its provider. Web sites offer this service at no cost or very low cost.

Reflection

Blogs provide an area where the author can develop highly personalized content which means that self-expression is encouraged. Preliminary research (Shoffner, 2005; Fiedler, 2003; West, Wright, & Graham, 2005) suggests that blogs promote reflective practice. Lin and Yuan (2006) used blog as a platform of learning reflective journal. In their study with 76 students, learning reflection has a positive effect on students' learning performance. Correlation is significant at a significance level of 0.001 (two-tailed). About 88% of the students felt that expressing learning reflections on a blog was a positive experience. About 88% of the students felt that learning reflection had a positive influence on their learning. Students who have higher learning performance tend to take more time on learning reflection.

Ray, Hocutt, and Patterson (2005) qualitatively investigated whether blogs support reflective and creative expression. They identified the known population a sample of K-12 teacher created, teacher centered blogs (n=138). Using Dhalen's method of sampling to the identified research sample, thirty blogs were randomly selected. Sixteen agreed to participate in the study. Even though interviews could not be generalized to the known population or to the sample, the results remain useful. Twelve out of sixteen participants reported that blogging supported reflective practice. The depth and level of reflection, however, varied within entries and between bloggers.

Collaboration

Blogs allow learners to share knowledge and experiences as well as be aware of their peers' opinions. It could be used as a supplementary channel to the classroom discussion. Wang and Hsu's study (2007) provided an example of adopting blogs as an alternative channel to the classroom discussion. The findings of this study suggest that appropriately adopting blogging tool could help instructor facilitate in-depth discussion, encourage participants who are not comfortable to express opinions face to face to express opinions, and provide an interactive way for participants to debate or discuss on issues.

Lin and Yuan (2006) also stated that over 90% of the 76 students looked forward to receiving their classmates' comments and feedback on their reflections. More than 86% of the students felt that viewing classmates' learning reflection on blogs has a positive influence on their learning.

Glogoff (2003) investigated 21 students geographically dispersed across North America. Blogs were introduced as an additional communication tool to the course's threaded discussion forums and chat room. Conclusions drawn from this study are 19 out of 21 students had a positive experience with the blog, felt that they learned useful and relevant material, and 14 planned to join at least one new blog in the coming months.

Students and instructors can use blogs to cultivate ideas and share them online with colleagues and others. Blogs provide an electronic forum for reading, writing, and collaborating with peers and others. They can give students and teachers a sense of connection with their peers and form an online community.

Statement of the problem

The use of blogs in K-12 is a relatively new phenomenon and has been documented only recently. However, such papers rarely discuss the blogs in K-12 science education even though many in the field are aware that the number of educational "bloggers " is growing daily. This study will classify how blogs have been used in K-12 science education into blogging as a content delivery tool, blogging as a reflective tool, and blogging as a collaborative tool. In doing so, this study aims to inform K-12 science teachers the appropriate way to implement blogs in the classroom to promote students' reflection and collaboration.

Method

Data Collection

This study is to understand how K-12 science teachers have used blogs to promote students' reflection and collaboration. The research papers first had to be located. Several major databases were used including JSTOR, ERIC, Proquest, Web of Science, Education Full Text and EBSCO. A variety of search terms were used including blogging, blog, science learning, science education, reflection, collaboration, teacher blogging, and student blogging. This extensive study resulted in the identification of 22 papers.

Operation definition of key terms

Blogs are personal journals made up of chronological entries. The features of a blog include text, audio, and video files that are archived on a Web page for easy student access. The text files are similar to those found on Web discussion boards. These allow students and teachers to engage in written, two-way communication. The audio files, commonly referred to as podcasts (play on demand), allow students to listen to a description or explanation. And the video files, called vodcasts (video on demand), allow students access to a file that combines video with audio.

Blogging is the act of creating and maintaining a blog. A blogger is someone who maintains a blog, while the blogosphere refers to the interconnected, interlinked and constantly self-referential community of blogs and bloggers.

Criteria

The focus of this study is to provide guidelines for K-12 science teachers to implement blogs in the classroom effectively. Case studies and blogs from the identified research papers were selected for potential inclusion in this study based on these criteria: (1) related to math and science education; (2) utilized by K-12 pre-service or in-service science teachers; (3) involving student contribution ; and (4) publicly available to afford access to the different ways the blogs were being used. Fifteen studies met these criteria.

Review

Blogs could support learning through promoting reflective thinking, encouraging peer support for one another, nurturing collaboration and relationship-building and extending learning outside classroom walls. Those features provide teachers with rich opportunities to use blogs in the K-12 science classroom.

Blogging as a Content Delivery Tool

Teachers' blogs extend learning outside classroom walls through delivering course content including syllabi, multimedia storytelling, assignments, links, and audio and video files as necessary

Glass(2007) used blogs into syllabus in order to provide a simple mechanism to alert everyone in the class. The tightly packed syllabus offered little room for the examination of classic problems and historical personages. Therefore, the online vehicle blog allowed the course instructor to enhance the syllabus by moving discussions on ancillary topics or those "we will get back to that" topics to the blog. On the blog, Dr. Glass introduced these interesting but tangential problems in a way that did not impact coverage of the actual syllabus. The blog allowed the authors to develop assignments that students could revise until correct. This was especially critical in the areas of information validation and citation. Working for mastery was more important than getting a one-time grade.

Blogs could be utilized as an excellent tool where storytelling advances for both individual expressions and collaborative learning (Huffaker, 2005). Literacy remains paramount in learning, not only for language development, but also as the foundation of all academic disciplines including science and mathematics. There are two cases as follows:

J.H. House Elementary School in Conyers, Georgia uses a blog to encourage writing for third-graders. The teachers use blogs to spotlight select writings of children. Buckman Arts Magnet Elementary School in Portland, Oregon uses blogs to create a portal for all classrooms. The blog links among each teacher, showcasing photographs, student artwork, and classroom news. Because of the effortless deployment and maintenance issues of blogs, as well as the focus on content, collaboration, and documentation of completed tasks, Huffaker (2005) states that teachers across all academic disciplines could use blogs as an effective tool in promoting verbal literacy, one of the most important aspects of education.

Blogs support communication in audio form. The audio files on blogs, commonly referred to as podcasts (play on demand), allow students to listen to a description or explanation. Some students may need additional support with the language of science and the pronunciation of science vocabulary. Others have difficulty reading and reviewing science texts and materials. Audio files on blogs provide a powerful tool to address these needs.

In 2007, elementary pre-service teachers were investigated in a university science course (Redman, 2008). They were introduced, and listened to, a range of international science podcasts produced by science communicators. Podcasts appeared to offer learning opportunities of great pedagogical potential for science where students could be listening to engaging auditory presentations, and to be mobile while listening. Students could access mobile technology that allowed them to listen anywhere and anytime.

In the study of differentiated science education, Colombo and Colombo (2007) investigated Ms. Daniels' classroom. She has a master's degree in science education and has been teaching life science for eight years. Through blogs, she differentiates instruction to help all students learn high-level science content and develop the academic language skills necessary to effectively communicate science concepts. She posts study guides that outline key points students should understand for projects, tests, and other assignments. She includes links to more advanced materials for students.

What's more, Ms. Daniels creates podcasts to introduce each topic within the text. She has chosen podcasts because they require less computer memory and download quickly. When students click on a podcast, they hear Ms. Daniels speaking slowly and clearly, providing time for them to locate pages and diagrams in their texts. Podcasts of each lesson are available to students, parents, and paraprofessionals on the class blog.

Blogs support communication both in audio and visual form. The video files on blogs, called vodcasts (video on demand), allow students access to a file that combines video with audio. Teachers can combine PowerPoint visuals and narration to review key points of class lessons and then save these as vodcasts. They then upload the vodcasts to the class blog, which increases the accessibility of these lessons not only to students but also to parents, tutors, teacher specialists, and paraprofessionals who work with students.

Again in Colombo and Colombo's study (2007), Ms. Daniels uses vodcasts to support the science content reading lessons she conducts at the beginning of each year. When students struggle with text that is difficult for them, they and their parents can access these reading-strategy lessons. With one click, students are able to download "Using Unit Objectives" and "Learning New Vocabulary." When students open "Using Unit Objectives," an image of the first page of a unit from the textbook appears. As they see the words "Unit Objectives" being circled, they hear Ms. Daniels explaining, "In this text, objectives are found on the left-hand side of the first page of the new topic.

The power of the vodcast was identified as partly being in the images and this visualization aspect was clarifying for some students. These comments refer to the vodcasting experience and the visualization aspect

This study examines students creating science video-podcasts, but importantly, only when the science content was well understood and the digital resources were created by the students. In Redman's study (2008), students worked on their blogs to present a vodcast to others at the end of the year. The students had been introduced to moviemaking in 2006 in their educational computer subject that introduced them to a range of technical skills. Students had opportunities to draw, photograph, research, model and create videos during the year.

Vodcast seemed to have contributed to sound levels of engagement as is evident in the final products. Students re-engaged with their science understandings, personally and professionally, and affirmed their ability to communicate effectively. The *v*odcast seemed to offer a richer learning opportunity that capitalized on the positive aspects of visualization and learning in science, and catered for another modality of learning, now covering auditory, kinaesthetic and visual modes.

Blogging as a Reflective Tool

Blogs provide students opportunities to reflect on their own knowledge, find the words to articulate and share it with others, and progressively students become aware of how they learn best. Redman (2008) documented the students' reflection on conceptual understandings of lunar phases.

Student

I felt frustrated with the concept of this assignment in the beginning stages, that it was a "hassle" for me to be looking up at the moon, and that I just plain old didn't want to wonder and ponder about the moon!! It wasn't that I don't like the moon; I just felt that I didn't feel that it deserved my time. Fortunately I had a big change of attitude, as I discovered that this ongoing and hands-on style of learning was really well suited to me as a learner.

Student

This blogging experience has unquestionably refined my understandings of the moon and its relationship with the sun and the earth. By beginning with observing the moon it gave me a chance to approach science in a completely different light. In observing the moon as a child would I felt as though I was starting from scratch and found myself more will to ask questions, to myself and others, which I would not normally.

Redman's study (2008) also noticed that students had opportunities to draw, photograph, research, model and create videos during the year, and this appeared to be a situation ripe with potential for reflective learning. The students were able to produce a vodcast and be provided with a chance to cognitively re-engage with what they had learnt, remembered and forgotten. Students affirmed what aspects of the learning experience contributed to the success of the learning journey.

The students found constructing the vodcast an empowering experience. The groups shared the strengths and weaknesses of their early conceptual understandings. Blogging seemed to have positively supported the reconstruction of understandings. The blogging experience appeared to have contributed to the positive perceptions of the vodcasting experience as a contributor to reassure students of their more refined and stable understandings.

Student

The knowledge that I have developed through blogging was stable and I easily slipped back into discussions (when working on the vodcast)'

Student

I understand the lunar phases and can explain it/use models.

Student

I can really 'see' or visualize where the sun is in relation to the moon each time I look up now.

Student

Yes, absolutely … remember in pictures, so doing the modeling and being 'in' the visual was really effective in helping me understand.

Student

It was really hard to recall in the mind, (but) images and modeling can visualize the concept.

Blogs could be used to encourage guided discovery and knowledge construction. In a module on information architecture, for example, students in Glogoff's course (2005) read the professional literature from blogs and visited Web sites that provided tutorials and other content. After this exploration, students completed an assignment which synthesized what they had learned and described those concepts in a real-world.

K-12 teachers could help students establish personal blogs to write reflections. Turnbull (2004) reports on the routine use of blogs in British primary schools as having positive effects, including bloggers doing better in their schoolwork than non-blogging peers, bloggers' interest in their schoolwork rising, and their literacy rates and IT competency becoming higher than that of their non-blogging peers. There is a three-step process involved in blogging: scouring, filtering, and posting. The blogger visits multiple Web sites relevant to his or her topic to find information to which they will respond, critique or hyperlink. The blogger must then filter the results to post the "best of" content for readers. Through this process, bloggers are exposed to vast amounts of information on their given topic, even if they do not comment on everything they find. The regularity of doing this at least once a week creates a repetitive process where the blogger builds an evergrowing scientific knowledge based on particular topics.

On the other hand, K-12 science teachers could use blogs to reflect on their teaching practices. Luehmann (2008) systematically analyzed the 316 posts Ms. Frizzle who is an urban middle school science teacher wrote over 1 school year. Ms. Frizzle used her blog to tell stories of herself and her classroom, reflect on her practice, work through dilemmas, solicit feedback, and display competence, among other things. She used her blog to revisit what she had done and written in the past, thus multiplying the potential for reflection offered by blogs. "When I choose an aspect of teaching that I wish to improve, I can return again and again to that theme in my writing, which helps me stay focused."

Blogging contributed to Ms. Frizzle's development of her vision and dispositions; led to new understandings of content, pedagogy, and her students; and positively affected her practice by helping her in planning and other decision-making processes. Ms. Frizzle's blog not only enabled her to reflect on her experiences with the goal of improving her practice but also enabled her to generalize from these experiences to wrestle with important issues and articulate new insights and resolutions that affected her understandings, beliefs, vision, and dispositions as an urban reform-minded science teacher.

Meanwhile, scientific Blogs allow and encourage students interact with experts and others outside of the classroom. Because of blogs' ability to provide thoughtful dialogue within a short time frame, they provide a platform within science education for discussion on current theories and recent discoveries and development to promote reflection. In May 2005, UniServe Science set up a blog called Blogging in Science and Science Education (http://scienced.blogspot.com/) to accumulate information on the use of blogs and other content aggregation tools in the area of science, scientific research, science education and research into science education. This type of blog is sometimes known as a knowledge log or klog.

Blogging as a Collaborative Tool

Bruner (1996) states that learners need to actively, and creatively, use tools from their culture to create their understandings with others. Blogs provide a platform for the interchange of information and ideas on how these tools can play a role in science and science education and to provide a forum for discussion of these issues. Blogging supports communication effectively.

One excellent example of a blog being used in this way is Real Climate (http://www.realclimate.org/) with its ongoing discussion of global dimming and other issues of climate change (Placing**,** Ward, Peat, & Teixeira, 2005). Unlike many less informed blogs, this one is the work of a number of scientists working in the area of climate and climate change, and is their attempt to ensure the general public and the media are kept informed on key issues.

In their own words: RealClimate is a commentary site on climate science by working climate scientists for the interested public and journalists. We aim to provide a quick response to developing stories and provide the context sometimes missing in mainstream commentary. The discussion here is restricted to scientific topics and will not get involved in any political or economic implications of the science.

Blogs create communities of learning, science understandings are refined, positive identities as learners are created and science ideas are continually investigated and articulated. K-12 science teachers could use blogs to form an online community. As educators and other users post to their blogs, they are also, potentially, creating an online resource for their peers to refer to for guidance (Campbell, 2003). Because Blog software often includes ways to link users together, others can comment on a peer's posts or even work together online to solve a shared problem. A science class, for instance, can give rise to an exchange of lessons learned after a scientific experiment. A discussion of fundamental concepts in science could help students understand the logic behind the formula.

MacBride and Luehmann (2008) did a case study to make contribution by exploring how one high school mathematics teacher effectively integrated classroom blogging into the central, disciplinary work of the class. At the time of this study (during the 2005-06 school year), Mr. K. had been a high school math teacher for 13 years and was using blogs for the second semester. The classroom blog he developed specifically for his llth grade Pre-Calculus class (which was publicly accessible on the Internet) provided rich examples of diverse ways a teacher could employ classroom blogging to support student learning. Mr. K's blog for the Analytical Geometry unit lasted 27 days (October 25, 2005-November 20, 2005). In this time period there were 1,292 lines of text written on the blog; 30 posts by students; 11 posts by Mr. K; 26 comments from students; and 3 comments from Mr. K.

Mr. K's blog included the following key features:

1. Mr.K. required each of his students to take a turn at writing a post that recorded what happened in class that day.
2. Mr. K. also used the classroom blog to support students' reflection concerning the
process and outcome of their learning over the course of a given unit.
3. Chat Boxes. Noticing that a large number of student responses to posts were abbreviated comments and questions much like the "talk" that occurs in synchronous communication forums such as text messaging, Mr. K. integrated a Chat Box tool as a feature of their class blog. Mr. K. added this feature to his blog primarily to facilitate students' communication with each other especially regarding specific class assignments.
4. Sharing of resources. Mr. K also used his blog to provide students with access to math specific resources such as assignments, reviews, online tutorial or quizzes. Students also contributed links to resources they had found useful.

Mr. K's classroom blog 1) increases collaborative learning and nurtures a community of learners; 2) creates a student-centered learning environment; 3) provides a place for reflection; and 4) provides enrichment to the class.

Discussion

Science education has acknowledged a need to engage students with science, to make the learning space a personalized one and one that is of interest to the learner. Using blogs, students have many ways to become engaged and motivated in the learning experience. While science classroom blogs like Mr.K.'s are still far from being common, some teachers using blogs in different instructional science contexts have found their experiences very rewarding and wrote about the benefits of blogging for them and their students.

Despite the lack of rigorous empirical studies in this emerging literature especially in peer-reviewed journals, these review results can be valuable for K-12 teachers as they begin to identify 3 potential benefits of classroom blogs that may warrant consideration and further exploration. As a result, the appropriate way to implement blogs in the science education to promote students' reflection and collaboration is to form an online community of practice.

Blogging as a Content Delivery Tool

Blogs extend learning outside classroom walls through delivering course content including text, hyperlinks, audio and video materials. The various forms of information promote students' active engagement in science learning.

In science education the process of visualizing has a perceptual emphasis referring to the learner's awareness of an object that can be seen and or handled, but also has a focus on the imagery that is produced as a consequence of the experience. The mental imagery is believed to be a major strategy in cognitive tasks and aids remembering and understanding and is particularly valuable in science. Blogs offer all kinds of ways for students to establish personal and intellectual ownership of new concepts while they visualize and interact with abstract scientific ideas.

Blogging as a Reflective Tool

The potential of blogs for reflection is shared by personal journals. Blogging allows students to have a real audience, and thus can motivate students to do their best work. Students posting on a classroom blog know that at the very least their teacher and classmates will be looking at their posts; as most blogs are public spaces, this audience could extend even further, beyond the classroom.

Besides, blogs have an advantage in terms that they provide easier ways to access and make connections across one's previous posts. Students could use blog to revisit what they have done and written in the past, thus multiplying the potential for reflection offered by blogs.

Blogging as a Collaborative Tool

The structure of blogs has great features to support professional practice in science. Specifically, the progression from post to comments then a new post to more comments in many ways reflects the practice of professionals in the scientific community in which a hypothesis is generated, tested, analyzed (or reviewed), followed by a new hypothesis, and so on.

As discussed above, forming an online science community of practice using blogs to promote reflection and collaboration would benefit students a lot. That community of practice refers to the process of social learning that occurs when people who have a common interest in some scientific subjects or problems collaborate over an extended period to share ideas, find solutions, and build innovations.

Blogs would be designed to support these opportunities for growth in human cognition, through active sharing of ideas, to help to create meanings that are socially and culturally shared, reflected upon and discussed.

Here are some guidelines to form an online science community of practice:

1. Decide the purpose of the blog

Blogs can either serve as a reflective tool or collaborative tool. Teacher's blog can deliver science content as well. Rules need to be set up at the beginning of the course to make sure each individual's responsibility. For example, students' blogs are for reflection. The formats could be text, audio and video.

2. Spend time visiting other science classroom blogs

A quick search on Google or other search engines for "blog" and the topic area should provide some interesting results. Finding out what challenges and successes other science teachers experienced with your content area could help your own learning community.

3. Model blogging for students

Spend some time introducing the concept of blogging, how it is done, why it is done, showing good and bad blogs, etc. Then, provide a set of strict rules for blogging such as frequency, length of posts, number of and staying on topic. This set of rules can be created together with students.

Students should be made explicitly aware of what is not appropriate on the blog. And remember that because blog are Web-based, informal communication, students may be apt to use inappropriate language on their blogs. They might also fail to use references and citations when quoting others' work.

4. Make blog into routine use

Developing and maintaining an active audience will inevitably present considerable challenges for beginning science teachers, as it requires time to build an audience for a new blog, as well as a commitment to a minimum level and frequency of posting in order to provide enough attraction to regular participants.

5. Enrichment

Be creative and fun! A new puzzle or problem solving game each Sunday may motivate your students into science learning. It does not need to be a requirement, let your students gave it a try and post some comments related to their attempts.

6. Technique tips

RSS up-to-date: RSS is a content aggregation tool. Electronic updates using RSS (Really Simple Syndication or Rich Site Summary) technology are often included in blogs to provide a way to aggregate forthcoming information on a topic or from a Web site. RSS makes a blog system more convenient. Students can actively subscribe interesting topics or content through RSS feeds, which in turn reduces the time for searching and querying information significantly.

Social bookmarking: It is a Web based service, where shared lists of user-created *Internet bookmarks* are displayed. These shared lists can be organized and tagged with appropriate subject headings. Web based bookmarks that are created and tagged by librarians can be update with additional, patron-devised, tags. *Del.icio.us*, *simpy*, and *BlogMarks*, are Web sites that support social bookmarking.

Conclusion

The characteristics of blogs create an excellent computer mediated communication context for individual expressions and collaborative. Therefore, it is an effective tool in promoting science education because of the effortless deployment and maintenance issues of blogs, as well as the focus on content, collaboration, and documentation of completed tasks. Meanwhile, as a valuable e-learning tool, blogging can be used in a number of ways to engage students in scientific discussion, exploration, and discovery.

However, Blogging is a time consuming issue since it involves great amount of reading, writing, responding, and thinking other than the required participation time in class and work to be done. Further research relating to the strategies and effectiveness of blogs in K-12 science education is necessary.

The life of blogs, even that of team blogs, is always dependent on participation. Many blogs come to a dead end, due to either waning interest by the blogger or because they have moved on to other blogs or other forms of communication and participation. The challenge for the educator is to maintain interest and relevance within the blog.

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Context Matters: A Description and Typology of the Online Learning Landscape

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Introduction

The field of online learning faces a challenge: While we speak of online learning as a single entity, it tends to look very differently depending on the context of delivery. K12 and higher-ed learners, for example, might expect a fixed-pace, instructor-led course, whereas corporate learners see a greater mix of self-paced tutorials. Differences in setting, audience, techonlogy, pedagogy, and subject matter make generalizations and comparisons extremely challenging. Just as instructional designers often neglect the context of instruction (Tessmer, 1990; Tessmer & Richey, 1997; Tessmer & Wedman, 1995), practitioners and researchers of online learning rarely place enough emphasis on the context of their practices and models. And context changes everything.

This is a happy problem of course, part of the growing pains of a successful infusion into established institutions. As online learning enters mainstream practice (Allen & Seaman, 2006, 2008; Lokken, 2009; Picciano & Seaman, 2007), we need more nuanced descriptions and specifications in order to guide practice and understand appropriate uses. This paper responds to that growing need by reviewing, synthesizing, and expanding on past classifications of online learning in an effort to develop an initial framework that presents key variables of the online learning landscape as well as a typology that can be used to classify specific instances of online learning. Our intent is to develop a framework to provide a more precise language for research, and help practitioners targeting quality assurance and program improvement.

The Role of Context

A need for greater attention to context should come as no surprise. History has shown that context plays an important role in education. From the importance of conducting a front-end analysis when designing training and instruction (Rossett, 1987), to the development of situated theories of learning (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; Wenger, 1998), to the rise of qualitative and mixed methods of research (Dellinger, 2007; Lincoln & Guba, 1985; Lowenthal & Leech, 2009), academics have been placing a greater emphasis on context over the last few decades. This is not generally true for online learning however. Rather than focus on or even acknowledge the situated and contextual nature of online learning, we tend to talk about online learning as a single entity. The language we use shapes the way we think, just as the way we think shapes the language we use (Lowenthal & Wilson, in press; White & Lowenthal, 2009). This lack of specificity when talking about online learning is problematic because it perpetuates a myth that there is a single type of "online learning."

An undifferentiated construct of online learning is problematic for a number of reasons, three of which are briefly outlined below.

- It *confounds research results* related to online learning (Philips, 2005, p. 541), which is regularly criticized for being low quality (Amiel & Reeves, 2008; Bernard et al., 2004; Reeves, 1995; Wray, Lowenthal, Bates, & Stevens, 2008). Researchers need to be as transparent and explicit as possible when researching anything – but especially when studying the ever-changing field of online learning. The ability to replicate findings is often seen as the hallmark of rigorous research and a basis for advancing knowledge (Moore &

Anderson, 2003). However, the lack of precision, explicitness, and agreement in the language we use to talk about, think about, and describe online learning makes this very difficult.

- It *confuses practitioners* by glossing over key differences in practice. While we continue to hear about how much online learning is growing each year, comparatively speaking, we tend to hear very little about online attrition and the difficulties encountered by students. Research suggests that attrition in online learning is higher than traditional face-to-face programs (Carr, 2000; Phipps & Merisotis, 1999; Willging & Johnson, 2004). Attrition, retention, and student persistence are complex issues that are difficult to study (Hagedorn, 2005) and overall research on attrition in online learning is relatively new (Shea & Bidjerano, 2008, p. 346). Therefore, there is a great deal we do not know about why some students drop out of online courses. Part of the reason may be the broad and often inaccurate assumptions of what online learning entails, when in fact students find themselves in a wide vary of online experiences when taking courses online.
- It likely influences *how faculty and instructional designers design online courses*. For instance, the overall popularity of asynchronous online learning environments coupled with past experience, leads faculty and instructional designers (especially in higher education spaces) to have a certain conception of "online learning." This conception is of a primarily (if not exclusively) asynchronous learning experience which then influences and possibly restricts the type of instructional activities they design.

Online learning manifests itself in many different ways and these differences need to be more consistently acknowledged, discussed, and valued. While dissertations might include thick descriptions of the context and type of online learning, journal articles (possibly due to restrictive word limits) often lack this type of rich and extremely important detail. We contend that when online learning is taken "out of context," we tend to have problems like those previously mentioned among researchers, practitioners, and students.

Background - Different Ways of Describing Online Learning

In the following section, we review and synthesize some common distinctions and characterizations made about online learning. These core concepts are later included in a list of key variables of online learning that researchers and practitioners alike should consider and serve as the basis of our initial proposed typology.

Synchronous vs. Asynchronous

Perhaps the earliest distinction made about online learning was between synchronous forms and asynchronous forms of online learning (Hrastinski, 2008). Simply put, synchronous learning requires the instructor and learner to be online at the same time to communicate and engage in instructional activities, whereas asynchronous learning allows instructors and learners to be online at different times, or proceed in an entirely self-paced mode with no instructor presence (Horton, 2006; Salmon, 2003). This distinction was especially useful with the rise of email, bulletin boards, and threaded discussion tools – contrasted with broadcast forms of delivery.

The reality though is that most online learning these days – especially in K-12 and Higher Education spaces – is mediated by Learning Management Systems (LMSs), which now come standard with both synchronous and asynchronous communication tools. While asynchronous activities still dominate online learning these days (Parry, 2009; WCET, 2009), increasingly online courses include a mix of synchronous and asynchronous activities (Salmon, 2003). Even when an instructor does not include any synchronous learning activities per se, he or she might use a chat tool to hold set office hours. Thus, it may be unproductive to characterize a course as simply being either synchronous or asynchronous, when in fact a mix of elements are used.

Instructor Led vs. Learner Led

Another commonly used way to characterize and differentiate online learning is to focus on the pacing of the course and the degree to which a learner can control the pacing of the course. This is often referred to as instructor led vs. learner led (e.g., DeRouin, Fritzsche, & Salas, 2004; Horton, 2006) or group-paced vs. self-paced (e.g., Brandon, 2007). Instructor led is used to describe a typical college course in which an instructor facilitates an online course (often self-designed and produced) with a group of students. Such a course would typically fall on a traditional semester schedule in a asynchronous environment. In instructor led courses, learners are expected to complete the course according to the instructor's predefined guidelines which typically include set deadlines. This structure often prevents a student from working ahead at his or her own pace (Horton, 2006). Learner led on the other hand is used to describe online learning environments in which the learner can proceed at his or her own pace (Horton, 2006). This typically takes place in workplace education rather than K-12 and postsecondary settings; however all levels of formal education have examples of learner led offerings.

While this differentiation is useful, some issues remain. First, while some courses are truly instructor led, very few full courses are completely learner led or self-paced. The typical college self-paced course, for example, must be completed during a traditional semester timeframe. Further, many learner-led online learning environments might have an instructor or facilitator (even if only in a tutorial role) just as many instructor led online learning environments might allow a learner to proceed at his or her own pace.

Harasim's Typology

Harasim, first in 2000 and later in 2006 – while not specifically setting out to develop a typology – offered an early description of the diversity that exists across the online learning landscape. She first differentiates between three types of online learning:

- *Online collaborative learning* is a common method used by institutions of higher education; it involves using asynchronous, synchronous, or a combination of the two, forms of communication to bring a group of students and teacher together.
- *Online distance education*, on the other hand, is essentially a correspondence or independent study course that uses technology (e.g., email) for students to access course materials and turn in assignments. This type of online learning is used by K-12 and post-secondary institutions. It is essentially a one-to-one or one-to-many model.
- *Online computer-based training* "refers to the use of the web for access to online courseware or individualized learning modules. There is typically neither peer collaboration nor communication with an instructor or tutor" (Harasim, 2006, p. 63). This is often the preferred method of online learning in corporate and workplace spaces, adding the flexbility needed for on-the-job and just-in-time learning.

Different Types of Education

Citing the work of Coombs and Ahmed (1974, as cited in Harasim, 2006), Harasim places these online learning types within three different types of education:

- *Formal* education refers to traditional education completed typically in P-16 environments for credit and credentialing.
- *Non-formal* education refers to the type of education often described as professional development, completing as part of one's job duties.
- *Informal* education refers to the specific lifelong learning individuals take part in throughout their life. Informal learning lacks the "deliberate instructional and programmatic emphases in formal and non-formal education" (Harasim, 2006, p. 63).

Different Roles of Online Learning

Finally, whether a course is formal or non-formal, the particular role of online learning in a course can vary greatly. Harasim (2006) uses three categories:

- *Adjunct* mode is when online learning activities are used only to supplement a course.
- *Mixed (blended)* mode is when online activities are used as a significant part of a course.
- *Totally online* mode describes courses in which the majority (if not all) of the course activities are done online (p. 64).

It's no surprise that Harasim, an early pioneer in the field of online teaching and learning (see Harasim, 1986, 1987, 1990, 1993; Harasim & Johnson, 1986; Harasim et al., 1995), has developed a very helpful description of the online learning landscape. However, some continuing issues remain. For instance, even within online collaborative learning, very important differences may exist. Further, the rise in popularity and access of online conferencing applications has aided in the rise of the webinar, a form of learning activity in its own right.

iNACOL's Classification of Online Teaching and Learning

A recent classification of online learning has been developed by the International Association of K-12 Online Learning or iNACOL. iNACOL's brief (Cavanaugh et al., 2009) "examines some of the aspects of online teaching, specifically those related to communication and interaction" (p. 4). An entire section of the brief focuses on characteristics of online teaching. In order to understand the range of virtual school models, they decided to survey and then describe each virtual K-12 school's instructional pacing, course design, delivery technology, instructor role, and teacher requirements (Cavanaugh et al. 2009). The additional considerations below give body to an emerging framework for online learning.

- *Instructional pacing*. Does the virtual course follow the traditional school schedule? Other options would be: does not have a formal schedule, includes a required or suggested pacing chart, or does not follow any specific pace.
- *Course design* describes whether a virtual school uses vendor produced courses as is, with modification, or whether they locally develop their courses (individually or by a curriculum committee).
- *Delivery technology* refers to whether the course relies on synchronous video, synchronous classroom software, asynchronous software, or blended.

- *Instructor role* touches on whether the instructor provides instruction primarily synchronously, provides synchronous supplemental instruction, provides asynchronous primary instruction, leads discussion, evaluates non-graded activities, and/or evaluates graded activities.
- *Communication* focuses on the type of teacher-to-student and student-to-student communication required. Options include requiring email, discussion forum, instant messaging, synchronous, and in-person communication between teacher to student and/or student to student.
- *Teacher requirements* addresses teacher qualifications: whether or not the teacher is required to meet minimum certification, have minimum teaching experience, have minimum online teacher training and/or minimum online teaching experience.

These additional constructs provide further specificity for online learning, and are incorporated into the emerging list of key variables and typology presented in the next sections.

A Typology (Topology?) of the Online Learning Landscape

We recognize that a typology of online learning cannot realistically take into account every possible variable, nor should it do so. For a typology to be useful – and therefore more than an academic exercise – it needs to be as comprehensive as possible while at the same time being clear and easy to use. We present in this section the characteristics / variables of the online learning landscape we have chosen to include in our typology. Only those variables likely to impact pedagogy, learning, and performance were included in the framework.

Table 1 extends the characteristics identified by Harasim and iNACOL and summarizes the typology. Each variable is then discussed below. The categories constitute a typology – but we could also use the word *topology*, consistent with the metaphor of the online landscape!

Table 1
Key Characteristics of Online Learning

Themes	Characteristics
Context	Formality
	Setting
	Curriculum Fit
	Synchronous/Asynchronous
	Pacing
	% Online
	Class Size
	Development Model
	Targeted Learning
	Subject Area
Media	Multimedia
	3-D Virtual Worlds
Teachers and Learners	Instructor Role
	Cohort Group
	Student Collaboration
	Teacher Preparation
	Student Diversity
	Class Size

Contextual Variables

Formality. As pointed out earlier, Harasim (2006), working from the work of Coombs and Ahmed (1974), distinguished between three types of education: formal education, non-formal, and informal education (see also Rogers, 2004). One distinction needs to be added to Harasim's list. We see two different types of non-formal learning: required and optional. An example of required non-formal online learning is when employees are required to complete an online training workshop on sexual harassment prevention. An example of optional non-formal online learning however would be when people (typically adults) complete optional "training" (e.g., attending a synchronous webinar or completing an asynchronous learning module online). The optional or required nature of a course or module can affect learner motivation and engagement.

Setting. As mentioned earlier, online learning tends to manifest itself differently across K-12, higher education, and workplace education spaces. Harasim alludes to the importance of setting when she distinguishes between three types of online learning (i.e., online collaborative learning, online distance education, and computer-based training) but in the end she does not go far enough. While differences exist even within settings (as we address, e.g., under subject area), there are important differences across setting of use. For instance, in K-12 online learning, online faculty have to address standards, standardized testing, and even continuous communication with parents in ways that higher education and corporate/professional faculty do not. Similarly, corporate/professional spaces often benefit from the ability to "require" an employee to complete an online learning experience, which adds affordances and constraints (particularly costs).

Curriculum Fit. This variable is related to the formality of a course. Some online courses and modules fit neatly into a larger curriculum plan, while others do not. Some smaller-scale modules, often self-paced, fit within a more traditional course. This link to a larger curriculum or credentialing purpose affects how students and instructors think of learning and instruction within the course. Prerequisites become an issue, as do the specificity of learning outcomes, which may be used by another course as prerequisite knowledge.

Pacing. The pacing is another key variable that must be taken into account. There really are two parts of pacing that should be considered. First, does the course (or non-formal learning experience) follow some type of pre-defined schedule? Second, does the learner have the ability to complete the learning experience at his or her own pace? Regarding the first point, for years the accelerated learning movement has questioned the importance of "seat-time." That is, they have argued that people (especially adult learners) can learn the same amount of content in an accelerated term (e.g., 8 weeks) than in a traditional semester (e.g., 15 weeks) (Wlodkowski, 2003; Wlodkowski & Westover, 1999; Wlodkowski, Mauldin, & Gahn, 2001). While more research needs to be conducted on this (especially on accelerated online courses), most can agree that there is nothing sacrosanct about a 15-week semester. And while seat time does not equate to learning, the amount of time available in an online learning experience influences the sequence and scope as well as learners' ability to connect with each other. For instance, research on social presence has suggested that social presence is established early in a course, which builds the foundation for a Community of Inquiry to be established and subsequent learning (Garrison & Anderson, 2003; Shea, Li, & Pickett, 2006). Shortening the duration could likely impact how learners establish a Community of Inquiry (Lowenthal & Lowenthal, 2009). Similarly, but for different reasons, allowing learners to progress at their own pace is likely to influence the types of instructional activities included.

% Online. The increased use of course management systems (CMS) at campuses across the country and Web 2.0 applications is making it easier for faculty to incorporate online aspects into their face-to-face courses. From simply uploading their syllabus to the web to having simple discussions online, face-to-face instructors are using the Internet in their courses – thus blurring the line between face-to-face and online courses. Further, online courses and programs throughout the country commonly integrate face-to-face components – e.g., a meet and greet before the course begins or required face-to-face meetings – into their courses and programs. While face-to-face encounters like these are a positive addition, and blended learning experiences perhaps the best of both worlds (Shank, 2004)), they are unquestionably different than fully online courses, often leading to different learning activities and designs.

Class Size. Class size is also an important variable to consider when designing or researching online learning. While some have argued that enrollments in online courses should be between 15 – 25 students, many online courses have anywhere from 25-70 students enrolled in them at any given time. An online course with 50+ students is very different from one with 15.

Development Model. Early attempts at online teaching, at least in the higher education sector, were simply adaptations of classroom-based courses designed and developed by individual faculty interested in the new medium (Lowenthal & White, 2009). Many colleges and universities still rely on a faculty-driven design and development model, which Bates (1997) has characterized as the "Loan Ranger and Tonto" approach because of its heavy reliance on individual faculty. However, as the demand for entire academic programs offered online has increased coupled with continued technological innovation – many institutions are realizing that the development and delivery of online education is an increasingly complicated process, requiring both a specialized pedagogy and a technological expertise possessed by few faculty (Lynch, 2005; Oblinger & Hawkins, 2006; Wray et al., 2008).

As a result, across all sectors of the online learning landscape, there is an increased use of specialized individuals (e.g., instructional designers, web developers, flash developers, programmers, video experts, etc…) to design and develop (and sometimes even host) online course materials. These range from specific online learning departments within an institution, to consortiums that lease courses to other institutions, to consultants and publishers leasing and or selling their course materials (see Lowenthal & White). While research needs to be conducted on how using course materials produced by others influences faculty and student satisfaction and student learning (Lowenthal & Lowenthal, 2009), there is a long history of research suggesting that instructional design can improve the quality of course materials (for a recent example see Kidwaii, Howell, Defrain, van Middlesworth, & Spielvogel, 2009).

Targeted Learning. For this variable we are interested in the level of learning targeted – is the course knowledge-based, skill-based, or targeting complex, authentic performance that integrates knowledge and skill together? Determining the primary kind of learning goal can be surprisingly difficult when reading research reports. Knowing the kind of learning being targeted can provide a context for understanding research findings and how to generalize them to similar cases and needs.

Subject Area. Researchers of online learning have not adequately investigated the differences among specific academic disciplines (Arbaugh, 2005; Lowenthal & Lowenthal, 2009; Lowenthal, Lowenthal, & White, 2009; Smith, 2005; Smith, Heindel, Torres-Ayala, 2008; White & Liccardi, 2006). Anderson et al. (2001) suggest that subject differences might exist across disciplines because of differences between "discipline related conceptions of the education process" (p. 13). Similarly, Lowenthal and Lowenthal (2009) argue that differences likely exist because faculty and students belong to different communities of practice, which are constructed and maintained in part upon the language its members use (Street, 1984). Online faculty in certain fields of study and practice (e.g., education) communicate differently than those in other fields (e.g., business). Similarly, students' expectations regarding appropriate forms of communication, and ultimately things like presence or even work load, are likely to vary across academic disciplines. While we often like to think of good teaching as good teaching (Ragan, 1999), in practice, good teaching always happens in a specific context with specific forms of discourse (Lowenthal & Lowenthal, 2009; Lowenthal, Lowenthal, & White, 2009).

Media

This category presently contains only two sub-items. We have kept it separate conceptually because of its importance for online learning and its potential for continuing development.

Multimedia. Despite the increase in the availability of multimedia, most online courses tend to be primarily text-based (Parry, 2009; WCET, 2009). There has been a long history of debates about whether or not media can actually improve learning. This is not the place to continue this debate. But suffice it to say that people assume that online courses leverage multimedia when in fact, research suggests that most online courses (at least in the post-secondary sector) remain primarily text-based (Parry, 2009; WCET, 2009). It is important for researchers and practitioners alike to recognize this trend and strive to be as explicit as possible about the media usage in any online courses or programs they talk about.

