Virtual learning: In search of a psychological model

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In an attempt to understand better the unique psychological learning characteristics of an increasingly popular, prevalent, and wide-reaching form of two-way interactive technology-mediated educational experience often called the Virtual Learning Environment (VLE), this paper systematically collects, groups, and analyzes the findings of a set of original research studies on VLEs in terms of the technologies, motivations, and responses identified in the studies. Findings are qualitatively reviewed and sorted in terms of eight principal psychological learning models of the 20th century in order to evaluate what models are relevant and whether there is consistency between and among the models chosen. Further, examples of Presence, a perceptual concept that relates specifically to technology-mediated interactions, are identified and coded, to explore the unique perceptual characteristics of the VLE, how these relate to the learning models used in each element of the VLE, and whether there is a need for a new model integrating the traditional frameworks of learning with dimensions of Presence to describe the VLE. The potential for and direction of a new model is forecast in light of the meta-analysis.

The following section details the motivations for this research. Subsequent sections include an introduction to eight principal models of learning and the concept of Presence, a summary of the evolution of the Virtual Learning Environment and an operational definition of it, a review of the research relating to virtual learning, a set of research questions regarding the inter-relationship of learning and perception in the VLE, and the prospects for the development of a virtual learning model. A methodology for the systematic qualitative exploration of the research questions is presented. Results and discussion sections offer a detailed sorting, description and analysis of the findings. Areas of future research are proposed.

Motivations for study

The advantages to understanding the technology, motivations, and responses in the Virtual Learning Environment are, as with any learning experience, as vast and as vital as the pursuit of knowledge itself. Particularly in the VLE, however, there is the potential that the curriculum designer and instructor may explore aspects of learning not possible in the traditional classroom, allowing the instructor to provide stimuli for and the learner to experience even more motivating and satisfying learning responses than would have been otherwise possible. A virtual environment, with its ability to recreate a physical or social environment through multimedia and sensory technology, may be able to maximize learning by facilitating a self-paced, individualized and motivating learning experience that offers immediate reinforcement and feedback (California Distance Learning Project, 1997). A history student, for instance, might be able to learn about the Revolutionary War firsthand by sitting with George Washington and his brave infantry at Bunker Hill by donning a virtual reality headset. A rehabilitation patient might practice walking without the fear of injury by maneuvering through a virtual obstacle course.

Despite the modern emerging technology that is driving the virtual learning movement, there is a particular need to consider which if any of the traditional frameworks of learning apply to the technology form and application, learner and instructor objectives, and responses in the VLE, since the technology and the appeal for the virtual learning technique is outgrowing theoretical frameworks of learning to describe and guide it. There is a further need to explore principles of perception that may be uniquely relevant to the VLE, since the instructional media field itself rests on the assumptions that people learn primarily from what they perceive, and that perception leads to communication and communication to learning (Kemp et al.). Potentially useful to understanding the sense of "being there" that the VLE can allow is the perceptual concept of Presence, suggesting that the technology's effectiveness may be measured by its own invisibility. This paper, therefore, categorizes and evaluates the findings of a set of original research studies on Virtual Learning Environments in terms of traditional frameworks of learning and characteristics of Presence. It is expected that an integration of learning and perceptual concepts will help identify a new learning model specifically relevant to the VLE. It is further expected that this meta-analysis of original research will help direct future research in a more relevant and purposeful direction.

The importance of perception and Presence.

In studying the technology, motivations, and responses in learning, perception has always been a vital component. “Perception is the process whereby one becomes aware of the world around oneself” (Kemp et al., p. 13). “In perception we use our senses to apprehend objects and events. The eyes, ears, and nerve endings in the skin are primary means through which we maintain contact with our environment.” When considering the effectiveness of any learning environment, therefore, an educator or instructional designer must consider that perceptual events consist of many sensory messages that are related and combined into complex patterns to which an individual reacts one piece at a time.

There are hundreds of principles of perception in the areas of memory, concept formation and attitude change (Kemp et al.). There are four basic principles, however, that summarize the major conclusions regarding perception: Perception is relative rather than absolute; perception is selective; perception is organized; perception is influenced by expectation. While any perceptual experience is uniquely individual, a series of perceptions by different persons can be related to become a nearly identical perceptual state.

There is a particular perceptual state called Presence, short for telepresence, which applies principles of perception particularly to the technology-mediated interaction. In the perception of Presence (Lombard and Ditton, 1997), a technology user's perceptions fail to accurately acknowledge the role of the technology in the experience (e.g., the user of a sophisticated flight simulator may, for some period of time, be totally unaware of the technology through which the experience is being generated and may perceive (s)he is actually flying an aircraft). As researchers begin to test the dimensions of Presence empirically, some argue that “the types should be divided into those that involve perceptions of physical environments, those that involve perceptions of social interaction, and those that involve both of these" (Lombard, 2001; see Appendixes B-1 and B-2 for Characteristics of Presence).

Traditional models of learning

There are eight generally accepted psychological models of learning and three domains of learning that have contributed greatly to an understanding of learning and to instructional design over the past century and that are useful in determining a framework for understanding and designing the VLE. Inherent in these models are various goals, strategies, technology applications and responses to learning. These models of learning include Operant Conditioning, Conditions of Learning, Component Display, Elaboration, Information Processing, Social Learning, Attribution, and Motivation. Further, there are three domains of learning in which most learning takes place: Cognitive, or thinking skills; Psychomotor, or movement; and Affective, or feelings and attitudes. The eight principal psychological models of learning and the three domains of learning are described in detail in Appendixes A-1, A-2, and A-3, with examples of the technology form and application that these models describe.

Understanding the terms and history

As advances in information and communication technologies continue to open up new opportunities for establishing different learning environments, the traditional models and applications of learning as well as the terminology to describe these are increasingly put to the test. The term Virtual Learning Environment had its beginnings in the term distance learning, which was first used to describe any learning that involved a one-way print or transport technology with no or limited face-to-face contact, e.g. at-home study through use of a text book, a video, or an audio cassette tape and an assignment book mailed back or faxed to the instructor. "Distance learning is not a new phenomenon (Phipps and Merisotis, 1999, p. 15). "With the development of the postal service in the 19th century, commercial correspondence colleges provided distance education to students across the country. This trend continued well into the 20th century with the advent of radio, television, and other media that allowed for learning at a distance." In the last decade, providing education at a distance has changed significantly as the use of computer-mediated communication (Palloff and Pratt, 1999), two-way interactive video, and other technologies has increased. "Many universities are making substantial investments in new technologies for teaching" (Phipps et al., 1999, p. 15)

As the definition of distance learning began to emphasize the qualities of computer-mediated interactivity between learner and mediated world, learner and learner, and learner and instructor, the California Distance Learning Project (1997) summarized the new learning environment in the following way: (a) the separation of teacher and learner during at least a majority of each instructional process; (b) the use of educational media to unite teacher and learner and carry course content; (c) the provision of two-way communication between teacher, tutor or educational agency, and learner; (d) separation of teacher and learner in space and time; and (e) volitional control of learning by students rather than by the distance instructor.

The evolution of virtual learning

Through the development and availability of such audio-visual computer delivery systems as video conferencing, interactive television, satellite, and online technology primarily in the academic, science, and business arenas, distance learning continues to develop as a uniquely interactive and sensory virtual learning experience. The experiences range in levels of interactivity and sensory stimulation, however, and are often qualified in terms of immersion effect. "Most virtual reality systems create a physical environment. Scenes such as a planet's surface can be created from digitized images sent back by space probes. In a non-immersive (system) . . . users only rely on conventional devices such as video display monitors, keyboards, and a mouse to manipulate the simulated environment" (Schwan and Silmon, 1999). Highly immersive systems are more complicated and may include a special helmet or headsets to create sights and sounds of the virtual world. Video displays may be set up to produce "a three-dimensional effect, like high-tech 3-D movie glasses. Headphones make sounds seem to come from every direction. Special sensors track head motions so that the visual and audio images shift in response" (Schwan, et al., 1999). "Not many agencies to date are fully virtual from administration to instruction, but there is a global trend to expand virtual services in educational institutions as well as in the corporate sector" (Commonwealth of Learning, 1999).

