In Search of Presence: A Systematic Evaluation of Evolving VLEs

Abstract

In an attempt to understand better the unique characteristics of an increasing popular, prevalent form of sense-engaging and interactive multimedia learning experience often called the “virtual learning environment” (VLE), this study systematically evaluates and analyzes the findings of seventeen original research studies in terms of technologies, teaching strategies, presence, and learning.

This evaluation identifies potentially significant relationships among these variables in VLEs with both low- and high-level learning objectives, from memorization and repetition to analysis and synthesis. The findings suggest, first, that, when technologies and teaching strategies are presented through a one-way immersion of the senses, learners most often respond with experiences of spatial presence; when technologies and teaching strategies are socially interactive in format, learners most often respond with experiences of social presence. This evaluation, importantly, suggests that levels of spatial presence may correlate with the achievement of lower-level learning objectives, that levels of social presence may correlate with the achievement of higher-level learning objectives, and that levels of spatial and social presence together may correlate most strongly with the achievement of higher-level learning objectives. The evaluation, finally, identifies a need and establishes a course for the consideration of presence in future VLE design and research.

I Introduction

During the 1990s, the face-to-face academic classroom changed significantly, particularly with the growing development and availability of electronic technologies, namely the computer. By the late 1990s, many classrooms had transformed into distance-learning environments built around communication technologies capable of facilitating social learning experiences, or psychological illusions of social interaction about subject matter, among physically separated teachers and learners (Learning and the Impact of Technology, 2001; The California Distance Learning Project, 1997). At the start of the twenty-first century, a growing number of educators and curriculum designers are taking the classroom to a new level by identifying electronic technologies that are not solely socially interactive but spatially or sensorially immersive as well, capable of evoking psychological illusions of perceptually “real” teachers and subject matter. This new multimedia learning experience is increasingly called the “virtual learning environment” (VLE).
Although a growing number of VLEs are beginning to include some three-dimensional electronic technologies such as virtual reality (VR), most continue to include two-dimensional technologies such as digital photographs, TV, videos, and films (Farrell, 1999; Palloff & Pratt, 1999). It is, in fact, this variation of technology types and intensities that is serving to define the evolving VLE as an environment whose designers base technology choices not solely on a technology’s apparent sophistication but on its potential to evoke spatial and social psychological illusions of teachers and subject matter conducive to learning. The education literature, in fact, has historically proposed a positive correlation between technology-evoked spatial and social illusions of teachers and subject matter and learning achievement (Kemp & Smellie, 1994), but has failed to identify the qualities that render technologies in a sense “invisible” so that teachers and subject matter might seem spatially and socially “visible.” The success of the VLE, therefore, may depend first and foremost on measures of illusions of nonmediation that enable illusions of teachers and subject matter, or spatial and social presence. Ultimately, the success of the VLE may depend upon the relationship of spatial and social presence to educational technologies, associated teaching strategies (organized plans for presenting the technologies), learning objectives, and learning achievement.

A few researchers have begun to explore the role of presence in VLEs, but most have failed to differentiate between spatial and social presence and to detail the characteristics of technologies and teaching strategies related to spatial and social presence. Further, most of the research has failed to associate spatial and social presence with levels of learning objectives and learning achievement. The authors of this systematic evaluation, therefore, have identified a sample of seventeen original research studies that fit the authors’ description of the VLE and that describe in some detail the types of technologies and teaching strategies used for learning, the learning objectives, the learners’ psychological “misperceptions” of technologies indicative of presence, and the levels of learning achievement. The authors have categorized technologies and teaching strategies as one-way sensory and/or two-way interactive, learning objectives as low (physical training) or high (cognitive or educational), and psychological responses as low or high spatial and/or social presence based on definitions extracted from the education and communication literatures (See Table 1.) The authors have identified patterns among these variables to provide valuable insights into the potential relationships of spatial and social presence to educational technologies, teaching strategies, and learning and to encourage the consideration of presence in future VLE research and design.

The following sections first offer an overview of the history of the VLE, tracing its beginnings to the distance-learning environment of the late-twentieth century. The authors reflect on distance-learning models of the late 1990s and a narrow classification of technologies and teaching strategies in terms of social mediation, focusing largely on the potential of telephone and Internet technologies to facilitate learner-teacher communication about subject matter. The authors then draw from traditional learning theories that propose the importance of technologies and teaching strategies to evoke both two-way interactive and one-way sensory, or spatially immersive, illusions of teachers and subject matter for a richer and potentially more meaningful learning experience. Subsequent sections present two evolving categorizations of presence—spatial and social—particularly relevant to the one-way sensory and two-way interactive classifications.