Virtual Worlds. Increasingly educators are exploring the potential for using 3-D virtual worlds like Second Life for learning – especially in online learning environments (see Bronack, Cheney, Riedl, & Tashner 2008; Bronack, Sanders, Cheney, Riedl, Tashner, & Matzen, 2008). The use of these virtual worlds ranges from fully immersed online learning experiences to blended approaches. Over time we expect immersive environments to be commonplace learning resources.

Teachers and Learners

Instructor Role. The role of the instructor in online learning environments is often described as being more of a “guide-on- the-side” rather than a “sage-on-the-stage” (King, 1993). However, this cliché can be taken to extremes; there is a fine line between being a guide on the side and being absent at critical learning junctures (Lowenthal & Parscal, 2008). The role of the instructor may reasonably be different across online courses. For instance, self-paced courses typically do not include an instructor. In contrast, many survey courses at the undergraduate level are fairly instructor- and lecture oriented.

Cohort Group. Research about online learning suggests that students often feel isolated (Bischoff, 2000; Ludwig-Hardman & Dunlap, 2003) and alone in online learning environments (Grubb & Hines, 2000; Robinson, 2000). Attrition rates for online programs continue to be higher than ground-based programs (Carr, 2000; Moody, 2004; Phipps & Merisotis, 1999; Willging & Johnson, 2004). Whether an online course is part of a cohort – that is, a group of students completing the program together, typically in a set sequence – is likely to influence students' ability to establish a learning community online as well as whether they persist and complete the program. Everything from group-work to project based assignments is likely to be influenced by the degree to which students have had past experience taking online courses together.

Communication. From its early days, online learning has been characterized by its use of communication technology (e.g., asynchronous vs. synchronous). While asynchronous communication technology – primarily threaded discussions and email – still dominates online learning (when communication technology is used), a growing number of people are using synchronous communication technologies and an even increasing number are using a blend of the two (Chundur & Prakash, 2009). Research on asynchronous and synchronous communication technologies suggests that each of these technologies have their affordances and constraints (Horton, 2006). These affordances and constraints are likely to influence student satisfaction as well as student learning and therefore should be carefully thought about and described in detail when describing an online course or program of study.

Student Collaboration. The degree to which student collaborate with each other in an online course is an important variable to consider. Some instructor-led courses are very teacher-centric, with some discussion but very little collaboration on projects and assignments. Other courses utilize and rely on a great deal of collaborative group work. In our experience, for every highly collaborative course, there are many others with very low levels of collaboration. Rather than assume a course is collaborative because it is a group-paced course or that it is not collaborative because it is more self-paced, we posit that researchers of online learning need to explicitly describe the level of collaboration in the courses they study.

Teacher Preparation. People tend to assume that anyone can teach. For instance, in the higher education sector, a terminal degree is a license to teach; that is, "knowing a subject well is sufficient training to teach it" (Stevens, 1988, p.64). Similar assumptions and practices can be found in workplace learning environments. And while K-12 sectors have a history of requiring some type of teacher training – whether a traditional teaching certificate or alternative/emergency license – before being able to teach, only six of the ten programs surveyed in Cavanaugh et al. (2009) – iNACOL's brief cited earlier – have minimum online teacher training requirements and only one out of ten programs actually required teachers to have online teaching experience. As mentioned earlier, while good teaching is good teaching, researchers and practitioners alike have shown that teaching online is different than teaching in a face-to-face environment (Palloff & Pratt, 1999; Ragan, 1999; Salmon, 2003).

A number of institutions are now requiring some form of preparation for online instructors. Prior to teaching online for the first time, faculty in Regis University's College of Professional Studies must take part in a three-week assessment and training process online followed by an internship/mentoring process (Parscal & Florence, 2004). Regis is not alone. A growing number of programs are providing (and sometimes even requiring) training and development to teach online. For instance, faculty in the SUNY system have received exceptional training and development for nearly a decade (see Shea, Fredericksen, Pickett, & Pelz, 2003; Shea, Pickett, & Pelz, 2003). We suspect that just like in K-12 face-to-face settings (see Monk, Walberg, & Wong, 2001), the quality of the online teacher highly influences student learning.

Student Diversity. Online courses are more diverse than ever before – but so are the students completing them. With the increase of non-traditional students (at least in the higher education sector) coupled with an ever-increasing number of international learners (in both the higher education and corporate/professional sectors), more online courses consist of a very heterogeneous audience. The level of homogeneity in terms of prior knowledge, culture, and language can affect levels of course participation and learning (Parrish & VanBerschot, 2009).

A One-Page Rating Form

The list of variables in the previous section is not meant to be exhaustive. Rather, we outline key variables that need to be considered when talking about online learning. We recognize, and invite, other researchers to help us expand or refine the framework. Table 2 below casts the framework into a rating form for use by researchers and practitioners. The form is in draft mode; a polished formatted version needs to be prepared. The goal is to keep it on a single page for usability reasons. We believe a convenient form can have significant value. Researchers and consumers of research can benefit from this kind of specificity to make generalizations and interpretations easier and more accurate. In practice, instructors and students can benefit from this level of description through improved information to consumers, and for accountability and program-improvement purposes.

Table 2

Draft One-Page Form for Rating or Description

CONTEXT – Course setup, puporse, and fit					
Formality	Formal/Credit	Required Non-formal	Optional Non-formal	Informal	
Setting	K-12	Higher Ed.	Workplace Learning	Other [specify]	
Curriculum Fit	Course within Credential or Degree	Module Embedded within a Course or Credential	Stand-Alone Module		
Synchronous	[Specify % synchronous and asynchronous]				
Pacing	Fixed – Standard Term	Fixd – Accelerated Term	Self-Paced on	Completely Self-Paced	
% Online	[Specify % online and on-site]				
Develpment Model	Course was purchased by a vendor	Course was collaboratively designed and developed by a team or unit	Instructor is teaching a course designed and developed by another faculty	Instructor is teaching a course in which Web-based or other materials designed by others are incorporated into his/her own materials	Course is designed, developed, and taught by the instructor
Targeted Learning	Knowledge/memory/text processing	Skills and operations	Higher-order/authentic performing		
Subject Area	[Specify]				
MEDIA – Use and integration of multimedia and virtual worlds					
Multimedia	Primarily Audio and Video	Blended Media	Primarily Text-based		
3-D Virtual World	Fully Immersed	Blended	Supplemental	No 3-D World	
TEACHERS AND LEARNERS					
Instructor Role	Instructor – highly engaged/present	Instructor – less engaged/present	No Instructor		
Cohort Group	Continuing Cohort or Established Group	New Cohort	Non Cohort – most students don't know each other		
Communication	Regular communication with faculty and between students	Communication primarily with students	Communication primarily with faculty	Very little communication with faculty or students	
Student Collaboration	Ongoing student collaboration on projects and issues that arise	Occasional collaboration among students	Student collaboration is rare		
Teacher Preparation	Trained/Experienced Online Instructor	Trained but First Time Teaching Online	First Time Teaching Online	Not Applicable (No Instructor)	
Student Diversity	Heterogeneous [Describe in space provided]	Homogeneous [Describe]			
Class Size	[Specify class size or class size estimate]				

Conclusion/Implications

We are fully aware that trying to develop a stable and comprehensive typology of the online learning landscape is a challenging agenda. It may require more than an analytic exercise – students and professionals, for example, could report the most salient features that distinguish one product or experience from another. We thus see this as a work in progress. However, we also recognize that many of the current ways we talk about and think about online learning are inadequate in that they simply fail to take into account the complexities of online learning.

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The Changing Nature of Online Communities of Inquiry: An Analysis of How Discourse and Time Shapes Students' Perceptions of Presence

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Introduction

The Community of Inquiry (CoI) framework was developed as a theoretical framework to support the practice and research of online learning. Garrison, Anderson, and Archer (2000) theorized that meaningful learning online takes place in a CoI made of teachers and students, through the interaction of three core elements: teaching presence, social presence, and cognitive presence. Over the past 10 years, a great deal has been written on each of these three presences (Anderson, Rourke, Garrison, & Archer, 2001; Dunlap & Lowenthal, 2009; Garrison & Cleveland-Innes, 2005; Lowenthal & Parscal, 2008; Richardson & Swan, 2003;; Shea & Bidjerano, 2009; Shea, Li, Swan, & Pickett, 2003; Shea, Pickett, & Pelz, 2003; Swan, 2002, 2004; Swan & Shih, 2005). During the past few years, researchers have turned from just studying each element separately to studying the three elements simultaneously (Akyol & Garrison, 2008; Arbaugh, 2007, 2008; Arbaugh, Bangert, & Clevelan-Innes, 2009; Garrison, Cleveland-Innes, & Fung, 2004; Swan, Richardson, Ice, Garrison, Cleveland-Innes, & Arbaugh, 2008). However, despite the increased interest in studying the CoI framework, researchers have not investigated how communities of inquiry differ across different discourse communities (Arbaugh, Bangert, & Cleveland-Innes, 2009; Lowenthal & Lowenthal, 2009) nor whether they manifest themselves in accelerated online programs (Lowenthal & Lowenthal, 2009).

The purpose of this study was to investigate how student's perceptions of each of the elements of the CoI framework differ across different discourse communities (specifically, business, education, computer science, and humanities) in accelerated (i.e., eight week long) online courses. The following paper reports the preliminary results of this study.

Background

Garrison et al. (2000; Garrison & Anderson, 2003) have argued that meaningful learning takes place in a CoI made of teachers and students, through the interaction of three core elements: social presence, teaching presence, and cognitive presence. Social presence, the first element of the model, is the “ability of participants in a Community of Inquiry to project their personal characteristics into the community, thereby presenting themselves to other participants as “real people” (p. 89). Social presence has been conceptualized as having three components: affective expression, open communication, and group cohesion (Rourke, Anderson, Garrison, & Archer, 1999). Research on social presence has a long history dating back to the 1970’s (Lowenthal, 2009).

Teaching presence, the second element in the model, is the ability of a teacher or teachers to establish and support social presence and eventually cognitive presence through instructional design and organization, the facilitation of discourse, and direct instruction (Anderson et al., 2001). While the research of Shea (2006) has questioned the direct instruction component of teaching presence, subsequent research by Arbaugh and Hwang (2006) and others (see Arbaugh et al., 2009) continues to support the inclusion of direct instruction as an important component of teaching presence.

Cognitive presence, the third element in the model, is “the extent to which the participants in…a community of inquiry are able to construct meaning through sustained communication” (Garrison et al., 2000, p. 89). Garrison, Anderson, and Archer (2001) conceptualized cognitive presence as developing through four cyclical stages—first a triggering event, then exploration, integration, and resolution—which they refer to as the practical inquiry model.

As previously mentioned, a great deal of research has been conducted on each these core elements individually. However, recently researchers and practitioners have begun using the *entire* CoI framework as a guide to the practice and research of online learning. Researchers have used the CoI to evaluate online discussions. For instance, Bartruff and Headley (2009) used the CoI to evaluate online discussions in teacher education courses at a small Christian college. They found that the CoI framework served as a "simple yet effective framework to describe the communication" (p. 800). Other researchers have combined the CoI framework with the Quality Matters framework to enhance curriculum development and program rigor (Bogle, Cook, Day, & Swan, 2009). The CoI framework has also been used to get a better idea of what is missing in online learning courses (Stodel, Thompson, & MacDonald, 2006) as well as to get a better idea of what exemplar online teachers do (Perry & Edwards, 2005). Others like Arbaugh (2008) have found strong empirical support for the CoI to predict perceived learning and satisfaction. Finally, Cleveland-Innes, Garrison, and Kinsel (2009) used the CoI to help better understand the challenges that first-time online learners experience.

Gaps in the Literature

Despite the growing popularity and increased use of the CoI framework, a number of gaps in the literature remain. We will outline a few of these gaps in the following paragraphs.

Discipline and Discourse Differences

Researchers of online learning have not adequately investigated the differences that might exist across academic disciplines (Arbaugh, 2005; Lowenthal & Lowenthal, 2009; Smith, 2005; Smith, Heindel, Torres-Ayala, 2008; White & Liccardi, 2006). This could likely be due to the fact that too many studies on online learning tend to focus on a single course. While Anderson et al. (2001), early on, pointed out that differences might exist across disciplines due to "discipline related conceptions of the education process" (p. 13), we posit that the issue is much more pervasive. That is, we contend that differences exist because faculty and students belong to different communities of practice or what we call discourse communities.

Communities are constructed and maintained in part upon the language its members use (Street, 1984). Participation in a given community requires knowing the specific language and literacy skills of that community (Gee, 1990, 1998, 2000; White & Lowenthal, under review). Thus acceptance within a community requires that one knows and employs the specific linguistic practices (reading, writing, speaking, non-verbal communication and even modes of thinking) of that community (Gee, 2000; Lave & Wenger, 1991; Wenger, 1998).

Just as faculty—and budding scholars—in different content areas engage in their own unique discourse communities, online faculty in certain fields of study (e.g., education) also communicate differently than online faculty in other fields of study (e.g., business). Further, because of these differences, students' expectations regarding appropriate forms of communication and ultimately presence are likely to vary across academic disciplines. While we often like to think of good teaching as a universal concept, in practice, good teaching always happens in a specific context with specific forms of discourse. In fact, part of good teaching, especially at the graduate level, involves indoctrinating students into appropriate forms of discourse for the career of their choice. Therefore, researchers of the CoI framework need to investigate whether each of the CoI framework differs across discourse communities (i.e., academic disciplines).

Course Format

In addition to academic discipline, course format can likely influence all three presences. Course format can include not only the way that a course is designed and developed but also how the course is delivered. The design or format of an online course or program can influence how faculty and student's develop and perceive social presence in general and teaching presence in particular (Anderson et al., 2001). For instance, having an online faculty member meet his/her students face-to-face before a course begins can affect a student's perception of social and teaching presence. In addition, whether or not a student is part of a cohort also is likely to influence how such things as teaching presence is developed and perceived (Lowenthal & Lowenthal, 2009). Finally, the context and manner in which online courses are designed and developed is rarely taken into consideration. For instance, the way that a course is designed and developed (e.g., by an individual faculty member vs. by a team of faculty and instructional designers) is likely to influence the types of activities and media used (Lowenthal &White (2009) as well as how presence is established in the course.

Time

Related to course format is the issue of time. Early research on social presence suggested that things (e.g., task completion and group work) take longer in computer-mediated environments (Thurlow, Lengel, & Tomic, 2004). Researchers have questioned how time affects social presence (Lin & Laffey, 2004; Tu & Corry, 2004) as well as the CoI as a whole (Akyol & Garrison, 2008). However this research has not specifically investigated each of the three presences in accelerated courses. Time, similar to the issue of format, is likely to influence teaching presence, social presence, and cognitive presence. For instance, we contend that whether faculty and students spend five weeks, eight weeks, or 16 weeks communicating online likely influences how each presence is developed, maintained, and perceived by students online. However, often these details are not adequately investigated in the research on each one of the presences individually or the CoI collectively.

In their recent review, Rourke and Kanuka (2009) criticized the CoI framework as a whole—essentially because of the general lack of research conducted on the CoI framework and student learning. While we agree that more research needs to be conducted on how a CoI results (or does not result) in student learning, we also think it is important to get a better understanding how the previously mentioned issues—specifically, discipline and discourse differences, course format, and time—influence student perceptions of a CoI.

Focus of the Study

This study was specifically designed to investigate these gaps. More specifically, the overarching goal of this study was to investigate whether a difference exists in each of the three elements of the CoI across discourse communities (specifically, business, education, computer science, and humanities) in accelerated (i.e., eight week long) online courses.

Methods

This study was conducted at a private Catholic university. For the purpose of this paper, we will refer to this university as Catholic Western University (CWU). In the following sections, we will outline the methods used for this study. CWU consists of three colleges; the students for this study came from the College for Professional Studies (CPS) which consists of adult learners—in fact, a student must be 21 years or older to enroll in (CPS). Adult students at CWU complete undergraduate or graduate accelerated degree programs—which consist of five week and eight week courses. CPS has an estimated 12,000 students; 40% of the credits each semester are completed online. Participants of the study came from four different schools and disciplines—education, business, humanities, and computer science—within CPS. CPS divides a normal academic year into three semesters. Each semester then consists of three five-week and two eight-week terms. However, completely online courses at CWU are only offered during eight-week terms. Students completing fully online courses in the first eight-week spring term (i.e., Spring 8 week 1, 2009) were invited to participate in this study. An email was sent out to 2303 students. The survey was completed 406 times (i.e., n=406). We are unable to compute a specific response rate because some of the 2303 students took more than one online course during the given term and were asked to complete the survey once for each course they took. However, as a follow up to a study Lowenthal and Lowenthal (2009) conducted on differences in teaching presence across discourse communities, we decided to focus only solely on the responses from graduate students (n=191) because there is reason to believe that graduate students are more entrenched in specific discourse communities than undergraduates who might be new to a field of study and practice (Lowenthal & Lowenthal, 2009).

A survey developed by Arbaugh and colleagues (2008)—to measure the three presences that make up the CoI Framework—was used to collect data from students. Both Arbaugh et al. (2008) and Swan et al. (2008) have published information about the development and validation of the survey. After seeking permission from Arbaugh to use the survey, an electronic version of the survey was created. The survey was then administered to all students taking an online course in CPS during spring 8 week 1 2009. We closed the survey and stopped accepting responses a month after we administered it.

Once the survey was closed, the data was downloaded and entered into SPSS. We coded any blanks as 99 and any unknowns as 98. New variables were created for teaching presence, social presence, and cognitive presence by averaging the responses. Descriptive statistics as well as an Analysis of Variance (ANOVA) was conducted to investigate whether a difference exists in each of the three elements of the CoI across discourse communities (specifically, business, education, computer science, and humanities) in accelerated (i.e., 8 week long) online courses.

Results

The demographics (see Table 1) illustrate that the sample for this study was roughly half males and females. Despite being an adult program, 56% of the respondents were between the ages of 21-30. Finally, over half of the respondents came from the school of business. At the same time, while the sample overall considers itself technology adept—with 76.7% rating itself as either a 7, 8, or 9 on a 1-10 scale with 10 being an expert—35.5% of the students were taking their first course online.

Table 1
Demographics

		Frequency	Percent
Gender	Female	92	48.2
	Male	99	51.8
Age	21-30	107	56
	31-40	55	28.8
	41-60	26	13.6
	62-older	3	1.6
Discipline	Management / Business	94	49.2
	Computer / Info Science	39	20.4
	Humanities / Social Science	16	8.4
	Education / Counseling	38	19.9

Table 2
Technology Skills and Prior Experience Learning Online

		Frequency	Percent
Technology Skills	7	25	13.2
	8	63	33.3
	9	57	30.2
	Total	145	76.7
Previous Experience	0	65	35.5
	1	24	13.1
	2	17	9.3
	3	15	8.2
	Total	121	66.1

To investigate whether there was a difference in average score of student perceptions of teaching presence, social presence, and cognitive presence across different disciplines a one-way ANOVA was calculated. No statistically significant difference was found (see Table 3). However, while not statistically significant, there are some observable differences. For instance, Humanities / Social Science students had a mean teaching presence score of 3.63 whereas Education / Counseling had a mean teaching presence score of 2.97. At the same time, Management / Business students had a mean social presence score of 3.47 whereas all three other disciplines had sub 3.0 mean social presence scores with Computer / Information Science with 2.82, Education / Counseling with 2.90, and Humanities / Social Science with 2.94. Finally regarding cognitive presence, Management / Business students rated had a mean cognitive presence score of 3.96 whereas Computer / Information Science had a mean cognitive presence score of 2.99.

Table 3
Descriptive Statistics

	Teaching Presence	Social Presence	Cognitive Presence
	Mean	Mean	Mean
Management / Business	3.35	3.47	3.96
Computer / Information Science	3.19	2.82	2.99
Humanities / Social Science	3.63	2.94	3.60
Education / Counseling	2.97	2.90	3.15

Discussion

Researchers struggle with finding the significance of results that reveal little or no statistical significance. The lack of statistical significance can quickly lead one to conclude that a study was unsuccessful. However, if for no other reason, the mean presence scores across the disciplines suggest more than anything else that students can and do perceive relatively respectable levels of presence in accelerated online adult programs that utilize enterprise models of course development (when compared to the results of Swan et al., 2008). Further, while the results of this study were not statistically significant, this alone does not unequivocally prove that differences do not exist across discourse communities or that subject matter differences are not important variables.

The College for Professional Studies at CWU has an atypical population of students in that as an adult accelerated college within a Catholic University, it attracts older—one could argue more mature—students than traditional colleges and universities. Not only does the average student work and pay for his or her own education but most students have experience working in the "real" world while managing multiple commitments that often include a family and children. Therefore, even though the sample for this study consists of a younger population than the typical student at CWU, it is likely that even these younger students had a full time job and responsibilities during the day.

Further, and perhaps even more importantly, the College for Professional Studies at CWU employs an "Enterprise Model" of course development, which is essentially a centralized-standardized approach to the design, development, and management of online programs (Lowenthal & White, 2008). This means among other things that all online courses in CPS at CWU are designed and developed in a systematic process that involves using faculty as subject matter experts coupled with instructional designers and a host of other instructional technology professionals to develop high quality and standardized courses. Faculty then, once completing a three week long online training and assessment, end up teaching courses that are designed and developed by others and courses that they often do not have the ability to author (i.e., change). It is unclear, and impossible to ascertain from this study alone, the degree to which the enterprise environment influenced the results of this study. Further research is needed to compare student's perceptions of presence in both enterprise like environments and traditional university environments.

Finally, while the overall presence scores seem respectable, the social presence scores are comparatively very low. Given the fact that these courses are taught in an accelerated eight-week term, it is likely that the accelerated nature of the courses are affecting students ability to establish social presence in the first few weeks of a course. Future research should look at specifically comparing the results from a study and sample like this to more traditional samples that employ more decentralized models of online education to see if the accelerated and/or enterprise characteristics of this study and sample are affecting students overall perceptions of presence.

Conclusion

At some abstract level, "good teaching is good teaching." However, in practice, good teaching is always situated in a specific context that gives it meaning and helps define it. The research on online teaching and learning can be strengthened by explicitly documenting how teaching and learning online change (or does not change) depending on its context. One important component of any learning context is the academic discipline and its related ways of being and knowing. This study was one example of investigating the role that academic disciplines play in the online teaching and learning process. Even though the results were not statistically significant, they serve as a foundation for future studies.

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A Study on the Relations of Spatial Ability, Mental Model Constructs, and Learning Effectiveness

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Abstract

This research study explored how spatial visualization and spatial relations impacted building mental models and affected learning performance on college students engaged in learning a statistical concept. The research design incorporated a Pearson correlation, factor analysis and multiple linear regression that explained factors of which will affect learner's performance. The purpose was to construct a relation between spatial ability factors and the mental model construct, and to assess the underlying construct.

Introduction

It has always been a controversial topic in terms of whether computer animations facilitate learning and produce positive learning effectiveness (Hegarty, Kriz, & Cate, 2003; Tversky & Morrison, 2002). Some researchers commented that animations might be too complicated or too fast to be correctly perceived. Since animations are usually understood as a sequence of steps, it might be more effective if visualization could help people understand the animated events (Tversky et al., 2007). In relation with the structure of visualizations, a lot of systems, for example, biological, physical or conceptual such as the statistics concept have spatial and temporal structures. Visualization can clearly describe the parts and their relations, therefore, enhance learning (Tversky et al., 2007).

Other recent research studies on visualization and animation concentrated on how spatial visualization can help build mental models. Bertel, Vrachliotis, and Freksa (2007) stated that the power of cognitive design tasks resided in the combination of mental models, visual perception and visual mental imagery. Hegarty, Keehner, Cohen, Montello, and Lippa (2007) reported that spatial abilities, including visualization, spatial rotation, and spatial orientation helped to build and kept a mental model of knowledge structure, therefore enhanced learning. They confirmed that spatial ability was important for perceiving computer visualizations. Hegarty et al. also stated, "We currently know relatively little about how learners interact with visualizations and how to best design these visualizations to aid in the acquisition of spatial mental models or spatial skills" (p. 293).

It is apparent that there is a need to further investigate the relations among spatial visualization and relations and learning effectiveness. Some researchers commented that animations can help learners build mental models of the concepts presented (Narayanan & Hegarty, 2002). Narayanan and Hegarty maintained that there was scant research based on the mental models of how people learn from graphical representations such as visual dynamic displays. Empirical research results have demonstrated that the effectiveness of comprehending visual dynamic presentations were more associated with comprehension processes than with the interactivity of the presentation media (Narayanan & Hegarty, 2002).

In light of computer 3D virtual learning environment, the following research questions were proposed:

- Are spatial visualization and relations correlated?
- What is the dimension underlying the six mental model construct?
- How accurately can knowledge transfer be predicted from a linear combination of comprehension measures?

Literature Review

The present study adopted cognitive learning theory and Narayanan and Hegarty's mental model. Cognitive learning theory believes that in memory there exists an organized structure, or schema, which constitutes the knowledge of the world. Schema is highly abstract and could be generalized. Schema could be changed through either instruction or personal experience and it is very dynamic. Schema can provide a context to understanding new knowledge. Schema can also provide a structure to hold the new knowledge (Winn, 2004).

Spatial capability and spatial knowledge are important to life since everything existing must have a solid spatial location. In order to understand human cognitive organization, we have to study how people navigate and mentally represent and manipulate spatial information. The internal comprehending of the spatial world would drive the machineries of constructing mental tools to understand the spatiality (Newcombe & Huttenlocher, 2000).

Newcombe and Huttenlocher (2000) believed that spatial capability is a very unique aspect in cognitive and computational levels of analysis. Spatial representations constitute spatial factors that form intelligence and reasoning. There are three major theories that entail the concept of spatial development. One is Piaget's approach of spatial development. One is Nativist's approach and another one is Vygotskyan's views.

Piaget states that children do not have knowledge of space when they are born. They do not occupy the capability of identifying space. Gradually they begin to foster their own ability of treating objects around them. Piaget argues that the initial understanding of spatial concept is formed by any objects that are either reachable or unreachable. Piaget describes the spatial development as different stages. He states that children see objects as closed to one another, not close to one another at their initial stage of understanding space. More mature comprehension comes in when they are nine or ten years old. He mentions that this stage is called as projective and Euclidean space. He defines projective space as the coding of the orders between different lines, and Euclidean space as the coding of objects metrically. Piaget indicates that adults are more accurate in spatial tasks (Newcombe & Huttenlocher, 2000).

Nativist believes that spatial understanding may be available to infants naturally. There are three arguments and evidence that support Nativist' ideas. The first argument is that spatial analysis capability exists early. Others believe that spatial ability develops very slowly and it is possible to develop spatial relations. The literature on blind children suggested that with given input, their spatial abilities increase rather than they possess these abilities at an early time (Newcombe & Huttenlocher, 2000).

Second, Nativist's ideas argue that understanding space is related to geometric module development. Young children depend on recognize relative position of a landmark to provide them cues. Research studies have found that young children used those permanent objects to search their objects after disorientated. Third, there is an argument that maturation of the brain areas assumes a unidirectional casual path that is currently unjustified. Nativists believe that environmental feedback assist to form spatial relation rather than a specific object work as a trigger for spatial ability. Nativism does not provide any focus on the strength of cognitive competence and any input on developmental change (Newcombe & Huttenlocher, 2000).

Vygotsky's ideas of spatial competence come from children's ability to understand the world guided by adults. These guided participations are important part of the development of certain spatial skills. The second thought is that cognitive effort is very adaptable with specific situations, which involved spatial tasks. For example, a security guard may provide a better direction than a librarian because of the situation specification. Third, Vygotskyan investigators are very interested in dealing with maps or diagrams. Vygotskyan researchers are also interested in learning the interaction of individuals with their cultural environment, from which a representational system is acquired. Children interact with their environment as they structure their social interactions. Vygotskyan ideas overly emphasize on the role of the social environment in developing individual thinking. Vygotskyan ideas of "zone of proximal development" are similar as Piagetian ideas of cognitive readiness. Thus, the complete theory should involve a developing child, a skilled adult and a cultural medium, while avoiding the idea of cultural input as all of the development (Newcombe& Huttenlocher, 2000).

As more microcomputers have been used in educational programs, students have the option of make predictions and assess hypotheses by interacting with computational simulations (Hegarty, 2004). The assumptions are that there are no clear evidences to show dynamic displays produce advantage over static media. One argument is that people can mentally animate static diagrams together to form an animation. Another argument is that it is expensive to produce dynamic media and producing media that cannot facilitate visualizations internally may not help learning (Hegarty, 2004).

One research study demonstrates that dynamic visual displays hold the advantage of exceeding static visual displays in knowledge transfer (Ma, 2008). In this research study, two types of visual presentations and their effects on college graduate students' cognitive load performance and knowledge transfer has been examined. The focus was on whether animation and static visual displays could enhance learning outcome. Graduate students consisting of 112 individuals participated in the study. Results indicated that students in the animation group had significantly higher knowledge transfer score than those in the static visual group. Students in the animation group also had higher mental efficiency scores than those in the static visual group. Post hoc data analysis results again confirmed the original result that the computer animation group out-performed the static visual group on the knowledge transfer test (Ma, 2008). Spatial orientation and visualization were used as two individual variables. The results reviews that animation is more associated with visualization with post hoc analysis result indicating a significant effect. Spatial orientation and visualization should be used as two individual variables to measure spatial ability (Ma, 2008).

Hegarty (1992) stated that when a machinery system has been presented, people started the mental animation. First they decomposed the representation of the system into smaller units. They then animated these smaller units in a sequence that constituting a casual relation. Making a causality that applied to the system was a preference that people tended to do. Hegarty (1992) mentioned that the mental animation model should include the encoding and comparison processes.

Hegarty, Kriz, and Cate (2003) stated that understanding a dynamic system involved several types of knowledge. First, it required the understanding of basic units of the system. Then, it involved how each component of the system moves and the chain effect. The understanding of the system will enable the understanding of the structure and behavior of the function, therefore, mental animation ability was highly correlated with spatial ability.

The research study also stated that when people read a text depicting the machine motion, they tended to construct mental models of the machines. Hegarty, Kriz, and Cate (2003) also stated that individuals with high spatial capabilities usually understood animations more accurately and these individuals may have more working memory to integrate different components of motion.

Narayanan and Hegarty proposed a mental model of how people comprehended multimodal presentations. Its purpose was to describe how the mental systems worked and how to use this model when designing applications using multimodal presentations. Narayanan and Hegarty stated that the model regarded comprehension as a series of steps in which the user integrated his or her prior knowledge into the concept domain and constructed a new mental model. They also said that this model was highly coordinated with spatial visualization processes, which helped to comprehend graphic displays (Narayanana & Hegarty, 2002). This mental model was used to study the relation among spatial cognition, mental model construct, and learning effectiveness.

The constructs of this model are: (1) user constructs a mental model of dynamic graphic system by first decomposing its simple components, (2) representationally connecting prior knowledge, (3) mentally encoding both spatial and semantic relations between each concept components, (4) hypothesizing causality, (5) mentally animating the model and inferences further, resulting in (6) comprehension of the basic information, for example, involved in the logic or physics (Narayanana & Hegarty, 2002).

Methodology

Participants

In this research study, 27 southeastern state university students participated in the workshop and most of them are undergraduate students. These undergraduate students were introduced to SecondLife 3D virtual environment. SecondLife is a 3D virtual environment created by its residents. The company was founded in 2003 and its residents are engaged in education, music, technology, fashion, real estate, and business world that are digitalized. SecondLife is collaborating with higher education settings to promote the benefits of using virtual world. Data collection was performed in Spring 2009 and Fall 2009.

Procedures

A consent form was distributed by the principal investigator of this research study and also the guidelines of the study were informed. Statements were delivered to the students that they have the right to choose to participate in the study or withdraw at any time. Once the students finished filling out the consent form, the researcher started the workshop. SecondLife was introduced and the researcher started to log into the system and locate the avatar. Then the statistical concept of population and sample were introduced to students using SecondLife environment.

The researcher divided the instruction into 6 parts based on the mental model. First, the statistical concept was decomposed to simple components and elaborated in SecondLife environment. Secondly, students were encouraged to representationally connecting prior knowledge using the 3D virtual world. Thirdly, students were encouraged to mentally encoding the concept components. Fourthly, researcher started to provide more examples to hypothesize causality. Fifthly, researcher instructed students to mentally animate the concepts further to infer to more cases. Last, researcher instructed students to mentally comprehend the concepts.

After the presentation, a package of survey forms was given to students. A paper copy of spatial visualization and spatial relations tests produced by ETS were distributed to students to gather their spatial visualization and relations scores. A paper copy of knowledge transfer test and a survey to measure the effectiveness of each construct of the mental model was distributed to students.

Data Analysis

- Research question 1: were spatial visualization and relations correlated?

The Pearson correlation coefficient was .496, and $p < .05$. If correlation coefficient was around .50, then it was interpreted as large coefficient. The spatial orientation and visualization were correlated. See figure 1.

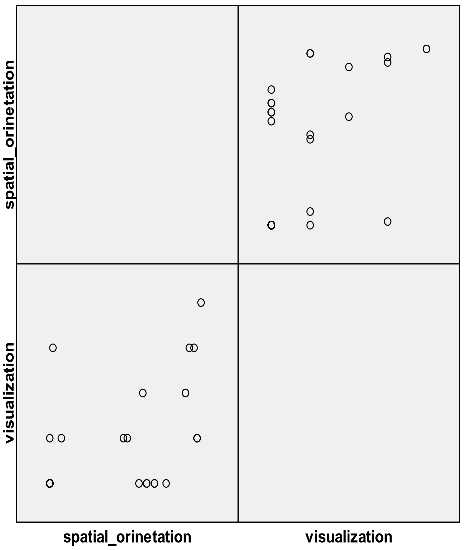

Figure 1. The correlation graph between spatial orientation and visualization.

- Research question 2: What is the dimension underlying the six mental model construct?

Two assumptions were performed before the factor analysis. Assumption 1. The measured variables were linearly related to the factors plus errors. To determine whether the variables were linearly related, the scatterplots for pairs of items were performed and this assumption was met. Assumption 2. The χ^2 test for the maximum likelihood solution assumed that the measured variables were multivariately normally distributed. The χ^2 test for the maximum likelihood was performed and yielded non-significant result with $p > .05$. The test assumed that the model did not constitute a multidimension.

Factor analysis was performed to structure the underlying dimension of the six mental constructs. The goal of running factor analysis was to reduce the overlapping measures to a smaller set of variables. The objectives were (1) measuring the six indicators and decide which one(s) was a poor indicator of the construct; (2) the item scales to measure each construct. Factor extraction and factor rotation were performed.

Factor extraction was performed. Eigenvalues were observed for counting the amount of variance of variables accounted for by a factor. Eigenvalues were the indicators to decide how many factors should be used in the analysis. One criterion was to keep factors that have eigenvalues greater than 1. The other criterion was to examine the scree plot and retain all factors with eigenvalues in the sharp decline part of the plot.

Table 1. Initial Analysis from Factor Extraction

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.966	66.103	66.103
2	.678	11.297	77.399
3	.576	9.602	87.001
4	.344	5.735	92.736
5	.277	4.619	97.354
6	.159	2.646	100.000

The eigenvalue associated with the first factor, decomposing, was 3.966 and the percent of total variance accounted for by the first factor was 66.103%. There were two rules that we can base to do the factor rotation analysis. One was to base on eigenvalue greater than 1. Second was to base on scree plot. Based on the scree plot, the factors that were to retain were the ones that in the sharp slope of the plot before the eigenvalues start to level off. Factor rotation was performed based on eigenvalue greater than 1. See figure 2 for scree plot.

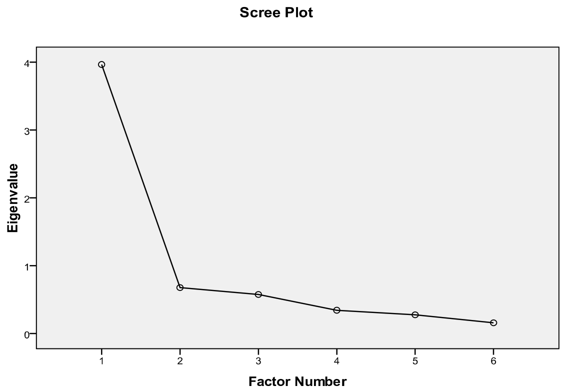

Figure 2. Scree plot of the eigenvalues.

The next stage was to rotate a one-factor solution. The decision of the underlying structure came from the rotated solution. The factor matrix and rotated factor matrix were shown in table 2 and 3. The matrix showed the factor loadings, which were the correlations between each variable.

Table 2. Factor Matrix

	Factor	
	1	2
Decomposion	.709	.079
Representation	.777	.363
Encoding	.764	-.141
Hypothesizing	.793	-.434
Mental_animation	.761	-.071
Comprehension	.871	.236

The dimensionality of the 6 items was analyzed using maximum likelihood factor analysis. The scree plot and eigenvalue greater than 1 both indicated that this model was a unidimensional construct. The factor matrix reviewed that all factors contributed to the model construct. Rotated factor matrix reviewed that there were underlying factors.

The first dimension of this model was constituted by representation, mental animation, and comprehension. The first step of this comprehension procedure was that user connected with prior knowledge; then user mental animated the procedure; and then user comprehended new knowledge.

The second dimension of this model was constituted by encoding, hypothesizing, and mental animation. The first step of this comprehension procedure was that user encoded both spatial and semantic relations; after that, user assumed causality; and then mental animation happened for further comprehension. This construct can be named as mental comprehension (See table 3).

Table 3. Rotated Factor Matrix

	Factor	
	1	2
Decomposion	.569	.430
Representation	.813	.271
Encoding	.458	.628
Hypothesizing	.277	.861
Mental_animation	.503	.575
Comprehension	.794	.427

- Research question 3: How accurately can knowledge transfer be predicted from a linear combination of comprehension measures?

To answer research question 3, a linear multiple regression test was run. The regression equation with all six comprehension predictors was not significantly related to comprehension index, R^2 = .21, F (6,20) = .892, p

=.52. the β s, as labeled on the output, were the weights associated with the regression equation. The standardized equation was as follows:
Knowledge transfer = -.34 decomposing + .62 representation + .18 encoding + .06 hypothesizing + .06 mental animation -.48 comprehension.

In this model, six comprehension predictors were used and the factor that was loaded with the most weights was representation, which involved the procedure of representationally connecting with prior knowledge. This procedure loaded .62 standardized weights on the equation. The next weight index was encoding, which loaded .18 standardized weights. Encoding was the procedure that learners mentally interpreted the spatial and semantic relations between each concept. For this data collection group, decomposing and comprehension were two factors that hindered learning procedure. Decomposing involved the procedure of breaking the concept into small components and comprehension involved the procedure of understanding the basic rules of how this complex procedure operated. For this group set, these two procedures lowered the effectiveness of the model (See Table 4).

Table 4. Coefficients

Model	Unstandardized Coefficients	Standardized Coefficients
Constant	51.28	
Decomposing	-9.14	-.34
Representation	20.14	.62
Encoding	5.01	.18
Hypothesizing	1.95	.06
Mental_Animation	1.70	.06
Comprehension	-14.18	-.48

Discussion

The objectives of this study were to test the correlation between two spatial concepts. One was spatial orientation and the other one was visualization. The study result reviewed that visualization and spatial orientation were correlated. Learning a 3D virtual world concept, spatial orientation and visualization would contribute to the learning effectiveness.

The second objective was to measure the dimensionality of the six factor model. The factor matrix result reviewed that this model was a unidimensional construct. The rotated factor matrix reviewed that underlying factors existed in this model. The first dimension of this model was constituted by representation, mental animation, and comprehension. The second dimension of this model was constituted by encoding, hypothesizing, and mental animation. Since the data set in the study only had 27 subjects. Further data collection was needed to study the dimensionality of the model.

The multiple linear regression was performed and the result reviewed that representation was contributing most to knowledge transfer. Representation factor was associated with connecting prior knowledge, which demonstrated that connecting with prior knowledge was the important step for building mental model construct and achieve learning effectiveness.

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The Relative Effectiveness of Positive Interdependence and Group Processing on Student Achievement, Interaction, and Attitude in Online Cooperative Learning

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Abstract

The purpose of this study was to investigate the relative effectiveness of positive interdependence and group processing on student achievement, interaction, and attitude in online cooperative learning. All of the participants, 144 college students enrolled in one of three different courses, received initial general instruction about teamwork skills and cooperative learning at the start of the study. Participants were then randomly assigned to one of three treatment groups: positive interdependence, group processing, and no structure. The Positive Interdependence groups received subsequent positive interdependence skills training which were then utilized in their instructional activities. The Group Processing groups received subsequent group processing skills training for use in their instructional activities. The No Structure groups received no additional instructional treatment beyond the initial basic teamwork and cooperative learning training.