"There is no simple definition of what constitutes a Virtual Learning Environment," (Milligan, 2001). "Strictly the term VLE should be used to describe software which resides on a server and is designed to manage or administer various aspects of learning; delivery of materials; student tracking; assessment etc. In this respect, a Virtual Learning Environment is essentially a database of objects, creating tailored web pages on request. Although there are various software packages that seek to control the entire learning process, there is no reason to presume that individual tools could not be brought together to create a loose (more flexible) environment for online learning. Here, [one may] adopt a broad definition of VLEs, considering not just single package solutions, but any attempt to create a unified environment for learning."

Operational definition. In its varying degrees of technological form and application, therefore, the Virtual Learning Environment (VLE) may be defined as that exercise, course or program that uses two-way interactive information or communication technologies to teach or train a learner. It continues to promise the same practical advantages as the distance learning experience: convenience, accessibility, and variety (Mitchusson, 1997). The virtual learning course continues to be accessible to those living away from school, in far-away regions, in foreign countries, for those with restricted mobility (e.g. the disabled and injured), and for those with irregular work schedules. It holds appeal to students with time constraints, work responsibilities, family responsibilities, budgetary restrictions, transportation problems, and daycare issues (Freitas, p.367).

VLE history in schools and businesses

While practical motivations are evident for use of the VLE, schools are increasingly identifying educational reasons for offering VLEs in their curriculum. Many schools see the virtual learning experience as a new way to reach a diverse population and to provide an open learning environment. There is some consideration that the virtual classroom enabled by the Internet, broadcast television and video-conferencing technology may make the learning experience a broader, more comprehensive, more collaborative, and more enriching one.

With communication networks that share information and knowledge on demand, VLEs are expected to expand dramatically in size and numbers. Based on data from a national survey of the National Center for Education Statistics (NCES), 33 % of U.S. colleges and universities offered distance-education courses in 1997-98, and another 25% plan to make remote education classes available within the next few years. Also the data estimated that nearly 55,000 different distance education courses were offered in 1997-1998 with the most dominant courses at the undergraduate level with an estimated 49,690.

Online learning is becoming a major force in virtual education, especially, at the Master's in Business Administration (MBA) level. Many schools see virtual learning as a new way to reach a burgeoning audience of business people who are eager to have quality educational opportunities conveniently delivered to their desktops without campus visits.

Colorado State University, which initiated one of the first virtual business schools in the United States, uses a multimedia-instructed delivery system. Delivered via computer conferencing and videotape, this program is one of a growing number of campus-free degree programs meeting the needs of the business community. Colorado State's program mails videotapes of lectures and classroom sessions to remote learners to allow students to view and study the videotapes weekly at their convenience. Students may then go online to discuss subjects with their colleagues in live chat sessions using a conferencing system called embanet. The university faculty maintain online advising hours and are also accessible by phone to answer questions that students may have after viewing the tapes or while working on assignments (Phillips, 1998).

The University of Wisconsin at Whitewater also launched a virtual version of its on-campus MBA program. Run through the technological platform LearningSpace, an integrated Lotus Notes educational system, the virtual program allows students and faculty to post and read assignments and class discussions online and is accessible to any student able to access the Internet with a Pentium computer and a Web browser.

Through advances in Internet technology, Carnegie Mellon University, likewise, has been able to offer students a technology-assisted curriculum. Ranked the first Digital University and the first wired campus by the magazine "Yahoo" (Hamm, 2000), the university offers students Internet access in the classroom for Web site references and e-mail communication with instructors and fellow students. Some instructors offer interactive Web sites for live discussions, and a virtual chemical laboratory allows students to explore graphical representations of solutions and materials.

Emerging models

While the virtual learning experience may have achieved advanced technological status, it is not always perceived as positive by the learner and educator. As advanced technologies are more and more a part of everyday life, faculty, students, and researchers are grappling with the impact these technologies have on motivations and responses in educational arenas.

The emergence and growth of the information and communication technology infrastructure, in fact, is directly linked to the emergence of certain virtual education models that attempt to make sense of the technology and motivations for using it (Commonwealth of Learning, 1999). Just as the emergence of the postal systems enabled by the development of transportation technology led to the development of the correspondence models of education delivery (p. 7), the recent development of real-time interactive media such as audio- and video-conferencing is driving the search for education models that define and guide it.

Most of these models have emphasized the technology and the definition of the environment in which the technology is being applied. The evolution of models designed to account for virtual learning in academic settings includes: (a) the traditional model, in which virtual programs are offered to supplement the traditional classroom environment; (b) the single-mode model, in which the organization which relied primarily on one-way print-based delivery now integrates technology into its system of instruction; (c) the broker-type model, in which the organization acquires technology programs from a variety of institutional providers; (d) the information and facility provider model, in which the organization responds to the support needs of learners; and (e) the credentials model, in which the institution provides a variety of assessment and commendation services but no direct instruction. The evolution of models designed to account for virtual learning in business settings includes: (a) the direct provider model, in which the instructor caters to a particular niche market; (b) the corporate training network model, in which external market opportunities are explored and formal recognition for training sought; and (c) the specialized service model, in which the instructor provides consultation, project management, and technical support on a fee-for-service basis.

Bridging the gap

Much of the research to date has focused on the form of the VLE and on identifying the levels of satisfaction and academic performance associated with the VLE, or the technology-response effect, without accounting or controlling for mediating factors. In the following studies, these VLE responses were considered: (a) student outcomes such as evaluation/grades (Ahern et al., 1994); (b) students' achievement and satisfaction in distance learning (Johnstone et al., 1996); and (c) student attitudes toward distance learning (Hacker et al., 1997). The findings suggest that distance learning courses can compare favorably to traditional classroom courses and enjoy high levels of learner satisfaction. Another study found no significant difference between student grades in online courses and grades in traditional classroom settings (Phipps et al., 1999).

Further research has pointed to the social and interpersonal effects of the VLE experience in terms of a student's engagement in the active learning process (Hiltz, 1986). The studies point to the collaborative or horizontal method of online learning as having a positive effect, since the students are more likely to rely on peer-to-peer learning and are expected to learn as much from one another as from the instructor. In surveys of students who attended online courses at the New Jersey Institute of Technology (NJIT), Hiltz began to identify the importance of certain mediating factors in the technology-response effect. Finding a strong correlation between measures of perceived greater interaction with other students, feelings of being more involved, and the perception of having learned more, Hiltz concluded that "the effectiveness of the virtual classroom approach rests in whether students take a more active role in the learning process and take advantage of the potential for more interaction with the professor and the other students, despite the absence of nonverbal cues to facilitate this interaction" (p.100).

Hacker and Wignall (1997) further suggest the importance of learner motivations in their survey of 72 students who participated in electronic conferencing. The researchers explored how inhibited the students felt about communicating in a computer conference, how much they agreed that computer-mediated communication (CMC) is a useful alternative form of communication, and how much they expected that the CMC would make their course more interesting. Hacker and Wignall identified some significant predictors of computer-mediated communication acceptance in relation to this form of educational conferencing: (a) initial CMC acceptance, and (b) how CMC makes the course more interesting. Their findings support that positive attitudes toward the virtual learning experience contribute toward positive attitudes later.

Arbaugh (2000) likewise begins to bridge the gap in the technology-response equation by considering the impact of learner and instructor motivations and expectations. In his research of Internet-based VLEs, he emphasizes the importance of common goals of interaction and student involvement in his identification of certain key factors for success in the VLE: (a) the perceived usefulness and ease of use of the course Web site; (b) the level of educational flexibility for students and faculty as a result of the asynchronous nature of these courses; (c) the ease of and emphasis on interaction as a teaching pedagogy; and (d) student experience with and engagement in Internet-based courses (p.10). Arbargh (2000) asserts that instructor motivations, ease of interaction and classroom dynamics are significantly associated with learning (p.18).

Designing success

Much of the VLE research to date focuses on the responses to the technology as perceptual, in terms of immersion or a sense of non-mediation; as practical, in terms of convenience, flexibility and affordability; and/or as educational, in terms of evaluations and grades. This is valuable, Bryson and de Castell (1998) assert, since the failures of educational innovation may show why success stories are arbitrary. Little research, however, considers a combination of the perceptual, practical and academic or learning standards in terms of motivations of both instructor and learner that may mediate the technology-response formula. An understanding of whether a VLE is effective, therefore, may depend on an understanding of whether the perceptual, practical and academic responses to it are consistent or inconsistent with the objectives put forth. “We cannot over-stress the importance of the concept of appropriateness when making decisions about information and communication technology applications” (Commonwealth of Learning, 1999). “This study has revealed nothing if not that the use of information and communication technology should be in the context of clearly stated educational outcomes accompanied by practical strategies for achieving them . . . "

Research questions

R1: Which if any of the eight traditional psychological models of learning and the eight perceptual characteristics of Presence does the research indicate best describe(s) Virtual Learning Environments in the three domains of learning?

R2: What relationships does the research show between and among the technology, learner and instructor motivations, and responses in Virtual Learning Environments as described by the eight traditional psychological models of learning, the eight perceptual characteristics of Presence, and the three domains of learning?

R3: In what ways do the original research studies succeed or fail to offer sufficient data in order to develop a model of learning for the VLE, and in what directions should future research proceed in order to develop a model of learning for the VLE?

Methodology

This paper uses a systematic qualitative approach to identifying those psychological models of learning and perceptual characteristics of Presence that best describe the technology in, instructor/learner motivations for and responses to Virtual Learning Environments found in a set of original research studies on VLEs. With this identification, the researchers look for consistencies, inconsistencies and patterns in order to analyze the need for a new model that will be useful in describing and better designing VLEs and to determine whether more research is needed in order to develop this model. Technology is defined as that educational media used in the VLE and is divided into form or type of technology (hardware) and application of the technology (software). Motivations are considered in terms of academic or learning objectives, practical desires, and perceptual objectives (Presence or a sense of being there) of both the instructor/designer and learner. Responses are identified in terms of learning outcomes (evaluation/grades), practical or personal results (satisfaction) and the perceptual state (Presence). Findings from the set of original academic studies are thoroughly reviewed and coded in tables as described by eight psychological frameworks of learning and eight perceptual characteristics of Presence as these relate to each element of the VLE experience (see Appendixes D-1, D-2, D-3 and D-4).

The set of original VLE research studies dating from 1990 to 2001 are selected through stratified random sampling from the libraries of Temple University and the University of Pennsylvania in

Philadelphia, through online academic and technology databases including ProQuest Direct, Communication Abstracts, Dissertation Abstracts, Science Abstracts, LexusNexus, Infotrac; and other search engines under the search terms of distance learning, virtual, virtual learning, virtual education, virtual classroom, virtual environment, virtual program and virtual institution. The research further collects and considers dozens of education books, journal articles and essays on the topics of learning, distance learning, and virtual learning.

Types of original research collected

There have been 17 original research studies reviewed in this analysis to date, as a collection and evaluation of studies is continuing. The methodologies of the studies range from quantitative to qualitative in the form of case studies, content analyses, surveys, experiments, and descriptive works. While the studies follow generally acceptable research guidelines, further research is required to determine the validity and reliability of the studies coded. The studies and their methodologies are summarized in the Bibliography section of this paper.

Procedures

Findings in the original VLE research were categorized in terms of VLE Technology (Form and Application); Instructor/Designer Motivations and Learner Motivations; and VLE Responses (Evaluation/Grades and Learner Satisfaction). Technology, Motivations, and Responses were then charted and defined by one or more of the eight Principal Models of Learning (see Appendixes A-2 and A-3), the eight Characteristics of Presence (see Appendixes B-1 and B-2), and the three Domains of Learning (see Appendix C). Studies were individually coded and then collectively reviewed in a collaborative style. Less emphasis was given to the demographic and economic aspects of the motivations for VLE use, although these are considered important and worth pursuing in future research. Virtual Learning Environment characteristics that were not described by the Models of Learning or Characteristics of Presence were considered uniquely VLE experiences.

Results

A thorough review, categorization, and descriptive coding of the findings from the original research suggest some potential relationships among the technology, motivations, and responses in the Virtual Learning Environment. Notably, the analysis identifies certain insufficiencies in areas of focus and provides direction for further research specific to the individual learning and motivational factors likely to affect the VLE technology-response relationship.

The analysis reveals that all of the studies coded in the Cognitive Domain of Learning focus primarily on Responses to the VLE in terms of Learner Satisfaction, with little emphasis on Instructor/Designer or Learner Motivations and the relationship of these to the Technology chosen. Also in the Cognitive Domain studies, the process of identifying Instructor/Designer Motivations and Learner Motivations in terms of academic objectives was cumbersome, as these factors were not addressed to any extent. In the Psychomotor Domain, conversely, curriculum or learning objectives were more readily provided.

Of the 17 studies reviewed, 12 were identified as primarily in the Cognitive Domain of Learning, as they related to academic content traditionally offered in a face-to-face classroom setting; and five were described primarily by the Psychomotor Domain of Learning, as they related to medical science therapeutic and rehabilitative training and learning. Nearly all of the VLEs described by the Cognitive Domain were also described by the Affective Domain, and nearly all the studies described by the Psychomotor Domain were also described by the Cognitive and Affective Domains. This was attributable, in part, to the VLE course topics, which were generally in the communication science or medical science areas, in which higher order thinking as well as attitudes and impressions played a part. The research studies, however, were found to be dominant in either the Cognitive or Psychomotor Domains and were coded accordingly.

Further, the Technology Form or type used in all of the studies generally involved Internet-based systems and/or audio/visual interactive computer technology capable of sophisticated applications described by any or all of the Psychological Models of Learning and the Characteristics of Presence. The studies in the Cognitive Domain of Learning, however, rarely listed the Technology Forms in terms of the learning or perceptual potentials associated with them. The studies in the Psychomotor Domain more often listed the Technology Form potentials.

The Cognitive Domain: Models of Learning

Technology Application. In the Cognitive Domain, each of the 12 studies reviewed indicated that the Technology Application in the VLEs was best described by some combination of the Social Learning, Motivation, or Component Display Psychological Models of Learning. There were other relevant Models of Learning suggested in certain curriculum-related technology applications, but these applications were not addressed in sufficient detail to allow a determination. The three primary Models of Learning used to describe the VLEs in the Cognitive studies -- Social Learning, Motivation, and Component Display -- were ranked in order of applicability to Technology, Motivations, and Responses. Studies that were described primarily by the Social Learning Model generally focused on the interactive and collaborative nature of the Technology Application; studies described primarily by the Motivation Model generally focused on the curiosity and attention that the Technology Application aroused and its emphasis on personalization and control of the learning experience; the few studies that were described primarily by the Component Display Model generally focused on the logical sequencing of instructions, objectives, stimuli, and learner guidance within the Technology Application.

In the area of Technology Application, eight of the studies were described primarily by either the Social Learning or Motivation Models or a combination of these models (C1, C2, C4, C5, C6, C7, C10, and C12), based on the technology's primary focus on interactivity, personalization, and/or a self-controlled learning environment. This Technology Application was described in the studies in the following ways: (C1) cable TV or the Internet to a national audience, as well as e-mail, file transfer and chat room discussion software; (C2) computer conferencing equipment, including Web sites with listservs; (C4) software with text, slides, photographs and job boxes for student discussion; (C5) software that allowed students to see and hear the instructor through a TV monitor and to discuss topics in real time; (C6) Electronic Information Exchange System software allowing discussions and written assignments; (C7) interactive audio-video software allowing teacher-student and student-student communication; (C10) software using audio-video animation and text; and (C12) software using audio-video exchange of text, images and sounds. Four of the studies were described primarily by the Component Display Model (C3, C8, C9, C11), and to a lesser degree by the Social Learning and Motivation Models, based on the technology's primary focus on listing, ordering, and organizing of facts and ideas. The Technology Application was described in these studies in the following ways: (C3) Web-based text; (C8) a Web site; (C9) Web-based technology that provides text-based information and a "group library," and allows online group working, sending messages, and individual notes; and (C11) a Web-based online discussion, chat, and e-mail discussion forum.

Instructor/Designer and Learner Motivations. In six of the eight studies in which Technology Application was described primarily by either the Motivation or Social Learning Models or a combination of these (C2, C4, C5, C6, C7 and C12), Instructor/Designer Motivations or Learner Motivations in terms of curriculum or objectives were not identified in curriculum or learning terms in any detail but were provided in terms of interactivity, collaboration, convenience, attention, interest and personalization described primarily by the Motivation or Social Learning Models of Learning. In one of the studies (C4), Instructor/Designer Motivations in terms of curriculum or learning objectives were the same as practical objectives and were described by the Social Learning Model. In C10, Instructor/Designer Motivations were best described by the Component Display Model, since objectives keyed to the organized presentation of science content related to lectures. In C1, no Instructor/Designer Motivations were identified.