Results indicated that there were significant differences among students in the Positive Interdependence, Group Processing, and No Structure groups with respect to their achievement scores and interactions. Participants in the Positive Interdependence groups had significantly higher achievement scores than participants in either the Group Processing groups or the No Structure groups. In addition, participants in the Positive Interdependence groups and the Group Processing groups interacted with each other to a greater extent than those in the No Structure groups. Regarding student attitude towards the experiences of cooperative learning (i.e. participation, communication resources, and online activities), there was no significant difference among any of the three groups. The overall results of this study suggest that instructors would be advised to incorporate positive interdependence strategies in their online courses to help students actively contribute to their online group activities. In addition, instructors are recommended to inform groups of the individual progress of each member's activities periodically by employing group processing strategies.

Keywords: Positive interdependence, Group processing, Online cooperative learning

Introduction

Unbalanced participation, or the existence of students who escape from responsibility in group activities (free-loaders /free-riders) has been identified by some researchers as a significant potential problem in online cooperative learning environments(McWhaw, Schnackenberg, Sclater, & Abrami, 2003; Slavin, 1995). This problem can lead to students' unwillingness to participate in online cooperative learning activities and to negative influences on group productivity. The problem can be addressed effectively by 1) investigating the essential components of online cooperative learning and 2) utilizing computer and telecommunication technology which enables meaningful asynchronous student communication in online learning environments(Buchs, Butera, & Mugny, 2004; Gunawardena, Lowe, & Anderson, 1997; Hancock, 2004; Nachmias, Mioduser, Oren, & Ram, 2000). Literature review showed positive interdependence and group processing activities as two essential components of online cooperative learning(Brewer & Klein, 2006; Johnson, Johnson, & Smith, 2007; McCafferty, Jacobs, & Iddings, 2006). Accordingly, research on the relative effectiveness of positive interdependence and group processing on student achievement, interaction, and attitude in online cooperative learning environments should prove to be useful in helping educators develop more effective instructional practices.

Research questions addressed by this study were:

1. Are there any differences in the relative effectiveness between positive interdependence, group processing, and no structure on student achievement in online cooperative learning environments?
2. Are there any differences in the relative effectiveness between positive interdependence, group processing, and no structure on student interaction in online cooperative learning environments?

3. Are there any differences in the relative effectiveness between positive interdependence, group processing, and no structure on student attitude in online cooperative learning environments?

Table 1. Contrast Coefficients for Each Group

	Group		
Contrast	1	2	3
1	1	1	-2
2	1	-1	0

To test these specific research questions, this study employed the method of planned orthogonal contrasts. Planned orthogonal contrasts are used when the contrasts are mathematically independent from each other, and they enable a researcher to test specific research questions that are meaningful to the researcher (Cohen, 2003). The above research questions are focused on whether the effects of positive interdependence (Group 1) and group processing (Group 2) are different from the effect of no structure (Group 3) and whether there is a relative effect between positive interdependence (Group 1) and group processing (Group 2). These focused research questions were tested with planned orthogonal contrasts in this study. Table 1 shows contrast coefficients for each group in this study.

Method

Participants and Description of the Research Design

This study examined the relative effectiveness of positive interdependence and group processing on the dependent variables: student achievement, interaction, and attitude. The activities incorporated in the various cooperative learning groups (positive interdependence and group processing, and no structured cooperative learning method) formed the independent variable. An existing course in each of three different universities in South Korea was selected as a means of examining these activities in a broad, real-world setting. Each course incorporated all three conditions using independent groups of students in the respective activities.

Prior to the start of the classes, the researcher conducted two workshops for the three instructors focused on teaching cooperative learning and how to incorporate positive interdependence and group processing activities. Each instructor was provided with general training on conducting online activities and then specific training for the individual groups: Group 1 (Positive Interdependence) utilized the Instructors' Guideline for Teaching Students Positive Interdependence (Johnson, Johnson, & Holubec, 1994), Group 2 (Group Processing) utilized the Instructors' Guideline for Teaching Students Group Processing (Johnson & Johnson, 1993; Johnson et al., 1994); Group 3 (No Structure) had no associated additional resources. The total 144 participating students were randomly assigned to three treatment conditions (144 = 48 X 3). To facilitate active online discussion, the 48 members of each treatment group were then randomly assigned to 12 small discussion groups with four students in each group. All of the 144 participants received initial general instruction about teamwork skills and cooperative learning at the start of the study. Participants then received instruction specific to the activities relative to their assigned treatment group: positive interdependence, group processing, and no structure. The Positive Interdependence groups received subsequent positive interdependence skills training using the Students' Guideline for Learning Positive Interdependence (Johnson et al., 1994) which they subsequently utilized in their instructional activities. The Group Processing groups received subsequent group processing skills training for use in their instructional activities using the Students' Guideline for Learning Students Group Processing (Johnson & Johnson, 1993; Johnson et al., 1994) and the Processing Interim Report (Weekly), which was developed by Johnson, Johnson, and Holubec (1994). The No Structure groups received no additional instructional treatment beyond the initial basic teamwork and cooperative learning training.

Instructional Conditions

The researcher and the instructors prepared online discussion rooms in the existing respective course management systems in each of the three universities. The course content for online student activities was specified by each instructor in order for the students to complete their group reports in their respective courses. Accordingly, in University A, each group discussed how to develop an instructional tool, WebQuest, as a group product. They then developed their own WebQuest using Web-editor software like Dreamweaver and FrontPage. In University B, members of each group played the role of Human Resource Development (HRD) specialists and discussed how to develop a 6-hour instructional program. In University C, each group discussed the analysis of a class and the processes involved in employing learning theories to teach it.

During the ensuing interactive instruction period, students exchanged asynchronous written communications in their individual groups to discuss their learning project with other members. The online discussion period lasted for 3 weeks. Throughout this discussion period Group 1 (Positive Interdependence) members could access the Students' Guideline for Learning Positive Interdependence (Johnson et al., 1994) in each online discussion room and follow it during the activity. They also rotated their complementary and interconnected roles every week. The instructors also helped Group 1 members achieve positive interdependence by using techniques presented in the Instructors' Guideline for Teaching Students Positive Interdependence. Group 2 (Group Processing) members followed the Students' Guideline for Learning Students Group Processing. Each member of Group 2 filled out the Processing Interim Report forms every week and submitted them in their online discussion rooms on the 2nd Sunday, 3rd Sunday and 4th Sunday. The instructors helped Group 2 members enhance their group processing by using the Instructors' Guideline for Teaching Students Group Processing. The instructors only answered Group 3 (No Structure) members' questions and did not provide any extra directions for online discussion or specific methods of their cooperative learning. On the last day of the 3rd week, each small discussion group in all the three conditions submitted the group report to be evaluated as the group's final assignment product.

Instruments

The Rubric for Assessing Learner Writing was adapted from the instrument used to measure five criteria for university writing (Barlow et al., 2006). In this study, the rubric was used to examine the differences in student achievement (writing a group report) as the results of positive interdependence, group processing, and no structure. The rubric contained five criteria: purpose, evidence-based reasoning, management of flow, audience awareness, and language control to evaluate writing in higher education. This study used only overall scores which were simply summarized from five criteria to evaluate the quality of each group's product. Instructor assigned an appropriate grade to the group reports from A+ to F (A+ (100), A0 (95), A- (90), B+ (85), B0 (80), B-(75), C+ (70), C0 (65), C-(60), D+ (55), D0 (50), D-(45), and F (0)). However, the final grade was based on both the knowledge of the course content and group participation (the group product (60%) + group participation (40%)). Each instructor evaluated how individual members participate in their online discussion well. Students had to post meaningful online messages at least two times every week. With this criterion, instructor measured the levels of participation in online discussion. Instructor also assigned an appropriate grade to the group participation from A to D (A (100), B (90), C (80), and D (70)).

To analyze student interactions, the researcher counted the total number of messages which were posted by each group member in each condition. This study also used the adaptation of the Interaction Analysis Model (Gunawardena, Lowe, & Anderson, 1997) to analyze characteristics of online interactions. The Interaction Analysis Model was adapted from a model previously used to examine meaning negotiation and co-construction of knowledge (Gunawardena et al., 1997). In this study, the Interaction Analysis Model was used to measure students' online interactions; the model defines and describes five types of co-construction of knowledge and negotiation of meaning. The five types were: 1) the sharing and comparing of information; 2) the discovery of dissonance and inconsistency among ideas, concepts, or statements; 3) the negotiation of meaning and co-construction of knowledge; 4) the testing and modification of proposed synthesis or co-construction; 5) the agreement statements and applications of newly-constructed meaning.

In addition, the 14-item survey was administered after the online discussion period to measure student attitude about cooperative learning methods based on the experiences in the course activities. The survey included 14 items such as "When I perceived that I as one group member should contribute to my group activity, I participated in it actively and positively," and "I was able to interact with other students more positively and often because I had a complementary and interconnected role in my group." A five-point Likert-type scale was provided for the participants to respond to the items as "strongly agree," "agree," "undecided," "disagree," and "strongly disagree."

Data Analysis

One-way analysis of covariance (ANCOVA) with student achievement scores as one dependent variable was applied to investigate the differences between Group 1, Group 2, and Group 3. Students posted 2766 online messages to the three-week online discussion. One-way analysis of variance (ANOVA) with student interaction (the total number of online messages which were posted by each experimental group) as another dependent variable was also employed to examine the differences between Group 1, Group 2, and Group 3.

The researcher investigated the student interactions in each condition by categorizing messages in the respective online discussion room. To obtain inter-rater reliability, the researcher and research assistant analyzed 288 sample data (approximately 10%) from the total of 2766 online messages, which were posted to the three-week online discussion. Also, this process used the operations as the specific standard of five categories in interaction analysis model. In this study, Cohen's Kappa was employed to examine the inter-rater reliability for the student interaction. In this study, the result of the inter-rater analysis was Kappa = .78, $p < .01$. It means that this measure was statistically significant and indicated a good level of inter-rater reliability.

Multivariate analysis of variance (MANOVA) with the five types of student interactions as the dependent variables was employed to examine the differences between Group 1, Group 2, and Group 3. In addition, planned orthogonal contrasts were applied to determine which group means between the three groups differed significantly from others with respect to the five types of student interaction. In order to analyze characteristics of online interactions, the researcher categorized all 2766 online messages which were posted for the three-week online discussion into the five types of co-construction of knowledge and negotiation of meaning, which were employed in the adaptation of the Interaction Analysis Model (Gunawardena et al., 1997). These data were coded according to the following categories: Type 1— sharing and comparing of information, Type 2— discovery of dissonance and inconsistency among ideas, concepts, or statements, Type 3— negotiation of meaning and co-construction of knowledge, Type 4— testing and modification of proposed synthesis or co-construction, and Type 5— agreement statements and applications of newly-constructed meaning.

In addition, a factor analysis was utilized to explore the underlying structure of a set of survey items measuring student attitude. This analysis identified two underlying factors: Factor 1— "Cooperative learning: participation and communication resources" and Factor 2— "Online activities." Factor loadings and factor scores were computed and interpreted with the Principal Component Analysis (PCA) including Varimax rotation method. Multivariate analysis of variance (MANOVA) was adopted to examine the differences in the responses of the positive interdependence, group processing, and no structure groups with respect to these two factors. In addition, planned orthogonal comparisons were applied to determine which group means between the three groups differed significantly from others with respect to student achievement, interaction, and attitude in online cooperative learning.

Results

Student Achievement

In Table 2, results indicated that there were significant differences among students in the Positive Interdependence, Group Processing, and No Structure groups with respect to their achievement scores. In addition, the results of planned orthogonal comparisons showed that participants in the Positive Interdependence groups had significantly higher achievement than participants in either the Group Processing groups or the No Structure groups, $F(2,140) = 16.75$, $p < .05$.

Table 2. Tests of the Difference in the Achievement Scores

Source	Type I *SS*	*df*	*MS*	*F*	*p*	Partial Eta Squared	Power
Corrected Model	10279.27	3	3,426.42	209.63	.00	.82	1.00
Intercept	966,944.44	1	966,944.44	59,158.81	.00	1.00	1.00
Fidelity	9,731.60	1	9,731.60	595.39	.00	.81	1.00
Group	547.67	2	273.84	16.75	.00*	.19	1.00
Error	2,288.29	140	16.34				
Total	979,512.00	144					
Corrected Total	12,567.56	143					

Note. Dependent variable = student achievement.
*$p < .05$.

Student Interaction

In Table 3, results indicated that there were significant differences among students in the Positive Interdependence, Group Processing, and No Structure groups with respect to student interactions. The results of planned orthogonal comparisons also indicated that participants in the Positive Interdependence groups and the Group Processing groups interacted with each other to a greater extent than those in the No Structure groups, $F(2,141) = 6.14$, $p < .05$.

Table 3. Tests of Group Effect for Student Interaction

Source	Type III *SS*	*df*	*MS*	*F*	*p*	Partial Eta Squared	Power
Corrected Model	1847.17	2	923.58	6.14	.00	.08	.88
Intercept	53,130.25	1	53,130.25	353.36	.00	.71	1.00
group	1,847.17	2	923.58	6.14	.00*	.08	.88
Error	21,200.58	141	150.36				
Total	76,178.00	144					
Corrected Total	23,047.75	143					

Note. Dependent variable = the total number of online messages which each student posted.
* $p < .05$.

Table 4. Tests of Contrasts for the Five Types of Student Interactions

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	Partial Eta Squared	*Power*
Contrast 1	Type1	425.35	1	425.35	22.01	.00*	.14	1.00
	Type2	160.50	1	160.50	6.47	.01*	.04	.71
	Type3	7.35	1	7.35	0.36	.55	.00	.09
	Type4	0.17	1	0.17	0.05	.82	.00	.06
	Type5	32.00	1	32.00	3.55	.06	.02	.46
Contrast 2	Type1	253.50	1	253.50	13.12	.00*	.09	.95
	Type2	23.01	1	23.01	0.93	.34	.01	.16
	Type3	140.17	1	140.17	6.78	.01*	.05	.73
	Type4	7.59	1	7.59	2.42	.12	.02	.34
	Type5	28.17	1	28.17	3.13	.08	.02	.42
Error	Type1	2,724.65	141	19.32				
	Type2	3,499.98	141	24.82				
	Type3	2,916.46	141	20.68				
	Type4	442.56	141	3.14				
	Type5	1,270.27	141	9.01				

* $p < .05$.

Table 4 shows the results of contrast tests for the five types of student interactions. For Contrast 1, each group mean of Group 1 and Group 2 was significantly different from that of Group 3 with respect to Type 1 and Type 2 categories (p < .05). However, for Contrast 1, each group mean of Group 1 and Group 2 was not significantly different from that of Group 3 with respect to Type 3, Type 4, and Type 5 categories (p > .05).

For Contrast 2, the group mean of Group 1 was significantly different from that of Group 2 with respect to Type 1 and Type 3 categories (p < .05). However, for Contrast 2, the group mean of Group 1 was not significantly different from that of Group 2 with respect to Type 2, Type 4, and Type 5 categories (p > .05).

Student Attitude

The results of MANOVA showed that regarding student attitude towards the experiences of cooperative learning: participation and communication resources [F (2, 141) = .17, p > .05], and online activities [F (2, 141) = .28, p > .05], there was no significant difference among any of the three groups.

Discussion

This study investigated the relative effectiveness of positive interdependence and group processing activities on student achievement, interaction and attitude in online cooperative learning. Prior studies on cooperative learning have been limited, focusing on either the relative effectiveness of several types and structures of positive interdependence on student achievement (Brewer & Klein, 2006; Jensen, Johnson, & Johnson, 2002; Johnson & Johnson, 1989) or on the relative effects of some structures of group processing on such achievement

(Garibaldi, Johnson, Johnson, & Stanne, 1989; Johnson & Johnson, 2006). Those studies revealed that both positive interdependence and group processing had a significant impact on student achievement. The present study built on this research by comparing both; examining the relative effectiveness of positive interdependence strategies with those of group processing strategies on student achievement in online cooperative learning. The results of this study show that using positive interdependence strategies is more effective than using group processing strategies in order to improve student achievement. This may result from the fact that positive interdependence has more "diverse" instructional methods: i.e. providing students with the strategies of rewards, facilitating students' learning motivation effectively through explaining the specific goals, and implementing the role activities. Group processing has relatively simple methods, basically writing periodic processing interim reports. Because of this reason, students have more responsibilities to participate in, and contribute to their online activities when receiving positive interdependence strategies.

In addition, positive interdependence strategies are more "structured" and "prescriptive" than group processing strategies. During the pre-activities period instructors provide students with goals and explain their role activities. During the activities period instructors provide students with appropriate rewards. In other words, positive interdependence is focused on improving the final product and incorporates activities during the entire process of online cooperative learning, whereas, group processing is focused only on the evaluation of the process of writing the interim report, making it difficult to facilitate student motivation effectively.

The results of this study showed that each condition (positive interdependence and group processing) was effective on student interaction. They also showed that there were significant differences in the relative effectiveness of positive interdependence, group processing, and no structure on student interaction while completing assignments in online cooperative learning environments. The results on student interaction, as measured by the total number of online messages posted, revealed that there were significant differences between the means of the positive interdependence, group processing, and no structure groups. The results of planned orthogonal comparisons showed no indicated differences between the positive interdependence and group processing groups. The results corroborate prior studies that examined the usefulness of positive interdependence on student interaction (Brewer & Klein, 2006; Jensen et al., 2002; Johnson & Johnson, 1989) and the usefulness of group processing on student interaction (Garibaldi et al., 1989). However, further study will be necessary to determine the relative advantages of these two strategies on student interaction.

To examine the differences among the influences on the specific types of interactions, planned orthogonal comparisons were employed. While the results of planned orthogonal comparisons indicates a desired effect on learning outcome, these types of interactions ("sharing and comparing of information," and "discovery of dissonance and inconsistency among ideas, concepts, or statements") represent basic involvement with the course content and may not be as associated with higher levels of understanding. They also suggest that an instructor's decision to incorporate positive interdependence strategies or group processing strategies can be crucial to student performance, especially when the types of student interactions are associated with basic or lower levels of understanding. Further research is recommended for to determine the relative desirability of each type of interactions in relation to overall instructional goals and the best way of increasing the occurrence of the desired interactions.

A factor analysis was utilized to explore the underlying structure of a set of survey items measuring student attitude. The two factors that were identified, "Cooperative learning: participation and communication resources" and "Online activities", show that instructors need to consider 1) how positively students participate in their group activities, 2) how they use communication resources, and 3) how they feel about online cooperative learning activities while developing and using online cooperative learning strategies.

Previous research on cooperative learning has also shown that some types and structures of positive interdependence (Brewer & Klein, 2006) and some structures of group processing (Garibaldi et al., 1989) increase positive student attitude toward cooperative learning. A meta-analysis of 11 studies presented some evidence that cooperative learning with small online discussion groups had affected undergraduate positive student attitude significantly (Springer, Stanne, & Donovan, 1999). The results of this study do not corroborate these prior studies as positive interdependence and group processing activities did not show an improvement on student attitude when compared to the group with no such activities. However, this difference in findings may be due to the difference in the way student attitudes were measured. In addition, this study did not employ as large a subject sample which might reduce the statistical power (Howell, 2002). Also, these students generally engage in many online course activities that may have a more general effect on their overall attitude and are not changed by one class experience. Consequently, further research would be suggested to investigate the additional factors of student attitude, develop more appropriate measures of student attitude, and determine the relative usefulness of these two strategies.

Implications

The findings of this study provide positive implications for ways to improve cooperative work in undergraduate students who want to know the best ways to participate in online group activities and help them be productive and actively contribute to their online group activities. First, these results suggest that instructors should be encouraged to consider incorporating cooperative learning formats in their classes and also to incorporate strategies into group activities that will enhance student interaction and their resulting achievement. Students in such courses should be instructed in the use of these strategies and should be shown the potential benefits of these activities early in the course to encourage them to participate fully. Given the choice, positive interdependence would be preferred over group processing as it more effectively influences student achievement in online cooperative learning environments. Specifically, it is recommended that instructors help students perceive that they should actively contribute to, and be more aware of, their online group activities by utilizing positive interdependence strategies such as goal-, reward-, role-, and resource-interdependence strategies. In addition, they should be prepared to provide students with ongoing feedback about whether they cooperate with each other members effectively or not during their online discussion activities by employing group processing strategies by having the students submit their group processing reports and post them into their online discussion rooms.

Second, to take advantage of the benefits offered by Group Processing it is recommended that instructors inform groups of the individual progress of each member's activities periodically and provide students with regular, opportune feedback. In other words, group processing might be desired when instructors want to observe students' group activities systematically and obtain better information about how well the students work together (Johnson & Johnson, 1994). If students obtain meaningful feedback and perceive that they are evaluated fairly and regularly by other group members and by their instructors during their online group activities they may maintain positive attitudes about their activities and meaningfully interact with each other to a greater extent. For example, instructors are advised to announce that students will be evaluated every week during their online group activities, and post the results of their activities in their online discussion rooms In addition, instructors are recommended to respond each contribution quickly. They need to post a personal, complementary message to positive contributor (Berge, 1995).

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The Underlying Reasons of the Signaling Effect in Multimedia Learning? Evidence from Eye Movements

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Abstract

The goal of this study was to examine the effects of signaling on learning outcomes and to reveal the underlying reasons of this effect by using eye-movement measures. Forty undergraduate students studied either signaled or nonsignaled multimedia materials. The results suggested that the signaled group outperformed the nonsignaled group on matching and transfer tests. Eye-movement data showed that signaling directed attention of participants to relevant information and reduced unnecessary visual search to find relevant information.

Theoretical Framework

Several research studies have shown that learning is enhanced when instructional materials include illustrations and narration (Flecther & Tobias, 2005). This phenomenon is called the modality effect. However, simply presenting information by using multiple modalities does not ensure superior performance, especially when the limitations of the human cognitive system are not taken into account (Sweller, van Merriënboer, & Paas, 1998). According to Cognitive Load Theory (CLT), the unnecessary visual search associated with finding the relevant information in the diagram will consume some processing resources in the mind (Kalyuga, Chadler, & Sweller, 1999). Consequently, fewer processing resources will be left for learning (Sweller, et al., 1998). There will be impairment in performance as a result of extraneous cognitive load related to the presentation format of instruction. One technique that can minimize this problem is signaling, providing cues to students in the most effective and efficient way to process the instructional materials (Mautone & Mayer, 2001).

Although several research studies have examined the effects of signaling on learning, the underlying mechanisms of the signaling effect are not clear. Theoretical assumptions of these studies have been mostly based on indirect measures such as learning outcomes (Brünken, Plass, & Leutner, 2004). This creates the need to use more direct measures to obtain insight about on-line processing of learners. Considering this need, eye-movement data such as average fixation duration, total fixation time and fixation count can provide real-time measures of cognitive processing during multimedia learning (Henderson, Brockmole, Castelhano, & Mack, 2007).

One of the goals of this study was to investigate the effects of signaling on learning from multimedia instructional materials. Retention, matching, and transfer tests were administered to measure learning outcomes. The other goal of the current study was to find the underlying reasons of the signaling effect by eye-movement data.

Method

Participants

A total of 40 undergraduate students (23 female, 17 male) took part in the study. Participants' age ranges from 10 to 26 years old (*M*=21.63, *SD*=1.28). Participants were randomly assigned to the signaled (n=20) or to the nonsignaled group (n=20). An independent-samples t-test results suggested that there was no significant difference between the signaled group and the nonsignaled group in their prior knowledge about the topic, $t(38)=1.57$, $p=.44$.

Instructional Material

The 91 second-long Adobe Flash-based narrative instruction was developed by the authors. The multimedia package included a labeled illustration of a turbofan jet engine and a narration explaining how turbofan jet engines work. The signaled format was identical to the nonsignaled one (see Figure1) except each corresponding terminological label (e.g. nozzle) in the illustration was presented in red color during the narration of the sentence in which the item was mentioned. After the narration of the sentence, color of the signaled terminology was returned to its original color. The presentation of the computer-based instruction was system-paced.

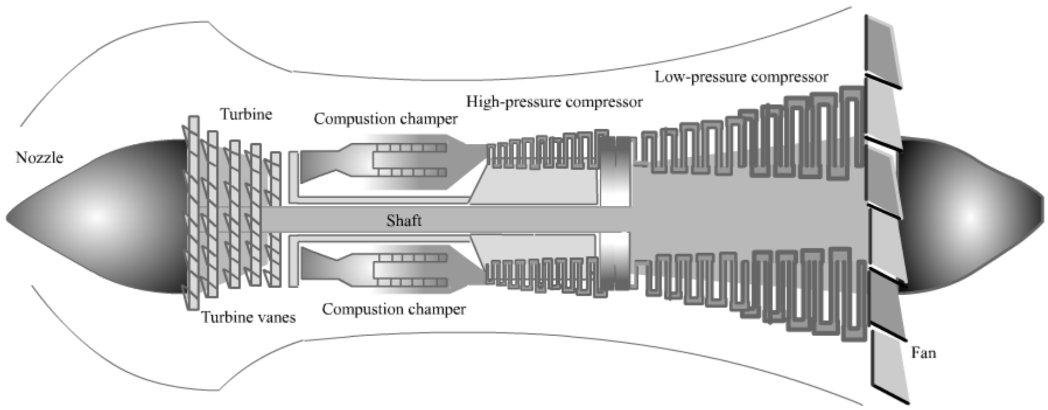

Figure 1. The nonsignaled format of the instructional material

Procedure

Each participant was tested individually in a single session. After giving information about the study, the participants were asked to complete the prior knowledge test on turbofan jet engines and a questionnaire on demographics.Eye movements of each participant were calibrated automatically by Tobii's ClearView software with 5 fixation points. Afterwards, the participants were asked to study the material which was presented only once for a fixed total duration of 91 seconds. After studying the instructional material, each participant was administered paper-pencil tests consisting of the retention test, the transfer test, and the matching test. Participants were given unlimited time to answer the paper-pencil tests.

Data Collection

The eye-movement data of the participants were collected by Tobii 1750 EyeTracker while they were studying the instructional material. To assess learning, the multiple choice retention test, the open-ended transfer test, and the matching test were used.

Retention test measures how much factual information the learner remember. It includes eight multiple-choice questions. Each question consists of five options. Transfer test assesses what extent participants could apply the presented instructions to novel problems that were not directly addressed in the material. It consists of five open-ended questions, such as "There is not enough air in the turbofan engine. Which components of the engine may not be working appropriately?",

In the matching test, participants were asked to match the names of the elements (i.e. high-pressure compressor, low-pressure compressor, shaft, turbine, fan, combustion chamber, turbine vanes, and nozzle) with the parts of the jet engine on a non labeled version of the illustration from study phase.

Results and Discussion

A separate independent sample t-test was used to analyze the data. The results suggested that the learners in the signaled group had higher transfer and matching scores than the learners in the nonsignaled group, $t(38)=2.27$, $p=.03$ and $t(38)=2.45$, $p=.02$ respectively. However, both groups performed similarly in the retention test, $t(38)=.42$, $p=.68$, indicating that the effect of signaling was on deeper processing. Participants engaged in more meaningful learning when the relevant visual information with respect to the narration was signaled by color variation (Mautone & Mayer, 2001).

In this study, the source of signaling effect was further explored by the help of eye-movement data. We may argue that enhancement of meaningful learning by signaling had two reasons. First, signaling directed the attention of participants to relevant information (Lorch, 1989) which was evident from higher number of fixations, $t(38)=4.44$, $p<.001$, and longer total fixation time on relevant information including both labels and related parts of the illustration, $t(38)=3.32$, $p<.05$. Participants spent more time on relevant information when they were guided by signals. Second, consistent with previous research on signaling (Kalyuga et al., 1999) signaling facilitated the efficiency and the effectiveness of visual search to find necessary information. Spending less time and having higher accuracy to locate necessary information might enable learners to have more time to think about critical information to understand the material. Moreover, participants could use more of their processing resources for learning when these resources were not consumed by unnecessary visual search (Sweller, et al., 1998). Learners could engage in higher order cognitive processes (e.g. integration) when appropriate signals assisted their cognitive processes (Kenneth, 1987). Taken together, these results supported the directing attention and the unnecessary visual search hypotheses. Our results that employed measures on relevant information did not rule out the possibility that signaling may affect learners processing of the whole material, rather than the signaled content (Lorch & Lorch, 1995). This possibility was examined by testing eye-movement measures on the entire material. The differences were not significant on fixation count, average fixation duration, and total fixation time on the whole content (all *p*s>.20). This demonstrated that the signaling did not influence the way participants processed the material in general.

Instructional designers should derive benefit from such scientific evidences to create more effective and efficient multimedia learning environments. The findings of this study demonstrated that multimedia learning materials have great potential in instructional settings. Use of text, illustration and narration in an effective way can improve the learning process. Instructional designers should use appropriate signaling cues to help the learner find the visual element within the diagram which is related to its corresponding narration (Jamet , Gavo & Quaireau, 2008). Moreover, users' attention should be directed to the relevant information during this period of time (Kriz &Hegarty, 2007). Especially when the content is complex and the learning environment is system-paced, signaling cues are so important (Harpskamp, Mayer & Suhre 2007).

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Generational Differences between Hispanic Digital Natives and Digital Immigrants: A Higher Education Perspective

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Abstract

The present study is intended to investigate information literacy of digital natives (those who were born after 1980) in the context of learning online and implications of this information literacy on practice and research within a Hispanic-serving institution in South Texas, U.S.A. Five latent factors are involved in the study as dependent variables. They are behavior pattern (pertaining to technology use), technology ability, learning preference, attitude toward technology use, and perception of instructional strategies. In particular, learners' demographics (e.g., age) are factored into this investigation as independent variables. A *t*-test for independent samples suggests that age be the factor to how Hispanic learners perceive (a) the use of technology for course work and (b) instructional strategies.

Introduction

While digital natives are going to college, they are bringing in values that seem to distinguish them from other generation groups (those who were born before 1981). Prensky (2005) states that when compared to the older groups (i.e., digital immigrants), digital natives tend to be more causal; they are more inclined to multi-task; they have a shorter burst of interest in things. Prensky believes that because this generation group (a.k.a. Net Generation or Net-Gen) grows up with all different kinds of digital gadgets (e.g., cell phones, Internet, and computer games) around them, the way the Net Gen perceives and behaves is enormously affected by these digital devices and media. This argument echoes the work by Tapscott (1997, 2007), who claims these "digital kids" are learning exactly the skills that are deemed essential for the 21st century.

Apparently, not everybody shares the same optimistic view as Prensky and Tapscott do. Mark Bauerlein (2008), author of the book, titled *The Dumbest Generation: How the Digital Age Stupefies Young American and Jeopardizes Our Future*, contends that the Net Generation in the United States may be the dumbest generation, compared to their parents and other older groups. But, the truth is, according to the U.S. Department of Education's National Assessment of Educational Progress (NAEP) (as cited in Howe, 2008), the lowest scores on mathematics and reading tests ever recorded by NAEP were reported by those who were born between 1961 and 1965. These children are now in their late 40s. And, most of them are parents of the Net Generation.

Whether they are the smartest generation or not, these digital natives are now sitting in the classroom. As professors, we ought to attend to any differences in values between this new generation and others before, in particular, information literacy in the digital era. Information literacy (for the 21st century workforce) generally includes, as Speak Up 2008 national research report (by Project Tomorrow, an education non-profit organization based in Irvine, California, U.S.) suggests, communications, collaboration, creation and contribution. Often time the majority of people (including university professors) would conveniently assume that the digital natives are equipped with great technology skills, which enable these young learners to better search, organize, evaluate, and share any given information. Is this true? If so, does this assumption also hold true for Hispanic students? This is what this investigation is aiming at.

Background

Prensky (2001) coins two terms, digital natives and digital immigrants. The former is a take-off on the phrase, native speakers. According to Prensky, digital natives refer to those individuals who interact with the computer and video games to an extent equivalent to speaking the first language whereas digital immigrants are those who interact with the computer and games in a fashion similar to learning to speak a foreign language. He argues that because digital natives grow up with the frequent interaction with the technology their cognitive thinking seems to be programmed in a differing fashion than their classmates who were born earlier. Prensky (2005) claims that these younger learners are now able to achieve learning through a cellure phone, which is one significant activity or behavior in their digital life. As more and more digital natives attend college, a debate whether or not university professors ought to restructure their instruction in a hope to accommodate these digital natives has received further attention (Carlson, 2005).

Following upon the previous thought of digital natives entering the college, literature shows the Net Generation (those at the age between 21 and 25) or the Net Gen tends to demonstrate stronger abilities of using technological devices in their daily activities than their peers (Gracia & Qin, 2007). Garcia and Qin's study in 2007 indicates that technology ability is a factor that clearly distinguishes the Net Gen learners from their fellow students. As far as student's perception of instructional strategies, there is not any significant difference between the two groups. For instance, the surveyed 280 students report that university-level courses are effective if they are taught via instructor's lectures and discussions with the faculty.

What about this age group of students' learning preferences for campus technology and attitudes toward technology use? With 4,374 college students (those at the age of 25 or younger) from 13 institutions of higher education within five states of the United States of America surveyed, a study by Kvavik (2005) reports that 41% of these students seem to have a preference for classes using moderate information technology (IT), 2% favor fully Web-based classes, and 3% prefer a class without any IT. The large-scale study also suggests that this preference for IT is positively correlated with students' prior experience with the classroom technology and professors' technology skills. So far as ethnicity is concerned, there is little generational difference research that indicates the findings aforementioned hold true across races or ethnic groups (Reeves, 2008). For this matter, the present investigation purposively targets Hispanic learners, specifically Mexican American students. Four research (alternative) hypotheses are formed for the present study:

Hypothesis 1: There is a significant difference in means between age groups in terms of technology ability. (H_0: There is not any significant means difference between age groups in technology ability.)

Hypothesis 2: There is a significant difference in means between age groups in terms of learning preference. (H_0: There is not any significant means difference between age groups in learning preference.)

Hypothesis 3: There is a significant difference in means between age groups in terms of learner attitude toward technology use. (H_0: There is not any significant means difference between age groups in learner attitude toward technology use.)

Hypothesis 4: There is a significant difference in means between age groups in terms of instructional strategies. (H_0: There is not any significant means difference between age groups in instructional strategies.)

The results of this study are expected to inform online course developers and cyber instructors of potential instructional strategies that may be taken into account in the design and development of any course with an online component integrated. Knowing that the disagreement on the digital natives previously mentioned in the introduction, this inquiry may be able to shed some light on how these Net Gen students perceive their online learning, compared to the digital immigrants, and how this perception may be worth further effort by designers and instructors to better prepare their instructional materials. It is also anticipated that their students are able to further reflect on their perceptions, attitudes, and behaviors pertaining to information literacy and better enjoy their learning experience in an online environment in light of this study.

Method

Design

This quantitative inquiry centers on information literacy in the Hispanics' perceptions of online learning and their implications on the development of elearning (i.e., online learning). Targeting a Hispanic-serving institution in the U.S., learners' age difference is factored in to the study, along with five other factors: behavior pattern (pertaining to technology use), technology ability, learning preference, attitude toward technology use, and perception of instructional strategies.

Setting

The setting of this survey research is located in the online learning environment within a state university in South Texas, U.S.A. According to Santiago (2006), the university is a Hispanic-serving institution (HIS) with approximately 94 percent of total undergraduate Hispanic full-time equivalent student enrollment.

Participants

Target population is the entire student body (both graduate and undergraduate) that is enrolled in any class that has an online Blackboard (a course management system) component in it. Accessible population is those whom investigators are given instructor's permission to survey. The surveyed students must be at least 18 years old and participate in this study on a voluntary and anonymous basis. As suggested by Hartman, Moskal, Dziuban (2005), participants are divided into three age groups: (a) those born before 1965 (aka Baby Boomers), (b) those born in 1965 through 1980 (aka Generation X), and (c) those born after 1980 (aka Net Gen).

This study was first launched in the summer of 2008. As of March 2009, 147 students have successfully responded to the questionnaire. Of all, 110 are Hispanic learners, with 50 identified as Non Net Gen and 60 as Net Gen. Please note that due to the sparse distribution of the baby boomers group, the three age groups are collapsed into the dichotomy, Non Net Gen and Net Gen. See the data analysis section below for more information.

Data Collection Procedures and Instruments

Data are collected using a password-protected computer server through an online questionnaire. The questionnaire is composed of six instruments:

1. Demographics Instrument (9 questions) on a nominal scale
2. Behavior Pattern Instrument (23 questions) on a nominal scale
3. Technology Ability Instrument (25 questions) on an interval scale
4. Learning Preference Instrument (27 questions), adapted from the work by Loo (2004) on an interval scale
5. Attitude Instrument (20 questions), adapted from the work by Ajzen and Fishbein (1980) on an interval scale
6. Instructional Strategy Instrument (8 questions), adopted from the work by Tapscott (1997) on an interval scale

The four instruments on the interval scale are on a five-point Likert scale with "1" as strongly disagree, "5" as strongly agree, and "3" as neutral. The questionnaire is administered at one occasion earlier in a semester, which begins in the third week and end in the fifth week of a regular semester (fall and spring). In any summer semester, the administration begins in the second week and end in the fourth week. With instructor's prior approval, investigators email the consent form through Blackboard email system. Data sets will be purged from all the computer hard drives in five years after the research begins (by the end of spring 2013).

Data Analysis

Data sets are exported from the password-protected computer server to Microsoft Office Excel before entered to the SPSS program. Due to the number of the participants, the baby boomers group and the Generation X group are combined. The merged group is then named, Non Net Gen. *T*-test for independent samples is used in addition to reliability testing.

Results

The table below shows descriptive statistics by variable and group.

Summary Statistics					
Variable	Group	N	Mean	Std. Deviation	Std. Error Mean
Technology Ability	Non Net Gen	50	1.0702E2	16.51652	2.33579
	Net Gen	60	1.0240E2	16.56850	2.13898
Learning Preference	Non Net Gen	50	97.98	13.797	1.951
	Net Gen	60	94.38	15.245	1.968
Learner Attitude	Non Net Gen	50	92.34	8.198	1.159
	Net Gen	60	85.17	14.039	1.812
Instructional Strategy	Non Net Gen	50	25.56	4.554	.644
	Net Gen	60	22.95	4.986	.644

Hypothesis 1

The research hypothesis here is, "There is a significant difference in means between age groups in terms of technology ability." An independent samples *t*-test indicates that there is not any scientifically significant difference, $t(108) = 1.46$, $p = .15$, suggesting the alternative hypothesis is rejected in favor of the null hypothesis.

Hypothesis 2

The research hypothesis here is, "There is a significant difference in means between age groups in terms of learning preference." An independent samples *t*-test indicates that there is not any scientifically significant difference, $t(108) = 1.29$, $p = .2$, suggesting the alternative hypothesis is rejected in favor of the null hypothesis.

Hypothesis 3

The research hypothesis here is, "There is a significant difference in means between age groups in terms of learner attitude toward technology use." An independent samples *t*-test indicates that there is a scientifically significant difference, $t(108) = 3.19$, $p = .002$, suggesting the alternative hypothesis is accepted.

Hypothesis 4

The research hypothesis here is, "There is a significant difference in means between age groups in terms of instructional strategies." An independent samples *t*-test indicates that there is a scientifically significant difference, $t(108) = 2.84$, $p = .005$, suggesting the alternative hypothesis is accepted.

Conclusions

Intended to better inform concerned instructional designers and online instructors, the current phase of the investigation on generational differences in information literacy is able to collect more participants from both graduate and undergraduate students than the earlier one. Of all the 147 participating students, 110 Hispanic learners are divided into two independent groups, Net Gen and Non Net Gen and further analyzed. The four instruments on the interval scale adapted from the literature appear reliable as the reliability testing suggests. Respectively, Alpha values are .94 for Technology Ability Instrument, .89 for Learning Preference Instrument, .95 for Attitude Instrument, and .76 for Instructional Strategy Instrument. There is not any significant difference between Non Net Gen and Net Gen in their perception of self technology abilities (e.g., use of email and the WWW) or their preference to instructional activities (e.g., group discussions and individual reflection writing). Nevertheless, there is a significant difference between Non Net Gen and Net Gen in their attitude toward technology use (e.g., Blackboard and electronic devices used for coursework) and their preference of instructional strategies (e.g., teacher-centered vs. learner-centered). The Net Gen group seems to favor an instruction that is more structured, and more instructor-centered. This finding is not supported by the literature (e.g., Prensky, 2005). This may have to do with the fact that the majority of the participants are freshman and graduate students. Almost all of these surveyed freshmen are Net Gen whereas most of the surveyed graduate students are Non Net Gen. Besides, these graduate students are enrolled in some fully-based class, and these freshmen are not. Perhaps these discrepancies result into the finding. Further research should probe into the generational differences on the manifest variable level.