Learner Motivations. Learner Motivations in six of the eight studies (C4, C5, C6, C7, C10, and C12) were described primarily by the Motivation Model, because of interest in the convenience and flexibility of the technology. In the remaining two of the eight studies (C1 and C2), there were no Learner Motivations found.

In the four studies in which the Technology Application was described primarily by the Component Display Model (C3, C8, C9, and C11), the Instructor/Designer and Learner Motivations in terms of curriculum objectives were not the focus of the studies, and Instructor/Designer and Learner Motivations were best described by the Motivation and Social Learning models of learning as they related to all or some aspects of flexibility, convenience, interest in the technology, or interactivity. In C9 and C11, Instructor/Designer Motivations were not identified.

Responses: Learner Satisfaction. In six of the eight studies in which Technology Application was described primarily by either the Motivation or Social Learning Models or a combination of these (C2, C4, C5, C6, C7, and C12), Responses in terms of Learner Satisfaction were described primarily by the Motivation and/or Social Learning Models: C1 -- Not found; C2 – Motivation, High; C4 -- Social Learning, High; Motivation, Low; C5 -- Social Learning, Motivation, Low; C6 -- Social Learning, Low; C7 -- Motivation, High; C10 -- Not found; C12 -- Motivation, Social Learning, High. Four studies indicated High levels of Learner Satisfaction (C2, C4, C7, and C12) as described by positive attitudes toward the VLE (C2), ability to interact electronically with instructor (C4), interest in the technology (C7), and increased sense of participant motivation and collaborative learning (C12). Three studies indicated Low levels of Learner Satisfaction (C4, C5, and C6) in terms of technology problems and unhappiness with the lack of face-to-face contact (C4), an intrusive effect of the camera technology (C5), and a sense of isolation (C6).

In all of the four studies in which Technology Application was described primarily by the Component Display Model of Learning (C3, C8, C9, and C11), Responses in terms of Learner Satisfaction were described primarily by the Motivation and/or Social Learning Models: C3 Motivation, High; C8 -- Social Learning, High; C9 -- Social Learning, Motivation, High; C11 -- Social Learning, Attribution, Low. Three studies reported High levels of Learner Satisfaction (C3, C8, and C9) in terms of student-student communication (C3); interactivity (C8); and collaborative use of the technology (C9). One study reported a Low level of Satisfaction (C11) in terms of lack of feedback from the instructor.

Instructor Evaluation/Grades. In two of the eight studies in which Technology Application was described primarily by the Motivation and/or Social Learning Models, the Responses in terms of instructor Evaluation/Grades was primarily described by the Attribution Model (C1 and C10); in the other six studies (C2, C4, C5, C6, C7 and C12), no mention of Evaluation/Grades was found. Both studies C1 and C10 reported High levels of Evaluation/Grades in terms of improved writing skills (C1), and exam scores higher than those in a traditional course (C12).

In two of the four studies in which Technology Application was described primarily by the Component Display Model, the Responses in terms of Instructor Evaluation/Grades were primarily described by the Attribution Model (C3 and C9); in the other two studies (C8 and C11), no mention of Evaluation/Grades was found. Both studies C3 and C9 reported High levels of Evaluation/Grades in terms of outperforming those in a traditional course (C3) and increased outcomes (C9).

The Cognitive Domain: Presence.

Of those eight studies in which Technology Application was described primarily by either the Motivation or the Social Learning Models (C1, C2, C4, C5, C6, C7, C10, and C12), none addressed potential for Presence in terms of Technology Form or Application, one study expressed a motivation for Presence in Instructor/Designer Motivations (C4), no studies expressed a motivation for Presence in Learner Motivations, and no studies offered Evaluation/Grades relating to the Presence effect. Four studies offered general comments relating to a sense of Presence or feelings of non-mediation in terms of Responses of Learner Satisfaction: C1 – Not found; C2 – Not found; C4 – Social Presence, High, expressed as "I felt like I was talking to instructor in the classroom;" C5 – Spatial Presence, Low, because students felt technology was ineffective at achieving sense of being together; and Social Presence, Low, because students felt the technology was ineffective at bringing them together; C6 – Social Presence, Low, students did not feel a sense of being together; C7 – Not found; C10 – Not found; and C12 – Social Presence, High, because students perceived they were working together in a collaborative environment.

Of those four studies in which Technology Application was described primarily by the Component Display Model (C3, C8, C9, and C11), none addressed potential for Presence in terms of Technology Form or Application, none expressed a motivation for Presence in Instructor/Designer Motivations or Learner Motivations, and none offered Evaluation/Grades relating to the Presence effect. One study offered general comments relating to a sense of Presence or feelings of non-mediation in terms of Responses as Learner Satisfaction: C3 – Not found; C8 – Not found; C9 – Not found; C11 – Social Presence, Low, students expressed a sense of isolation because of the technology's ineffectiveness.

<u>The Psychomotor Domain: Models of Learning</u>

<u>Technology Form and Application</u>. There were five studies coded primarily in the Psychomotor Domain of Learning (P1-P5); all five were in the field of medical science, and all five indicated that both the Technology Form and Application were described primarily by a combination of the Social Learning, Motivation, Conditions of Learning, Operant Conditioning and Component Display Models of Learning: the Social Learning Model, focusing on the interactive nature of the technology and on individual needs to interact with others and other environments; the Motivation Model, focusing on elements of novelty, curiosity, interest, attention, and personal involvement in the technology; Component Display Model, focusing on the logical sequencing of instructions, objectives, stimuli, learner guidance with content and performance; Operant Conditioning, focusing on behavior as a result of conditioning through stimuli and

response; and Conditions of Learning, focusing on basic information or simple skills that are learned to contribute to more complex skills, e.g. verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes. The Technology Form and Application are described in the studies in the following way: P1 – A computer, screen, mouse and joystick and a specially designed data glove with sensors worn to assist in manipulating objects and movement within a virtual environment; P2 – An interactive sensory computer network; P3 – Sensory 3-D equipment displaying a simulated hospital environment; P4 – Human-computer interface technology, in the form of a mannequin head with two small TV cameras for eyes and two microphones for ears, 3-D glasses and stereo headphones used to create a life-like environment with use of real objects or events; P5 – A computerized treadmill, with overhead harnesses and a head display placing simulated obstacles of various sizes, shapes, colors, and locations in the user's path for experimental ambulatory training.

Instructor/Designer and Learner Motivations. Instructor/Designer and Learner Motivations were consistently described by a combination of the Social Learning, Motivation, Conditions of Learning, Operant Conditioning, and Component Display Models of Learning. In each of the five studies, Instructor/Designer Motivations key to the content of the curriculum, and knowledge or skill objectives are identified as the focus of the study: P1 – using technology to help foster positive motivation with people with disabilities; learning includes pulling virtual levers, wheels and boxes around on the screen monitor while having fun rehabilitating; the method is used as a way to analyze and interpret rehabilitation planning for the disabled person; P2 – using the VLE for physics instruction to enhance a disabled student's conceptual and manipulative experience; science laboratory courses are chosen because they require hands-on experience, which is challenging to the physically disabled student; P3 -- increasing the learner's awareness, use and recognition of her surroundings in a real hospital unit by training her in a virtual hospital unit; P4 -- using human-computer interface technologies including electronic sensors to measure the movement of the eye and the activation of facial muscles to allow severely handicapped people to move a cursor on a computer terminal in order to train them how to increase mobility within their limited environment and to accomplish their goals and be happy with their quality of life; and P5 – using treadmill equipment and virtual displays to train patients to effectively handle real situations such as walking in hallways, tripping hazards such as rugs and floor clutter, and common outdoor hazards such as uneven pavement, curbs, misplaced gardening equipment. Learner Motivations are identified as P1 -- to have a sense of escape within a virtual environment and to develop self-reliance, mobility and confidence in building strength in upper extremity functions; P2 – to acquire and have knowledge in the natural and physical sciences in order to increase chances of successful entrance into college, study of science, and employment in a high-demand field in order to counter experiences of limited access to employment, housing, education, and other normal life experiences; to be able to contribute to society and the social good rather than feel isolated from normal opportunities and cost society money in taxes; P3 -- to regain and maintain memory by use of repetition and location recall in a real environment through practice in the safety of a virtual environment; P4 -- to increase mobility within a limited virtual environment in order to accomplish goals and be happy with their quality of life; and P5 -- to increase awareness of potentially dangerous and unknown conditions in order to help regain confidence after falling, to increase freedom to travel in unstable or unsafe environments, and to develop independence and confidence in domestic mobility.