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Layout, Structure, and Semantic Embedding. On the Problem of Finding Accessible Features for the Evaluation of the Quality of Learning Texts.

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Abstract

The fact that the quality of a text influences learning outcome is no surprise. Better text will certainly evoke better learning, and it is not hard to find general advice on writing a good text. On the empirical basis of semantic, syntactic, and layout text features we conducted a study to find out more about the text features which we believe to cause performance gain and loss. Within the data analysis we show that the prediction of text quality is far more complex than it is usually assumed to be. Common qualitative categories and quantitative features both could not explain effects which text has on learning outcome. Additionally, we found out that the subjective perception of the learner on several important text quality measures has no effect on learning performance. This is an important lesson to learn – especially for the evaluation of texts which are meant for learning.

Keywords: Text Quality; Reading Comprehension; Semantics; Syntax; Layout; Learning and Instruction

Text Quality influences Learning Outcome

There is plenty of evidence that text quality can influence learning (Goodman, 1967; Jones, 2005; Townsend et al., 1979; McNamara et al., 1996; Kintsch & van Dijk, 1978; Just & Carpenter 1976; Stevens, 1980; Deuze, 2005; Skinner et al., 2001). In a previous study (Pirnay-Dummer & Ifenthaler, under review) we found out that some texts, though intended specifically for learning, may even systematically decrease learning performance. We assumed that the influence on learning outcome had to come directly from text features. Choosing the features outlined below, we designed a new study to shed light on the text features we believe to influence performance.

Semantic Features and the Semantic Embedding Indices

The question of what a text is about and how information is carefully connected is of key interest when we think about learning from texts. In linguistics, the field of semantics provides strong implications on the generation of meaning from natural and written language. According to Leech (1974), “semantics (as the study of meaning) is central to the study of communication” and “also at the centre of the study of the human mind – thought processes, cognition, conceptualization” (Leech, 1974, p. ix). This idea starts with identifying the smallest possible increment, the letter, and then broadening the perspective to include phrases, sentences, texts, and even entire discourses involving world knowledge or more information than the actual text itself may provide (Bach, 1989; Schwarz & Chur, 2007). Investigation of semantic features has enjoyed growing interest among linguists since the 1970s, especially in the area of model-theoretic semantics (Schnotz, 1987).

In this study, we will focus exclusively on text semantics with a model-theoretic background. The semantic features believed to facilitate the understanding of a text can be separated into three major areas: Cognitive structure, cognitive dissonance, and semantic redundancy. Two of these areas can be further subdivided as shown below.

Cognitive structure

The cognitive structure describes the systematic use of the reader’s mental models, their restructuring, or additions to them.

Summary. A summary will help the reader to either see what the text will be about or to reconstruct its main arguments (Groeben, 1982). Summaries can be presented in the form of introductions, abstracts, advance organizers, or a classical post-text wrap-up. Ballstaedt (1997) argues that every text consisting of more than 2,500 words should contain a summary of some sort to facilitate understanding.

Structure. A well-structured text will provide orientation for the model a text provides and thus facilitate the restructuring of the reader’s own models. This structure can take on a wide range of forms: inductive or deductive (Seel, 2003b), chronological, thematic, or hierarchical (Anderson, 2001) to name a few.

Examples. With the help of examples, the reader may be able to use his world knowledge (Seel, 1991) to understand unknown concepts in the text more easily. Examples may incorporate a simple analogy to known facts, a recapitulation of previously stated similar ideas, or a physical phenomenon in the real world.

Foreign words. Words unknown or at least obscure to the reader will not only slow down the reading process (Ballstaedt, 1997), they will also impair the creation of coherence (Groeben & Christmann, 1999) and inference structures (Seel, 2003a), as they do not correspond to objects in previous experience. In this study a foreign word is operationalized as a rarely used expression or abbreviation unless it is a proper noun representing a unique entity.

Explanation of foreign words. Heavy and frequent use of foreign words may be mitigated by an explanation of these words to facilitate reader inference. Of course, as with examples, these explanations have to incorporate prior knowledge to be effectively added to the reader's mental model (Seel, 1995).

Cognitive dissonance

Cognitive dissonance describes the destruction and rebuilding of the reader's mental models. Not only will the reader more easily remember the elements that caused the dissonance, he will also be more motivated to learn more from the text (Seel, 2003b).

Change of perspective. Adding different perspectives to a topic will not only make the text less biased, but also more rich and rewarding for the reader (Groeben & Christmann, 1999). By questioning certain facts stated in the text, the reader is forced to challenge the models already provided and thus to either accommodate or assimilate the new information. Change of perspective may also add to semantic redundancy (see below). *Novelty.* Offering new areas inside the text will enable the reader to perceive more elements of the topic, to cross-reference between them, and ultimately to construct a much more advanced model (Seel, 2003b).

Questions and consolidation. A text which raises questions will enable the reader to take a more critical look at the topic. In contrast to a mere change of perspective, questions force the reader to seek for the answer inside his or her mental models from the outset (Groeben & Christmann, 1999). If these questions are later answered by the text, the reader will be able to confirm the answers previously provided and consolidate his or her model of the areas covered.

Semantic redundancy

Semantic redundancy describes repetition of a previous statement or concept in a different way. Basically, this means explaining the same ideas with different words several times. According to Groeben & Christmann (1999), this can help reinforce the main ideas of the text. As stated by Groeben & Christmann (1999), semantic redundancy will only have an effect if the repetitions are also syntactically well structured.

Syntactic Features and their Main Indices

Syntax is one of the most important features for rating a text and making it useable from the perspective of comprehension (Urban, 1994). Text characterization may be based on a number of syntactic features. For example, there are distinctions between word classes and classifications of sentence parts for defining their position in a sentence (Merten, 1995). However, analyses on the level of individual words and sentences are difficult to realize, especially for longer texts such as instructional texts, in which one has to invest a lot of time and cost to identify syntactic features (Merten, 1995). With the average number of words per sentence it is possible to measure sentence length. The longer a sentence is, the more complex its structure will be, making it more difficult to understand content coherence (Ballstaedt, 1997). Syntactically complex sentences measurably impede fluent reading and understanding; they require more processing efforts and may lead to the establishment of incorrect content references and overload the working memory (Ballstaedt, 1997). Word length and sentence length have demonstrable effects on the understanding of texts (Hartley, 1985; Bamberger & Vanecek, 1984). In nested sentences, for instance, it is very difficult for the reader to establish coherence. The short term memory is overloaded with overly long and frequent insertions. Hence, sentence length can serve as a rough indicator for sentences which are difficult to understand (Ballstaedt, 1997). To help identify texts with too many syntactically complex structures, there are readability and comprehensibility formulae which measure word length and sentence length as indicators for the readability of a text (Groeben, 1989; Ballstaedt, 1997).

The Amstad Index

One of these formulae, the Reading Ease Index developed by Flesch in the year 1948 (e.g. Groeben, 1989), is still in use today. It was developed to rate English texts and is calculated via the number of syllables per 100 words and sentence length. An index of 0 means factually illegible or very difficult to read, and a factor of 100 means best readability (Bamberger & Vanecek, 1984). However, a transfer to German does not work very well (Groeben, 1982). Amstad adapted the Flesch Reading Ease Index to the German language in the year 1978 (Bamberger & Vanecek, 1984). The text which had a negative impact on learning in our previous study also had a low score on the Flesch index. The Amstad Comprehensibility Formula is calculated as follows (Ballstaedt, 1997): A sample from a text is taken, containing a minimum of 100 words. The word length (wl) is calculated via the average number of syllables per word. To this end, an online tool which automatically counts syllables is used (Bachmann, 2007). Before using the tool for our study, we tested it on several sections of text and counted the syllables with and without using the tool. The error rate of the tool was below 5%. In a third step, the average sentence length (sl) is calculated as the average number of words per sentence. We counted this using a tool in Microsoft® Word. Finally, the calculated values are computed with the following equation:

$$CF = 180 - (sl + wl \times 58.5).$$

As in the Flesch Index, the accessible values range from 0 to 100. The higher the value, the easier the text (Ballstaedt, 1997).

Parentheses

Further investigation of the syntactical features of the texts used in our previous study unveiled another important feature that influenced learning negatively. The text with a negative impact on learning had a particularly high number of parentheses in comparison with the other two texts used in the study. Parentheses interrupt the main sentence and thus may also interrupt reading fluency (Schneider & Raue 2003; Ballstaedt, 1997); they have a distracting effect while reading a text. Hence, another syntactical feature we varied in our study was the occurrence of parentheses.

Features of Layout with Resulting Indices

When we think about text layout, we may think about books and other print materials which have to fulfill aesthetic demands. According to Bamberger and Vanecek (1984), reading can be described as figuring out sense from written signs (such as words), but understanding is also influenced by other features, among them text layout (Bamberger & Vanecek, 1984). As pointed out by Sauer (1995, 1997), a common mistake in editing a text and designing its layout is trying to make it look "aesthetic" without regard to the integrated concept of the text. It is important to take the aspect of layout seriously, as it is not just a matter of creativity or the pleasure of graphic designers.

From a background of didactics it can be argued that layout is not only a way to support the marketing of texts. The layout's power to influence attention, motivation, and remembrance also may be expected to have an impact on higher cognitive learning functions (Ballstaedt, 1997). In our study the focus was on aspects of macro-typography rather than micro-typography as features like font, font size, line spacing, etc. were identical among the texts in the previous study. In comparing the layout of the three texts, we found three features which were different: the text length in words, the number of headings per page, and the number of paragraphs per page.

Headings per page

Hartley (1985) points out that headings support search, recall, and retrieval and thus play an important role in reading and furthermore in understanding and learning text contents. In addition, Groeben (1982) emphasizes the role of headings as a way to summarize information in the text and stabilize concepts. According to Ballstaedt (1997), a heading is a short and introductory formulation set before a paragraph. Its purpose is to ease the reader's access to the text and provide a concise key word or key sentence so that the reader receives an idea of what the text, and especially the following paragraph, is about. One may differentiate between formal, perspective, and thematic headings. In our study the focus was on thematic headings (like in the previous study). A thematic heading provides a central word or core statement concerning the following paragraph and helps the reader create a macro-structure for his or her long-term memory (Ballstaedt, 1997).

Number of paragraphs per page

Another important feature of text layout is the structuring in paragraphs (Bamberger & Vanecek, 1984; Ballstaedt, 1997). On the one hand, a text with too small a number of paragraphs may appear monotonous, tedious, and unhelpful for comprehension and learning. Overloaded pages can also cause discouragement and thus inhibit the motivation to read. On the other hand, too many paragraphs interrupt the reader's train of thought and can disturb his or her acquisition of the text's sense (Bamberger & Vanecek, 1984). It thus seems logical that it is useful to find a middle road between too many and too little paragraphs.

Text length

Langer et al. (1993) defined length and verbosity as another striking attribute of text layout. Texts that are too short or too compact can inhibit understanding as well as those that are too long and long-winded. Langer et al. (1993) recommend taking the middle road between briefness and verbosity.

Research Question

The study's main purpose was to investigate the influence of the theoretical assumptions from semantics, syntax, and layout on learning outcome:

How can easily accessible semantic, syntactic, and layout features predict the learning outcome of a learning text? And: How can these measures be applied to evaluate texts?

Hypotheses

Accordingly, our hypotheses cover the influence of semantics, syntax, and layout on learning outcome as well as their interactions.

$H_{1.1}$: Texts with better semantic embedding indices lead to better learning performance.
$H_{1.0}$: Texts with better semantic embedding indices do not lead to better learning performance.
$H_{2.1}$: Texts with better syntactic indices lead to better learning performance.
$H_{2.0}$: Texts with better syntactic indices do not lead to better learning performance.
$H_{3.1}$: Texts with better layout indices lead to better learning performance.
$H_{3.0}$: Texts with better layout indices do not lead to better learning performance.

Since semantics and syntax are not independent of one another, we expect minor interaction effects between the two indices. Analogously, we do not expect interactions with layout features.

Methods

The study was conducted with instructional design students in their second semester. They had no significant prior knowledge in any of the subject domains.

The content was chosen from the diverse subject domains of medicine, physics, history, law, sports, biology, technology, and society. The texts were taken from the online resource *Wikipedia* and altered afterwards to selectively resemble the feature sets under investigation. Like in the previous study, the subjects were given a declarative knowledge test prior to and after reading. Additionally, the subjects filled out the general text understanding questionnaire which was also used in the original study. The test was constructed on the theoretical basis provided by Groeben (1982) and Langer et al. (1974). All items within this test are measured on five-point Likert scales. The four scales of the test are:

Simplicity [12 items] (e.g. ease of reading), *order* [12 items] (e.g. structure and design), *length* [13 items] (e.g. appropriateness of length), and *motivational aspects* [8 items] (e.g. mood of the text, writing style acts as stimulant).

Semantic features

Each text was qualitatively analyzed via a systematic content analysis for the semantic features listed above. Features were rated on a five-point scale: Texts that incorporated strong presence of a feature were awarded five points for that feature, texts that hardly ever incorporated it were awarded only one point. For the feature *"foreign words"* the scale had to be reversed, i.e. five points for none to very few foreign words, one point for too many. Additionally, there was an option for zero points if any of the features was not present in a text at all. Some texts were manipulated by deleting or adding foreign words, explanations of foreign words, examples, and summaries to further improve or impair their overall semantic embedding. A main feature's point value was calculated via the median of its sub-features; the total point value of a text was calculated via the average of the main features' point values. Texts with a point value of ≤2.3 were considered semantically lacking, those with a point value of ≥3.7 were considered semantically well embedded. These limits were set taking into account the semantic embedding and test results of the texts used in the previous study.

Syntactic features

In the previous study, the text which had a negative impact on learning had a Flesch Index of 31.6, whereas the second best text had an index of 34.8 and the best one had an index of 45.3. Consequentially, we assumed that texts with an Amstad Index of 30 or less could be characterized as syntactically poor, whereas the syntactically well-designed texts would have an Amstad Index ranging from 48 to 60, assuming from the previous study that an Amstad Index of 45 or higher characterizes syntactically well-designed texts. To vary the Amstad indices of the texts used in the study we elongated the text's sentences by combining short sentences. Long sentences are one variable which influences the Amstad Index of a text, while word length, which is the other variable, cannot be varied without major interference with the other features. In checking the number of parentheses per page, we found that the text with negative results in the previous study had the most parentheses per page of the three texts used in the previous study with an average of 7.5 per page, while the best text had an average of only 3.25 per page and the second best text 6.5 (including dates).

Hence, in our study we varied the number of parentheses per page. Few parentheses per page are assumed to enhance reading ease while many parentheses reduces reading ease. Few parentheses were operationalized with a number of parentheses per page of ≤ 3.5. Many parentheses per page were operationalized as ≤ 8.4 per page. These values were based on the previous study.

Layout features

By analyzing the three texts used in the previous study, we figured out that the text with the worst learning outcomes had an average number of 1.6 headings per page and the text with the best results 2.8 per page. Thus, we modified the texts in such a way that a value for good layout was 2.5 to 3 headings per page and for bad layout 1.5 to 1.7.

With reference to the three texts from the previous study, the text yielding the worst outcomes had an average number of 7 paragraphs per page whereas the text with the best outcomes had an average of 5.4. Using these facts we determined that an amount of about 7 paragraphs per page is an index for bad layout and 5 per page an index for good layout. The text from the previous study with the best learning outcomes had about 1800 words and the one with the worst results a length of about 3000 words. We thus chose texts which ranged from 1800 words as an indicator for good layout and about 3000 words as an index for bad layout.

For every text property set (semantics, syntax, and layout) there were features which were derived from the original study. Each property set was treated as a joint factor of all its subsuming features. All features of a set were explicitly either favorable or unfavorable, leading to a 2x2x2 factorial design:

Table 1. One Text for each Factorial Condition

		Semantics +	Semantics -
Layout +	Syntax +	1 Text	1 Text
	Syntax -	1 Text	1 Text
Layout -	Syntax +	1 Text	1 Text
	Syntax -	1 Text	1 Text

The eight fields had one text each which fulfilled the property set, e.g. there was a text with high semantic embedding, low syntactical quality, and high layout quality.

Table 2. Feature Variation between the Texts

Text	Layout	Syntax	Semantics
Colorectal Cancer	-	-	-
Stellar Evolution	+	-	+
Battle of Badr	+	+	+
Guardianship	-	-	+
Lacrosse	-	+	+
Polymerase Chain Reaction	-	+	-
Stereoscopy	+	+	-
Urbanization	+	-	-

Each text featured three questionnaires, one for pretesting subject knowledge with six questions on the text, one for testing reading motivation, and one for post-testing subject knowledge with randomized pretest questions. The knowledge tests were rated in a simple point system, correct answers being awarded with one point, wrong answers with none. The mean pre-post-test difference was calculated for each test. Every subject went through three learning cycles with a different text each time. All texts, features, and positions were systematically balanced to exclude position effects in all factors.

Results

Like in the previous study, the texts themselves had the most important influence on the learning outcome.

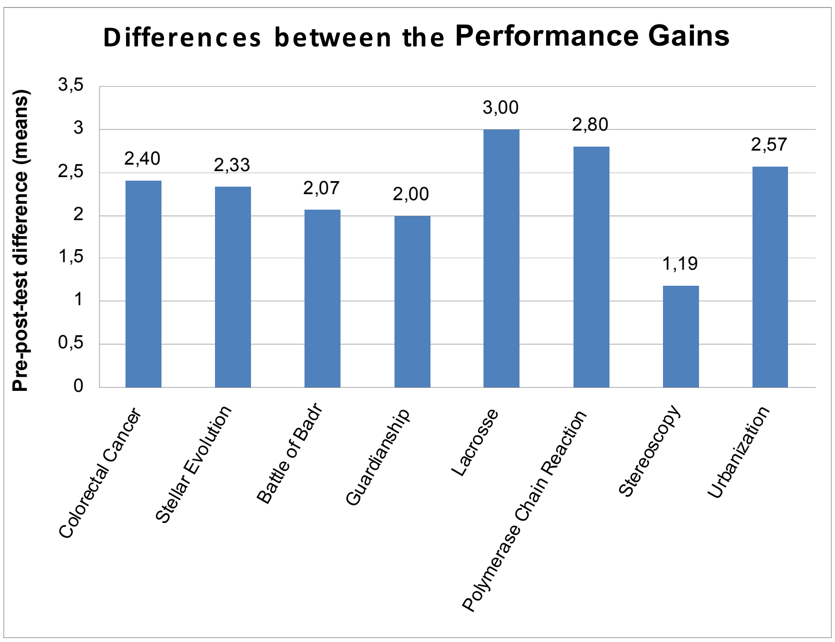

Figure 1. Differences between the performance gains by the texts

The differences between the pre- and post-test results of the texts were statistically significant with a strong effect (Text, $F=2.2622$, $df=7$, $df_{res}=112$, $p < 0.05$, $\eta^2=0.141$).
Furthermore, none of the three categories (semantics, syntax, and layout) yielded a significant pre-post-test difference by themselves.

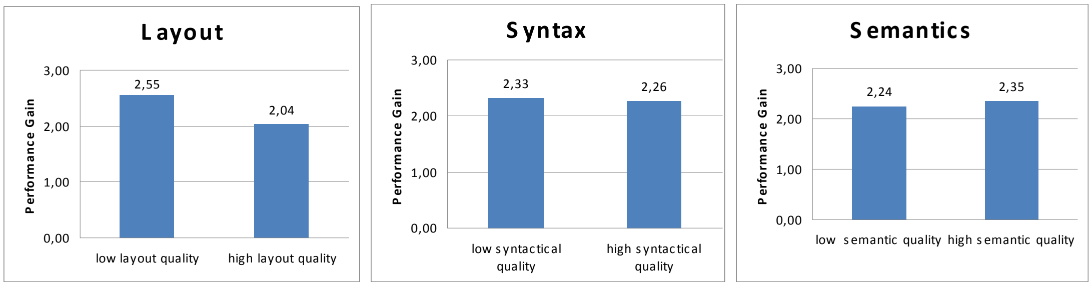

Figure 2. No significant differences in performance gains

For our core hypotheses in this study we have to keep all three null hypotheses:

$H_{1.0}$: Texts with better semantic embedding indices do not lead to a better learning outcome.
$H_{2.0}$: Texts with better syntactic indices do not lead to a better learning outcome.
$H_{3.0}$: Texts with better layout indices do not lead to a better learning outcome.

Only the interaction between layout and syntax yielded a significant difference (Layout:Syntax, $F=5.9491$, $df=1$, $df_{res}=112$, $p < 0.05$, $\eta^2=0.053$).

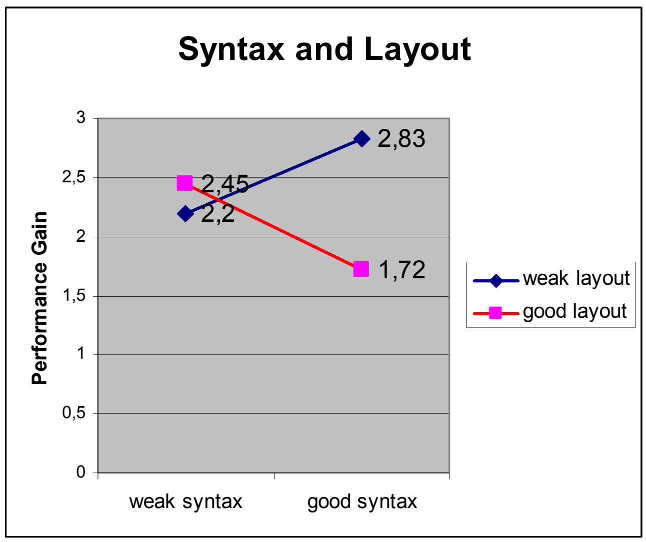

Figure 3. Pre-post-test difference means for syntax and layout

This interaction has a medium effect and works in such a way that strong syntax combined with weak layout results in better learning performance (pre-post-test difference means) as does weak syntax combined with strong layout.

So far, it seems that text quality is determined by idiosyncratic text properties rather than by systematic semantic, syntactic, and layout features.

Post-Hoc Analysis

Interestingly, the features do have effects on how the text is perceived by the learners – as rated on the general text understanding questionnaire. As mentioned above, all subjective ratings are rated on multiple-item five-point Likert scale where 5 indicates the best quality and 1 the worst.

Perceived order

First of all, the semantic features influenced the perceived order (structure and design) of the text.

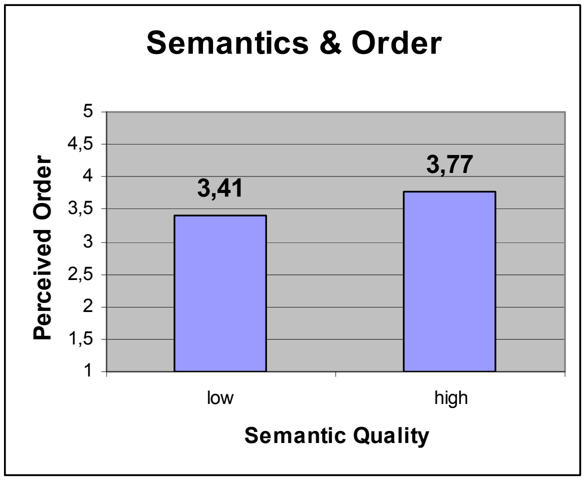

Figure 4. Semantic features influence the perceived order

The texts with strong semantic features were perceived as more orderly than those with weak semantics. The influences of all three text quality dimensions are distributed as follows.

Table 3. Semantics, Syntax, and Layout Influence the Perceived Order (Means)

	Weak Syntax		Good Syntax	
	Weak Semantics	Good Semantics	Weak Semantics	Good Semantics
Weak Layout	3.22	3.90	3.05	3.71
Strong Layout	3.92	3.66	3.43	3.81

The differences from semantics are statistically significant within a multi-factor ANOVA (Semantics, $F=8.2616$, $df=1$, $df_{res}=112$, $p<0.05$, $\eta^2=0.074$). Layout and semantics had also a small interaction effect (Layout:Semantics, $F=5.5805$, $df=1$, $df_{res}=112$, $p < 0.05$, $\eta^2=0.05$).

Perceived simplicity

The perceived simplicity measures how accessible the learners find the text. We also tested all three dimensions for this scale.

Table 4. Semantics, Syntax and Layout Influence the Perceived Simplicity

	Weak Syntax		Good Syntax	
	Weak Semantics	Good Semantics	Weak Semantics	Good Semantics
Weak Layout	2.38	3.51	2.87	3.74
Strong Layout	3.68	3.02	2.96	3.69

There were high effects on the perceived simplicity from semantics (Semantics, $F(1,112)=16.1303$, $p<0.05$, $\eta^2=0.144$) and the interaction between layout and semantics (Layout:Semantics, $F(1,112)=12.799$, $p<0.05$, $\eta^2=0.114$).

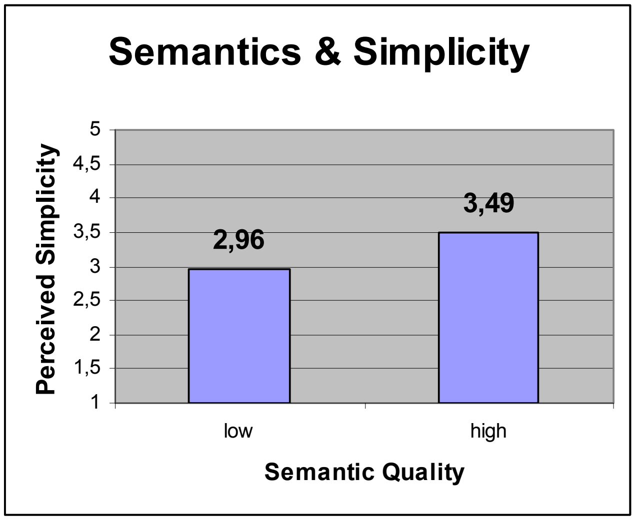

Figure 5. Semantic features influence the perceived simplicity (means).

Additionally there were interaction effects between semantics and syntax (Semantics:Syntax, $F(1,112)=4.7358$, $p<0.05$, $\eta^2=0.042$) and between all three feature dimensions on the perception of text simplicity (Layout:Semantics:Syntax, $F(1,112)=9.9174$, $p<0.05$, $\eta^2=0.089$).

Perceived length

All three text quality dimensions were also tested for perceived length.

Table 5. Semantics, Syntax, and Layout Influence the Perceived Length (Means)

	Weak Syntax		Good Syntax	
	Weak Semantics	Good Semantics	Weak Semantics	Good Semantics
Weak Layout	2.73	3.35	2.74	3.09
Strong Layout	3.41	2.87	3.08	3.34

For the perception of whether a text had a proper length, the interaction between layout and semantics was statistically significant (Layout:Semantics, $F(1,112)=8.5077$, $p<0.05$, $\eta^2=0.076$) as was the interaction between all three factors (Layout:Semantics:Syntax, $F(1,112)=6.5315$, $p<0.05$, $\eta^2=0.058$).

Perceived motivation/stimulation

All three dimensions were also tested for their influence on the scale for perceived motivation and stimulation.

Table 6. Semantics, Syntax, and Layout Influence the Perceived Motivation (Means)

	Weak Syntax		Good Syntax	
	Weak Semantics	Good Semantics	Weak Semantics	Good Semantics
Weak Layout	2.45	2.48	2.62	2.99
Strong Layout	3.08	2.93	3.08	2.93

Whether a text was rated as being motivating and stimulating depended only on the interactions between layout and syntax (Layout:Syntax, $F=5.4955$, $df=1$, $df_{res}=112$, $p<0.05$, $\eta^2=0.049$) and between semantics and syntax (Semantics:Syntax, $F(1,112)=5.4364$, $p<0.05$, $\eta^2=0.049$).
As a simplification, we can state that good syntax goes better with weak semantics and the other way around. Again, good syntax goes better with weak layout to induce good motivation.

Learners subjective text rating and learning performance

To see whether the learners' text quality perception corresponds to their real learning performance, we tested a multiple regression model. However there is no correlation between any of the learners' ratings and the real learning outcome ($R^2_{corr}=-0.03$). The learner's performance cannot be predicted by how positively he or she rates the text ($F(4,115)=0.1271$, $p\geq0.05$). Whether a learner finds a text to be in good order, stimulating, of reasonable length, or simple enough does not have anything to do with how he or she gained performance from the text.

Text rating per text

The rating of text quality depends significantly on the text itself, and high effects can be shown on all four scales:

- *Text x Order:* $F(7,112)=3.1424$, $p < 0.05$, $\eta^2=0.196$
- *Text x Simplicity:* $F(7,112)=7.2018$, $p < 0.05$, $\eta^2=0.450$
- *Text x Length:* $F(7,112)=3.2648$, $p < 0.05$, $\eta^2=0.204$
- *Text x Motivation/Stimulation:* $F(7,112)=2.6504$, $p < 0.05$, $\eta^2=0.166$

This can be seen as indicator for the discriminatory power of the ratings.

Discussion and Conclusion

This study clearly shows that the prediction of text quality is far more complex than it is usually assumed to be.

If features and indices other than pure content influence the performance which may be expected from a learning text, then they will have to be identified in further studies. If content were the only criterion, it would not be possible to design text quality by any means. This is, however, still very unlikely. But yet, the theory-based common features discussed here (semantic, syntactic, and layout) did not help at all to predict the learning outcome, although they are all commonly used as criteria to evaluate texts for learning. The somewhat counterintuitive results of this study also show that simple evaluation methods – especially learners' ratings – can not be used to make stable predictions of learning outcome, nor can the typically applied semantic, syntactic, and layout features: The qualitative categories and the quantitatively oriented features both failed to influence the transfer quality of the texts. Our post-hoc analysis indicates that semantic quality had an especially strong influence on how good a text is perceived as being by the learners. The fact that this subjective perception has no effect on learning performance is an important lesson to learn – especially for the learner-oriented evaluation of texts. In future studies we will try to find more indices through empirical means, which may help us to gain a systematic understanding of the factors influencing the quality of learning texts.

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Professors´Methodological Profiles at Virtual Environment Teaching/Learning Processes

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Abstract

The purpose of this paper is to describe a research done with Spanish universities, where professor's practices at the virtual campus have been studied and the works dynamics proposed by students. The goal was to prove if there were usage patters or associated teaching models to different variables like: scientific field, platform usage time, within others. A qualitative methodology was used with 89 open interviews at 17 universities.

Key Words: Learning model, virtual environment, university teaching, didactic strategies.

1. Introduction.

While efforts have been devoted to the study of the quality indicators associated with technology and contents at e-learning environment, methodological aspects issues related with adaptation and harnessing or possibilities of e-learning, has been a field, comparatively underdeveloped. The absence of this methodological substrate that will include and rationalized practices developed in virtual environments of different learning models, makes it difficult to obtain predictable learning results, as well as to verify quality assurance needed at the teaching learning process

Regardless of the methodology used, a transition is taking place from the conventional class in campus to cyberspace class. Professors and students act in differently in both types of classes, learning products are also different. Virtual environment courses and programs have emerged so quickly, that neither socially nor educationally philosophy has been developed, regarding the impact of these distribution methods. There is quite an amount of thought over the need to modify the teaching approach, but what is mostly used is to rehearse with traditional teaching methods in these settings.

Failure is not in using ICT at a distance, nor in the sophisticated tools, but on the pedagogical design, more in the absence of this design (Spector, Wasson y Davidson, 1999; Cook, 2000). We use pedagogical, physiological and other related theories, but progress is needed in the theoretical principles for the design and implementation of virtual environments, since they are complex at the moment to incorporate organizational, administrative, educational and technological components (Avgeriou et al., 2003; Salinas, 2004; García Aretio, 2007).

The functions that a teacher must develop in these new learning scenes have been analyzed from different perspectives and in a continuous form in the last decade. The principal contributions from those studies are cantered in the focus change toward methodological update, necessary to obtain better results, in terms of learning.

Literature is available regarding the analysis of technological and pedagogical possibilities that virtual tools offer us. One of the principal conclusions that emerge from these works is the assurance that ICT possibilities for education do not depend on technical potentiality of the tools used, like from the learning model used, from the way to understand and potentiate the relation between teachers and students and definitely, from the importance that teaching processes acquire in the virtual environments formation. Definitely, creating virtual effective teaching and learning environments, requires considering methodological changes at the deployed teaching techniques.

If we understand teaching/learning like processes of knowledge creation that considers users characteristics, the organization and the technology, the teaching strategies divide one of the variables of greater richness to acquire quality teachings/learning results. Also within the set of possible strategies some will result more adequate in certain usage contexts.

It seems adequate then to study how this process is being developed at university contexts, what types of teaching models are being used, what teaching and learning strategies and what learning activities. Having testable information makes it possible to identify and establish usage profiles from professors and teaching models.

2.-Study discription

The study presents the results from *EA2007-0121 project: Teaching models in university virtual campuses. Methodological profiles generated by professors at the virtual environment teaching/learning process*, project which was funded by the Directorate General of Universities of the Spanish Ministry of Education.

2.1. Study objective

In this study, professors usages of virtual campus and the work dynamics proposed to students were analyzed, in order to identify use patters or teaching models, related with different variables associated with professors (like scientific field, professional categories, teaching experience, age, time the teacher has been using the platform campus,…)

With this approach and starting with the data obtained from professors, we hope to offer a general vision of VLE (Virtual teaching/learning environments) usage models and analysis elements from those, among the spanish universities.

2.2 Methodology

The study must be framed between research methodologies for design and development, the ones that pretend to produce knowledge to better the educational design process, development and evaluation. In our case, we aim to better professors´ teaching strategies.

The study was done with a team of 27 researchers from different Spanish universities.

Data gathering was done applying 89 open interviews at 17 different universities. The object of the interviews was to describe work dynamic and the subject organization that the professor thought at the virtual campus, attending virtual and on site processes activities.

Data treatment was made applying qualitative procedure, to analyze interview contents

2.3. Population and Sample

Population was made up of all professors that developed activity at the virtual campus of the 17 universities.

From the total population a stratified sample of professors was taken, in relation to the knowledge field and to the time that they had been teaching at the virtual campus. Considering the capacity of the research team, original 100 interviews were planned. From 4 to 10 from each university, at the end 89 were actually applied.

The professors sample interviewed show the general profile of an experienced professor, since majority (80%) have worked at the virtual environment for more than an academic year, they represent different knowledge areas of study, the typology of the subject thought is representative of the curricula at Spanish universities and a great deal. (48%) use Moodle like Learning Management System (LMS) or technological platform for teaching.

2.4. Procedure

Data gathering procedure and process include the following activities:

- Design of an interview protocol.
- Recording the interviews
- Transcription of the sound files to text.
- Qualitative treatment of the data by coding the interview transcriptions into significant units.
- Category system construction. The building of the final category system was done after to. After reviewing and coding 25% of the interviews, a previously design category system, which was tested and review by experts to finish with the final construction of categories and codes

3. Results.

Data analysis given by professors in the interviews let us observe differences regarding activities that the professor gives to students. The materials that are given to students and VLE usage to the management of the subject, through the calendar, blog, forum, or to make other activities like virtual tutorials.

3.1. Tipology of virtual environment use.

From the information given by professors at the interviews, a typology comes up, regarding the use of virtual environments, that are supported in other previous studies (Pérez, Darder, Piccolotto y Salinas; 2006). Typology is organized with respect to the differences observed at "activities" and "materials" dimensions.

We specifically identify 5 types of usage:

- Type 1 professors who use the virtual environment to distribute materials, they might propose some kind of punctual activity in a voluntary way.
- Type 2 professors who use the platform to distribute materials and who propose making individual obligatory activities.
- Type 3 professors who use the platform to distribute materials and propose making individual activities and/or obligatory group activities.
- Type 4 professors who use the platform to distribute materials and propose individual activities and/or obligatory group activities. This group of professors has specified in the interview that they do collaborative work also in an obligatory way.
- Type 5 professors who use the platform to do individual, group or collaborative work activities. These activities are obligatory. They differ from the other profiles, that they do not distribute any kind of material.

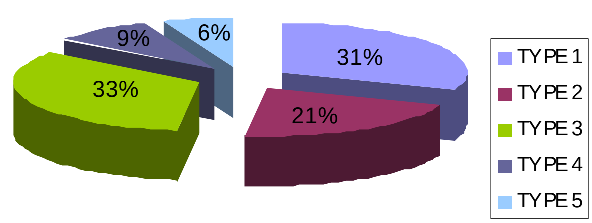
In order to see the differences, the typology is schematically presented in the table 1.

		Activities		
	Materials	Individual	Group	Collaborative
TYPE 1	X	O	O	O
TYPE 2	X	X	O	O
TYPE 3	X	X	X	O
TYPE 4	X	X	X	X
TYPE 5	O	X	X	X

Table 1. Types of virtual environments usage

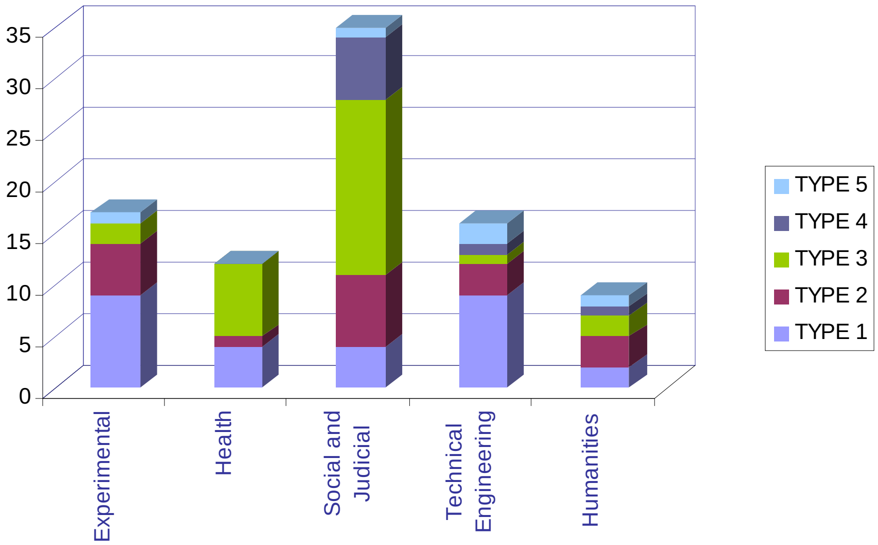
Distribution according to these types of use

a. The assignment of identified types of virtual environment use, correspond in its majority to the first three types in 3, 1 and 2 order. The principal use of the platform include the materials presentation by students, with the activities proposal, with out the activities proposal for type 1 (28 cases) or with the activities proposal only individually for the type 2 (19 cases), or also group activities for the group 3 (29) cases. In less proportion we observed that 8 correspond to group 4 and 5 to group 5



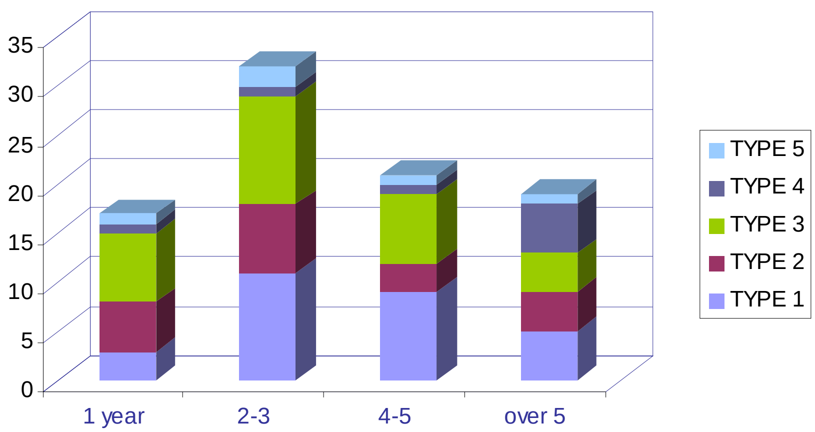
Graph 1. Interview distribution according to the type of platform usage

b. When relating the use and knowledge type of, there is certain domain of type 1 in Experimental Sciences and Technical Engineering, while type 3 denotes in Health Sciences and in Social and Judicial Sciences. In Humanities, no domain is clear even though the one with more frequencies is Type 2.



Graph 2. Interview professors distribution according to the type of platform usage and the general knowledge of the subject.

c. The distribution of the types of uses in relation to the professors years of experience using the web to support teaching, no meaningful differences are shown with respect to its distribution at the different types



Graph 3. Interview distribution according to type of usage in the platform vs years of experience.

3.2 Professors profiles regarding methodological strategies use for web learning

Observing at the same time, the level of on site and virtually in work dynamics and to the levels of frequency that stand out of the collected data in the categories, types of activities, used material and type of intervention that the teacher makes, general tendencies can be observed that sketch different professors´ profiles In the following table we collect the principal elements and identifiers of each profile:

ON SITE	100% face-to-face. The weight of the subject is on the classroom sessions. Platform is used to distribute material.
COMPLEMENTARY	Complementary use of face-to-face classes. The work dynamics is done at on classroom. The virtual environment is used to distribute the materials and some specific activity voluntarily and/or to give the activities that will be done in site.
SUPERIMPOSED	Superimposed use of the face-to-face classes. Even though the weight of the activity or dynamic is basically at on face-to-face sessions, it complements itself with materials distribution and doing activities at VLE. In this case no substitution or very little substitution is done of the time on classroom intervention at VLE, which could be considered some flexibility with respect to students that do not attend classroom sessions.
ALTERNATE	Between 50 and 70% of the subject; is done face-to-face and the rest virtually. In this case there is an explicit division between virtual and face-to-face procedure, that could be temporal or do some precise tasks.
INTEGRATED	Between 50 and 70% of activities are done face-to-face and the rest virtually. In this case there is not an explicit division between virtual dynamics and the face-to-face that could be temporal or for some specific tasks.
VIRTUAL	professors give their class completely on line

After studying these general profiles described, more definite profiles appear, that refer to types of activities, evaluation, tutoring, management, of the environment by the professor, they are presented as alternatives to what is happening at VLE in Spanish universities and they can contribute to the study of methodological elements of the above profiles.

The following data relates to the type of use and professor´s profile in VLE. These profiles will be hard to tell apart, because more than a classification it is an spectrum that includes from the totally on site profile that only offers materials (like presentations, tutorials and notes) up to the one working completely virtually, bases all its intervention in activities with out offering materials in the environment.

64% of professors interview belong to 5 of the profiles defined. Higher frequencies are decanted by teaching methods are decanted taken in consideration. By one face-to-face profile with the ICT help (on site, complementary and superimposed) When distribution is done between in site and virtual is more balanced, an integrated profiles stands out, without explicit division between on site and virtual and dynamic group work.

	Type 1	Type 2	Type 3	Type 4	Type 5	
On site	16	0	0	0	0	16
Complementary	12	3	0	0	0	15
Superimposed	0	7	13	1	1	22
Alternate	0	2	3	2	2	9
Integrated	0	4	9	3	0	16
Virtual	0	3	4	2	2	11
	28	19	29	8	5	89

< 5 % (between 5 and 16 prof)	
2 - 5 % (3 a 5 prof)	
> 2 % (1 o 2 prof)	
Without professors	

In all cases, profiles that present less frequency, are still interesting., when they include valuable experiences in relation to the methodology used and the work dynamic developed

If we establish the diagonal that runs in the graph from left corner at the top, towards the inferior to the right we can see an evolution in professors practices in VLE which let us show that common practices are based in certain methodologies centered in the teacher even though we find valuable practices that develop methodologies centered in the student. From this last one, we find examples in the dynamic collaborative profile.

4.. Evaluating results obtained

The usage of ICT at Spanish universities could be considered something of general use. The evolution of the observed phenomenon the previous studies (CRUE, 1997, 2004; Area, 2001; Valverde, 2004; Sangrà, 2004; Infante, 2005; etc..) and the results obtained here verify them. This utilization presents, according to the results obtained, the following characteristics:

- The general usage of VLE is distributes among the first types that suggest the classification proposed by Roberts, Romm and Jones (2000).
- 65% of professor show that they keep on with face-to-face teaching but we observe the profiles described in the study, the first three profiles, on site, complementary and superimposed, which its presence if practically 100%, they represent 60% of the interview professors.
- The course model used at the studied universities matches the original model, the one that shows a minimal use of the platform and is centered on putting materials at student's disposition, with one model characterized by the presence of basic teaching materials, complementary and of the organization, together with a activity individual and group proposals. The majority of activities that are asked for are evaluated and affect the final grade of the subject
- That is why and keeping in mind that a high percentage of professors consider it necessary the access to the platform in order to keep up with the dynamism of the worked planned for the subject (to consult the material, do activities and/or hand them in). We can say that the use of virtual learning environments exceeds the support to face-to-face sessions, and supposes one proposed extension of the same drawing the web´s potential to blend time and spaces.
- Subject typology developed in VLE reproduce the actual configuration university curricula, so we can conclude that cannot be appreciated differences related to matter in VLE
- The presence of teaching material stands out. If we keep to basic materials, 79% of teachers manifest they usually or always presentations in classroom. 77% of the practice guides and the proposed drills and 72% of study guides. On the other hand, 94% of interview students the use basic classroom material. Either in study guides and instruments for practices or the form of developed contents. Parallel a relation is shown between the used profile and the variety of materials that are the service of the student, participating in multimedia approaches
- In the same way, an evolving tendency of different profiles cannot be appreciated, related with the time the teacher´s experience at the virtual campus
- Relating to defined general profiles, we can say that after studying in relation to other variables, not only type, environment and experience that we have presented here, they are presented as representative of what is happening in VLE of the universities and it could contribute to the study of the methodological aspects, to contemplate in the same.
- To define more detailed profiles, we can start from the relation between general profiles and the definite use types- Si we look the table we can find 18 possible profiles more detailed related to these variables, use type and general profile associated to others like the type of the materials offered, types of activities developed or the evaluation used. In any case, these profiles will be very difficult to tell apart, so more than one classification, what they can take is an spectrum, that includes from the profile completely on site that offers only notes material type, until the one that working totally in virtual form bases all intervention in activities, without offering materials in the environment

5. Conclusion

Analyzing the results obtained, lets us think that starting with the same, a reference schema could be organized, a reference schema in relation to the pedagogy practices developed in teaching/learning virtual environments, that could serve for the analysis and the methodological proposals and resources aimed to the net of upper studies formation and as base for the confection of a planning and development guide for planning and development of training and coaching activities.

Gathering, systematization and diffusion of the most usual methodological Strategies at universities virtual environments, contributes, on one side, to go ahead on the status of the courses resources offered digitally and to be able to know what today's reality is. On the other side, it offers the possibility to compared the real experiences that the professors are using for pedagogy and finally to give a relation of resources and experiences that professors or our university could use in the redesign of the same experiences

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Teachers´ Uses and Methologies at theVirtual University Campus

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ABSTRACT

We are presenting the results of a study carried out on methodologies used in the virtual university campus.
The study was carried out using an online questionnaire, which was answered by 782 professors from 17 different Spanish universities.
The purpose of the questionnaire was to describe teachers use of the virtual learning environmet and the working dynamics they propose to their students, as well as to verify if patterns were given or teaching models were related to different variables

KEYWORDS

Teaching models, didactic strategies, learning virtual environment, e-learning.

Introduction

In current times, it is expected from the university to be the leader at innovation and research system. This supposes a present and future planning regarding e-learning possibilities and an adequate use of ICT in teaching, in line with the main trends in the universities at an international level. It is know that Spanish universities are incorporating ICT and as consequence, they have started to build virtual learning environments for teaching and learning (VLE) making it possible network connections to a larger number teachers and students in training activities either at a distance since they complement the conventional classroom and they characterizes above all for a major flexibility.

We start from the virtual learning environment conception, like a space or community organized with the purpose to obtain learning, and for it to take place, it requires certain components: a pedagogical function (that makes reference to learning activities, to teaching instances, to learning materials, the support and tutoring in stock, to the evaluation, etc) the appropriate technology (that makes reference to the tools selected in connection with the pedagogical model) and the organization framework (that includes the space, organization, the calendar, the community management, etc.. But also the international framework and the implementation strategy) (Salinas 2004).

The application to institutional and corporate e-learning contexts has centered its efforts up to now in technology (LMS platforms, content treatment, communication and collaboration spaces etc) and in its contents and materials. But, e-Learning understood from both points of view , centered in technology and centered in information, has neither fulfill the promises of success that it seem to offer, nor has explain successfully how they develop learning activities in a virtual environment. The failure is not on the use of distance ICT nor in how sophisticated tools are, but the pedagogical design or in its absence better said. (Spector, Wasson and Davidson, 1999, Cook 2000). It is common to insist that quality resides in contents, but to make effective virtual environments for teaching and learning that obtain results in terms knowledge construction, requires considering methodologies changes and didactic strategies changes implemented (Salinas, 2004)

Characteristics determination in terms of effectiveness, that teaching strategies must include is very complex process, since great amount of variables interact, conditioned by each of the different contexts in which they develop.

It seems adequate, to study how this process is developing to the interior of our universities and what knowledge we can get out of it, having testable information that permits us to identify and establish certain usage of virtual environments teacher profiles, didactic models display by teachers in its daily practice.

Attention to this phenomenon has some trajectory at Spanish universities and the new modalities of teaching in VLE and institutional projects to exploit them, has been reached from different perspective, since ICT teaching incorporation produces a great processes diversity:

- Communication and distribution system for teaching material, adequate computer mediated communication working in virtual environments, etc. Related both with process selection and platform and software exploitation, tools, the analysis of the technological and pedagogical possibilities that the developed tools offer us.
- Rol changes from professor as well as from students, the first one passing from actor to situation and learning mediated environments designer and the second from spectator to actor of its own learning.
- Innovative processes associated with the incorporation of the university to the *European higher* education *space*
- Professors methodology changes that imply the use of new e-learning techniques, to complement students formation.

From all of these changes, may be the most important ones from quality point of view, are the methodological changes, since they incorporate elements from all the rest.

The research presents part of the results from one of these studies we developed as *EA2007-0121. Teaching models at virtual university campuses. Methodological patters generated by professors at teaching/learning processes at virtual environments*. On line questionnaire constitutes the first of three phases of the study. Which was done by a team of 27 researchers and data collected belong to 17 Spanish universities. The research questionnaire was answered by 782 professors aiming to study the virtual campus usage by university professors and the work dynamics they propose to their students, with the goal to find out if there are any patters of use or didactic models related to different variables like: scientific environment, time the professor has been using the platform at the campus or the institutional of ICT integration to the one it belongs to., etc.

Study objectives.

The principal objective is to detect patters of use or usages of certain teaching models in the virtual campus, related with different variables: scientific field, professional categories, teaching experience, age, time the teacher has been using the platform campus, institutional ICT integration program in which he participates, experiences in ECTS, etc.

This objective could be detailed as follows

- To identify use profiles existence of different platforms at virtual learning environments, that could lead to the organize different teaching models to use.
- To analyze if this virtual learning environment use by professors, responds to some general parameters: knowledge field, ECTS projects incorporation pertinence, teaching innovation projects, experience at the virtual campus, age etc.
- Create a reference schema with the results obtained, that could serve as a guide and reference for the planning and development of learning and tutoring activities, that could give methodologies and resources for decisions making over methodological strategies, to utilize at learning networks in higher education.

Research procedure description

The research procedure consisted of an on line survey to a sample of professors at the universities participating in the study (17) The objective was to identify usage profiles with respect to different variables. All these through:

- Adapting data gathering instrument (Questionnaire, design of the one line form, validating the questionnaire.)
- Applying the questionnaire
- Data capturing
- Review, classification and debugging of the results obtained.

The research universe was made up of all the professors that developed activities in the virtual campus of each university. We received 782 responds. The distribution by universities is represented in Fig. 1.

The questionnaire contains the following elements:

- General data, age, number of years in the virtual campus, etc.
- Type of activity; lecture, reflections, analysis, creating, observation and findings. –
- Grouping
- Learning activities and teaching *techniques*.
- Learning materials

- Evaluation.

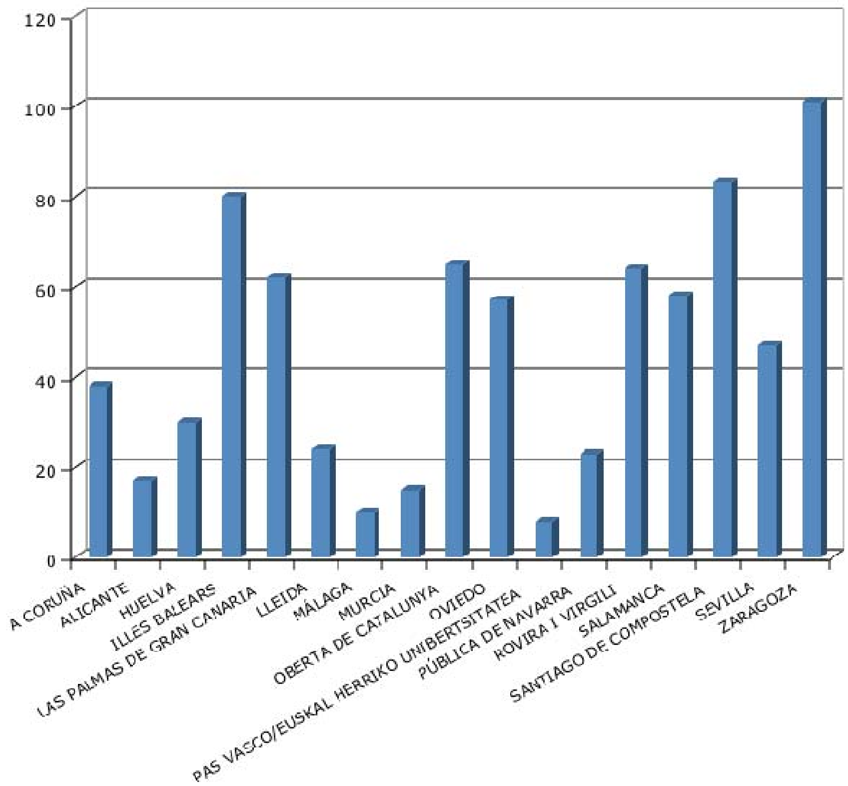


Fig. 1. Number of questionnaires recollected by university

Results

Within the most significant results obtained once data was treated, we can point out:

a. Years of on line teaching experience.

From professors that answered the questionnaire 12% has one year or less of on line teaching experience, 35% between 2 and 3 years, 30% between 2 and 3 and 20% more than 5 years (Fig 2).

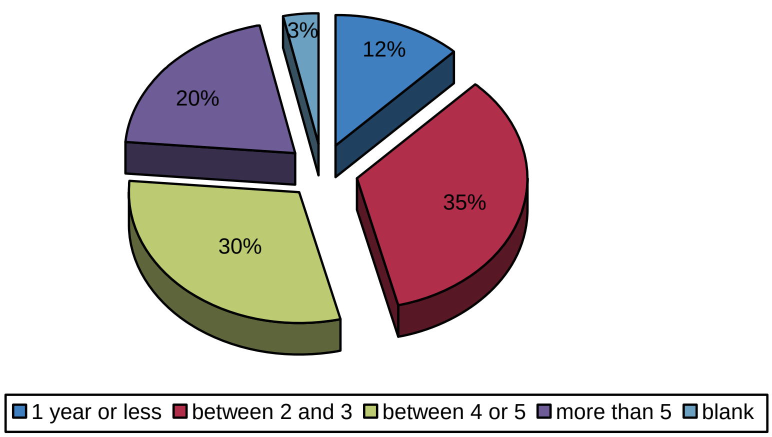


Fig 2

Years of on line teaching experience (in percentiles)

On the other hand, according to the knowledge field to which the subject being thought (see fig 3) belonged, the majority belonged to social and judicial sciences (41%) In the rest of the area, its distribution is very similar.

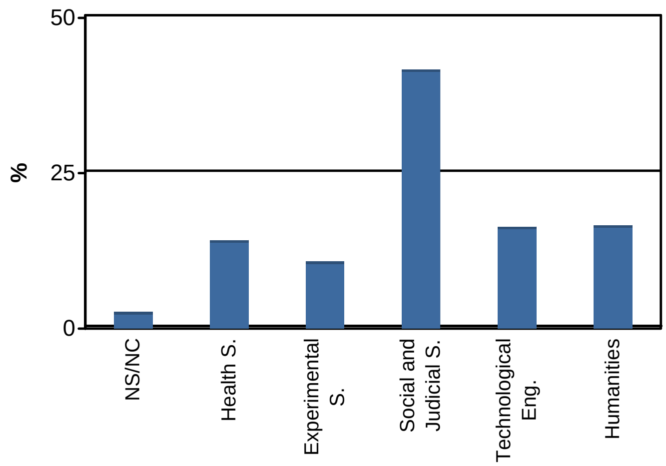


Fig 3 Percentage of professors according to the area to which the subjet belonged.

b.- Teaching Modality

Teaching modality that professor manifest, participating in virtual campus project at virtual universities, is still face-to-face (65%) blended modality (16%) and distance (19%) do not reach a significance proportion.

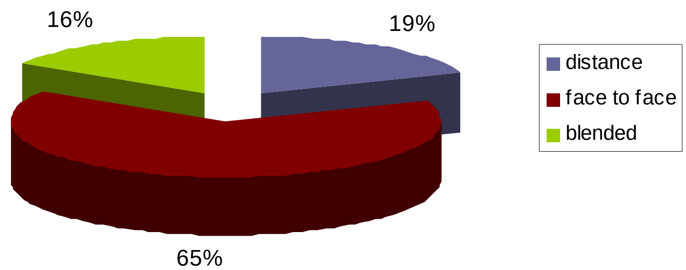


Fig 4 Modality teaching.

Regarding platform usage, 80% manifest they have used some, with respect to 20% that doesn't use or doesn't answer the question. The platforms mostly used are WebCT/Blackboard and Moodle, from which 36% and 35% of professors respectively, affirmed they have used them. Regarding the use of other platforms like Dokeos, SUMA, SAKAI or the belonging to UOC, the usage percentages for each of them are around 1% (which is equivalent to 7 and 15 professors).

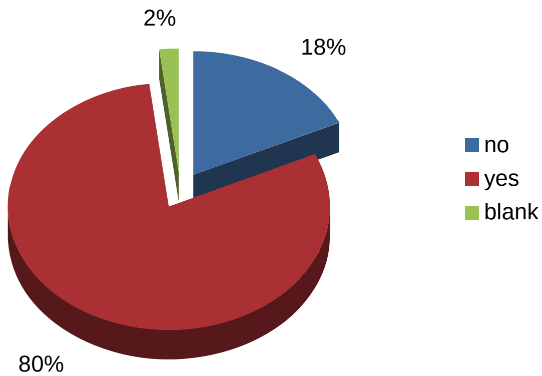


Fig 5 Professors percentage that use some platform for teaching.

c.- Learning activities

Typology of proposed learning activities in the questionnaire in order to show the frequency while being done, the lecture is the most generalized, together with reflexion and analysis. The creation and discovery in that order, are the less utilized. .

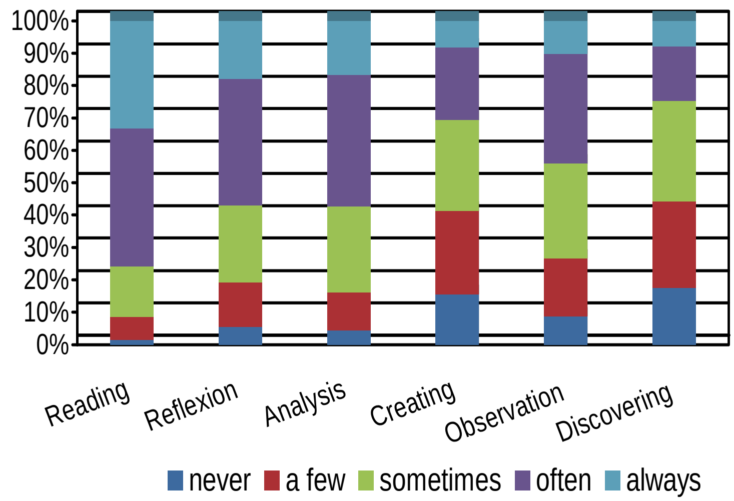
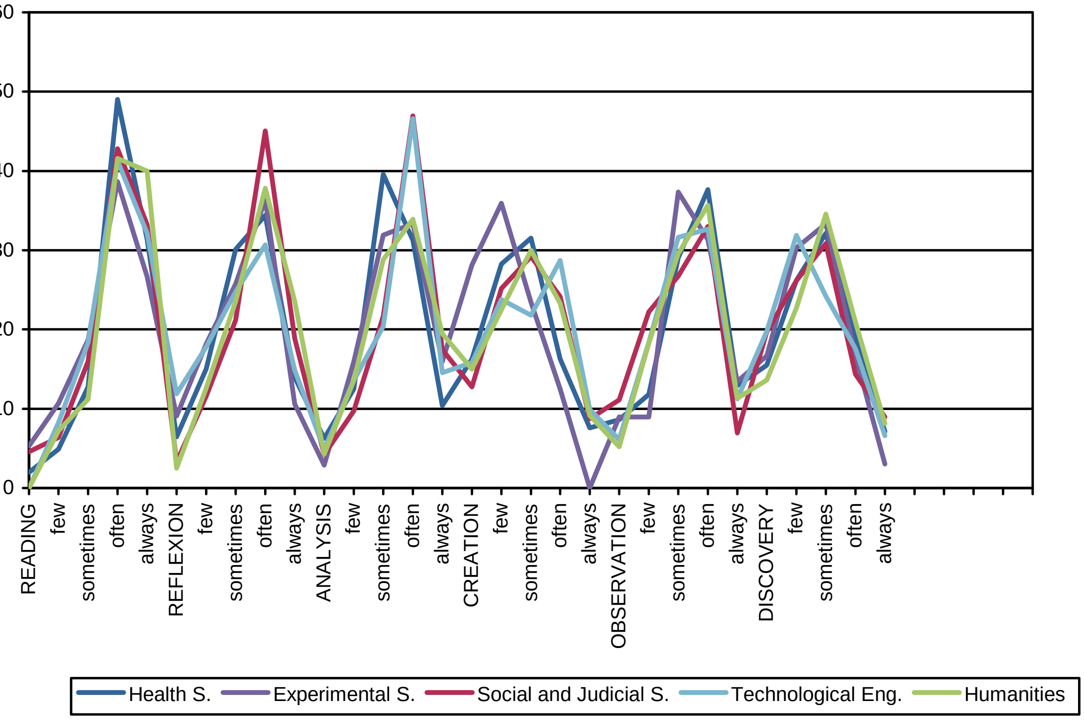


Fig. 6 Use frequencies according to type activities (in percentiles)

If we compare use frequencies of different types of activities with knowledge area to which subjects , being though by professors, belong to, we observe, just as fig. 7 shows, the type of activities that are mostly proposed by area they are also, reading, reflex ion and analysis.



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ig. 7 Use frequency of activity types by knowledge area.

d. Learning activities and teaching techniques

From the different techniques and activities from the questionnaire, the ones that are mostly used in a greater proportion by professors (78%) mostly or always are group activities and simulating. It is correct to say that demonstration, symposium and study cases show less professor proportion, (57%, 58% and 56% respectively), with respect to the two last ones, the ones that manifested using it sometimes are 37% and 36% respectively.

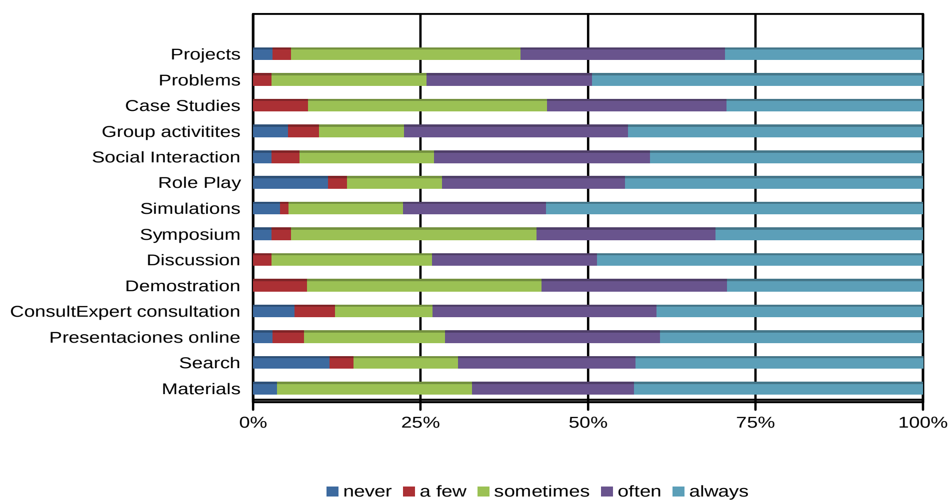

Fig. 8. Usage frequency for learning activities and teaching techniques

Considering techniques and activities that according to professors they use often or always together with the experience with online teaching, we observe as Fig 9 shows, a general level techniques less utilized seem to coincide with professors that have two or more on line teaching experience (they relate to case studies, symposium and demonstrations). But professors who have a year or less of experience the techniques used in lower proportion are: case studies, materials access and project methode.

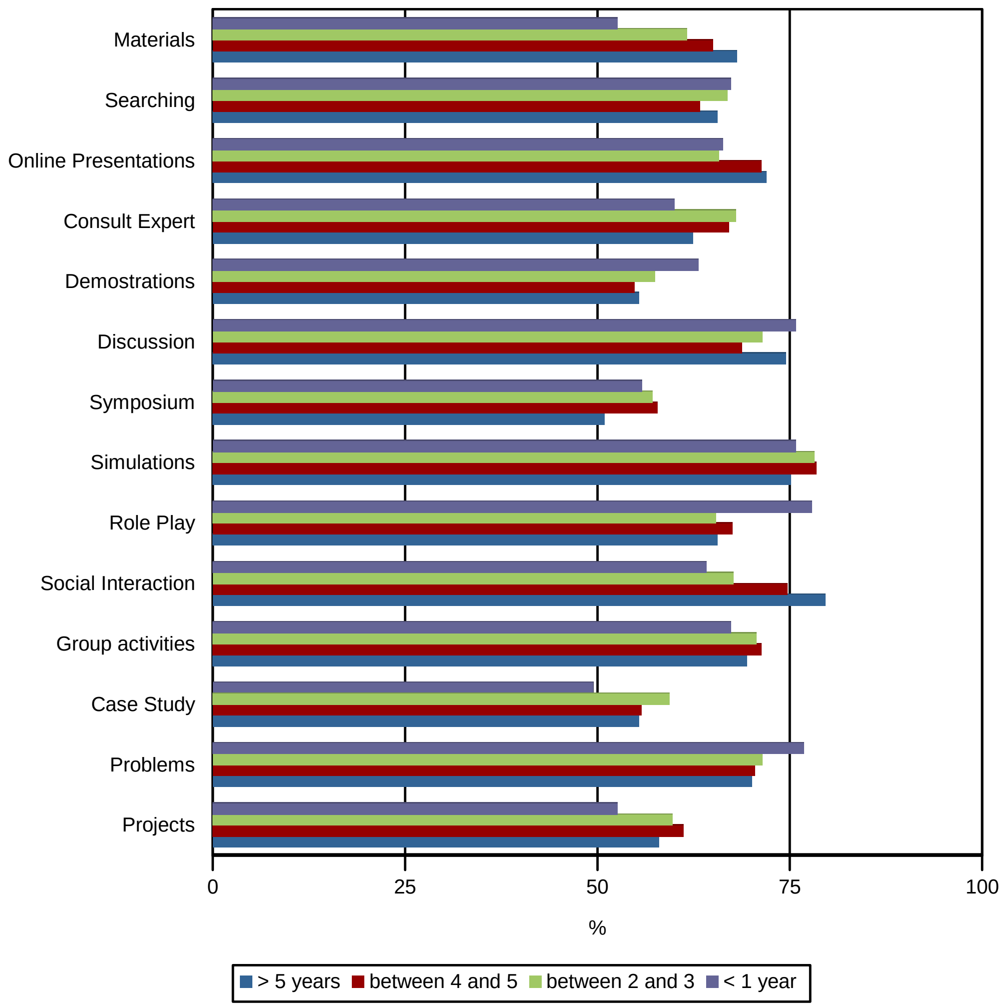

Fig 9 Teaching techniques and professors experience.

With respect to most commonly used techniques by professor with more experience, the results obtained show that role play, problem resolution and debate in that order. Professors with 2 to 3 years of experience use simulations in first place and problem resolution, group activities and debates in equal proportion. The ones that have between 4 and 5 years of experience , use in first place simulations followed by social space and group activities as well as online presentations. Professors with 5 years or more manifest the use in higher proportion the social spaces (80%), followed by simulations and debates.

Analyzing professors that manifest to often use or always use different learning activities and teaching techniques according to the knowledge field to which the subject they teach, belongs to, we can see differences between the used techniques (Fig 10) In health sciences the technique mostly used by professors is simulation(88% manifest has used it often or always) followed by the resolution of problems and debates, meanwhile the less utilized are, first symposium, followed by demonstrations, study cases and project work. In experimental sciences area the technique mostly used was social space followed by problem resolution, debate and role play, and the least used were expert consultation, search and information retrieval, the access to materials and demonstrations. But on social and judicial sciences they manifest to use more simulations, on line presentations and problem solving and less study cases, symposium and Project work and demonstrations. In teaching techniques, as more used technique stands out debates, followed by group activities, simulations and search information and the least used, symposium, Project work, and demonstration. To finish, in Humanities the mostly used was expert consultation, followed by group activities, simulation and social spaces and the least used, study cases, and demonstrations.

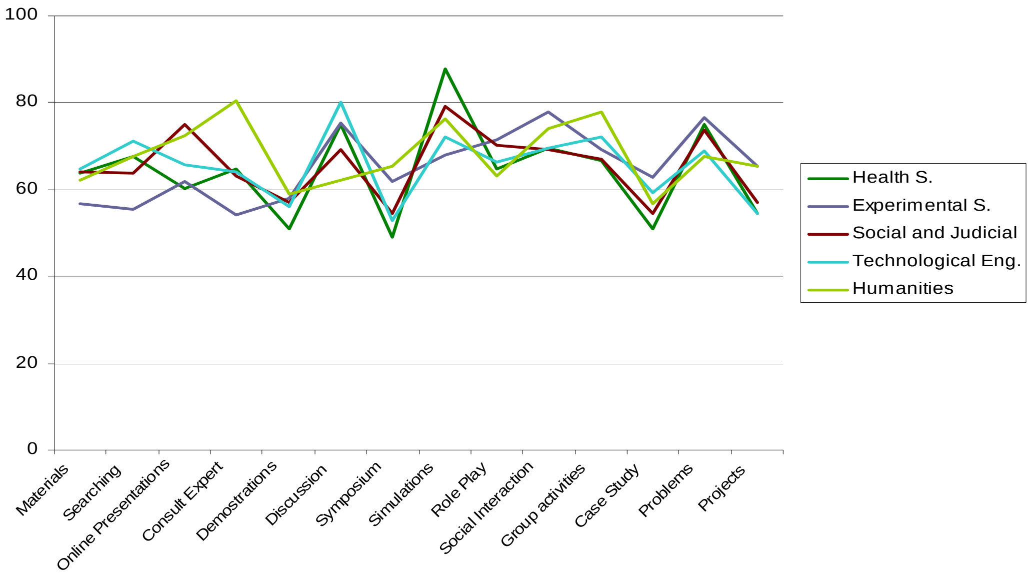

Fig 10 Teaching techniques and knowledge area

e. Types of learning materials and resources used.

The types of teaching materials and resources used by professors has been analyzed, globally and separately following the classification showed in table 1.-

Globally we observe that the mostly used materials are the ones in basic categories and academic guidelines. So 79% of the professors manifest to often or always use presentations in class, 77% practice guides and practice proposals. 72% study guides. Around 75% of the professors confirm they have used interactive multimedia materials, virtual labs, discussion forums or glossary.

If we take into consideration the variable “sometimes” other types of resources are used for learning, like practice and exercise materials, on line applications, tutorials, class notes or schemas, or the subjects syllabus.

The type of material less often used by professors are, first, video files, followed by on line interests groups, animations, Reading articles and on line magazines.

Regarding basic materials the ones that are often or always used in higher proportion are: class presentations, followed by tutorials and class notes or schemas.

Regarding the materials types that we have classified like activities, the ones that are mostly used in proportion are practice guides and practice proposals. The ones that are least ones used are auto evaluation exercises and previous exams.

The proportion of professors that manifest using study guides (72%) often or always is higher tan the program utilization (53%), if the ones that sometimes utilize the program, it will be the material classified as academic guides more utilized (by 90% of the professors)

From the different formats used, conceptual maps are the one mostly used or always in a less proportion but they are the ones that a higher number manifest using them often. The same happens with images or drawings and simulations.

BASICS	• Tutorials • Classroom presentation • Notes, schems
ACTIVITIES	• Practice proposals • Selfevaluation exercises • Previous exams • Glossary • Materials for exercices/Practice • Electronica Diary or weblog
ACADEMIC GUIDES	• Syllabus • Study guide
FORMAT	• Video files • Sound files • Animations • Images, drawings, photos • Interactive multimedia material • Concept maps • Virtual labs • Interest groups • Applications on line • Reading articles • On line datebase • On line magazines • Simulations • Electronic books
OTHERS	• Forum translation • Discussion forum

Table 1. types of materials

The ones mostly used are in first place, interactive multimedia and virtual labs, followed by on line data bases and magazines on line. If we point out that taking into consideration professors proportion that utilize little or nothing, as a result we have that these last ones are the one that are less used together with reading articles, interests groups, animations and videos.

Taking into consideration, the ones that manifest to use it sometimes, the mostly used formats are: sound files, online applications, followed by online data bases and animations.

To finish, with respect to the types of materials included in “other” category, discussion forums are the ones most often used or always, followed by the forum transcriptions and students work. If we take in consideration occasional usage the three types of materials are used by professors in a similar proportion.

CONCLUSIONS

Of the results obtained through this study, the main conclusions are:

- The use of the virtual environment greatly overcomes the face-to-face sessions; this implies their wider use taking advantage of the network potential in order to make space and time more flexible.
- It is possible to teach within the EVEA any sort of subject no matter their characteristics and knowledge field.
- The use of didactic material is outstanding
- There is a relationship between the use and the variety of materials at students disposition , creating a multimedia approach.
- The dominant teaching pattern in our universities is the one that overwhelmes elements and strategies of the traditional teaching model even though we are starting to observe teachers that apply didactic strategies based on student
- The most used didactic techniques are the teaching material access, the search and information retrieval. Other techniques have appeared showing an evolution towards student’s based methodologies.

- As good relationship between the profile usage and the variety of teaching materials at the student's disposal has been shown.
- The organizational patterns need to be separated into different levels: those that affect the institutions and those that affect the teacher's tasks.
- The organizational model should be defined based upon two-dimensional criteria. It would be better to keep in mind arguments such as the transaction distance or the combination of two or more of these dimensions. We need to invest in new typologies and it would be convenient to look for agreements regarding the main dimensions that could be used as central idea for these typologies.

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The Effects of Integrating a Virtual Lab in an Online Class: Student Perceptions and Implications for Future Practice

Bude Su

Abstract

Online instructors are still facing a number of challenges despite the advancements in today's technologies. One of the challenges of online teaching is providing visible guidance within a virtual learning environment. Visible guidance becomes especially important for those courses that involve lab sessions. The focus of this study is to empirically investigate what and how different instructional strategies --especially the use of a virtual lab -- are used to support student learning. Two classes of sixty graduate students participated in the study. The same content is delivered using different instructional strategies and different delivery methods. The course evaluations of these two groups are compared and findings are discussed.

Introduction

Activities that require student interaction and idea sharing are known to promote reflective thinking. Since students are physically isolated in online learning environments, any decision-making or exchanging ideas requires more time and efforts compared to those in face-to-face settings. To help facilitate student needs, both instructors and students must adjust themselves to the delivery method and use of new technologies.

The types of technologies and how they are used can impact both the quality and depth of learning process and learning outcomes. How technologies facilitate personal connections with instructors and students affects the degree of social presence among them (Duarte & Snyder, 1999). Previous research has demonstrated the use of active instructional strategies for improved learning outcomes in science education (Bredderman, 1982). Obviously, watching a PowerPoint lecture online is not an active way of learning certain content. Such passive learning becomes especially problematic when it comes to those courses that require a lab component. Many agree that online learning environment certainly brings challenges, but also provides opportunities for innovative instructional practices. Incorporating a virtual lab into an online class is one of the relatively new approaches in online educational practice. Compared to a print-based job-aid on how to carry out lab activities, a virtual lab can facilitate a more engaging learning experience and helps decrease instructor workload on answering lab-related questions. Therefore, in theory, such active instructional strategies enhance learning outcomes and increase student satisfactions. But is this true in practice?

In order to understand how certain instructional strategies such as using a virtual lab may affect student learning and satisfaction, the researcher conducted a two-semester exploratory study to examine:

1. Is there a statistically significant difference in the willingness to attend lab and the perceived usefulness of the lab between two groups (virtual lab group vs. face-to-face lab group)?
2. How do students perceive the virtual lab or the face-to-face lab in terms of helping them to understand statistical concepts and procedures?
3. What factors are perceived to make either type of lab most effective and why?

Study Overview

The immediate purpose of this study is to investigate student perceptions about their experiences studying a graduate level course, "Assessment and Evaluation", using different learning strategies. In this course, students are asked to explore and develop methods of assessing learning and performance through the use of psychometric techniques. The first four weeks of the classes focus on reviewing statistical concepts and procedures. Learning statistics online is considered to be very difficult. Some even claim that it is impossible to do it effectively. Two classes totaling 60 students participated in this study in two different semesters. The same content was taught to the participants using different pedagogies. One class of 27 students received text-based instructions with a weekly face-to-face optional lab while the other class of 33 students had a weekly virtual lab along with the text-based instructions. Participant age ranged from 24 to 65. Most of them chose this blended learning program due to work and family commitments. Over 90% of the participants are employed fulltime. The virtual lab was done through Adobe Connect where the instructor could share her computer screen with the lab attendees while explaining things through audio. The students could ask questions via a text chat window or using a microphone. The multi-channel audio conversation feature of Adobe Connect was somewhat problematic, such as hearing back own voice echo. Therefore, one-way audio delivery was used (only the instructor talking) with the students typing their questions into their text chat boxes.

An end-of-course survey was used to collect data and to explore issues related to perceived effectiveness of the virtual lab used in the online graduate assessment and evaluation course. Survey data was collected using the course management system that allows anonymous responses. The survey consisted of 15 questions that focused on student perceptions of effectiveness of the instructional strategies and delivery methods used in the class, in terms of increasing their understanding of the concepts covered in the class.

Results

A total number of 38 students responded to the course survey. Twenty-one of the respondents were enrolled in the first term where an optional face-to-face lab was offered along with text-based instructions. Seventeen of the survey respondents were enrolled in the second term where a weekly virtual lab was offered along with text-based instructions. Students in the both groups thought that having a lab for the statistics components was helpful. Although there is no statistically significant difference in their responses toward the statement "the weekly lab was helpful", the students who enrolled in the virtual lab class rated the usefulness of the lab higher than the group who had optional face-to-face lab.

Table 1: Perceptions on Lab Usefulness and Intention of Attendance

	Virtual lab	Face-to-Face Lab
Weekly lab was helpful	4.6	4.1
I would come to lab sessions regularly	4.5	3.3

While the idea of face-to-face lab was attractive, not all of them were willing to drive to campus and attend the lab. The rating for "I would like to come to the lab session regularly" resulted a statistically significant result between two groups (two tailed $t=2.03$, $p<.01$). The face-to-face lab group received 3.3 on average out of 5 possible points. Student comments provided explanation for the low rating.

"It is an online course and I would not have time to attend a weekly lab [on-campus]."

"As an out-of-area student, I would like the lab – but would prefer it be done online."

Clearly, a face-to-face lab was not an ideal option for the given target population and needed another kind of intervention. That was why the instructor modified the lab delivery mode from face-to-face to a virtual lab when the course was re-offered the second time. Despite of the technical issues at the beginning, the students who were enrolled in the virtual lab class highly rated the effectiveness of the virtual lab (4.6 out of 5). Some of the comments were:

> "Actually the virtual lab was very helpful. Participation in the lab gave the atmosphere of a real classroom. Also, gave chance to everybody to interact more than just emailing the professor our questions."
>
> "Even though I wasn't able to attend the lab, I was really happy that the lab sessions were recorded, so I could listen to them at my own pace."
>
> "I attended the lab and used the recorded session for the one time I missed the lab. It was helpful to prepare my questions in advance and I learned a lot from other students' questions."

Needless-to-say, the students appreciated the virtual lab component of the class and they were happy that the recording was available for them to access after the lab session. This is another good feature of Adobe Connect, which allows you to record the entire lab for future use.