Responses. In each of the five studies coded in the Psychomotor Domain, Evaluation/Grades were rated High, and Learner Satisfaction was rated between Medium and High and were described by a combination of the Social Learning, Motivation, Conditions of Learning, Operant Conditioning, and Component Display Models of Learning, consistent with the Instructor/Designer and Learner Motivations. Learner Satisfaction was described in the studies as: P1 -- Many patients are in strong support of utilizing multi-sensory teaching techniques and in creating interactive teaching situations to assist in the generalization of skills from one setting to another; P2 -- Patients feel that they are increasing their chance of entering college by using an interactive virtual technology; P3 -- Patients feel they will regain and maintain memory by use of repetition and location recall in the interactive virtual environment; P4 -- By using this virtual technology, disabled persons feel they will be able to access the "Information Superhighway," use online services such as CompuServe, Prodigy, and AOL, and gain access to the Internet and World Wide Web; P5 -- Patients feel they are learning to effectively handle real-life hazardous situations by manipulating an interactive virtual environment. An example of an Evaluation was: P5 – Patients showed improvement in walking speed, cadence, stride length, and ability to step over stationary objects.

The Psychomotor Domain: Characteristics of Presence

Characteristics of Presence were noted in terms of the potential of the Technology Form and Application in each of the studies: P1 – Social Presence, Sensory -- An interface tool called the DataGlove, which can mediate a person's muscles and a computer to create virtual objects and synthesized speech; P2 -- Co-Presence, Sensory -- Interactive sensory computer network with software that generates virtual objects with no mass or resistance (i.e. virtual science lab instruments--gas jets, glassware etc.); P3 – Spatial, Sensory, Social Realism – Sensory 3-D equipment that displays a simulated hospital environment for an amnesia patient; P4 – Medium as Social Actor, Sensory -- A mannequin head with two small TV cameras for eyes, two microphones for ears, 3D glasses and stereo headphones used to create a life-like environment with use of real objects and events; P5 – Spatial, Social Realism -- A treadmill with overhead harness and computer head display placing simulated objects in patient’s way for ambulatory training.

Instructor/Design Motivations. In the Instructor/Designer Motivations, the Characteristics of Presence identified in the five studies focused on: P1 – Social Presence, Sensory -- to create a fun, productive and confidence-building learning environment for those with disabilities by using fiber optic technology, virtual objects, and voice synthesis; P2 -- Co-Presence, Sensory -- to provide a networked, sensory experience, so that disabled students from various places could be working continuously on the same experiment, thus providing cooperative learning experiences with additional benefits to learning; to modify the physical structures and characteristics of laboratory-oriented learning typically used in science education; P3 -- Spatial, Sensory -- to increase the learner's awareness of their surroundings in a virtual hospital through sensory equipment to promote use and recognition; P4 -- Medium as Social Actor, Sensory – to develop a computer interface system for a child; to create a real-life environment (simulcast) with human effects through an electronic mannequin so that the child is able to sense the true presence of swimming in a pool for the first time; main motivations are entertainment and enjoyment; and P5 -- Spatial, Social Realism – to allow patients to interact with relatively realistic environments but in rigorously controlled safe conditions; to develop a clinically useable system to measure and train performance of stepping over responses in frail elderly individuals who demonstrate impaired stepping over responses; also to demonstrate clinical efficacy in a randomized, controlled intervention study.

Learner Motivations. In Learner Motivations, Characteristics of Presence were noted as follows: P1 – Not found; P2 -- Co-Presence, Sensory -- to acquire knowledge in the natural and physical sciences through a unique sensory learning technology that offers an interactive experience for the physically disabled that would be essentially unavailable any other way; P3 – Not found; P4 -- Medium as Social Actor, Sensory -- to be able to use computer simulated environments with use of facial muscles (i.e. the cheeks, eyebrows or winking of the eye); to enjoy the fun of being a kid; P5 -- Spatial, Social Realism -- to be capable of moving about, being aware of obstacles and when faced with them, finding a way to maneuver the body without the risk of falling.

Responses. Characteristics of Presence in terms of Evaluation was not listed in specifically in any of the studies, but each study reported some patient improvement through use of the virtual environments. Presence in terms of Learner Satisfaction was identified generally as a willingness to keep using the virtual technology and specifically in one study (P3) as Medium-High in terms of Spatial, Sensory and

Social Realism characteristics – enthusiastic with regaining and maintaining of memory by use of repetition and location recall in real environment (hospital unit).

Discussion

In accordance with a similar research meta-analysis conducted by The Institute for Higher Education Policy in 1999, this VLE research analysis finds that there continues to be a need for more original research dedicated to explaining or predicting phenomena related to virtual learning. Generally, the original research in this analysis that fell primarily in the cognitive domain of learning was found to focus primarily on the technology and on the responses to the technology in terms of attitudes and overall satisfaction or practical considerations. Few studies in the cognitive domain took into consideration learning motivations or outcomes, and few offered specific perceptual motivations or outcomes, despite the fact that a consideration of motivations is a required educational standard in instructional design. Those studies that were coded in the psychomotor domain of learning, conversely, more often offered motivations in terms of learning, perceptual and practical criteria. It is through an examination of the relationship between technology and responses in terms of learning, perceptual and practical motivations that consistencies and inconsistencies began to emerge in the VLE studies and that specific areas of further research are proposed.

Content of curriculum

First, it should be stated that there is a clear need for original research to focus on a breadth of course topics. Most of the courses in this review were found to focus on communication, technology, or medical science related topics, e.g. "Computer-mediated communication and organizational change."

Subsequently and importantly, researchers should attempt to gather specific information about the learner's and instructor's learning, perceptual and practical motivations, which can be defined by and interpreted through the models of learning and the characteristics of Presence. Studies in the cognitive domain were especially weak in identifying learning and perceptual motivations, focusing more on learner practical motivations of convenience, flexibility, affordability, and technology fascination, loosely described by the Motivation and Social Learning models of learning and by the Social and Spatial characteristics of Presence.

Once instructor and learner motivations are identified, technology form and application in the VLE should be studied for consistency with these motivations.

Perhaps most importantly, research should investigate responses to the VLE in terms of the relationship between and among learning (evaluation/grades), practicality, and the perceptual state of Presence. In fact, in all of the studies, learner satisfaction and Presence reflected parallel ratings. In many of the studies, however, evaluation/grades were not noted.

The importance of Presence

While this analysis does not find evidence to support or refute cause-and-effect relationships or correlations between and among technology, motivations, and responses in the VLE, it is worth noting that in the cognitive domain studies in which there was inconsistency between or among two or more of the elements of technology, learning motivations, practical motivations, and perceptual motivations, there was inconsistency in the ratings of learning, practicality, and/or Presence responses: learning response, high – C1, C3, C9 and C10; practicality response, high – C1, C2, C3, C4, C7, C8, C9 and C12; practicality response, low – C1, C4, C5, C6 and C11; Presence response, high – C4 and C12; Presence response, low – C5, C6 and C11. Learning, practical and Presence responses were not identified in some of the studies. Reasons identified for low Presence and for low satisfaction in C5, C6 and C11, and for low satisfaction in C1 and C4, in fact, pointed to a possible failure at identifying and addressing the learners' perceptual and practical motivations, e.g. students felt the technology was ineffective at achieving a sense of being together, and students expressed a sense of isolation because of the technology's ineffectiveness. Reasons for high Presence and satisfaction in C4 and C12, for satisfaction in C1, C2, C3, C7, C8 and C9, and for high learning responses in terms of evaluation/grades in C1, C3, C9 and C10, likewise, pointed to possible success in identifying and addressing the learners' perceptual, practical and/or learning motivations, e.g. students "felt like [they were] talking to the instructor in the classroom;" writing skills improved.

Conversely, in the five studies coded in the psychomotor domain of learning, in which there was generally consistency between and among the elements of technology, learning motivations, perceptual motivations, and practical motivations, there was consistency in the learning, practical and/or Presence responses, with ratings of medium to high (P1-P5).

Applying perception and learning

This analysis suggests that an evaluation of the technology alone may be insufficient in understanding the responses to the VLE. A combination of factors, including academic, perceptual and practical motivations, may be vital to transforming the technology from its raw form to an effective application that evokes high responses of learning, satisfaction, and Presence or engagement in the learning process.