One interesting perceptual difference between the two groups occurred on answering the question, "if there is a virtual office hour, which communication methods do you prefer".

Table 2: Preference Differences in Communication Methods

	Virtual Lab Group	Face-to-Face Lab Group
Text chat	2.7	3.9
Telephone	2.9	3.4
Video conferencing such as AIM/iChat/Skype, etc.	4.5	3.6

The group who had experience using video conferencing such as the Adobe Connect wanted to use it much more than the other group who did not have experience using it ($t=2.47$, $p<.01$). On the other hand, the experienced group did not want to go back for text chat ($t=-2.93$, $p<.01$). Like the old saying goes, "You don't know until you try". This result seems to indicate that those who did not experience using media-rich two-way communications had no clue how much better it could be than using simple text chat.

One of the challenges of blended learning is the balancing of the degree of blending. To understand the important factors that adult students perceived as important, the researcher asked the students to rate a few items.

The result showed that the students perceived the flexibility to learn at their own pace as the most important factor for their successful learning (Mean=4.3). The second important factor was the depth of reflection, where the students had enough time to thoroughly digest learning materials so they could generate deeper and more thoughtful reflections (Mean=4.3). Spontaneity that allowed for real time conversations and discussions was rated as important, but was viewed as not critical to learning success in general (Mean=3.8). Face-to-face human connection was rated as the least important factor among the four factors listed in this section (Mean=3.4).

The factors mentioned above tend to provide a reasonable explanation as to why the virtual lab was more successful than its face-to-face option. First, it met the criterion of flexibility. The students were able to participate in the lab session as long as they had an Internet connection, no matter where they were. They did not need to travel to the school as the other group did. Second, the recording feature of Adobe Connect provided not only another level of flexibility, but also a chance for them to digest on their own later. If this feature was unavailable, I do not think that we were able to see the statistically significant differences on several results between the two groups. Third, the virtual lab allowed for a real-time conversation and discussion, where the students were able to hear and learn from other students' questions. Because it satisfied all three of the features that the students perceived to be very important for successful learning, the virtual lab component of the class was highly rated by the students. And of course, this positive attitude, in turn, resulted higher learning outcomes and student satisfaction at the end.

Implications

Learning from personal experience through trial and error, I would like to provide a few suggestions for the instructors who have similar needs in the future.

Be brave and try new technologies. You don't know what you are missing until you try! I was hesitant to use Adobe Connect in the beginning because I was already overwhelmed with all the courses and other tasks in my job. However, I am glad I did use it because it made my teaching so much easier during the semester. Challenge and opportunity always go together, and taking the challenge is well worth for this situation.

Prioritize student needs and try to meet the critical needs first. When I offered an optional face-to-face lab for my online students, I thought that most of my students could come because they are local. But it was difficult for the students to come to the lab not only because the lab was offered at a fixed time, but also because they were not used to the idea of meeting in-person regularly in this online program. Flexibility (both in when and where) is the #1 need for these students and you have to satisfy this need before going any further.

Let the students write down their questions before the virtual lab session. Since the students needed to type in their questions, it was more effective if they prepared the questions ahead of time and then cut and pasted them into the text block during the lab. This also helped to decrease any possible embarrassment from typing and spelling errors.

Build a friendly communication atmosphere. It helps a lot if the virtual lab provides a friendly communication atmosphere. This can be achieved through many tactics such as encouraging students to ask questions, providing positive feedback to their questions, acknowledging your limitations of answering certain questions, etc. Online students do not see each other often so they value the virtual lab session very much.

Conclusion

Results of this evaluative research show that online students do not like the optional face-to-face lab because it is unrealistic to have an on-campus lab for an online class. Not everyone lives within driving distance and most of the students have a full-time job. As a result of not being able to fully utilize the lab, they struggled with the statistics part of the class in general. On the other hand, the students who had virtual lab option highly rated the value of the lab not only because their questions were answered, but also because they learned a lot from each other's questions. The recording feature of the lab was very helpful as well.

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Effects of Students' Identity Salience on Their Attitudes toward Face-to-face Classroom Collaborative Learning Activities

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Abstract

This study explored the effects of students' identity salience on their attitudes toward face-to-face collaborative learning activities. In addition, this study also sought to find out whether there was an interrelationship between students' identity salience and their ages and nationalities, as well as whether students' prior experiences of collaborative learning affected students' attitudes toward collaborative learning? Twenty graduate students attended the study by completing a survey. The findings indicated that students' attitudes toward the collaborative learning approach were affected both by students' identity salience and their prior collaborative learning experience. However there was no significant relationship between students' identity salience and their age ranges and nationalities.

Introduction

In educational settings, the issue of peer collaborative learning is often the subject of the studies (Ozmantar, 2005). In peer collaborative learning, students with similar levels of competence share their ideas in order to jointly solve a challenging learning task that cannot be accomplished on their own prior to the collaborative engagement (Damon & Phelps, 1989; Goos, Galbraith, & Renshaw, 2002). The peer collaborative learning environment provides students with a free and open forum to facilitate active and productive exchange of ideas (Driscoll, 2000). Studies have found that the collaborative learning approach could possibly increase learners' motivation (Bruffee, 1999), catalyze the development of critical thinking and problem-solving skills (Waite & Davis, 2006), build social atmosphere for small interdependent groups to con-construct knowledge (Vygotsky, 1976) and so on. However, not all forms of peer interaction are considered collaborative (Ozmantar, 2005). As Thomson and Perry (1998) pointed out "collaboration is like cottage cheese. It occasionally smells bad and separates easily" (p.409). The failure of a collaboration may be attributed to problems such as communication, effort-avoidance (Salomon & Globerson, 1989), underlying paradoxical tensions (Smith, 2005), and perceived group statues (Barron, 2003; Nuthall, 1999). Researchers claimed that the effectiveness of collaboration only happened under certain circumstances (Dillenbourg, Baker, Blaye, & O'Malley, 1996; Slavin, 1999). Three distinctive and interrelated conditions for effective collaboration are group members' mutuality, interdependence (Ozmantar, 2005), and equality (Damon & Phelps, 1989). Although researchers have pointed out these conditions for effective collaboration, the fundamental causes of collaboration problems or motivational factors for the mutual communication, continuous sharing, and perspective taking have left mainly untouched.

An individual's identity has three aspects: personal, relational, and collective identity (Brewer, 1991; J. E. Cote & Levin, 2002; Y. Kashima, et al., 1995; Lord, Brown, & Freiberg, 1999; Sedikides & Brewer, 2001). Only one identity aspect takes the dominant position for a person in a given situation (Burke, 2003; Lord, et al., 1999; Stryker, 1968; Stryker & Burke, 2000). Thus, it makes three different types of identity salience: individual, relational, and collective identity salience (Brewer & Gardner, 1996; E. S. Kashima & Hardie, 2000; Sluss & Ashforth, 2007). Individual's identities, in general, have potential impacts on motivation, judgment, self-esteem, and behaviors (Breckler & Greenwald, 1986; Brewer & Gardner, 1996; E. S. Kashima & Hardie, 2000; Triandis, 1989), so does an individual's identity salience (Benson & Mekolichick, 2007). Among the three identity salience, one type of identity salience may be more consistent with the collaborative learning atmosphere than the other. In other words, students with one type of identity salience may have more positive attitude toward collaborative learning than the other. This study used identity salience as the prism to explore students' attitude differences toward face-to-face collaborative learning. In addition, this study also looked into the relationship between students' prior collaborative experience and their attitude toward collaborative learning; as well as the relationship between students' identity salience and their age ranges and nationalities.

Review of Literature

Collaborative Learning

Collaboration with others has always been a central form of human activity (Barron, 2000). Collaboration has started to gain its attention and prominence in the educational field since the last two decades of the 20th century (Dornyei, 1997; Martin, 2007). In the educational realm, collaboration is specified as collaborative learning, that is, as defined by Johnson and Johnson (1996), “the instructional use of small groups so that students work together to maximize their own and each other’s learning” (p. 786). Collaborative learning evolved from the work of some psychologists such as David Johnson, Roger Johnson, and Robert Slavin (Alavi, 1994).Collaborative learning was claimed to be a complex and not universally defined concept (Resta & Laferriere, 2007), and the meaning of it was defined or adopted differently by researchers based on their specific perspectives. However, the fundamental elements of collaborative learning have been kept the same: group based activities, shared academic goals, mutual help, and resource sharing.

Collaborative learning and cooperative learning

Collaborative learning and cooperative learning have been used interchangeably by lots of researchers (Aiken, Bessagnet, & Israel, 2005; Sawyer, 2006). Even definitions of collaborative learning and cooperative learning are sometimes hard to distinguish. Kirschner (2001) summarized seven shared common elements between collaborative and cooperative learning: 1) learning is active; 2) the teacher is usually more a facilitator than a “sage on the stage”; 3) teaching and learning are shared experiences between teacher and students; 4) students participate in small-group activities; 5) students take responsibility for learning; 6) students reflect on their own assumptions and thought processes through discussing and articulating ideas in a small-group setting; 7) social and team skills are developed through the give-and-take of consensus-building.

Some researchers insisted on the necessity of differentiating collaborative learning from cooperative learning. There are three main differences between these two learning approaches. The fundamental difference is the structure (Dillenbourg, 1999; D. W. Johnson & Johnson, 1996; Slavin, 1995, 1997). Cooperative learning requires the division of labor and role taking among participants and the task is split into independent subtasks. Collaborative learning, as John and Johnson (1996) point out, is historically less structured and more student directed than cooperative learning. Collaborative learning provides only vague directions to teachers about its use. In a cooperative learning activity, each participant is required to be responsible for a portion of the problem solving, whereas collaborative learning involves the mutual engagement of participants in a coordinated effort to solve problems together (Dillenbourg, 1999; Lehtinen, Hakkarainen, Lipponen, Rahikainen, & Muukkonen, 1999; Roschelle, 1996; Teasley, 1995). Consequently, cooperative learning is normally associated with well-structured knowledge domains, while collaborative learning is associated with ill-structured knowledge domains (Slavin, 1997). Research on cooperative learning tended to emphasize the importance of individual accountability (D. W. Johnson & Johnson, 1986, 1993; D. W. Johnson, Johnson, & Scott, 1978; R. T. Johnson & Johnson, 1983; Slavin, 1999), while research on collaborative learning focused more on the group as a whole. Individual accountability means “each student is assessed individually concerning his/her mastery of the concepts and the material involved in the group learning exercises” (Alavi, 1994, p. 165). Secondly, some researchers believe that cooperative learning and collaborative learning differ in their depth of interaction, integration, commitment, and complexity. When putting cooperative learning and collaborative learning on a continuum measured by levels of these four factors, cooperative learning falls at the low end of the continuum, whereas collaborative learning falls at the high end of it (Himmelman, 1996). Lastly, other than their implicational differences, studies on collaborative learning and cooperative learning tended to use different research methodologies. Studies on cooperative tradition tended to use quantitative methods that looked mostly on the learner achievement. Studies on collaborative learning, on the other hand, took mostly the qualitative approach by analyzing students’ interactions (Panitz, 1996, 1997).

In general, both collaborative and cooperative learning involve the instructional use of small groups in which students work together to maximize their own and each other’s learning. Therefore, when a study’s focal point is rather the interactive group learning than the specific group learning approaches, it is legitimate to use these two terms without clarifying their differences. This study focused on the group interactive learning in general; therefore, it blurred the line between collaborative and cooperative learning and treats them as the same learning approach.

Identity

As Buckingham (2008) pointed out “identity is an ambiguous and slippery term” (p.1). There are various assumptions and definitions of identity based on disciplinary paradigms from which they are derived. In the sociology realm, the root for the concept of identity can be traced back to the early sociological interests in “self and society” (James E. Cote & Levine, 2002). Sociologists believe that identity is essentially a social and historical construct, and identities exist only when people participate in structured social relationships (Stryker, 1968). The essential focus of collaborative learning is the social interactions within a learning group; therefore, the sociologists' tradition of identity concepts and studies are appropriate for studies that explore collaborative learning from the perspective of identity.

Structure of Identity

Identity is multifaceted and dynamic (Brewer & Gardner, 1996). It should be viewed as an organized structure instead of a fixed unity (Stryker, 1968). The crux of social identity theory is the notion that individuals' identities contain both personal and social components (Banaji & Prentice, 1994; Bettencourt, 1999; James E. Cote & Levine, 2002; Fearson, 1999; James, 1907, 1980; Mead, 1934; Turner, 1982). The social component of identity was later divided by researchers into two identity aspects: relational and collective identity (Brewer & Gardner, 1996; Kashima & Hardie, 2000; Lord, Brown, & Freiberg, 1999; Sluss & Ashforth, 2007) to describe "those that derive from interpersonal relationships and interdependence with specific others and those that derive from membership in larger, more impersonal collectives or social categories" (Brewer & Gardner, 1996, p. 89). Relational identity generally refers to an individual's sense of self in terms of his power, entitlement, and social affiliation in relation to others (Holland, Lachicotte, Skinner, & Cain, 1998). It is derived from the connections and role relationships with significant others such as relationships between children and their parents, students and their teachers, and employees and their bosses (Brewer & Gardner, 1996; Lord, et al., 1999). In a group setting, relational identity refers to an individual's apprehension of his social position in the group derived from ties with other group members (E. S. Kashima & Hardie, 2000; Ozmantar, 2005). The idea of collective or group identity addresses the "we-ness" of a group and stresses the similarities and shared attributes of group members (Hardy, Lawrence, & Grant, 2005). Given together, an individual's self-conception is composed of three aspects: individual, relational, and collective identity (Brewer & Gardner, 1996; E. S. Kashima & Hardie, 2000; Y. Kashima, et al., 1995; Sedikides & Brewer, 2001; Sluss & Ashforth, 2007; Triandis, 1989).

Identity salience

Identity salience theories believe that within an individual's multiple identities, only one identity can take the dominant position for a person in a given situation (Burke, 2003; Lord, et al., 1999; Stryker, 1968; Stryker & Burke, 2000). Identity salience defines the probability and readiness of acting out an identity across a variety of situations, or alternatively across persons in a given situation (Stryker & Burke, 2000; Stryker & Serpe, 1994). When combining the identity salience theory with the three identity aspect theory, it makes three different types of identity salience: individual, relational, and collective identity salience (Brewer & Gardner, 1996; E. S. Kashima & Hardie, 2000; Sluss & Ashforth, 2007). In other words, each individual has salient identity aspects among the three identity aspects.

An individual's identity salience is viewed as trans-situational and stable across time and situation (Stryker & Burke, 2000; Stryker & Serpe, 1994). A person will tend to perform according to his/her identity different a situations as well as seek opportunities to perform in terms of that identity (Stryker, 1968).

Collaborative Learning and Identity Salience

Although most studies have proved the positive effects of the collaborative learning approach, not all collaborative learning activities were successful (Dillenbourg, et al., 1996). Many collaborative groups were ineffective and failed to generate any collaborative action, and some were even destructive (Hardy, et al., 2005; D. W. Johnson & Johnson, 1996). Because the increasing pervasion of the collaborative learning approach in today's education realm, it becomes more and more important to determine the demotivating factors of this learning approach in addition to its motivating factors. Researchers indicated that the failure of collaborative learning activities was mostly attributed to participants' communication problems, perceived group statuses (Barron, 2003; Nuthall, 1999), effort-avoidance/social loafing (Salomon & Globerson, 1989), and the consequent group tensions (Smith, 2005). Researchers also pointed out that putting students together and telling them they were a group could not ensure the happening of collaborative learning (D. W. Johnson & Johnson, 1996; Slavin, 1999). The accomplishment of effective collaboration depends on the leverage of participants' differences, the balance of participants' different concerns (Hardy, et al., 2005), and the achievement of intersubjectivity and common ground between participants (Ozmantar, 2005; Tudge, 1992). Intersubjectivity is the status of a shared understanding among group members (Bober & Dennen, 2001; Davidson, 1992; Dennen & Wieland, 2007; Fawcett & Garton, 2005; Summers, Beretvas, & Gorin, 2005).To this end, researchers claimed three distinctive and interrelated conditions for effective collaborative learning: group members' mutuality, positive interdependence, and equality (Damon & Phelps, 1989; Dillenbourg, et al., 1996; Granott, 1993; Hardy, et al., 2005; Ozmantar, 2005; Slavin, 1996; Suzuki & Kato, 1997). Positive interdependence is achieved when participants feel responsible for one another's learning and believe that their goals can only be attained when their team members also attain their goals (Alavi, 1994; Deutsch, 1962; D. W. Johnson & Johnson, 1996; Soller, 2001). In other words, interdependence indicates the necessity of group members' reliance on each other to accomplish their shared goals. The sense of interdependence leads to promotive interaction in which participants encourage and facilitate each other's efforts to complete tasks in order to reach the group's goals (D. W. Johnson, Johnson, & Stanne, 1989) through sharing of resources, information, and knowledge. Mutuality is concerned with a reciprocal bilateral communication amongst team members (Goos, et al., 2002). Equality means each participant takes other group members' perspectives and directions rather than a unilateral flow of direction (Damon & Phelps, 1989).

Although researchers have pointed out the problems and conditions regarding collaborative learning, it is a comparative passive remedial approach. The fundamental causes of collaboration problems and motivational factors that contribute to effective collaborative learning have been left mostly untouched.

Identities are motivators of human actions (Stryker, 1968). Different aspects of identity are associated with different social motivations and implications for an individual's self-esteem and behavioral tendencies (Triandis, 1989). Therefore, students' different identity salience may affect them to behave positively or negatively in collaborative learning activities.

The individual identity salience orients towards one's own interests and profit (Brewer & Gardner, 1996; E. S. Kashima & Hardie, 2000; Lord, et al., 1999). It does not resonate well with the collaborative learning setting, which emphasizes collective efforts. As Stryker & Burke (2000) pointed out a mismatch or discrepancy of an individual's identity salience results in negative emotion. Therefore, it may hinder the individual's tendency to perform of that identity. Consequently, students with individual identity salience may not feel comfortable working in a collaborative setting. On the other hand, collective identity salience places a premium on the success of the group other than him own success or benefit (Brewer & Gardner, 1996; E. S. Kashima & Hardie, 2000; Lord, et al., 1999), while the relational identity salience values interdependence (Markus & Kitayama, 1991). Both of these two identity salience are more consistent with the collaborative learning setting. As a result, students with collective or relational identity salience may feel more comfortable working in collaborative groups. Based on this, the hypothesis of this study is that students with relational identity or collective identity salience have more positive attitude toward collaborative learning than students with individual identity salience. In addition, what factors will affect students taken of certain identity salience is also the purpose of the study. The main factors includes in this study are participants' age and nationality. Some researchers claimed that different cultures tend to have nurture different identity salience. For example, Triandis (1989) and Singlis (1994) suggested that Asians tended to have collective and less individualist relative to Europeans or North Americans. Moreover, attitude is only influenced by an individual's intentions to act with regard to the content, but also affected by the individual's direct experience (Nabi & Krcmar, 2004). That is to say, the prior experience of collaborative learning also affects students' attitudes toward collaborative learning. What specific experience matters is the focus of this study, such as being a leader, feeling of doing most the group work and so on.

To this end, this study sought to answer one main quantitative research questions and two sub-questions: 1) Do students' identity salience affect their attitudes toward collaborative learning? 2) Do students' age and nationality affect students' identity salience? 3) Do students' prior experiences of collaborative learning affect students' attitudes toward collaborative learning?

Research Methodology

Research Participants and Procedure

Twenty graduate students in the school of education attended this study. The participants' age ranged from 20 to above 50 including: 10 (50%) in 20-30, five (25%) in 30-40; two (10%) in 20-50; and three (15%) above 50. Fourteen (70%) participants attended this study were first year graduate students. Eight (40%) participants were American, five (25%) participants were African American, four (20%) participants were international students from Asian, two (10%) participants were African, and only one (5%) participant was from South America. In order to draw a feasible but representative sample from target population, participants were randomly selected to include students from different age ranges and genders.

Survey Instrumentation

A survey questionnaire was used for this study. It consisted of three sections. The first section was adapted from the Kashima and Hardie (2000) RIC-scale survey to measure participants' identity salience. The Kashima and Hardie RIC-scale has 10 items, and each of the items is followed by three response items corresponding to relational, individual, and collective identity aspect. The second section of the questionnaire included 10, 5-point Likert-scales ranging from strongly agree to strongly disagree to investigate participants' attitudes toward peer collaborative learning and their prior experience in the collaborative learning activities. Questions in this section combine questions that developed by the researcher. The last section of the questionnaire asked participants to report their demographic and other school-related information.

Data Analysis Method

One way ANOVA, simple regression, multiple regression, reliability analysis, and correlation were used to analyze the data. The main statistic test used for this study was ANOVA, a powerful and common statistical procedure in the social sciences (Plonsky, 2009). The regression statistic analysis was used to analyze the relationship between students' prior experience in collaborative learning and their attitudes toward collaborative learning.

Findings and Discussion

According to the statistic description, among the 20 students that participated in the study, 11 (55%) students had individual identity salience, six (30 %) had relational identity salience, and only three (15%) had collective identity salience. The mean score of the attitude toward collaborative learning of the three identity groups were 0.5455 (individual), 1.3750 (relational), and 1.3333 (collective). That means all identity salience group had positive attitudes toward collaborative learning.

In table 1, the ANOVA output was F=4.238 ($p<0.05$). It indicated that the difference of students' attitudes toward the collaborative learning between three identity groups was statistically significant. As illustrated in table 2 there was a statistically significant difference ($p<0.05$) between students with individual identity salience and relational identity salience toward collaborative learning. Student with collaborative identity salience consistently viewed collaborative learning more favorable than did students with individual identity salience. There was a statistically significant difference ($p < 0.05$). Collective identity salience was not significantly different to both relational identity salience and individual identity salience in terms of students' attitudes toward collaborative learning. Since the mean score of collective identity (17.33) is similar to the mean score of relational identity (17.5), the insignificance may due to small number of the collective identity group (N=3)

ANOVA

attitude1478Mean

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.297	2	1.648	4.238	.032
Within Groups	6.613	17	.389		
Total	9.909	19			

TABLE 1: ANOVA output

Multiple Comparisons

Dependent Variable:attitude1478Mean

	(I) identity	(J) identity	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tukey HSD	individual	relational	-.82955*	.31653	.045	-1.6416	-.0175
		collective	-.78788	.40623	.158	-1.8300	.2542
	relational	individual	.82955*	.31653	.045	.0175	1.6416
		collective	.04167	.44101	.995	-1.0897	1.1730
	collective	individual	.78788	.40623	.158	-.2542	1.8300
		relational	-.04167	.44101	.995	-1.1730	1.0897
Scheffe	individual	relational	-.82955	.31653	.056	-1.6779	.0188
		collective	-.78788	.40623	.183	-1.8766	.3009
	relational	individual	.82955	.31653	.056	-.0188	1.6779
		collective	.04167	.44101	.996	-1.1403	1.2236
	collective	individual	.78788	.40623	.183	-.3009	1.8766
		relational	-.04167	.44101	.996	-1.2236	1.1403

*. The mean difference is significant at the 0.05 level.

TABLE 2: multiple comparison among three identity groups

As indicated in table 3 and table 4 students' identity salience were not significantly related to their age ranges (χ^2 =5.545, p= 0.476 > 0.05) or the countries (χ^2 =15.386, p= 0.052 > 0.05) where they were from. However, the χ^2(0.05, df =8) =15.51. It was very close to 15.368. Because this study only had 20 participants, adding new participants might change the result.

Crosstab

Count

		age				
		20-30	30-40	40-50	50-	Total
identity	individual	7	2	1	1	11
	relational	3	2	0	1	6
	collective	0	1	1	1	3
Total		10	5	2	3	20

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.545[a]	6	.476
Likelihood Ratio	6.852	6	.335
Linear-by-Linear Association	2.841	1	.092
N of Valid Cases	20		

a. 11 cells (91.7%) have expected count less than 5. The minimum expected count is .30.

TABLE 3: output for age and identity relationship

Crosstab

Count

		nationality					
		USA	African american	Ascian	african	south america	Total
identity	individual	7	0	3	1	0	11
	relational	1	3	1	0	1	6
	collective	0	2	0	1	0	3
Total		8	5	4	2	1	20

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.386[a]	8	.052
Likelihood Ratio	18.953	8	.015
Linear-by-Linear Association	1.666	1	.197
N of Valid Cases	20		

a. 15 cells (100.0%) have expected count less than 5. The minimum expected count is .15.

TABLE 4: output for nationality and identity relationship

As indicated in table 5, in general, the relationship between students' prior experience in collaborative learning and their attitudes toward the collaborative learning approach was statistically significant (F=5.868, p= 0.004 <0.05). Item2 ("doing most of the work"; t=-3.029, p=0.009 < 0.05) and Item 6 ("explaining of ideas to group members"; t=2.789, p=0.014<0.05) were significantly related to students' attitudes toward the collaborative learning approach.

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	9.989	3.934		2.539	.024
	doing most of the work	-1.558	.515	-.570	-3.029	.009
	good relationship with peer	.038	.658	.012	.057	.955
	explain ideas	2.719	.975	.579	2.789	.014
	frequent communication	-.206	.884	-.080	-.233	.819
	role awareness	-.185	.889	-.073	-.208	.838

a. Dependent Variable: atitudeTotal1478

TABLE 5: Coefficient table of students' prior experience in collaborative learning

As shown in table 6, 67.7% of students' attitudes toward collaborative learning can be predicted by students' prior experience of collaborative learning.

Model Summary[b]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.823[a]	.677	.562	1.91265	.677	5.868	5	14	.004

a. Predictors: (Constant), role awareness, doing most of the work, good relationship with peer, explain ideas, frequent communication

b. Dependent Variable: atitudeTotal1478

TABLE 6: Model Summary table

Conclusions

This study explored the relationship between students' identity salience, prior collaborative learning experiences, and students' attitudes toward collaborative learning. The research findings were consistent with the study hypothesis that students' attitudes toward collaborative learning were affected both by students' identity salience and their prior collaborative learning experience. Three different identity salience groups all had positive attitudes toward collaborative learning; however, the relational identity salience group had significantly more positive attitudes toward collaborative learning than the individual identity salience group. In addition, students' experience of doing most of the group jobs was negatively related to students' attitude toward collaborative learning, while experience of explaining ideas to group members was positively related to students' attitudes toward collaborative learning. At last, the findings also indicated that students' identity salience were not related to their age ranges and nationalities.

This study provides researchers with a new perspective to explore effectiveness in collaborative learning settings. It also provides a new factor, identity salience, for instructors to consider when grouping students for collaborative learning activities, and cultivating student toward team work. There are two major limitations of this study. First, the sample size of the study is small. It limits the generalization of the findings. For the future study, a bigger sample size is desired. Second, there were only six questions asking about students' prior collaborative learning experience. The limited number of the questions may have excluded other possible experiences that affect students' attitudes toward collaborative learning.

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Evaluating the Effectiveness of a Simulation-based Collaborative Learning Environment and Validating New Ways to Assess Learning Outcomes

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Abstract

Technology-based learning environments offer new ways to support learning in complex domains, but there is still a lack of understanding as to under what conditions learning is most likely to be successful. Moreover, reliable and valid methodologies for assessing the learners' performance are required. We designed and developed a simulation-based learning environment in the area of school management which includes (1) instructional support to facilitate learning, (2) collaborative features, and (3) a methodology to determine the learning outcome. A study with 66 participants was conducted to evaluate effects of the learning environment on learning outcome and validation of the used instruments. Results showed that students' performance significantly improved after using the learning environment and they had no problems with the complex domain. Data also revealed validation issues for the applied instruments. We discuss our initial findings and conclude with directions for future research.

Introduction

The rise of computer technology affected the design of learning environments and raised hopes and expectations regarding effective instruction. Features such as the multimedia capability and networking opportunities of computers opened new paths for applying instructional principles in many ways. However, technology alone will not lead to successful learning and it is more the underlying pedagogy than the technology that will facilitate learning which requires thorough design of effective learning environments. And even though technology-based learning environments offer opportunities to support learning in complex domains, there is still a lack of understanding as to under what conditions learning is most likely to be successful (Cannon-Bowers & Bowers, 2008). Moreover, to evaluate effectiveness of a learning environment, methodologies for assessing the learners' performance are required.

One possible application of technology to enhance learning involves the use of simulations, which play an important role in education. Clariana and Strobel (2008) define a simulation as "an executable (runnable) model, computer software that allows a learner to manipulate variables and processes and observe results" (p. 330). Simulations are particularly useful for learning about complex domains, because they enable learners to form and test hypotheses in a setting as complex as the field of application, but without risking negative consequences when making mistakes. Learners do not per se have the ability to construct meaningful and desired outcomes when working with complex problems (Dörner, 1996; Spector, 2000). Thus, we claim that learning environments which utilize technological enhancements such as simulations are only effective if instructional support is provided.

Moreover, determining the effectiveness of learning environments requires well-defined performance criteria and valid measurement instruments. Christensen, Spector, Sioutine, and Cormack (2000) claim that learning should be assessed through a comparison of learners' thinking and performance with that of experts.

We developed a simulation-based learning environment in a complex domain which includes (1) instructional support to facilitate learning, (2) collaborative features, and (3) a methodology to determine learning outcome. Our goals were firstly to examine the effect of a simulation-based learning environment on students' learning outcome and secondly to develop a methodology for assessing students' performance when working on complex problems.

The next section will focus on rationales for the use of technology-based learning environments including our research questions and hypotheses. Then we will introduce the design and procedure of our research study, followed by the presentation of our results. Finally, we will discuss our findings and present directions for future research.

Rationales for the Use of Technology-based Learning Environments

The mere use of technology alone does not lead to successful learning, but computer-based learning environments have the potential to facilitate authentic learning where students can construct meaningful knowledge. When providing learners with authentic activities, knowledge is not presented in abstract forms, but rather embedded in a meaningful context. Learner-centered activities play a central role where the teacher's role moves from a directive disposition to a supportive one. This means, that instruction is not broken down into manageable parts and then presented to the learner, but rather experienced by the learner under the teacher's guidance (Harley, 1996). Learning is an active process where students simulate and recreate real-life complexities without a simplified knowledge base (Karagiorgi & Symeou, 2005). Students do not absorb decontextualized knowledge and skills, but learning is situated which means that it occurs in context, because learners build personal interpretations of the world with knowledge emerging in the context within which it is relevant (Lave & Wenger, 1991; McLellan, 1996). Advocates of situated learning approaches argue that students are not prepared effectively for job performance if learning is separated from practice (Enkenberg, 2001) and claim that decontextualized knowledge also contributes to the problem of inert knowledge which refers to information that a learner may possess, but is not able to recall or apply in order to solve problems (Whitehead, 1929).

Computer-based learning environments can be effective tools when it comes to implementing situated learning activities. One possible application is the use of simulations of complex systems as a means for training and research. Educational technologists have been employing computer-based simulations and games in a variety of educational contexts to utilize technology in supporting effective instruction. Simulations have become a prevalent tool in learning and instruction since they provide a broad applicability in different instructional settings (Ifenthaler, 2009). The following elements are essential to an effective instructional simulation: complexity, learning objectives, interaction, real-world processes, and embedded, and non-random outcomes (Shelton, 2007).

Additionally, the meaning making process in situated learning environments often includes collaboration between learners, because learning is a social, dialogical process based on the negotiation between learners (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). The influence of social interaction and individual meaning making is reciprocal, because personal understanding and social knowledge building are interdependent and cannot exist separately (Stahl, 2006). A different kind of interaction can be found in a continuing acquisition of knowledge and skills when novices learn from experts in the context of practical activities. Experts can either act as role models or coaches or both. Lave and Wenger (1991) propose to let the participant move from being an observer to a fully functioning agent within the culture of the group. This will enable learners to learn how to speak about and within a community of practice.

Instructional designers need to be developing learning environments which enable learners to construct meaningful knowledge. This can be achieved by providing learners with collaborative activities that are embedded in a context meaningful to them with room for reflection with others about their learning progress (Jonassen et al., 1995). An example for an instructional model that applies principles derived from the situated learning approach such as learning activities and collaboration is problem-based learning (Jonassen, 1997; Savery & Duffy, 1995a, 1995b). Problem-based learning describes an instructional method where learning occurs when learners are working on a solution for a given, authentic problem. Learning is considered the process of creating content knowledge and developing problem-solving as well as self-directing skills (Hung, Jonassen, & Liu, 2008). Other models implementing principles from the situated learning approach are cognitive apprenticeship (Collins, Brown, & Newman, 1989), project-based science (PBS), and communities of practice (Lave, 1991). Cognitive apprenticeship refers to a way of learning, where novice learners first observe an expert and are then guided by a more experienced person to utilize their own cognitive and metacognitive skills. The experienced person may demonstrate the skills and levels, provide examples, and support the novice through feedback and assistance (Dennen & Burner, 2008). Project-based science is characterized by a driving question, investigations, artifact development, collaborations and use of tools to support inquiry (Singer, Marx, Krajcik, & Chambers, 2000). A community of practice (CoP) is a sustained social network of people which can be bound in a formal or informal way. They are engaged in a common practice and share a common set of values and knowledge (Dennen & Burner, 2008). All approaches have in common that learners actively work on a complex task in interaction with peers and/or a more experienced person. The teacher is in the role of a coach who provides information and support when needed.

The Learning Environment

Our modular learning environment is concerned with the area of school management. It was derived from principles of the situated learning approach and includes questionnaires to assess dependent variables, instructional materials, communication tools, and a simulation which is embedded in an authentic scenario. Students work individually as well as collaboratively.

The learner's mission is to improve a school's efficiency, which is represented by means of the school's dropout rate. Student retention is an important issue in schools today (Attewell & Seel, 2003). Many factors which lead a student to drop out of school may be found in the students themselves, such as socio-economic status, their parents' level of education, etc. (Grob, Jaschinski, & Winkler, 2003). However, some studies have revealed that changing the school itself rather than the student may contribute to preventing at-risk students from dropping out of school. Schools are systems with many interrelated variables which contribute in different ways to dropout rates. Leithwood, Lawton, and Cousins (1989) identified seven categories that are indirectly and directly related to dropout, such as teachers, programs & instruction, and school-community relations. Their empirical model was used as the underlying causal model of the simulation (see Ifenthaler, 2009). Complex systems are characterized by interconnected variables which influence each other (Funke, 1991; Seel, Ifenthaler, & Pirnay-Dummer, 2009). In the simulation, all seven categories of the underlying model are represented as investment fields, i.e. learners can allocate money from a given budget to different areas with each standing for a particular attribute of one variable of the causal model.

The main learning objective is to explore the underlying causal model of the simulation. Students can enter data into the simulation and receive an output, but calculations as well as causal relationships between the variables are not known by the user. Thus, students need to infer the causal model from the output. To facilitate the exploration, they will be given information about the variables which allows for conclusions regarding their interrelationships. Moreover, students will learn about the underlying model through feedback from the system (simulation output such as the school's dropout rate) and collaboration with peers. The collaborative part enables them to exchange ideas, reflect on past results, and further refine their mental model. Collaboration may facilitate learning in complex domains, but evidence about its effectiveness has not yet been demonstrated clearly. Nevertheless collaboration is effective insofar as it enhances active learner engagement, which is generally crucial to improved learning outcomes (see Christensen et al., 2000).

Research Questions and Hypotheses

According to Johnson-Laird (1989), it is important to understand the learning-dependent progression from a novice's to an expert's understanding of a complex domain (Ifenthaler & Seel, 2005). Therefore, we will compare the learner's understanding of the underlying model of the simulation with that of the expert to assess the final learning outcome. Accordingly, we will address the following research questions in our empirical investigation:

1. Is the simulation-based learning environment an effective instructional method for improving the understanding of complex domains (systems)?
2. Is the comparison of novice models and expert models a valid instrument for assessing learning-dependent progression in complex domains?

We claim that our simulation-based learning environment is an appropriate tool for enhancing students' complex problem solving skills. Interacting with a simulation that models the behavior of a complex dynamic system enables learners to create and test hypotheses in order to refine their mental model about the problem. Collaborating with peers provides learners with new perspectives, facilitates reflection, and thus helps them to develop a solution to the given problem. We hypothesize that students will perform better on the posttests than on the pretests.

We argue that learning can be viewed as moving along a continuum towards expertise. Therefore, the similarity between students' models and the expert model (the causal model of the simulation) should increase, thus indicating improved learning. To measure these outcomes, we have two different instruments. The simulation output, which calculates the new dropout rate of the school, provides a direct indication about the quality of a learner's decision. Success is reflected by decreased dropout rates and failure by increased dropout rates. Secondly, a questionnaire will be given to the learners in which they will be asked to rate the impact of the variables on each other and on dropout rates. The data from the questionnaire will be transformed into a causal model which will then be compared to the expert model, i.e. the underlying model of the simulation. The higher the similarity score, which ranges from 0-1, the more similar are the models.

Method

Participants

The sample consisted of 66 students (54 female and 12 male) from a German Gymnasium (high school). Their average age was 17.94 years ($SD = 1.28$). It included three classes from grades 11-13. The Gymnasium participating in the study is specialized in pedagogy, which means that the area of school management is part of the students' curriculum, might be related to future job opportunities, and is likely of personal interest to them.

Design and Procedure

The study was conducted during two regular 90 minute class sessions and was divided in four main phases (see Table 1). The study started with a short introduction in phase 1 and then students logged into the online learning environment and completed a demographic survey and pretests. Then they were given more information about the study and scenario along with instructions in class. The students' first learning task was to work through the provided instructional materials and learn about the categories involved in school management in phase 3. Students were randomly assigned to discussion groups of five for the collaborative part in phase 3. During the second 90 minute class session, students were given 60 minutes to discuss their results and collaboratively explore the causal model of the simulation in order to achieve an optimal result in the last simulation run. After the collaborative activities, the study closed with the posttests and an evaluation survey (see Table 1).

In the evaluation survey, students were asked to evaluate different aspects of the learning environment on a five-point Likert scale (1 = I disagree, 5 = I fully agree). It served to assess usability of the learning environment, the benefit of instructional support, and success of the collaboration. Both pretest and posttest consisted of two scores that will be further explained in the following paragraph on outcome variables.

Table 1 Study phases and components

Phase	Activities	Obtained Data	Point in time	Duration
1	Pretest and demographic survey	dropout rate causal model similarity score	Day 1	45 min
2	Learning activities I: individual tasks		Day 1	45 min
3	Learning activities II: collaborative task		Day 2	60 min
4	Posttest and evaluation survey	dropout rate causal model similarity score students' evaluations of the learning environment	Day 2	30 min

Outcome Variables

Two outcome variables were used for this study, namely (1) *dropout rate* and (2) *causal model similarity score*. The simulation returned a new calculated dropout rate after each run based on the learner's input which provides performance information. Good decisions from the learners and effective placement of investments will lead to a lower dropout rate. Non-effective investments result in an increased dropout rate. This means that the lower the dropout rate, the better the performance. Participants were asked to rate the impact of variable that are part of the causal model underlying the simulation on each other with a score between 1 and 10. Each score was transformed into a directed relation. All obtained relations combined resulted in a causal network. This was then compared to the causal model underlying the simulation using the SMD (Surface, Matching, Deep Structure) software developed by Ifenthaler (2008b). The software calculates a score ranging from 0 (no similarity) to 1 (identical) indicating similarity of a participant's causal model with the underlying model of the simulation. The closer a participant's causal model is to the expert model, i.e. the underlying model of the simulation, the better the person performs.

Results

The collected data were quantitatively analyzed to first explore the effectiveness of the simulation-based learning environment on students' learning outcome. It was expected that students performed better on the posttests than on the pretests. Second, a correlation analysis between the two outcome variables, dropout rate and similarity score, was conducted to cross-validate the two measurement instruments.

Effectiveness of simulation-based learning environment

A prior version of the simulation (DIVOSA; see Ifenthaler, 2002, 2009) had been used before and showed promising results. The instructional materials along with the collaborative part should have enhanced students' understanding of the complex problem, namely school management. We thus expected indicators for learning from pretest to posttest reflected by a higher similarity between the learner's model and the expert model on the one hand and a lower dropout rate on the other hand. Paired t-tests were conducted to assess learning gains (posttest - pretest comparison). The descriptive data included in Table 2 show that the mean 6.86 (*SD* = 2.23) of the dropout score in the pretest is higher than the mean 5.71 (*SD* = 1.81) of the score in the posttest.

Table 2 Paired samples statistics

Dropout rate	*N*	*M*	*SD*
pretest score	66	6.86	2.23
posttest score	66	5.71	1.81

Note. A lower score indicates better performance

A paired-samples t-test was employed to test the hypothesis that *there are differences between the dropout rate obtained in the posttest compared to that in the pretest*. The t-test revealed significant differences between the dropout rates obtained in the pretest and those from the posttest with *M* difference = 1.15 (*SD* = 2.54), *t*(65) = 3.69, *p* < .01, *d* = .61 (medium effect). Therefore, the data support the stated hypothesis which means that students performed better on the posttest than the pretest.

Not all students completed the questionnaire for the similarity score and therefore, six datasets had to be excluded from the analysis due to the missing values. The descriptive data of the remaining sample (N_{rem} = 60) in Table 3 show that the mean .248 (*SD* = .179) of the posttest causal model similarity score is higher than the mean .230 (*SD* = .178) of the pretest causal model similarity score.

Table 3 Paired samples statistics

Similarity score	*N*	*M*	*SD*
pretest score	60	.23	.18
posttest score	60	.25	.18

A paired-samples t-test was employed to test the hypothesis that *there are differences between the similarity score obtained in the posttest compared to that in the pretest*. The t-test revealed no significant differences between the dropout rates obtained in the pretest and those from the posttest with *M* difference = .02 (*SD* = .22), *t*(59) = .59, *p* = .56. This means that the data do not support the hypothesis and the similarity score did not improve during the study.

Table 4 shows the results of the survey where students were asked to evaluate the learning environment with 1 representing a low score and 5 a high score. The survey covered three different areas, namely usability, instructional support, and collaboration. Each of them was represented by several items as presented in Table 4. The data show that students positively rated the learning environment since all three factors received high average ratings with acceptable standard deviations.

Table 4 Statistics of the evaluation survey

Factor	No. of Items	*M*	*SD*
usability	21	3.80	.48
instructional support	14	3.63	.45
collaboration	13	3.40	.56

Comparison of expert and novice models for assessing learning gains

It was argued that learning is regarded as a progression from novice to expert models. We assumed that a success in the simulation game (low dropout rate) will be associated with a high similarity score between the learner's model and the expert model (simulation's causal model). Thus, we expected a high validity of our research instruments using a cross-validation approach between the two instruments (simulation output, and causal model assessment) respectively. We expected a negative correlation between the two measurement instruments. Correlations between the two scores were calculated and revealed a positive correlation of *r* = .26 between the two posttest scores and a negative correlation *r* = -.03 between the pretest scores. None of the two correlations were significant which indicates that the there is no correlation between the measurement instruments. The results raise concerns regarding validity of the two applied measurement instruments that requires further examination which will be taken on and discussed in the discussion section.

Discussion

Purpose of this study was to examine effects of a simulation-based collaborative learning environment as well as methodologies to assess learning outcome. The learning environment included instructional materials, communication tools, and a simulation which was embedded in a complex, authentic scenario. The content evolved around the topic area of school management and learners were asked to reduce the dropout rate of a school and thus to improve its efficiency. 66 students from three classes from a German gymnasium specializing in pedagogy participated in the study. Two outcome variables were used to assess students' performance. The first one was the dropout rate returned by the simulation with a low score indicating success. The second one was a score representing similarity between students' causal models and the simulation's underlying model with a high similarity indicating success.

The first research question concerned the effectiveness of the learning environment and was addressed by a pretest-posttest comparison for each of the two outcome variables. Additionally, an evaluation form was given to students to rate usability of the learning environment. Results varied between the first outcome variable, the dropout rate and the second outcome variable, the similarity score. On the one hand, paired samples t-tests on the first output variable showed that students were able to significantly reduce the dropout rate of the simulation from pre- to posttest thus indicating learning gain. On the other hand, paired samples t-test on the second output variable, showed that the similarity between students' causal models and the simulation's underlying model did not increase. This means that students' performance did not improve after students began working with the simulation-based learning environment given the assumption that that learning is a process whereby novices move towards expertise.

At first, it seems odd that the two outcome variables revealed contrary results regarding the effectiveness of the learning environment. The contrary results also affect the second research question concerning the applicability of the used instruments for assessing learning-dependent progression in complex domains. Results revealed that a cross-validation between the two instruments failed since no correlation between the scores was found. A possible explanation might be validity problems with either one of the outcome variables or both. The following five reasons suggest that the similarity score has validity issues: first, software errors occurred during that data collection process which resulted in missing datasets. Second, students asked many questions when filling out the online questionnaire which indicates that the interface needs improvement in its user friendliness and usability. Third, students reported that the similarity questionnaire made not much sense to them which might be a result of missing prerequisites to work with that instrument. They were not particularly trained regarding system thinking, modeling, and other prerequisites that might be necessary to understand a school and the involved areas such as teachers and curriculum as a complex system that consists of interrelated components. Fourth, the diagnosis of internal knowledge structures is one of the most challenging tasks and remains unsolved in many respects (Al-Diban, 2008; Ifenthaler, 2008a). Measuring an internal encoding requires the process of externalization which can be seen as a re-representation of the person's understanding about the world. Each assessment technique may exacerbate the externalization process and thus lead to invalid results (Ifenthaler, 2008a, in press; Ifenthaler, Masduki, & Seel, 2009). A fifths reason for the validity problems with the similarity score might be, that students' mental models might be organized in a way that enables them to operate and understand the simulation, but differs from the simulation's underlying model. This would explain why students were able to reduce the dropout rate without increasing the similarity of their causal network to the model underlying the simulation. There might be a knowledge structure or mental model that enables students to successfully manage the school not being analogous to a causal network like the one underlying the simulation.

Based on the assumption that the similarity score is not a valid measure, but the dropout rate is a valid measure for students' performance in the present study, we claim that our simulation-based learning environment is an effective learning tool. The significant reduction of the dropout rate from pretest to posttest suggests learning gains. Students' positive attitude towards the learning environment reflected by the evaluation questionnaire indicates an adequate challenge level, which means that students did benefit from this particular implementation of technology in education. Students were coping well in the new territory and seemed to enjoy the complex, authentic activities. These findings support the benefit auf authentic activities and are in alignment with researchers who advocate inquiry-based learning and recommend to have students work on complex problem-solving rather than providing them with well-defined tasks (Collins et al., 1989; Harley, 1996; Jonassen, 1997; Karagiorgi & Symeou, 2005; Savery & Duffy, 1995b).

Future research will include a further development of our learning environment. Based on our empirical findings, we will continue developing adequate assessment techniques and investigate their effectiveness in future research studies.

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Evaluation of a University Level Computerized Language Learning Architecture through the Perceptions of Students, Instructors and Administrators: A Case Study

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Introduction

In order to increase student engagement outside the classroom as well as providing a repository of resources for independent learning, Bilkent University School of English Language (BUSEL) preparatory program in Ankara, Turkey established a project that would integrate the use of computers into its existing foreign language curriculum. The project started by identifying its own goals based on the institutional mission statement of the preparatory program, which are to:

- enable students to make the successful transition from life at school and home to life at university;
- ensure that students attain the level of proficiency in English necessary to enter their chosen School or Faculty;
- develop students' potential as independent 'autonomous' learners;
- support the further development of students' English language and study skills throughout their study in the faculties and vocational training schools.

The study was conducted in the English Preparatory Program in BUSEL, whose aim is to fully equip students with the necessary language skills that are required in their departments. In the system, there are five levels: Elementary, pre-intermediate, intermediate, upper-intermediate and the advanced level. For each level there is eight weeks of instruction, each of which is called a 'course'. During one course the students are given two progress tests which determine whether they can sit the achievement test to pass to a higher level. If the students have an overall sixty percent they can sit the achievement test. At the end of the advanced level, the students take the proficiency exam and if they get sixty percent from the proficiency test, they start their departmental studies.

The computerized learning project was established in the first academic semester of 2002-2003 by the researcher who designed, developed, and implemented the computerized learning architecture together with materials writers, who provided content for the level strands. The computerized architecture consisted of two tracks. Track 1, a discrete skills strand that was initially developed for two levels, both intermediate and upper-intermediate in the English preparatory program, consisted of discrete skills, i.e. listening, reading, and language components, i.e. grammar and vocabulary. This track accompanied the in-house coursebook in a unit-by-unit fashion and it was based on the prioritized language objectives for both of the levels. Track 1 focused on reading, listening, vocabulary and grammar and was designed in tandem with the institutional course book. Track 2 was an extended project strand that made use of in-house produced WebQuests, which were based on a common theme as the coursebook and Track 1 units and exposed students to language in an integrated manner. Students read and listened to texts, watched videos or movies about the topic and worked towards outcomes such as presentations, class debates and written work, where they were expected to synthesize the input materials they had received.

Background to the Study

The purpose of this study was to depict the existing computerized learning architecture of the program as utilized by the groups in the program, i.e. the students, teachers and administrators, and identify its perceived benefits on learning and teaching English as a foreign language as well as on transferable skills, i.e. computer literacy, higher-order thinking skills, handling of information and working collaboratively. The study also aimed to identify areas that would need further improvement as a result of the evaluation conducted.

The study was inspired by two of Kirkpatrick's (1994) 4 levels of evaluation. It was mainly influenced by Level 1 Reaction and Level 4 Results. However, the levels were not followed exactly in a sequence moving from one to another as suggested by Kirkpatrick himself. The influence from the two levels was mostly on determining the areas to be evaluated: In this particular study, one major area for evaluation was satisfaction of all those involved in the implementation of the computerized learning architecture, which corresponds with Level 1. The other major area for evaluation was the effects of Track 2 as perceived by faculty students, which corresponds with Level 4, results. However, the results level, which has been designed particularly for business contexts to measure increased production, higher profits or decreased costs, was adapted for this study's context in that it was used to explore the evaluation of results gained through Track 2, i.e. transfer of the skills, through the perception of students. Also one of the original underlying principles of this level, measuring the cost-benefit balance, was adapted in this study as an attempt to find out about the worth of the investment of time and resources in the learning architecture through the perceptions of end users, which would then lead to further design and development decisions of the architecture. Level 2 Learning has been deliberately left out as it would be very difficult to measure the level of learning that could be attributed to the use of the computerized architecture under the given circumstances. The use of this level has been recommended for further research in more controlled environments. Also it was believed that evaluating the learning would be quite a tedious effort, which could mean going back to the media or method dilemma (Clark, 1994; Kozma, 1994) so this aspect of the evaluation was left out to avoid media comparison. It was also decided that Level 3 Behavior also needed to be assessed under controlled conditions shortly after the implementation of the computerized learning program, which was not possible during the course of the study, so it was left out as well.

The problem statement of this study was:

> How effective are the computerized learning architectures used at two levels of English language preparatory program of a private university, which are called Track 1 and 2, in terms of their contribution to the students' language development and the enhancement of their transferable skills according to the perceptions of those involved in its implementation?

This study investigated the following research questions:

- What is the general reaction in the English preparatory school towards the use of computers through Tracks 1 and 2 in learning and teaching English as a foreign language?
    - What are the students' perceptions of the potential benefits of Tracks 1 and 2 for their language skills?
    - What are the students' perceptions of the potential benefits of Track 2 for the development of their transferable skills?
    - What are the instructors' perceptions of the potential benefits of Tracks 1 and 2 for students' language skills?
    - What are the instructors' perceptions of the potential benefits of Track 2 for the development of students' transferable skills?
    - What are the administrators' perceptions of the potential benefits of Tracks 1 and 2 for students' language skills?
    - What are the administrators' perceptions of the potential benefits of Track 2 for the development of students' transferable skills?
- What skills do faculty students perceive they can transfer to their studies in their departments as a result of being involved in computerized language projects through Track 2?
    - What are faculty students' perceptions of the transferability of the skills they gain through Track 2 to their studies in their departments?

The evaluation conducted through this study was significant for three reasons. It would:

- help the computerized learning coordinator, materials writers, and instructors have a better understanding of the use of Computer Aided Language Learning (CALL), which would in turn enable them to further develop and integrate it to the remaining levels in the preparatory program;
- help the computerized learning coordinator, materials writers, and instructors find out how the CALL architecture was being used in reality and compare their own designs against their actual use. This could help identify the differences in perception and then help build a common vision of CALL and lead to effective implementation. It would also provide the kind of information that the senior management would need for decision making about the future of CALL in the institution;
- contribute to the literature in the field by providing an insight from a specific case of implementation.

Literature on Evaluation of CALL

Evaluation in foreign language teaching initially seems to have followed an outcome-oriented approach and focused on effect studies (Chapelle, 2001). Most of the studies seem to have focused on the use of a single aspect of language teaching, that is either one skill such as reading or writing; another trend has been to focus on students' perceptions of the programs' effectiveness, which would be equivalent to Kirkpatrick's (1994) Level 1 evaluation: Reaction. Levy and Stockwell (2006) categorize the evaluation carried out on CALL materials in three major categories in terms of their focus: a designer-evaluator focus, a language-skills focus, and a student-courseware focus. They also categorize CALL evaluation for large-scale frameworks as methodology driven, e.g. Hubbard's use of "an approach checklist, a learner strategy checklist and other considerations" (as cited in Levy & Stockwell, 2006, p.58), or theory-driven, e.g. Chapelle's use of the second language acquisition (SLA) theory as a basis of research (2001). This study had a particular designer-evaluator focus, and a language as well as transferable skills focus.

Despite the interest in evaluation of CALL through numerous local and international studies, the effectiveness of the use of computers in improving second language competence cannot be generalized as it is now a fact that CALL covers a variety of activity types that may involve or require other skills, not just simply clicking on words or filling the blanks; moreover, second language competence consists of complex and interrelated competencies, which means it might not always be possible to ascribe the favorable results to learning through the use of computers; third, the importance of the processes in language learning, not just the product, is now recognized as a justifiable reason for research; lastly, student characteristics and preferences have a significant effect on CALL and how it is utilized (Chapelle & Jamieson, 1989). Therefore, the aim of this particular study was to focus on the specific institutional use of Track 1 and 2 and their perceived results on language and transferable skills from the view points of all those involved in its implementation.

Method

Participants

For research question 1, the accessible number of participants for the questionnaires was 896 in total, of which 497 were intermediate students, and 399 were upper-intermediate students. Also for interviews 22 students from this group were selected through maximum variation sampling. For research question 2, the participants included 14 students for the interviews who had completed either intermediate or upper-intermediate Track 2, passed the proficiency exam and had started studying in their departments four months before they were contacted. This group was selected through criterion based sampling in that only students who took part in at least one Track 2 project were selected.

As for the instructors in this study, all of the class instructors of the target classes, which was 69 in total, 40 in intermediate and 29 in upper-intermediate, were asked to fill in the instructor questionnaires. The administrators, all of the heads of the teaching units responsible for the two levels, 3 intermediate and 3 upper-intermediate, were given the head of teaching questionnaire.

Table 1 Number of participants in the study according to research questions

<table>
<tr><th></th><th colspan="2">Research Question 1</th><th>Research Question 2</th></tr>
<tr><td rowspan="2">Students in the program</td><td>Questionnaires</td><td>Interviews</td><td rowspan="4"></td></tr>
<tr><td>896</td><td>22</td></tr>
<tr><td>Instructors</td><td colspan="2">69</td></tr>
<tr><td>Administrators</td><td colspan="2">6</td></tr>
<tr><td>Students in faculties</td><td colspan="2"></td><td>14</td></tr>
</table>

Methodology

This was a case study that focused on evaluation through the use of mixed methods of collecting data. This evaluation was based on many of the characteristics of evaluation studies listed by Levy and Stockwell (2006). It:

- was aimed at establishing the worth of the computerized learning architecture of the preparatory school
- was primarily decision-driven
- drew value from the process as well as from the product of the evaluation
- focused on "Did it work?" (p.42)

Johnson and Christensen (2004) categorize case studies into three groups: the intrinsic case study, in which the interest is in understanding a specific case, the instrumental case study, which focuses on more than the specific case being studied and the collective case study, in which several cases are examined in one study. This particular study falls under the category of intrinsic case study, which focused on the computerized learning architecture of a preparatory English program with the purpose of having an overview of the perceptions of the participants so as to make informed decisions for both short and long term planning.

The evaluation in this study was summative evaluation which was applied to the whole computerized learning program by using survey instruments, which are common tools for CALL evaluation (Levy & Stockwell, 2006, p.43) and observations.

Johnson and Christensen (2004) explain that case study methodologists advocate using several methods and several data sources and assuming an eclectic approach for research. Similarly, the data for this study has been collected through using mixed methods, which is a questionnaire with a numerical part, as well as an open-ended part, two sets of interviews and laboratory and classroom observations. Mixed methods have been chosen for the way they can explain the relationship between variables, allow the researcher to study the relationships in depth with qualitative data and "confirm or cross-validate relationships discovered between variables" (Fraenkel & Wallen, 2008, p.558). Riggin (as cited in Tashakkori & Teddlie, 2003) also supports the use of mixed methods as it is "not only advisable but inevitable" (p.492) in the research design and collection of data. Fraenkel and Wallen (2008) classify mixed research designs into three basic categories: The exploratory design, which starts off with qualitative data, then quantitative, the explanatory design, which moves from quantitative to qualitative data and the triangulation design which studies both quantitative and qualitative data at the same time. Of these three, the one that applies to this particular study is the triangulation design: the data has been gathered from different parties involved in the computerized architecture, i.e. students in and out of the preparatory program, their instructors and the administrators as well as collecting data using multiple tools such as questionnaires with both numerical and a comments part, laboratory and class observations and interviews. The reason why mixed methods was used is that the quantitative and the qualitative data collected were expected to complement each other, thus providing a more reliable account of perceptions of those involved in the computerized tracks.

Instruments

The main instruments that were used to gather data were:

(1) Student questionnaires for the group still studying in the preparatory program
(2) Instructor questionnaires
(3) Administrator questionnaires
(4) Student interview forms for the group still studying in the preparatory program
(5) Student interview forms for faculty students who passed the proficiency exam
(6) Classroom observation forms for Track 2
(7) Computer laboratory observation forms for Track 1

Data collection

Data collection spanned approximately four months. Initially the evaluation scheme was introduced to all parties involved, the observations started immediately. However, the researcher waited until week 6 of the 8 week course so that the students would have completed most of Track 1 and 2. The interviews were carried out in week 8, which is the last week of the course, so that students would have completed Track 2.

Prior to the actual research, the first version of the student questionnaires, consisting of 76 questions, were administered to a pilot group of 122 mainstream and repeat students, of which 60 were intermediate and 62 upper-intermediate. The questions were filled in on optic forms, and they were sent for processing to the Student Services in the preparatory program, an administrative unit that conducts item analyses and are involved in item banking, who then transferred the results to Excel workbooks and offered their services for the analysis part as well. Inter-item correlation was also conducted on SPSS to see any overlaps between items.

For reliability, Cronbach alpha was conducted for Part II, Familiarity with Computers; Part III, the scale section for materials in Track 1; Part IV, Reasons for Non-use, and Part V, Project Work in Track 2. All the factual questions were left out. Namely, these were the Part I, General Information and some sections of Part III, Materials in Track 1, which contained questions such as the number of materials completed or ordering from the most useful to the least. The reliability of all the subscales was examined, as well as for the whole questionnaire. Cronbach alpha values for each single part varied between .73 and .94. For the whole questionnaire, it was .94. Cronbach alpha was also computed for the real data from the instructor and the administrators' questionnaires. For the instructor questionnaire, the values ranged between .73 and .90 for the separate parts. For the whole questionnaire, it was .91. For the HTU questionnaire, it ranged between .40 and .83 for the separate parts. For the whole questionnaire, it was .85.

Phase 1

In Course 1 of the 2006-2007 academic year, an announcement was sent to teaching units explaining that an evaluation of Tracks 1 and 2 in both intermediate and upper-intermediate levels was going to take place during the course. The researcher herself also visited each intermediate and upper-intermediate teaching unit to explain the rationale behind the research, data collection procedures and also identified volunteer instructors for computer laboratory and classroom observations.

Track 1 had been designed in concordance with the textbook; therefore, for each unit in the textbook that is to be covered in a week, there were corresponding materials in Track 1 for all of the skills and language components, except for speaking and writing. Each class in the intermediate and upper-intermediate levels had been allocated computer laboratory slots. Starting with week 3 of Course 1, classroom and computer laboratory observations started taking place. For two weeks the pre-determined intermediate and upper-intermediate classes, 3 intermediate and 3 upper-intermediate, were observed, in the computer labs for Track 1. Each of these classes, with the exception of one, was observed three times in terms of 4 skills in Track 1: Reading, listening, and grammar and vocabulary. Listening and reading lessons were observed in a 50- minute teaching block each; vocabulary and grammar lessons were observed in one 50-minute block as they were shorter than the skills materials. Due to different practices and preferences of the instructors, the number of classes observed was as follows:

Table 2 Number of laboratory observations for each Track 1 skill

	Intermediate	Upper-intermediate
Only reading	4	1
Only listening	2	3
Listening or reading	-	2
Grammar and vocabulary	2	3

Due to a scheduling mishap, one reading lesson was missed in one of the Upper-intermediate classes. Instead a different class was used to observe another reading lesson. After each observation, the observation form was shared with the main class instructor and the instructor was asked if s/he shared the same opinion about the observation and to add his/her own comments if s/he had any. All of the instructors agreed with the written account of the observations.

For Track 2 two classes from each level were also observed during oral presentations. The researcher made appointments with the main class instructors to observe the classes on presentation days for a 50-minute block. At the end, the class instructor was asked to comment on the filled in Classroom Observation Form and add his/her own comments if s/he liked.

Phase 2

In week 6, when both levels had finished the majority of Track 1 and 2, the questionnaires were administered to all of the intermediate and upper-intermediate classes. The questionnaires were filled in during class time under the supervision of the instructors. Each class was given an envelope which included the questionnaire booklets and optic forms which had options from A to E. The students were given half an hour to fill in the questionnaires. The instructions were explained to the instructors with a written memo as well as in person, and instructors were asked to explain them to students in class.

The instructor questionnaires as well as the HTU questionnaires were administered in Week 7. A deadline was given to the instructors and the HTUs, and they were asked to return the filled in questionnaires to the researcher's mail box so as to ensure anonymity. After the questionnaires were collected, the optic forms were sent to Student Services, who processed them in the form of Excel workbooks. All the letters from A to E were also transformed into 1-5. The comments pages from the questionnaires were also transcribed to be evaluated with the interviews and the quantitative data from the questionnaires.

In Weeks 7 and 8, intermediate and upper-intermediate students who were still in the program were selected through maximum variation sampling for interviews. From both intermediate and upper-intermediate levels, 12 classes were selected each. For the intermediate level, it was every fourth class; for upper-intermediate, it was every third. For the interviews the researcher tried to ensure that the number of the participants was representative enough through maximum variation sampling. This was done by selecting an equal number of males and females, mainstream students and repeaters, students scoring over 60% and those below 60%. In two of the classes, there weren't any students that met the selection requirements, so the available students were selected.

The students that are still in the program were invited to the researcher's office, where they were asked questions from the interview form. In total 22 students were interviewed, 12 from intermediate and 10 from upper-intermediate. 2 students from upper-intermediate failed to show up. Each interview lasted around 25 minutes. The interviews were conducted so as to have a more detailed insight into the students' responses to the questionnaires as part of the triangulation efforts.

Phase 3

Faculty students who had completed Track 2 in either intermediate or upper-intermediate levels in the 2005-2006 academic year were identified. The students were selected through criterion-based sampling: The researcher went through a list of freshmen students who had completed a Track 2 project either in Course 1 or Course 3 of the previous academic year. The researcher tried to choose students from different departments as well as different gender. The English instructors of these students were approached and were asked to inform the relevant student of the interview. If the student consented, an appointment was made to meet these students after their English classes in an available classroom. In order to ensure full participation, the researcher herself went to the appointment locations instead of inviting the students to her office as the classes and her office were on two different campuses. This group of students was approached after they had spent several weeks in their departments with the idea that they would have developed some familiarity with their departments and course requirements. This period was thought to be crucial in raising their awareness about what kind of tasks they would have to carry out in their departments. Thus, it was believed that they would be in a more objective position to able to evaluate the benefits of Track 2 projects on their learning behavior and transfer of learning to real contexts.

Data Analysis

In the study both quantitative and qualitative data were gathered through various instruments such as questionnaires, interviews and observations. The details of the data analysis are explained in the following sections.

The Quantitative Part

The quantitative data from the actual study were collected through preparatory student, instructor and HTU questionnaires, the analysis of which followed the same procedures described for the pilot study except for the inter-item correlation. Descriptive statistics were calculated with Excel and Cronbach alpha was calculated with SPSS for the reliability of all the questionnaires. Cronbach alpha levels for ranged from .76 to .93 for the student questionnaires. For the whole questionnaire it was .92. For the instructor questionnaire, the values ranged between .73 and .90. For the whole questionnaire, it was .91. For the HTU questionnaire, it ranged between .40 and .83. For the whole questionnaire, it was .85.

The Qualitative Part

The qualitative data were collected from three categories of instruments: the open-ended sections of the preparatory student, instructor and HTU questionnaires, the classroom and laboratory observations, and interviews with both preparatory and faculty students.

To increase reliability and objectivity as well as easing the coding process as suggested by Yildirim & Simsek (2000), the researcher quantified the open-ended sections of the questionnaires. These parts were analyzed by the researcher for Track 1 and Track 2 separately to find emerging themes under three broad categories for the sake of simplicity: positive comments, negative comments and suggestions/requests. Each of the comments for each track was then quantified and categorized.

The laboratory observations were analyzed by the researcher under the headings of the Computer Laboratory Evaluation Forms: Students' responses to the tasks assigned, students' reactions to the program, students' computer skills and students' emerging needs. For reliability purposes these forms were also checked by the class instructors after they were filled in. Common themes from the observations that were recorded on these sheets were identified and categorized as positive or negative. The observations led to very similar results so common themes emerged quite naturally. The classroom observations were recorded using the headings in the Classroom Observation Forms: Students' level of the grasp of the task assigned, students' level of interest in the task they are involved in, classmates' level of interest in their friends' work and other comments. These forms were also checked by the class instructors after the observations for reliability purposes. Similar to the laboratory observations, common patterns were categorized as positive and negative. Likewise, the themes emerged effortlessly from the classroom observations.

The interviews with all the preparatory program students, both intermediate and upper-intermediate, and faculty students were transcribed into a 113-page document. The transcriptions were analyzed through content analysis. For the reliability of the coding process and finalizing the coding list, 4 interviews, 2 from intermediate and 2 from upper-intermediate, were initially coded by a second rater. First the total comments from both raters were calculated. Each of the codings was examined together with the second rater and the rationale behind the coding was discussed until reaching an agreement. Then, the initial coding list was finalized leaving out ambiguous codes, merging and reducing some codes.

Results

Track 1: Current Students in the Program

It was found that the students completed Track 1 materials mostly after school and during computer laboratory blocks on a weekly basis or in their free time. The number of materials they completed was fewer than expected: approximately sixty percent of students had completed between 1-6 materials in individual strands.

The Track 1 strand students most liked and found most useful was the listening strand. The one they liked the least and found least useful was the vocabulary strand, which can be explained by the fact that the vocabulary strand was not updated according to the latest word lists, so they included words that students were not tested on. The reading strand was the second best according to the upper-intermediate group, whose third choice was grammar. For the intermediate group, it was vice versa: grammar was their second best strand, whereas reading was ranked third or fourth.

The students were able to see the connection between the course book and Track 1 strands and found them useful in learning English in general as well as for the during and end-of-course achievement tests. The level was appropriate for most and the materials were relevant to their needs, which was also evident in the observations during which the majority of students were engaged with the materials. The materials were easy to use on their own. During the laboratory observations, there were no problems in terms of usage. However, it is hard to say the students enjoyed doing the materials. Nevertheless, they expressed their desire to see such exercises in other levels. One of the questions which had the greatest level of agreement was whether making Track 1 materials accessible through the Internet would increase usage. The complaints about the computer laboratories came from quite a few students, who felt the conditions needed to be improved. Although the students felt it was a good idea to learn English through the computers, they still preferred more traditional methods: using books, learning from the instructor and learning in class.

Track 1: Instructors and Administrators

As for the instructors and administrators most of them felt the training they received on Track 1 was adequate. However, only half of them had gone through the materials in detail themselves. The group was not very confident about making the best use of Track 1 materials. They felt they needed more time and access from home or the TU computers to familiarize themselves with the materials. They also wanted to be able to better track student usage of Track 1 materials.

The vast majority was very positive about Track 1 materials. They said the connection between Track 1 and the course books was clear, making Track 1 useful in learning English, and preparing students for the exams. The instructors and the administrators liked especially the listening strand like the students, which was followed by reading. They were not keen on the vocabulary or the grammar strands, which was consistent with the students' preferences. They either encouraged their students to use the materials in the computer laboratory blocks or assigned them as part of the Outside the Class Strand (OCS) on a weekly basis. The instructors' and administrators' belief in the benefits of the materials is important in encouraging student engagement with the materials. According to the findings, most instructors and administrators supported the use of Track 1 materials for the way they provide practice outside the class. The vast majority said they would like to see such exercises in other levels as well. The general management support is also likely to be a factor in such acceptance of innovations in that the instructors are strongly encouraged to implement them in a systematic way. The need for more time and training for familiarizing with both Tracks also came out of the study.

Track 2: Current Students in the Program

The students did not enjoy doing the Track 2 project or using the electronic platform used to publish it and said they would not really like to do more projects in other levels. They did not have very positive feelings about the topics either. Despite this, more than half of them felt it was a good way of learning English. The students felt the projects helped learn transferable skills such as learning collaboratively and to a certain extent computer skills, and felt the projects could help them prepare for the department. They also expressed their interest in using computers and the platform used for Track 2 more in their studies.

Track 2: Instructors and Administrators

The instructors and the administrators had favorable views about the Track 2 projects. The vast majority believed the project effectively integrated all four skills and had the potential to change the teaching methodology in a positive way. They felt the students learned a lot about the topic, which made them think critically. They also enjoyed the project but as the students said the instructors did not think the students enjoyed it much.

The instructors and administrators found Track 2 useful in teaching English as well as transferable skills. In addition, they thought the project was similar to what the students would do in their departments. They also stated that they would like to use computerized learning more in their teaching and design or help design such projects in the future. One request was to have more time to become familiar with the project, which was also made for Track 1, and have an earlier start during the course. This is very important as research indicates that the administration of the institution plays a very important role in the adoption of using computers in teaching (Dupaigne & Krendi, 1992).

Track 2: Faculty Students

Most of the students remembered their Track 2 experiences vividly, and compared to the current students had much more positive views about the benefits of the project. Although the project was seen as tedious, unnecessary and uninteresting by half of them at the time they were doing it, most of them realized its benefits for the skills they needed in their current department and their future careers. They specifically referred to the presentation, computer and research skills, taking responsibility, learning collaboratively and language learning as positive outcomes of the project. They also unanimously agreed that the project should be made available in other levels.

Conclusion

The findings are explained under the headings of the two research questions The implications and suggestions resulting from the processes employed during the design, implementation and the evaluation of the particular computerized learning (CL) architecture studied include the following areas:

- In terms of student engagement:
    - Providing more incentives for the completion of the materials
    - Making computerized learning equally appealing and effective
    - Making the potential gains from CL more explicit
    - Adding the fun factor both to Track 1 and 2
    - Increasing student choice, thus voice, in Track 2
    - Providing learner training
        - In usage of the programs
        - In learner-centered instruction
    - Strengthening the role of CL as a core course requirement
    - Increasing accessibility
    - Improving the computer laboratories
- In terms of instructor engagement and ownership:
    - Providing more time for integrating CL
    - Ensuring a slower-paced implementation
    - Providing more varied and ongoing training
    - Continuing with strong management support during the implementation
    - Involvement of more instructors in the design and development
    - Diffusion of CL through best practices and change agents
- In terms of instructional principles:
    - Placing the user at the center of the design process
    - Establishing a strong base of theories of instruction
    - Strengthening the close connection among all course components e.g. the syllabus, the textbook and CL
    - Strengthening the role of CL as a core course requirement
    - Continuing with the iterative design process to ensure quality check and control
    - Ensuring continuity in the implementation of CL
- In terms of design principles:
    - Examination and selection of the software early in the design process
    - Ensuring the reliability and robustness of the software
    - Consideration of the needs and abilities of teacher-designer-authors
    - Adapting a team approach
    - Increasing the resemblance of the materials to the existing materials e.g. the textbook
    - Continuing with the iterative design process
    - Bringing in usability testing before launching CL
    - Continuing with modularity and easy adaptability of CL
- In terms of research:
    - Establishing a team approach in the collection of data through mixed methods
    - Employing several methods in collecting data from students
    - Not aiming for generalizations

This study investigated the general reactions of current and faculty students, instructors and HTUs towards the computerized learning architecture used in the preparatory program. The findings indicate that overall, all these groups have positive feelings towards architecture because of the way it is perceived as useful for both language learning and some transferable skills. The students in the preparatory program found the materials useful for their present needs as well as future goals although they didn't really enjoy doing the materials, and still had a strong preference to learn in the traditional way rather than computerized learning packages. The instructors and the HTUs were on the whole very positive about both Track 1 and 2 in terms of their benefits for language teaching and transferable skills; however, a common request was to have more time to get familiar with and integrate the materials into their teaching. The students in their faculties were very positive about Track 2 projects in terms of transferable skills needed in their faculties and admitted that although they perceived them as a burden at the time they were studying in the preparatory program, they could see the benefits in their departments.

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Extracting Heuristics from Expert Instructional Designers

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Abstract

Expert instructional designers make sense of ill-structured problem situations more quickly than novices by drawing upon prior knowledge, previous experiences and an "established repertoire of heuristics" (Day & Lord, 1992, p. 45). This study examined heuristics used by expert instructional designers when engaged in the instructional design (ID) process. Qualitative interview methods were used to capture the individual and shared heuristics 16 instructional designers use when completing complex ID projects. Results are presented in the form of 8 categories and 25 instructional design heuristics. Although some of the identified instructional design heuristics overlap with other fields of study such as business management and communication, others appear to be unique to this study. Implications for the field of instructional design are discussed.

Solving problems is a big component of what instructional designers do (Muraida & Spector, 1993; Perez & Emery, 1995; Rowland, 1991; Seel, Eichenwald, & Penterman, 1995). They are presented with a situation that may be ill-defined and asked to close the gap between where we currently are and where we want to be. This can be considered a "problem." When solving a problem, a person not only selects rules, but they combine multiple rules in order to arrive at a solution (Gagne, 1985). The solving of a newly encountered problem could require a learner's use of declarative knowledge and cognitive strategies as well as the inclusion of previously learned relational and procedural rules. Johnson (1988) elaborated on the use of rules in solving ill-structured problems when he stated, "… no single correct procedure exists, and there is no definitive way of assessing the correctness of a rule based upon the outcome of a single case. There is no *optimally* correct rule… only rules which are *relatively* more accurate" (p. 212).

This study is about expert use of heuristics in instructional design (ID). Heuristics are "simple decision rules through which individuals make judgments" (Dudczak, 1995, p. 4). When solving ill-structured problems, there is no one set of strategies that can be used in all situations, thus many people rely on heuristics to solve problems (Ingram, 1988). "A heuristic is a general strategy for approaching a problem" (Ingram, 1988, p. 215). Heuristics help to simplify the problem (Abel, 2003). Heuristics may be called many things: informal procedures, generalizations, strategies, principles, decision rules, intuition, or rules of thumb [list not inclusive]. For purposes of this paper, 'heuristics' and 'rules of thumb' will be used interchangeably (Abel, 2003).

"Procedures for intelligently applying past knowledge to new experience often seem to require common sense and practical rules of thumb in addition to, or instead of, formal analysis" (Schank & Abelson, 1977, p. 3). According to Davenport and Prusak (2000), rules of thumb are "guides to action" that have developed over time through extensive experience and observation (p. 10). Rules of thumb are "neither 'simple facts' nor general knowledge about reasoning, but are of the form 'If you are trying to deduce this particular sort of thing under this particular set of conditions, then you should try the following strategies'" (Winograd, 1975, p. 190).

Expert use of heuristics has been examined by a number of researchers (e.g., Day & Lord, 1992; Murphy, 2005; Seel et al., 1995; Woods, 1988). In a study by Day and Lord (1992), 38 experts and 30 novices participated in the task of sorting organizational problems. Results showed that experts categorized the ill-structured problems faster than novices. They specifically stated, "Experienced executives quickly make sense of relevant problems and draw upon an established repertoire of heuristics to guide their sense-making efficiently" (p. 45). Chi (2006) stated that experts may use heuristics of which novices are not aware. Although, experts may perform with some heuristics so automatically, that even the expert is unaware of their use (Lee & Reigeluth, 2003).

The foundational piece on heuristics in instructional design is a piece by Haney, Lange, and Barson (1968). The premise was to provide instructional developers with heuristics to use when working with professors in higher education. From empirical observations of an instructional development project, they created a collection of 18 heuristics. These heuristics are so general that even though they were compiled 40 years ago, they still apply today. Hoban, Heider, and Stoner (1980) elaborated on Haney et al. (1968) by identifying additional heuristics they noted from their empirical observations of a large instructional development project. Noel and Hewlett's (1981) theoretical article on heuristics in instructional development derived from their own experiences and that of colleagues. They explained when heuristics can be used in the development process. They listed both general heuristics as well as heuristics that align with the instructional systems development (ISD) model.

Ertmer et al. (2008) suggested expert instructional designers use their prior knowledge and experiences to create and apply personal "rules of thumb" (i.e., heuristics) when solving instructional design problems (Haack & Mischke, 2005; Kolodner, 1997; Rowland, 1993). These rules are not taken from textbooks, but are much more personalized – acquired from the individual's schema of previous experiences that they bring to the design situation (Klein & Calderwood, 1988; Kolodner & Guzdial, 1999). In his textbook, *Designing Instructional Systems*, Romiszowski (1981) conjectured that instructional designers take the systematic approach they were taught and change it into heuristics they can use.

Jonassen and Hernandez-Serrano (2002) addressed the complexity and ill-structured aspect of instructional design problems in that they offer much uncertainty during problem-solving, thus experts tend to use more heuristics than if the problem were well-structured: "When reasoning under uncertainty, people rely on a variety of *heuristics,* that is, rules of thumb" (Kunda, 1999, p. 109). Nelson (2003) stated, "designing, like problem solving, is based on systematic processes and situational 'rules of thumb' (Perez, 1995) that should lead to purposeful and practical outcomes" (p. 40). The literature supports the use of heuristics in instructional design (Haney et al., 1968; Hoban et al., 1980; Noel & Hewlett, 1981; Silber, 2007; van der Meij & Carroll, 1995) however it is time for some empirical-based evidence of heuristic use.

Purpose

This study was designed to explore what heuristics experienced instructional designers use when engaged in the instructional design process. Qualitative methods were used to capture and describe the individual and shared heuristics instructional designers use from the instructional designers' perspectives. In order to achieve this, semi-structured interviews took place with instructional designers who have practiced instructional design for at least ten years. Instructional designers were purposively selected (Patton, 2002) according to their experience with instructional design as well as their availability to be interviewed. During this interview, participants described their experience in the form of a narrative. These instructional designers reflected on complex or challenging instructional design projects they have worked on in order for us to elicit heuristics they now use in their practice. Specifically, the research question was: *What heuristics do experienced instructional designers use to solve instructional design problems?*

Theoretical Framework

A qualitative phenomenological research design, utilizing semi-structured interviews (Patton, 2002) of expert instructional designers, was used. Phenomenology originated as a method of philosophy based on the investigation of phenomena in the 20th century by German philosopher Edmund Husserl (Smith, 2005). Phenomenology is an approach that revisits the conscious experience as a way of capturing the core of that experience through thorough first person descriptions (Moustakas, 1994; Smith, 2005). Interviews elicited this first-person point of view and situated it within the participants' narratives of their instructional design experiences. In order to develop a deep understanding of the essence of instructional design heuristics by experienced instructional designers, it was important to examine a group of instructional designers' experiences (Creswell, 2007). In this study, the researchers elicited multiple participants' personal experiences of instructional design through their own words. This framework enabled the researchers to elicit first-person points of view and situate them within the instructional design experience in order to get an accurate picture of heuristics used in actual (not theoretical) instructional design projects. The researchers' intent was to determine what heuristics instructional designers perceived they used in their past instructional design experiences. In order to understand the heuristics described by the participants, the context in which they were used needed to be described by the participants as well. This context formed the essence of the experience surrounding the heuristic use. Because the participants share the experience of being instructional designers, there is a component of phenomenology that allows for the examination of the "essence of shared experience" (Patton, 2002, p. 106). Therefore, in the attempt to elicit instructional designers' *shared* heuristics from their past experiences, phenomenology was the approach that was undertaken for this research.