The analysis indicates that the use of high forms of technology did not necessarily result in high levels of Presence and/or satisfaction. For instance, in C5 and C6 in which satisfaction and Presence levels were low in the categories of Spatial and Social Presence, the applications were sophisticated audio-visual interactive videoconferencing systems, yet (C5) the students were bothered by the "camera... seeing themselves on TV monitors, and . . . delays in the audio system;" and (C6) the students felt a sense of isolation. In C9 in which the satisfaction level was high, the application of the technology was a relatively uncomplicated Web site and e-mail system that evoked a sense of effective collaborative use of the technology and a feeling of satisfaction that increased over time. In the psychomotor domain of learning, in which there was generally consistency between high-tech technology forms and applications, e.g. virtual reality headsets, robotics, and 3-D displays, the levels of Presence ranged from medium to high in the categories of Social Presence, Spatial Presence, Co-Presence, Social Realism, and Medium as Social Actor.

Moving forward

In order to increase the instructor/designer's chances of tapping the VLE's potential, it seems essential that research provide a richer understanding of the technology--motivation--response equation through a more thorough investigation of learning and perceptual motivations and responses inherent in the virtual learning experience. It is unlikely that the VLE, a uniquely two-way interactive technology-mediated learning environment, can succeed if a combination of both perceptual and learning factors are underemphasized or ignored.

In particular, this snapshot of the research in a rapidly evolving virtual learning field uncovers a lack of awareness or acknowledgment of the potential of Presence. There is a paucity of research investigating the importance of the invisibility of the medium in understanding VLE learning motivations, in designing and applying VLE technology, and in attaining positive learning and perceptual responses. The research suggests that the success of the learning experience may be inadequately determined if testing concentrates solely on practical considerations, e.g. convenience, flexibility, interactivity, interest, but ignores learning motivations and responses or Presence expectations and experiences and the interaction of these. While the nature of Presence itself is elusive, testing for Presence must be concerted, as it may hold the key to understanding to what extent the form of the technology, or rather, the invisibility of it, helps generate a successful virtual learning experience.

Further research

Future research should explore individual learning styles and approaches as well as specific demographic factors of learners and the availability and affordability of the technology in the VLE experience. Importantly, research should probe further the reliability and validity of methods used in

VLE studies to date. Ultimately, a working model of virtual learning should consider the usefulness of course design in the broader program and university context.

Appendix A

Table 1

Principal Psychological Models of Learning

1) Operant Conditioning (Skinner, 1954) incorporates the view that learning is behavioral change based on stimuli and responses, e.g. when the microcomputer is used to teach basic skills like identification, discrimination, and problem solving, often in drill and practice programs. An example would be a children's software program that teaches colors by flashing them on a screen and soliciting a touch-screen response for verbal representations of the color.
2) Conditions of Learning (Gagne, 1985) examines the complex nature of human learning as a cumulative process. Basic information or simple skills that are learned contribute to more complex knowledge and skills, i.e. learning names, dates, definitions and facts which provide basic terminology for a topic; learning how to use verbal information to generalize and group facts, to form concepts and rules and to use these to solve problems; learning how to use motor skills such as typing, swimming or tool use; developing beliefs and behaviors toward persons, objects, events.
3) Component Display (Merrill, 1983) classifies learning outcomes in terms of content (facts, concepts, procedures, and principles) and performance (remembering, using, and finding a generality). In delivery of instruction, the theory distinguishes between primary presentation forms (expository presentation of a rule, an example, recall, and practice) and secondary presentations forms (prerequisite material, attention-focusing help, mnemonics, and feedback), i.e. each lesson segment identifies an objective based on the content and performance elements and provides detailed guidelines for presenting stimuli, contributing to learner guidance, and promoting transfer of learning. An example would be an online string or guided e-mail discussion.

4) Elaboration (Reigeluth and Stein, 1983) offers an alternative to the cumulative approach by sequencing content in terms of increasing complexity, i.e. the most simple application is taught first, then details are added until the objective is attained. At each step, the learner is reminded of the procedure and the relevance of it as a whole, e.g. a math software program that adds more difficult problems as the learner accomplishes each task until the total objective is accomplished.
5) Information-Processing (Norman, 1976) views the brain as a complex organ that stores information in short-term and long-term memory with the help of advanced organizers such as examples and analogies, instruction-based aids such as synonyms, and learner-generated cues such as rhymes and acronyms. Examples would include a history CD-ROM system with biographical audio clips recited in first-person.
6) Social Learning (Bandura, 1986) explains that certain learning takes place through observations of models and through an interaction among these models, the environment, and personal factors. The attention is given to personality factors and interactions among people. This theory explains that certain learning takes place through the ability of individuals to observe the behaviors of other persons serving as models. These models can be exhibited in the mass media, e.g. film, video and television instruction. An example would be Internet-based interaction through e-mail or teleconferencing.
7) Attribution (Weiner, 1980) seeks to identify ways the learner learns through inferences (s)he makes about the world and the outcomes (s)he anticipates in the areas of ability, efforts, luck, and task difficulty. The search for understanding is a primary source of motivation for human behavior, so motivation plays an important part in this theory. Feedback from success or failure affects individual motivation and the determination to continue with learning. An example would be a simulated tread mill virtual reality system for disabled elderly that helps develop walking skills by building confidence through graduated task difficulty.

8) Motivation (Keller, 1983) identifies degree of commitment as important to learning and considers interest, relevance, expectancy or confidence, and satisfaction keys to learning. An example would be a head-mounted display that recreates real-life experiences or arouses interest by altering reality.

Appendix A

Table 2

Guide Psychological Models of Learning (Technology) (GM1)							
Operant Conditioning	**Conditions of Learning**	**Component Display**	**Elaboration**	**Information-Processing**	**Social Learning**	**Attribution**	**Motivation**
• Primary presentation forms or expository presentation of both a generality (rule) and an instance (example), inquisitory generality (recall), and inquisitory instance (practice) • Secondary presentation forms or prerequisite material, attention-focusing help,	• Basic information or simple skills that are learned to contribute to more complex skills, e.g. verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes.	• Each lesson segment identifies an objective based on content and performance.	• Instruction is ordered in terms of increasing complexity.	• Use of advanced organizers such as examples and analogies • Development of instruction-based aids such as synonyms, questions in text • Use of learner-generated cues such as rhymes, acronyms, images.	• Learning is through contact with and observation of live models and portrayals.	• Use of understandings to achieve personal fulfillment and self-actualization.	• Novel and unexpected events in instruction; concrete language and examples to which the learner can relate • Providing opportunities to achieve excellence under conditions of moderate risk • Using attributional feedback devices to help learners connect success to personal effort and ability • A combination of extrinsic and intrinsic rewards.

mnemonics, feedback.							

Appendix A

Table 3

Guide to Psychological Models of Learning (Motivations) (GM2)							
Operant Condi-tioning	**Conditions of Learning**	**Component Display**	**Elaboration**	**Information-Processing**	**Social Learning**	**Attribution**	**Motivation**
• Behavior as a result of conditioning through stimuli and response; • Feedback through immediate knowledge of results; • Reinforce ment through reward.	• Cumulative approach through selective perception of stimulus feature; • Semantic encoding or providing learning guidance; • Retrieval and responding or eliciting per-formance; • Reinforceme nt or providing informative feedback; • Cueing re-trieval or assessing performance; • General-izing; • Attending or gaining attention.	• Instruction objectives, stimuli, learner guidance and transfer of learning are aligned with content and performance; • Content (facts, concepts, procedures, and principles) and performance (remembering, using, and finding a gener-ality).	• Elaborations relate to more than a single idea or concept, and at each step in the process, the learner is reminded of the procedure as a whole; • Learner sees the reason for each step in the process.	• Advanced or-ganizers, aids and cues help the brain store information in short-term and long-term memory centers; • Information recall and pattern recognition through use of advanced or-ganizers, aids and cues.	• Learner makes choices about the behaviors of others and adapts those (s)he wants to emulate (model); • There is a three-way interaction be-tween the envi-ronment, personal factors and behavior models; • Outcomes are individual visual and verbal cues of behav-ior.	• A person searches for understanding by choosing one of these causes to explain success or failure out-comes: ability or feelings of confidence or incompetence; effort or feelings of pride for success; • Luck or no change in success expectancy; and task difficulty or no enhancement of self-esteem for success outcome; • Feedback from success or failure and actions following an outcome affect the individual's motivation and determination to keep learning.	• The learner's curiosity and attention are aroused; • Learner can relate instruction to satis-fying personal needs; • The learner per-ceives the likelihood of success in learning and the extent to which the learning is under his control; • The learner is mo-tivated to continue learning through extrinsic and intrinsic rewards; The learner's curiosity and attention are aroused; the learner can relate instruction to satisfying personal needs; the learner per-ceives the likelihood of success in learning and the extent to which the learning is controlled, motivating.