Methodology

Participants and Site

A purposeful sampling technique (Creswell, 2007) was used to select potential participants who had at least 10 years of instructional design experience, are currently active in the field, and known by their peers as expert instructional designers. An initial list of potential participants (n = 31) was created from a list of "seasoned" professionals who regularly attend the annual Association for Educational Communications and Technology (AECT) conference. This was done by looking at past conference programs and identifying those who the consulting professor had professional knowledge of and thought were both experienced enough and might be willing to participate. In addition, participants were selected based upon their availability for either a face-to-face interview at the Association for Educational Communications and Technology (AECT) 2007 conference or a phone or video conference in the three months following AECT. The snowball method (participants identifying other potential participants) was used to increase the number of potential participants to 49. After approval from the university's IRB, persons who met the inclusion criteria were emailed requesting participation. Participants (n=16) had an average of 23 years of professional instructional design experience. There were six female and ten male participants.

Of the 16 participants, 7 (44%) were interviewed at AECT face-to-face while 9 (56%) were interviewed in the following months via videoconference and phone interviews. In addition, those who agreed to participate were asked to complete a demographic survey that allowed the research team to determine if they met a minimum level of criteria for expertise in order to be included. For example, 10 years of professional instructional design experience (Ericsson & Charness, 1994; Ericsson & Lehmann, 1996; Ertmer et al, 2008; Eseryel, 2006; Foley & Hart, 1992; Korth, 1997; LeMaistre, 1998; Perez, Johnson, & Emery, 1995; Perez & Neiderman, 1992; Rowland, 1992), highest educational degree (Day & Lord, 1992; Ericsson & Charness, 1994; Eseryel, 2006; Korth, 1997), and whether they are currently practicing/managing instructional design (Ericsson & Charness, 1994; Ertmer et al, 2008; Rowland, 1992). All 16 participants met the aforementioned minimum criteria for expertise as defined for this study. The research team felt 16 interviews would be enough to answer the research question, but left open the option that if after the interviews they felt they needed more data, more participants could be found and more interviews conducted.

Role of the Researchers

The first author took primary responsibility for the research, including designing and implementing the study. A faculty member and a visiting scholar acted as consultants. The first author is a doctoral student in an educational technology program at a large mid-western university. With each participant she established her own background in instructional design. This was done to foster their freedom to use instructional design terminology during the interview. However, it also led some of them to take on a "teacher" perspective since she was considered a "novice" or "student." Whether this impacted their responses during the interview or not, cannot be said.

Interview protocol

A six-page interview protocol was created and piloted by the research team. It included the steps the researchers should complete before, during, and after the interview, as well as demographic survey questions, research questions, possible interviewee questions and appropriate responses, follow-up questions, and an interview check-out list (to ensure necessary data were collected). Jonassen and Hernandez-Serrano (2002) stated that experienced practitioner stories provide relevant information about strategies they use in the instructional design problem-solving process. They listed specific steps for working with practitioners to identify lessons learned. Some of these steps were used in the interview protocol as probing questions. For example, participants were asked to identify the problem goals and to describe the context in which the problem occurred. In addition, they were asked to describe the solution that was chosen and the outcome of that solution. Participants were also asked to identify any lessons learned from the project.

Prior to the start of the study, the research team conducted three practice interviews with professors in the Educational Technology program at the university, in order for the lead researcher to familiarize herself with asking the interview protocol questions. Subsequently, the research team refined the interview protocol; some research questions were added, eliminated, and altered for better interview communication procedures.

Demographic survey

A demographic survey was provided via email to participants prior to interviews. It requested the following information: participants' gender, age, current position, number of years in that position, current organization or institution, highest degree earned, area of specialization, number of years in the instructional design field, context and years of instructional design positions, and instructional delivery formats used.

Data Collection

After approval from the university's IRB, persons who met the inclusion criteria were emailed requesting participation. Once participation was accepted, the demographic survey and consent form were emailed to participants. Participants returned the survey and consent form via US Postal Service, Email, in-person, or fax.

Interviews were conducted over a four-month period. Interviews took place in a face-to-face manner at AECT, as well as via telephone and video-conferences; at a time and location convenient to participants. An email was sent to participants verifying interview location and time as well as providing them a brief question to prepare them for the interview. A semi-structured interview was used to elicit a story about a complex or challenging instructional design problem on which the instructional designer has worked. In-depth information was obtained from each participant in the form of personal narratives. Interviews were used to elicit these personal narratives so as to acquire the participants' perspectives using their own words (Kvale, 1996). The lead researcher began the interview by stating the following:

> I would like you to start by telling me a story about an instructional design project you worked on in which you had to solve a complex or challenging instructional design problem. If you could, I would like you to start with you entering the situation and continue the story until you solved the problem. Include as much of the following as is needed to make the story understandable: setting, context, environment; characters involved, roles; time span or timeline; and actions, events, or decisions. I am interested in hearing your story about solving the instructional design problem. Remember the ultimate goal is to identify some of the rules of thumb you use in your practice.

Narratives were elicited via interview questions such as: (a) What major constraints or functional requirements existed for the completion of the task? (b) How did you go about determining possible solutions? (c) What was the outcome of that solution? and (d) Were there any lessons from this ID problem you've continued to utilize in solving future ID problems? Probing questions were used by the lead researcher to elicit lessons learned and extract rules of thumb by which the participant operated in the design process (e.g., In hindsight, were there any aspects of the project that could have been improved? What types of lessons did you take away from this ID problem? After having these experiences, what advice would you give to someone who has just discovered that he or she is in the same situation? What is your greatest challenge when trying to solve ID problems?). Each interview lasted between 30 and 90 minutes. All interviews were audio/video-taped and transcribed verbatim.

Transcription of the interview data was completed with outside assistance. The lead researcher verified the accuracy of each transcript by reading through the transcript while listening and viewing the audio and videotaped interviews. Corrections to transcripts were made during the verification process.

Data Analysis

Phenomenological methods employed by Colaizzi (1978) and modified by Moustakas (1994) were used to analyze the data. Giorgi (1985) described the two separate descriptive levels of the approach: Level one utilizes the original data (the verbatim transcript of the interview) and can be considered 'naive' descriptions, whereas level two contains the researcher's interpretation of the data, where through reflective analysis, he/she describes the structures of the experience. These structures are the "underlying structures that account for an experience being what it is" (Moustakas, 1994, p. 137) and are the 'essence' of the experience. In the final step, the researchers combine the two descriptions (raw data and interpreted meanings) into a comprehensive analysis of the phenomenon. For example, a level one comment was, "I let people describe the problem. And again, even though it can be difficult for me, I will not ask any questions, what so ever, until they are completely finished." This statement is verbatim from the interview. The level two analysis led to, "the instructional designer needs to really listen to the client when the client is describing the problem". From these two descriptions, the rule of thumb that emerged was, "As a designer you need to listen more than you talk."

To begin, videotapes were viewed and audiotapes listened to as well as transcripts read a number of times in order to obtain an overall feeling for the interviews. Significant statements related to instructional design heuristics were identified in the transcripts. These were highlighted and extracted. Statements were written on index cards for easier organization. Systematic steps (i.e., open coding, axial coding, and selective coding) were used to generate categories of rules of thumb (Creswell, 2007). Statements were then grouped into themes (within the categories) common to all participants' transcripts. A theme would be a recurring idea, thread, meaning, etc. that might not be mutually exclusive; statements might fit into more than one theme (Graneheim & Lundman, 2004). Themes were then described as an in-depth look at the phenomenon. Findings were validated with the participants and any discrepancies were negotiated or noted (Creswell, 2007).

Trustworthiness of the Study

Trustworthiness of the study appears through the systematic, rigorous steps executed in the data collection and analysis procedures (Patton, 2002). The development of an interview protocol and use of a pilot study ensured consistency of the interviews. The interview process allowed for the collection of rich, detailed, personal narratives from the participants. Reliability of the data was enhanced by viewing the videotapes multiple times, listening to the audiotapes multiple times, and verification of the transcripts by a second person (Patton, 2002). Through the numerous readings of the transcripts, along with listening and viewing audio and videotapes, the lead researcher was able to bracket out her own personal experience and present only the participants' perspectives (Creswell, 2007).

Results

This study examined the heuristics used by experienced instructional designers when solving complex design problems. Analyses of interview transcripts led to the identification of eight categories of heuristics. Categories included: (1) communication, (2) management, (3) learner/audience, (4) solutions/deliverables/outcomes, (5) design process, (6) design team, (7) design problem, and (8) client. Within each category, multiple heuristics were identified. In the next section, we describe the eight categories, the heuristics included in each category, and supporting statements made during the interviews by participants. It should be noted that these are not listed in any order of importance. In addition, the number of participants who referred to a specific heuristic is listed after the heuristic.

Communication

The Communication category (see Table 1) includes heuristics that relate to communication between the instructional designer and his/her client. In this category six participants discussed listening to what the client was saying in order to get as much information as possible. For example, "Go to the meeting and keep your ears open. They are going to say things there that you are going to need to know about later" [E.B.].

Once the instructional designer felt he/she had the information from the client, five participants said it was necessary to verify that he/she heard that information correctly. For example, "The first thing I want to do is I verify things that I've heard. Just literally, honestly, and completely verify the things that I've heard. Not to ask a leading question, but just simply for me to verify that what I think I've heard is what the client is trying to say" [J.Q.]. "I put things in writing and I say 'do you agree with this? Is this accurate? Let's change this until it's accurate'" [S.P.]. The confirmation message, written after meetings and sent usually by email, seemed to be an additional way of documenting and verifying statements regarding the instructional design problem. Seven participants discussed the importance of visuals and documents when communicating with the client. That documentation was very important in facilitating communication. As one participant described, "It is always more successful for me to show people what I am thinking, than it is to tell them about it" [E.B.]. Another said, "Visually portray whatever process model you will be using and consider sharing that with the client or the primary stakeholder group early on in the process to help make sure the lines of communication are clear" [R.B.].

In addition, three participants discussed using the correct lexicon when conversing with the client in order to facilitate communication and reduce misunderstandings. "I think the important thing for any designer to do would be to provide yourself with ample time to learn the lexicon ahead of time so that you can more easily just follow on the conversations faster" [P.L.]. This means the instructional designer needs to understand the terminology used by the client and only use instructional design terminology if it is necessary to the conversation. Otherwise, it was suggested that the instructional designer use terms the client would understand. As J.Q. explained, "We use our technical terms, but when we talk to clients, not only should we not do it unless we explain it, I don't think we should do it unless we need to do it. It builds up a barrier in a sense, or it can, with a client if they aren't familiar with this terminology."

Table 1
Communication Instructional Design Heuristics

Heuristic	No. Participants
As a designer you need to listen more than you talk.	6/16
Verify all information received from the client to prevent miscommunication. Send a follow up email (confirmation message) after meetings.	5/16
Use visuals and documents to prevent miscommunication.	7/16
The instructional designer and client need to understand the lexicon used by the other.	3/16

Management

Managing the first meeting with the client was discussed as important by three participants (see Table 2). One participant explained how the first meeting progresses: "I would say to [the client], 'In the first meeting, you are going to be doing a lot of the showing and talking because I want to hear all your perspectives on this situation that you are faced with. I will be taking notes and if you have any materials, etc. send them to me ahead of time.' And then I will say, 'I will either give you some initial thoughts on the situation, or if the problem seems quite complex, I will take it away and come back in a week and give you my thoughts on where we should go from then on'" [J.Q.]. This indicates that the instructional designer took time to process the provided information and did not just jump into designing in the first meeting with the client. R.B. supported this notion when he said, "Don't even do any instructional design things in the first meeting."

In addition to managing the first meeting with the client, five participants stated how the instructional designer needs to identify the constraints placed on a project as well as negotiate the scope of the project with the client. "The first thing I do is I look for the constraints that have been placed on the project. Those constraints are the key to design" [A.G.]. M.G. stated, "It was really ingrained, very early in my head, about how limitations at the end impact what you are able to do at the beginning, and so understanding what those limitations are really makes it more successful for you to not have to redo work." When looking at the beginning of a design project and the constraints, eight participants discussed how a statement of work should be created and verified by the client. As M.Sp. noted, "Getting the scope of the effort right is important. And I think that people are constantly underestimating what the scale of the training design effort was going to be, they just never scoped it correctly. They underestimated how long it would take, how much and what kind of resources would be required." Because of the constraints placed on a project by the client, as well as the resources provided, four participants discussed not being able to create "perfect" instructional design. As J.Q. explained, "One cannot often do the best project that you would like to. You can do the best instructional design with the resources that your client provides."

Table 2
Management Instructional Design Heuristics

Heuristic	No. Participants
Don't do any instructional design in the first meeting.	3/16
Look for constraints that have been placed on a project.	5/16
Negotiate the scope of the project. Create a statement of work upfront.	8/16
Do the best ID you can with the given resources and constraints.	4/16

Design Team

This category resulted from four participants describing how important it was to have the right people on the team (see Table 3). "Design is a people process. If we don't have tools, if we don't train ourselves to think about how we work with people and how we respect people, especially including our coworkers, that has a huge impact on what we are a able to do and how things get done" [E.B.].

Some participants discussed involving everyone from the beginning, while others stated that they only involve certain people at certain times. As E.B. stated, "One of the things they did that really impressed me was, we didn't just sit with one writer, he called in the whole team. The entire group came. We didn't even know why some of them might be necessary… but that rule of thumb goes something like this: Get together all the excited, exciting people you can find and when the problem is truly something unique to them bring in more, not less and don't ask yourself, 'well, are we really sure we need one of these or one of those?'" Whereas W.C. noted that more than three people can stifle the process, "One person is almost never as smart as two. Two people are never as smart as three, but when you begin to get above that, it gets really interesting. You'll get lots of ideas, but you'll have a hard time getting finished." Those who discussed this category agreed that instructional design is done in teams and that you have to work well with other people in order to come to a viable solution. "I would say that one of the common problems that you see is, especially if you're working with a team, that it's hard to get internal consistency. It's hard to get everybody to really communicate enough so that you finally come to an agreement on what it is that you're doing. That's the real problem …" [S.P.].

Table 3
Design Team Instructional Design Heuristics

Heuristic	No. Participants
Design is a people process.	4/16
The team is critical. Involve the right people at the right time.	4/16

Design Process

The Design Process category (see Table 4) included items related to the overall instructional design process such as knowing the foundational theories, design models, and past solutions. Six participants mentioned that analysis was a very important step in the instructional design process. As N.D. stated, "Analysis, analysis, analysis; you can never do enough analysis." M.G. also stated, "Making sure that as you move through the instructional design process that you come back to the analysis component again and again."

In addition, understanding the fundamentals of learning theories, instructional design models, and principles of instruction seemed a predominant theme discussed by six participants throughout the interviews. For example, M.T. said, "You need to know the theories. You need to know the models. You need to have that foundation. If you don't have that foundation…that almost needs to be your ground floor." D.M. noted, "We need to implement those principles of instruction that work."

Table 4
Design Process Instructional Design Heuristics

Heuristic	No. Participants
During the ID process revisit the analysis component again and again.	6/16
You need to know the theories and models. Implement those principles of instruction that work.	6/16
When faced with something complex, draw from past experiences.	5/16

Another concept discussed by five participants in the Design Process category was the idea of using ideas that have worked in the past. For example, W.C. stated, "Don't try to break too much new ground." A.G. expanded on this by explaining that you can use past situations that have worked, but to add to them, "Be prepared to have to think abstractly, and don't just copy old solutions, try to add something new in every design."

Learner/Audience

The Learner/Audience category (see Table 5) was mainly comprised of knowing your target audience and what it was you wanted them to be able to do after the instructional experience. This specific heuristic had the largest number of participants (n=8) discuss it. As W.C. stated, "Invest as much time as you can in your audience analysis because it pays probably the biggest returns of all of them. Task analysis gets a lot of attention because it is core to it, but a lot of times people don't spend enough time looking at learning skills and other things about the audience and if you're not careful you'll miss some crucial property of that audience in terms of their experience."

In regards to the performance outcomes of the learners, seven participants discussed knowing what it was you wanted your learners to be able to do at the end of the instructional experience. "When I approach any instructional design problem, I always try to use the mantra of, 'what do we want people to be able to do?' How can you create an instructional activity that approximates the kinds of activities they are going to be doing in the job you are trying to prepare them for?" [P.P.]. B.B. stated, "Let's spend our time giving [learners] opportunities where we show them what success looks like. Give them an opportunity to practice it. And give them feedback about how to improve. Teach them how to do it well, give them practices to show they can do it well and they're going to be motivated." This indicates that not only should an instructional designer look at the performance outcomes at the *end* of the instructional experience, but also look at the desired performances *throughout* the experience.

Interestingly, it appears that not all of the designers agreed about the specific implementation of the rules. For example, in the Learner/Audience category, although four participants discussed including scaffolding in the instructional experience, as shown in the heuristic "Consider utilizing scaffolding in your instructional experience," S.P. felt it was necessary to hold off on using scaffolding in the beginning whereas B.W. thought it should be used in the beginning and then tapered off at the end of the instruction. "Don't scaffold at first. Don't direct. In the first version you want to give the minimal amount of direction and support that you can give – because you really want to find out what it is the student needs. Where things break down. And then start trying some of those things out on a verbal basis" [S.P.]. "Use relatively high scaffolding and support early with moving toward more independent work as they get their bearings" [B.W.]. These different viewpoints both take into consideration using scaffolding, but the amount and placement vary depending on the instructional situation.

Table 5
Learner/Audience Instructional Design Heuristics

Heuristic	No. Participants
Know your learners/target audience and their pre-requisite knowledge.	8/16
Determine the criterion for successful performance.	7/16
Give learners the tools they need to succeed. Consider using scaffolding in the instructional experience.	4/16

Solutions/Deliverables/Outcomes

The Solutions/Deliverables/Outcomes category (see Table 6) has three heuristics. Four participants described the first, whether instruction is the answer to the client's problem. "It's really important that you recognize that education and training will only get you so far, education and training only are appropriate viable solutions when there is a skill and knowledge deficit" [B.B.]. Or as J.Q. stated, "I always listen quietly and I'm always asking myself, 'is it actually instruction that is needed here or not'."

The second idea was discussed by eight participants (again, the largest number of participants to discuss a heuristic). This rule is to approach the design problem with the end in mind. This entails considering what the deliverables, learning, and performance outcomes are. "When it comes to instructional design, I identify what the deliverables are, what do we want to be able to accomplish at the conclusion of the project. And then work backwards from there" [M.Si.]. This heuristic is very similar to one in the Learner/Audience/Pedagogy category: Determine what it is you want your learners to perform after the instructional experience. However, it differs slightly in that this heuristic is the way to *approach* the problem, not just a step in the process. As B.B. stated, "Always start with figuring out what are the ways you want people to change as a result from this experience."

In addition, four participants suggested generating and providing the client with multiple solutions to solving the problem and letting the client choose which one to implement. For example, "We got to the point where, after developing instructional strategies, we developed alternatives for several instructional strategies so that even the clients could make some judgments about which might be best or which might be preferred given the circumstances of that specific situation" [R.B.]. "You have to first understand a variety of solutions, so you have to have an idea of what are all of my possibilities of outcome" [P.L.].

Table 6
Solutions/Deliverables/Outcomes Instructional Design Heuristics

Heuristic	No. Participants
Ask yourself, "Is *instruction* the solution to this problem?"	4/16
Approach the design problem with the end in mind. What are the deliverables? What are the learning/performance outcomes?	8/16
Generate multiple possible solutions that will solve the problem.	4/16

Design Problem

The Design Problem category (see Table 7) comprised understanding the particular unique design problem. This category had the fewest participants discussing the same concept, but the researchers felt these heuristics were important enough to include. Two participants mentioned that although the instructional designer might have worked on similar problems, every situation is unique. As B.B. noted, "I think because every single situation is different, because every single situation is unique, that taking clients language to figure out how can I turn this into a viable solution that actually addresses the need and I am not just doing something to do it and I'm not just doing something they asked to do." E.B. said, "You find out immediately there are no cut and dried situations, there are no situations where you can look up in your book [acts as if following a diagram] right…this is what we need to do."

In addition, three participants said that getting to the core of the problem and identifying all of the sub problems was important. For example, "I came back wondering - have I got the real problem? Have they just sort of, for whatever reason, just sort of given me pieces of the problem because of things that might be going on in their own organization or for their own needs, or am I forgetting to ask something about the problem that is really important, but I didn't think to ask?" [J.Q.]. A.G. stated, "I think that every design problem that comes to us has many sub problems that need to be solved. If we can look at our design in terms of, what I call layers, of the design, we find that we solve a bunch of individual problems which then integrate together into one coherent design."

Table 7
Design Problem Instructional Design Heuristics

Heuristic	No. Participants
Never look at the problem at face value. Get to the core of the problem and solve all the sub-problems.	3/16
Understand that every design situation is unique.	2/16

Client

In the Client category (see Table 8) six participants discussed determining if the client was able to describe what it was they really wanted from the instructional designer. And once this was communicated, the instructional designer needed to "manage" the client's expectations. Part of this overlaps with developing a statement or scope of work. As N.D. stated, "Manage the client's expectation. So don't just take the project as is. Look at the project, look at what they want you to develop, look at your time limits." As M.Si. said, "Many times the client comes to you and they're not really sure what they want. And so you run the risk of proposing something that will satisfy their initial need for some help, some assistance, but without really solving the instructional design situation that brought them to you in the first place." In order to determine what the client wants, the instructional designer needs to listen. As, P.L. stated, you "understand the client by listening to them. By listening to what questions they ask you."

Another theme that emerged from the Client category was that different clients have different levels of cultural sensitivity. Five participants discussed cultural and contextual sensitivity when working with a client. "You have to be sensitive to the context. It's probably the biggest thing that will help you be successful or not" [P.L.]. By creating a trusting relationship utilizing honesty, the instructional designer and client will have a more successful partnership. For example, a project that R.B. discussed was centered on tax accountants who worked with huge sums of money. This resulted in the instructional designers maintaining sensitivity when asking about "the client's companies, what were their sources of income or what were their expenditures" as well as "how questions are perceived by the client." Or as B.B. stated, "I tell them why I'm doing what I'm doing, think out loud, try and help them understand I've got their best interest at heart and go from there. But that means instructional designers really do need to have principles and practices that guide them." The trust and honesty components of working with a client go hand in hand. As M.T. phrased it, "Be honest with the client- in terms of your recommendations." M.Sp. said, "I think you have to be totally brutally honest with the clients."

Table 8
Client Instructional Design Heuristics

Heuristic	No. Participants
Determine if the client knows what he/she wants. Manage the client's expectations.	6/16
Be sensitive to the context and the culture of the client.	5/16
Build trust with clients so that they know you have their best interests at heart.	3/16
Be honest with the client.	3/16

One interesting theme from the results was how many times participants would state that "*Blank* is the key to instructional design." For example: A.G. stated that constraints are the key to design. "The first thing I do is I look for the constraints that have been placed on the project. Those constraints are the key to design." Whereas M.T. thought the key to design was recruiting the right people. "…and that was key- recruiting the right people." M.T. also thought that asking the right questions of the client as well as looking at the problem from different perspectives was also key. "Asking the right questions is critical. And looking at it from many different perspectives. Those are really key." B.B. felt that understanding what performances the learner should do at the end of the instructional experience was key. "If I can articulate what the practice experiences should be and what the critical success factors are for knowing how somebody's performed in that practice what success looks like or doesn't look like, and if I can figure out what demonstrations, if I can get that in place, then I've done what I think is the key job of an instructional designer." This demonstrates that there are many aspects to instructional design that cannot be ignored. It also begs the question, are some rules of thumb more important to the instructional design process than others?

Discussion

Results from this study suggest that instructional designers use a number of heuristics in their ID practice. Ertmer et al. (2008) also described the use of rules by instructional designers in their study examining how expert instructional designers used knowledge and experience in the instructional design process. The twenty-five heuristics listed above were found as themes discussed across interviews. The list of heuristics above is a partial list due to the limited number of participants. Some of these heuristics seem to be common sense, such as verifying information to avoid miscommunication. Three of the eight categories of heuristics (Communication, Client, and Management) would appear to be common knowledge to business, or project management fields. One possible reason for the overlap would be the common use of problem solving in the different fields. In the management science / organizational research (MS/OR) field, problem solving is a common component (Evans, 1992). He stated that many MS/OR problems fall into the ill-structured category. This is the same with instructional design (Jonassen & Hernandez-Serrano, 2002). Powell, (1995) described three heuristics used in the MS/OR field that are similar to the heuristics found in this study. For example, one of the heuristics he describes is "Decomposition" of the problem, or in other words, break down the problem into smaller problems. This is similar to the ID heuristic we found: "You have to get to the core of the problem and solve all of the sub-problems." It has been said that breaking down the problem into smaller problems allows it to be solved easier (Goel & Pirolli, 1988; Jonassen, 1997). In Nelson's (1988) study, experienced instructional designers did just that and broke down the larger ill-structured problem in order to work on sub-problems separately.

Another MS/OR heuristic Powell (1995) noted was "Prototype: Get Something Working." This is similar to the ID heuristic we found: "When communicating with the client use visuals and documents." Two of the participants in this study did mention using prototypes when involved in instructional design, but not as a rule of thumb they follow. More in common with this ID heuristic is Powell's "Sketch a graph: Visualize" heuristic which is a manner of representing the system they are working on. Shanteau (1992) found that experts use *decision aids* or visuals when working on a problem that requires decision-making. In Hartley and Bruckmann's (2002) book, *Business Communication,* they discuss how to use visual aids as a way to reduce miscommunication. These all support the use of visuals and documents when communicating with a client.

Other heuristics could have been predicted from the instructional design literature and the fact that the majority of the participants are in the academic field of instructional design. Those would consist of the Design Process heuristics, the Learner/Audience heuristics, and the Solutions/Deliverables/Outcomes heuristics as many of these are taught in introductory instructional design courses and are in the textbooks. For example, using the models and theories, knowing your target audience, and determining learning outcomes is in a number of instructional design textbooks (e.g., Dick & Carey, 1985; Reiser & Dempsey, 2002; Romiszowski, 1981; Smith & Ragan, 1999). Of the instructional design heuristics above, the lead researcher has yet to find the following in the textbooks or journal articles: (a) As a designer you need to listen more than you talk. (b) Don't do any instructional design in the first meeting, and (c) Generate multiple possible solutions that will solve the problem. This last heuristic seems to follow the idea that ill-structured problems have multiple solutions (Jonassen, 2000). However, the idea of presenting the client with alternatives seemed to be the supporting foundation for this heuristic.

What is unique about the list is that it combines these different areas of business, project management, and design into one overall package of heuristics that instructional designers might possess. This leads us to ask if there should be a business/project management course in instructional design curricula.

Not every participant in this study described using every heuristic. This does not necessarily mean that they do not use that heuristic, only that it did not emerge during the narrative interview. It could be because the interviews were limited to one story told by participants, although a few participants told more than one story because the context of their story was not complex enough to answer the interviewer's questions.

Educational or scientific importance of the study

Why is it important to have a list of heuristics used by practicing instructional designers? Some believe that because instructional design is a problem-solving process, novice instructional designers need to be taught more of what practicing instructional designers actually do, rather than only teaching instructional design model steps (Rowland, 1991; Silber, 2007). Allowing novice instructional designers to learn vicariously through the stories told by practicing instructional designers may provide them experiences they would otherwise not encounter (Jonassen & Hernandez-Serrano, 2002). If we can determine the heuristics practicing instructional designers believe should be taught to novice instructional designers, the field of instructional design could gain an additional tool to use in the education of novices as well as to help increase the foundational knowledge of the field of instructional design. Having a list of heuristics may help make designers more efficient in their design problem-solving processes.

The underlying rationale for examining expert use of heuristics is to help novice instructional designers develop expertise. However, this concept needs to be examined in future research. It is currently not yet known if these heuristics will help novices develop expertise. The results of this study suggest that in addition to teaching novice instructional designers the foundational models and theories, we should also be including business and project management content.

Limitations and Suggestions for Future Research

One limitation to this study is the number of participants. Sixteen instructional designers took part in this study. A number of them (14) are also academicians in addition to being instructional designers. Therefore, their full-time profession is not as an instructional designer. They were chosen because of their experience in the field as well as their willingness to be interviewed both at AECT and in the following three months. The fields in which these 16 instructional designers worked did not represent all possible areas of instructional design; for example, designers working in the military were not included. This is because the researchers did not have access to any instructional designers currently working for the military. In order to create a more comprehensive list of heuristics and get a better sense of shared heuristics the number of participants would need to be increased as well as the fields in which they work.

A second limitation was the different modes of communication for interviews. Interviews in consisted of face-to-face, video-conference, and telephone interviews. The varying modes could have produced different results. The face-to-face interviews might have provided for more thoughtful responses, whereas the telephone interviews might reduce interviewer effects.

Another limitation is the amount of access the researchers had to the participants. Interviews consisted of only one 30-90 minute interview. Follow-up interviews might verify the use of heuristics not mentioned in the initial interview. Another limitation is the context of the story told in the interviews. Different contexts might result in different heuristics (e.g., military, industry, academia).

Future research will be devoted to validating these heuristics via the Delphi technique using a panel of carefully selected participants, different from the ones for this phase. The Delphi panel will consist of full-time practicing instructional designers. In addition, the panel will be comprised of enough participants from different fields (e.g., military, industry, academia) that the researchers can examine if there is a difference in heuristics used in the different fields. In addition, the researchers will focus on determining the best methods by which to share the resulting rules of thumb with novice designers and whether it impacts their experiences as instructional designers. Some questions we would like to ask are: 1) Can we *teach* heuristics to novice instructional designers? 2) What methods should we use to provide this information (stories, cases, guest speakers)? And 3) How does this impact their practice?

Conclusion

"Procedures for intelligently applying past knowledge to new experience often seem to require common sense and practical rules of thumb in addition to, or instead of, formal analysis" (Schank & Abelson, 1977, p. 3). This study elicited these rules of thumb from experienced instructional designers as a way of expanding our understanding of what practicing instructional designers utilize during their design process. This knowledge of instructional design heuristics could be imparted on novice instructional designers while they are learning the intricacies of becoming an instructional designer possibly as a way of providing them some wisdom from more experienced designers.

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Appendix
Participants' Demographics and Description of Story Contexts

Participant	**Years of Professional ID Experience**	**Current Work Context (years in position/rank)**	**Story Context**
Bichelmeyer	20	Associate Professor (6 years) Faculty (14 years)	Industry – large telecommunications company Creating a new employee orientation program and building a company culture
Boling	25	Associate Professor (15 years)	Small independent company working with a large publishing firm to create early reading software (using Apple IIe's)
Branch	24	Professor (8 years) Faculty (25 years)	Training company (intern) Developed tax training for accountants working with clients of significant net worth Consulted with transportation company; led development of training development model for the learning service unit.
Cates	34	Associate Dean (2 years) Professor (34 years)	Department of Defense (consultant) Building a multimedia engine for teaching thinking skills to middle school students
Dabbagh	11	Associate Professor (3 years)	Academia/Industry – Project manager Managing an internship experience for students, partnered with an underground coal mining operation, to create a refresher training system for supervisors
Gibbons	33	Chair – Instructional Psychology & Technology Dept (4 years) Faculty (15 years)	Military (consultant) Multiple projects described (capturing the evolution of his design thinking) including: 1) Redesigning an existing course for marine officers (how to plan an amphibious invasion). 2) Creating training to teach helicopter pilots how to conduct anti-submarine warfare
Grant	10	Assistant Professor (5.5 years)	Academia Creating an assessment of web-based instruction for another department
Loughner	15	President of Loughner and Associates Inc. (10 years) – Company that develops custom content training	Pharmaceutical company; lean operations initiative leading to redesign of work processes and organizational change
Merrill	44	Retired from academia Visiting professor FSU (2 years) Consulting Prof BYU Hawaii (3 years)	Center for International Entrepreneurship (consultant) Creating online business course for non-business majors using real-world examples
Parrish	20	Managing Instructional Designer (9 years) – Atmospheric research group	National weather agency Introducing (demonstrating the benefits of) a small scale numerical weather prediction model
Pedersen	10	Associate Professor (2 years) Faculty (8 years)	NSF grant - Project Manager Creating virtual learning environments for middle school science, designed to increase student engagement and ability to do scientific inquiry
Quinn	19	Associate Professor (11 years) Faculty (15 years)	Academia/Industry - Project manager Managing apprenticeship experiences for students who developed training for a new version of

			company software
Simonson	34	Professor (24 years) Faculty (33 years)	Military (consultant) US Navy – Surface Warfare Threat Matrix Creating software to teach naval officers how to identify enemy ships, weapons, and aircraft
Spector	20	Associate Director – Learning Systems Institute (3.5) and Professor (11 years)	Air Force Research Laboratory Creating CBT to teach research scientists acquisitions technology
Tracey	21	Associate Professor (1 year) Faculty (7 years)	Insurance Company (consultant) Moving / Closing / Condensing call-centers
Wilson	30	Professor (20 years)	Academia Exploring strategies, such as blogging, to increase student engagement in an online course

Investigation of Motivational Beliefs and Use of Learning Strategies in an Online Course with Respect to Gender

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Abstract. This study analyzed gender differences in an online course with respect to motivational beliefs and use of learning strategies. Sample of the study consisted of 145 participants from an online course which is based on synchronous and asynchronous communication methods over the Internet. Motivated Strategies for Learning Questionnaire was used to assess students' motivation and use of learning strategies. Multivariate analysis of variance were used to analyze the data. The results showed that there was no statistically significant mean difference among variables with respect to gender.

1. Introduction

Gender issues in education have been recognized as an important focus for research for a long time. When reviewing gender related studies, the effects of this variable are inconclusive on student experience in distance education. Actually, numbers of studies showed that male and female students experience the online environment differently with respect to several ways, such as, success, motivations, perceptions, and communication behaviors (e.g. Chyung, 2007; Price, 2006; Rovai & Baker, 2005;), on the other hand, several results suggested that gender effects are insignificant (e.g. Astleitner & Steinberg, 2005; Lu et al., 2003).

In the literature, women and men respond differently to different aspects of their learning environments while attending in online courses due to their dissimilar responsibilities in their life. Since female students are trying to deal with multiple roles such as mother, wife, and employee. Researchers agreed that there is a need for more research on gender debate about differences and similarities (e.g. Price, 2006; Rovai & Baker, 2005). Therefore, in this paper, we aimed at discussing gender differences in an online course with respect to motivational beliefs and use of learning strategies.

2. Research Hypotheses

The following two null hypotheses were tested in this study:

- There were no statistically significant mean differences between male and female students with respect to motivational beliefs in an online course.
- There were no statistically significant mean differences between male and female students with respect to use of learning strategies in an online course.

3. Subject of the study

The study included 145 volunteer students who attended at the online course, Middle East Technical University (METU) in Ankara, Turkey. Originally, one hundred ninety students were registered to the course; however this study included the ones who were volunteers to participate in the study. The number of male participants (N= 101) was greater than the number of female participants (N=44), and the participants' age ranged from 20 to 40 and above. The majority of the participants' ages were between 20 and 29 (Male N=77, Female N=38). The majority of the participants were university graduates and undergraduate students.

4. Instrumentation

The Motivated Strategies for Learning Questionnaire (MSLQ), which is a self-report questionnaire developed by Pintrich and colleagues (1991), was used to collect relevant data. It was adapted into Turkish by Hendricks, Ekici and Bulut (2000). Its pilot study was conducted by administering the scale to the students enrolled in Department of Foreign Languages Education at METU, Turkey. The MSLQ consists of two scales: (1) motivation and (2) use of learning strategies. The first scale has 31 items and six sub components: Intrinsic Goal Orientation (Intr), Extrinsic Goal Orientation (Extr), Task Value (Tskv), Control Beliefs (Cont), Self-Efficacy for Learning and Performance (Slef), and Test Anxiety (Tanx). In the learning strategies scales it has 50 items and there are nine sub components: Rehearsal (Reh), Elaboration (Elab),Organization (Org), Critical Thinking (CrTh), Metacognitive Self-Regulation

(MetaStr), Time and Study Environment (TSE), Effort Regulation (EfRg), Peer Learning (PeerL), and Help Seeking (HelpS). The MSLQ was distributed by the researchers to the students at the end of the online course. Multivariate analysis of variance were used to analyze the data.

5. Results

Two null hypothesis of the present study were tested at the significance level of 0.05. In order to test the first hypothesis regarding mean differences between male and female students, MANOVA was used with gender as independent variable, and six motivational beliefs as dependent variables. Wilks' λ revealed that there was no an overall significant mean difference among the mean scores of the six variables with respect to gender (Wilks' $\lambda = 0.949$; $F(6,146)=1.254$, $p>0.05$). Mean and standard deviations of measures were given in Table 1.

Table 1. Means and Standard Deviations of Six Motivational Beliefs as a Function of Gender

Items	**# of items**	M_{male}	SD_{male}	**Item Index** $Mean_{male}$	M_{female}	SD_{female}	**Item Index** $Mean_{female}$	M_{total}	SD_{total}	**Item Index** $Mean_{total}$
Intr	4	22.03	3.76	5.51	20.91	4.18	5.23	21.68	3.91	5.42
Extr	4	16.98	5.06	4.24	17.09	4.83	4.27	17.01	4.98	4.25
Tskv	6	35.33	4.72	5.89	34.89	4.44	5.82	35.19	4.63	5.87
Cont	4	22.67	3.56	5.67	22.78	3.55	5.70	22.71	3.54	5.68
Slef	8	41.45	7.48	5.18	38.84	7.63	4.86	40.65	7.60	5.08
Tanx	5	18.14	6.36	3.63	19.52	6.32	3.90	18.57	6.36	3.71

As seen in Table 1, it could be stated that male and female learners had the same tendency in motivational beliefs. Furthermore, they tended to reflect an "undecided" perspective toward their motivational beliefs regarding extrinsic goal orientation and test anxiety. Also, they tended to reflect an "agree" perspective toward their motivational beliefs with regard to the other dimensions of motivational scales. But these beliefs were not so strong.

In order to test the second hypothesis regarding mean difference between male and female students, MANOVA was again used with gender as independent variable, and nine variables related to use of learning strategies as dependent variables. Wilks' λ revealed that there was no an overall significant mean difference among the mean scores of the nine variables with respect to gender (Wilks' $\lambda = 0.920$; $F(9,146)= 1.310$, $p>0.05$). Mean and standard deviations of measures were given in Table 2.

Table 2. Means and Standard Deviations of Nine Learning Strategies as a Function of Gender

Items	**# of items**	M_{male}	SD_{male}	**Item Index** $Mean_{male}$	M_{female}	SD_{female}	**Item Index** $Mean_{female}$	M_{total}	SD_{total}	**Item Index** $Mean_{total}$
Reh	4	14.87	4.95	3.72	15.33	5.17	3.83	15.01	5.00	3.75
Elab	6	29.66	6.09	4.94	30.96	4.57	5.16	30.06	5.68	5.01
Org	4	19.18	4.49	4.80	20.76	3.16	5.19	19.67	4.18	4.92
CrTh	5	23.41	4.66	4.68	22.90	5.53	4.58	23.26	4.93	4.65
MetaStr	12	57.24	10.42	4.77	60.47	9.81	5.04	58.23	10.31	4.85
TSE	8	34.40	6.05	4.30	33.76	7.66	4.22	34.20	6.56	4.28
EfRg	4	17.31	4.29	4.33	17.69	4.33	4.42	17.42	4.29	4.36
PeerL	3	9.44	4.10	3.15	10.02	3.35	3.34	9.62	3.88	3.21
HelpS	4	15.12	5.07	3.78	16.58	4.68	4.14	15.57	4.99	3.89

As seen in Table 2, it could be stated that male and female learners had the same tendency in the use of learning strategies. Moreover, they tended to reflect an "undecided" perspective toward their use of learning strategies regarding time and study environment and effort regulation. Also, it could be stated that they tended to reflect a "disagree" perspective toward their use of learning strategies regarding peer learning and help seeking. They also accepted the items in other dimensions but their beliefs were not very strong again.

6. Conclusion

This study analyzed gender differences in an online course with respect to motivational beliefs and use of learning strategies. The results showed that there was no statistically significant mean difference among variables with respect to gender. These findings were supported by many of the existing findings from the literature. In other words, although several researchers stated that female and male students experience the online environment differently, gender in several learning environment were not reported as significant variable in the past (e.g. Astleitner & Steinberg, 2005; Lu et al., 2003). It can be stated that the gender-related studies might show similar results in different society. Moreover, the lack of gender-related differences might be partly explained by the participants' properties and nature of the online course. Online learners are mature enough and they are aware of their responsibilities and the course was offered with help of synchronous and asynchronous communication methods over the Internet in three months.

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