Appendix B

Table 1

Guide to Characteristics of Presence (GP)	
(1) Spatial presence (or Physical Presence, A Sense of Physical Space, Perceptual Immersion, Transportation, A Sense of Being There)	This occurs when part or all of a person's perception fails to accurately acknowledge the role of technology that makes it appear that s/he is in a physical place different from her/his actual location and environment in the physical world. * An example: A variety of stimuli provided by a virtual reality system can cause the user to perceive that s/he is moving through and interacting with the environment created by the technology rather than the user's actual physical environment; the user may comment, "It seemed as if I was someplace else!"
(2) Sensory Presence (or Perceptual Realism, Naturalness, Ecological Validity, Tactile Engagement)	This occurs when part or all of a person's perception fails to accurately acknowledge the role of technology that makes it appear that s/he is in a physical location and environment in which the sensory characteristics correspond to those of the physical world, i.e., s/he perceives that the objects, events, and/or people s/he encounters look, sound, smell, feel, etc. as they do or would in the physical world. * An example: Because it provides large, high resolution, three-dimensional images and high fidelity, dimensional sound, a 3D IMAX film presentation can cause the viewer to perceive that s/he is in an environment that looks and sounds as the viewer believes it does or would in the physical world; the user may comment, "It seemed so real!"
(3) Social Realism	This occurs when part or all of a person's perception fails to accurately acknowledge the role of technology that makes it appear that s/he is in a physical location and environment in which the social characteristics correspond to those of the physical world, i.e., s/he perceives that the objects, events, and/or people s/he encounters do or could exist in the physical world. * An example: A well written, well acted, filmed version of events that have occurred in the physical world can lead the film viewer to perceive that s/he is in an environment in which objects, events, and people act and/or respond in the way(s) the viewer believes they did or would in the physical world; the user may comment, "It seemed so realistic!"
(4) Engagement (or Involvement, Psychological Immersion)	This occurs when part or all of a person's perception is directed toward objects, events, and/or people created by the technology, and away from objects, events, and/or people in the physical world. Note that the person's perception is not directed toward the technology itself but the objects, events and/or people the technology creates. * An example: A virtual reality system, 3D IMAX film, or a well written and acted film can cause the user or viewer to devote all of her/his mental effort to processing the stimuli created by the technology and ignore stimuli (e.g., other people, equipment, furniture, etc.) in her/his actual physical environment; the user may comment, "It was so involving!"

Appendix B

Table 2

Guide to Characteristics of Presence (GP)	
(5) Social Presence (distinct from Social Realism)	This occurs when part or all of a person's perception fails to accurately acknowledge the role of technology that makes it appear that s/he is communicating with one or more other people or entities.
(6) Social Actor Within the Medium (or Parasocial Interaction)	This occurs when part or all of a person's perception fails to accurately acknowledge the role of technology in her/his perception that s/he is engaged in two-way communication with another person or people, or with an artificial entity (e.g., a computer "agent"), when the communication is in fact one-way, from the technology to the person without feedback from the person to the other entity(ies). * An example: Those who create and appear in television programs use a variety of techniques (e.g., direct address and sincerity) that can lead the viewer to feel that s/he is interacting with and/or in a "relationship" with the personalities and characters s/he encounters; the user may comment, "It seemed like we were interacting!"
(7) Co-Presence (or Transportation: Shared Space)	This occurs when part or all of a person's perception fails to accurately acknowledge the role of technology in her/his perception that the person or people with whom s/he is engaged in two-way communication is/are in the same physical location and environment when in fact they are in a different physical location. * An example: Advanced video-conferencing systems can create for a user the illusion that s/he is in a face-to-face meeting in which all the participants are in the same room; the user may comment, "It felt like we were all together there."
(8) Medium as Social Actor	This occurs when part or all of a person's perception fails to accurately acknowledge the role of technology in her/his perception that s/he is engaged in communication with another entity when in fact the other entity is merely a technology or medium (e.g., computer, television, etc.). * An example: The ability of a computer to interact with a user in real-time, use human (rather than machine or technical) language, and fill a social role (e.g., bank teller or teacher) can lead even an experienced user to follow social norms (e.g., regarding gender stereotypes and third-party evaluations) that are usually reserved for human-human interaction; the user might not be aware of this phenomenon, but if s/he is, s/he may comment, "It seemed like a person!"

Appendix C

Guide to Domains of Learning (GD)	
(1) Psychomotor	Involving performance skills through use of motor functions
(2) Cognitive	Including a range of intellectual levels from knowledge to comprehension, application, analysis, synthesis and evaluation
(3) Affective	Focusing on attitudes, appreciation and values

Appendix D

Table 1

Virtual Learning Environment (VLE) Coding Sheets

Instructions for each study:

1) Please read the VLE (Virtual Learning Environment) study carefully, looking for any identifications or descriptions of technology, instructor and learner motivations and learner responses.
2) Determine the course content of the VLE identified in the study.
3) **Begin coding Coding Sheet M**. Assign it a case identification letter and number, beginning with a 'C' if it involves primarily cognitive thinking skills, a 'PM' if it involves primarily psychomotor skills, and an 'A' if it involves learning focusing primarily on attitudes and impressions, e.g. Case C1. Refer to Guide to Domains of Learning (GD) to assign a case letter based on course content.
4) Identify yourself as the Coder with your initials, e.g. HH for Ha Sung, CM for Cheyene, and MS for Melissa.
5) Assign a date in the format of "mm/dd/yy," e.g. 04/09/01.
6) Identify the Technology used in the VLE (Form or type of technology used – hardware; and Application of the technology – software, presentation); the Motivations (Instructor/Designer and/or Learner) for learning in the VLE, and the Responses (Evaluation/Grades and Learner Satisfaction).
7) Decide which of the eight Psychological Models of Learning best describe(s) the Technology, Motivations and Responses and chart accordingly, citing examples (e.g. a CD ROM math program with a built-in rewards system might be best described by the Information-Processing Model and the Motivation Model). Refer to Guides GM1 and GM2 to the Eight Psychological Models of Learning to code.
8) **Begin coding Coding Sheet P**. Repeat steps #1-#6.
9) Decide which of the eight Characteristics of Presence best describe(s) the Technology, Motivations, and Responses and chart accordingly, citing examples. Refer to Guides GP1 and GP2 to the Characteristics of Presence to code.
10) **Begin coding Coding Sheet D**. Repeat steps #1-#5.
11) Decide which of the three Domains of Learning best describe(s) the course content, and chart accordingly, explaining your decision. Refer to the Guide GD to the Domains of Learning to code.
12) Submit each Coding Sheet to the assigned member as you complete it.

Appendix D

Table 2

Coding Sheet M: Psychological Models of Learning (Please refer to Psychological Models of Learning Guides (GM1 and GM2) for reference)						
Case # ______ Coder __________ Date ___________	<u>Technology</u>		<u>Motivations for Using VLE</u>		<u>Responses</u>	
	Form (type)	Application (presentation)	Instructor/ Designer	Learner	Evaluation/ Grades	Learner Satisfaction
(M1) Operant Conditioning						
(M2) Conditions of Learning						
(M3) Component Display						
(M4) Elaboration						
(M5) Information-Processing						
(M6) Social Learning						

(M7) Attribution						
(M8) Motivation						

Appendix D

Table 3

Coding Sheet P: Characteristics of Presence (Please refer to Characteristics of Presence Guide (GP1 and GP2) for reference)						
Case # ______ **Coder ___________** **Date ____________**	**Technology**		**Motivations for Using VLE**		**Responses**	
	Form (type)	**Application (presentation)**	**Instructor/ Designer**	**Learner**	**Evaluation/ Grades**	**Learner Satisfaction**
(P1) Spatial presence (or Physical Presence, A Sense of Physical Space, Perceptual Immersion, Transportation, Being There)						
(P2) Sensory Presence (or Perceptual Realism, Naturalness, Ecological Validity, Tactile Engagement)						
(P3) Social Realism						
(P4) Engagement (or Involvement, Psychological Immersion)						
(P5) Social Presence (distinct from Social Realism)						
(P6) Social Actor Within the Medium (or Parasocial Interaction)						
(P7) Co-Presence (or Transportation: Shared Space)						
(P8) Medium as Social Actor						

Appendix D

Table 4

Coding Sheet D: Domains of Learning (Please refer to Domains of Learning Guide (GD) for reference)	
Case # ______ Coder ________ Date ___________	Learning Focus
Cognitive	
Psychomotor	
Affective	

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Part A: Original research studies in annotation

C8: Arbaugh, B. J. (2000). How classroom environment and student engagement affect learning in Internet-based MBA courses. Business Communication Quarterly, 63, (4), 9-26.

By using survey methods, the study examined the effects of technological, pedagogical, and student characteristics on learning in Internet-based MBA courses. The findings suggested that (a) students had high level of perceived learning; and (b) instructor emphasis on interaction and ease of interaction were associated with the student's perception of online learning and his learning outcomes. The interactive teaching style of the instructor was strongly associated with that learning.

P3: Brooks, B.M., McNeil, J.E., Rose, F.D., Greenwood, R.J., Attree, E.A. & Leadbetter, A.G. (1999). Route learning in a case of amnesia: The efficacy of training in a virtual environment. Neuropsychological Rehabilitation, 9(1), 63-76. Retrieved February 10, 2001, from the World Wide Web: http://homepages.uel.ac.uk/E.A.Attree/vr.html

Through experimentation, the study examines an amnesia patient, who was trained on routes around a hospital unit using a detailed computer-generated 3D virtual environment based on the real unit. Prior to the training, she was able to perform ten simple routes around the real unit, all involving locations which she visited regularly.

C3: Chadwick, S. A. (1999). Teaching virtually the Web: Comparing student performance and attitudes about communication in lecture, virtual web-based, and web-supplemented courses. Electronic Journal of Communication, 9 (1).

Using a survey method, this study explores students' performance and attitudes in traditional, Web-based, and Web-supplemented courses. The results indicated that students found communicating via email and the Web with their classmates and teacher easy, effective, and satisfying. Also students in Web courses outperformed those in traditional courses and had positive attitudes toward Web using.

C5: Comeaux, P. (1995). The impact of an interactive distance learning network on classroom communication (1995) Communication Education, 44, (4), 353-361.

Using a qualitative methodology (observation and interview), the study examined how an interactive distance learning network impacted the communication and learning process in the classroom. The findings revealed the negative aspects of this learning because (a) communication and interaction were hampered by cameras, and microphones; and (b) students felt uncomfortable seeing themselves on the television monitors. Some findings, however, suggested that if the instructor used a sense of humor or a relaxed interpersonal style, the situation would be perceived more positively on the network.

C9: Flanagin, J. A. (1999). Theoretical and pedagogical issues in computer-mediated interaction and instruction: lessons form the use of a collaborative instructional technology. Electronic Journal of Communication 9 (1).

This case study (based on longitudinal data) indicated that (a) users became highly proficient in the use of web-based technology; (b) users felt it as a collaborative tool; and (c) satisfaction with group process and outcomes, and enjoyment of the process of working, increased over time.

C2: Hacker, K. and Wignall, D. (1997). Issues in predicting uses acceptance of computer mediated communication in inter-university classroom discussion as an alternative to face-to-face interaction. Communication reports, 10(1), 107-114.

Using a survey method, the study examined how students perceived computer conferencing technology. The results indicated that the initial acceptance of the technology, the degree of how

computer-mediated communication (CMC) made the courses more interesting, affected students' perceptions on CMC.

C11: Hara, N. & Kling, R. (2000). Students' frustrations with a Web-based distance education course. Journal on the Internet. Retrieved March 20, 2001 from the World Wide Web: http://www.firstmonday.dk/issues/issue4_12/hara/ or http://ccd.ubbcluj.ro/Curs/Web-frustration.html

This study presents a qualitative case study (observation, interview, and document review data) of a web-based distance education course. By arguing that many researchers were optimistic about distance learning, this study focused on the negative aspects of online learning such as student frustration toward using the technology, their feelings of "isolation," and their lack of feedback from the instructor.

C6: Hiltz, S. R. (1986, Spring). The "virtual classroom:" Using computer-mediated communication for university teaching. Journal of Communication, 36 (2), 95-104.

By surveying students in computer conferencing courses, the study found advantages to some students in terms of access and interactive opportunities between the teacher and student.

P5: Jaffe, David L. (1998) Use of virtual reality techniques to train elderly people to step over obstacles. Retrieved February 24, 2001, from the World Wide Web: http:// http://www.dinf.org/csun_98/csun98_001.htm

This research uses experimentation to study ambulatory training on the treadmill. Overhead harnesses are employed to stabilize persons with impaired gait. Simulated environment techniques are explored to address some of the shortcomings of current training methods.

C1: Kearsley, G., Lynch, W., and Wizer, D. (1995). The effectiveness and impact online learning in graduate education. Educational Technology, 35 (6), 37-42.

The study discussed student outcomes in online graduate courses by using a survey method. The results indicated that students perceived that the use of online learning enhanced communication and learning although they disliked the complexities associated with technologies.

C10: Goldberg, H.R. & McKhann, G.M. (2000). Student test scores are improved in a virtual learning environment. Advances in Physiology Education, 23 (1), 559-566.

The quantitative study evaluated the effectiveness of a virtual learning interface (VLI). The students' performance in the VLI was compared with that of students' performance in a conventional class. The results indicated that the raw average score on a weekly exam were 14 percent points higher for students in the VLI, and normalized test scores were more than 5 points higher for students in the VLI.

P2: Nemire, K., Burke, A., and Jacoby, R. (1993) Virtual learning environment for disabled students: Modular assistive technology for physics instruction. Center on disabilities virtual reality conference. Retrieved February 1, 2001, from the World Wide Web: http://www.csun.edu/cod/93virt/AVRSE~1.html

This study used a qualitative approach through interviewing of professionals who work extensively with physically disabled individuals. A number of key issues were raised consistently. These included the concerns about: (a) limited mobility, (b) loss of control over environment, (c) reduced manual capabilities, (d) isolation, and (e) limited access to education and employment.

C4: Russo, C. T., Campbell, S., Henry, M., and Kosinar, P. (1999). An online graduate class in communication technology: Outcomes and lessons learned. Electronic Journal of Communication, 9 (1).

By examining an online course entitled "Computer-mediated Communication and Organizational Change" through telephone interviews, this study sought to explore students' responses to the virtual learning environment. The objectives of the course designer was to present pertinent and engaging content and to support establishment of social presence for each participant. The study suggested that (a) the best motivations for students were flexibility and curiosity about course delivery technology; (b) most agreed that they learned more because of the delivery system, but some students suffered from technology problems and lack of face-to face meetings; and (c) most agreed that students felt a sense of "social presence" and said that they were comfortable interacting with the instructor electronically.

C7: Swan, M.K. (2000). Effectiveness of distance learning courses: Student's perceptions. Retrieved March 14, 2001, from the World Wide Web: http://www.ssu.missouri.edu/SSU

By using observation and survey questionnaire techniques, the study explored student perceptions on two- way interactive network courses. Students were satisfied with the quality of the courses and thought that the experience would benefit them in the future.

C12: Trentin, G. & Benigno, V. (1997). Multimedia conferencing in education: Methodological and organizational considerations. Educational Technology, 37 (5), 32-39.

By observing desktop conferencing, this case study investigated how the technology helped to improve the effectiveness of the learning process. The results indicated that (a) participant motivation was raised; (b) collaborative skills were perceived highly and developed; and (c) general areas such as planning, multiculturalism, and cognition benefited by the use of the technology.

P1: Warner, D. (1995). Virtual reality: Focuses on the quality of life. Paper presented at the Virtual Reality and Persons with Disabilities Conference, San Francisco, CA.

This study uses experimentation to study the effect of a technology being developed at Loma Linda University Children's Hospital to help sick children and severely handicapped people attain a better quality of life by practicing motor control in a virtual environment.

P4: Warner, D. (1995). Virtual reality: Focuses on the quality of life. Paper presented at the Virtual Reality and Persons with Disabilities Conference, San Francisco, CA.

This study uses experimentation to explore the effects of an interface tool called the Bio-Muse that mediates a person's muscles and a computer. An actor was hooked up to a computer via the facial muscles to help create an animated 3-D talking head on the computer screen. During the experiments, children who had not smiled in weeks began to laugh.

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Part C: Additional essays, articles and reports

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