Research questions then seek to identify the extent to which VLE researchers have reported evidence of one-way sensory and two-way interactive technologies and teaching strategies in the VLEs and to what extent they have listed learner responses that fit the definitions of spatial and social presence and learning achievement. Results and discussion sections, finally, present patterns among the one-way sensory and two-way interactive technologies and teaching strategies, learning objectives, levels of spatial and social presence, and learning achievement, and offer a course for more, purposeful research into the role of presence in the VLE.
2 Theoretical and Practical Evolution of the VLE

As advances in information and communication technologies opened up new opportunities for teaching and learning at a distance in the late-twentieth century, administrators, educators, and students began to identify advantages to incorporating distance-learning programs into their curricula (Farrell, 1999; Phipps & Merisotis, 1999; Milligan, n.d.). On college and university campuses in particular, business programs began to include audiovisual conferencing systems that allowed students and teachers greater flexibility to explore academic resources while maintaining a working lifestyle. With the development of computer-networked systems and eventually the Internet and the World Wide Web, distance learning quickly grew to include two-way textual, visual, and aural communication, such as email, Web-based bulletin boards, listservs, and synchronous online discussions. The computer technologies became widely available, affordable, and desirable by the end of the 1990s. National surveys showed that 78% of public four-year institutions and 62% of public two-year institutions offered some form of distance-learning technol-

### Table 1. Terms and Definitions

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definition</th>
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<tr>
<td>VLE</td>
<td>A multimedia environment in which the designer attempts to use technologies and teaching strategies to evoke psychological perceptions of spatial immersion (being there) and social interaction among teachers, learners, and subject matter</td>
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<tr>
<td>One-way sensory technology and teaching strategy</td>
<td>Technologies and organized plans for presenting the technologies to evoke a psychological illusion of seeing, hearing, touching, et cetera, “real” teachers and/or subject matter, such as, text, pictures, photographs, slides, films, TV, audiotapes, videotapes, artifacts, and simulations</td>
</tr>
<tr>
<td>Two-way interactive technology and teaching strategy</td>
<td>Technologies and organized plans for presenting technologies to evoke a psychological illusion of teachers and/or subject matter that can see, hear, touch, or somehow respond to the learner</td>
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<tr>
<td>High/low spatial presence</td>
<td>Psychological perceptions of seeing, hearing, touching, et cetera, “real” persons, places, or things. In this evaluation, spatial presence is considered highest when a technology user fails to see the technology creating the illusion and lowest when he/she notices the technology</td>
</tr>
<tr>
<td>High/low social presence</td>
<td>Psychological perceptions of technology-mediated persons, places, or things that can see, hear, touch, or somehow respond to the technology user. In this evaluation, social presence is considered highest when the perceived interaction involves a human’s response and lowest when it involves an object’s response</td>
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<td>Lower-level learning objectives (physical training VLEs)</td>
<td>A VLE with lower-level learning objectives involving little manipulation of facts and little formation of cognitive ideas and concepts, such as memorizing, understanding, repeating tasks</td>
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<tr>
<td>Higher-level learning objectives (educational VLE)</td>
<td>A VLE with higher-level learning objectives involving the manipulation of facts into cognitive ideas and concepts, such as analyzing and synthesizing</td>
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At the very end of the twentieth and start of the twenty-first centuries, with the growing availability of more-advanced multisensory technologies, such as three-dimensional audiovisual communication systems and desktop computer programs, some educators began to recognize the value of a sensorially or spatially immersive learning experience (Phillips, 1998). Psychological illusions of spatial immersion increasingly became as great a concern as psychological illusions of social interaction, and the distance-learning environment began to transform into the “virtual” learning environment. Primarily for economic reasons, nonetheless, most institutions continued to rely on two-dimensional technologies to form their VLEs, integrating these together to form desired spatial and social illusions. For instance, one of the first business schools to call itself “virtual” was Colorado State University, which combined video-taped lectures with online collaborative sessions to provide learners with a sense of presence and interaction with teachers and subject matter (Phillips, 1998). At this writing, most universities have some multimedia learning programs they call VLEs, and a few, such as Carnegie Mellon and the University of Wisconsin–Whitewater, have begun to integrate three-dimensional technologies into their lesson plans (Hamm, 2000).

2.1 Distance-learning Technology Classifications

As the VLE evolves, educators and curriculum designers have available to them a growing number of electronic technologies with which to evoke spatial and social illusions of teachers and subject matter. The distance-learning literature of the late-twentieth century, however, offers them few guidelines for understanding the technologies’ potential to optimize the psychological illusions. Much of the distance-learning technology and teaching strategy guidelines, instead, focus on the practical and social characteristics of convenience, ease of delivery, and affordable communication.

The distance-learning models, in fact, emerged initially to identify and evaluate the logistical advantages and disadvantages of a rapidly changing communication infrastructure. The at-home model, for instance, focused primarily on the characteristics of technologies that enabled independent study and user control. The connected model focused primarily on the potential of communication networks to facilitate both convenient and affordable at-home or at-work study while maintaining connection with the teacher, such as user control and interactivity (Farrell, 1999; The California Distance Learning Project, 1997). Although some of the distance-learning research has referenced technology scales that associate task accomplishment with psychological responses (“social learning theory (Bandura, 1986) and media richness theory (Daft & Lengel, 1984), few have related these scales to advanced learning technologies, categorized psychological perceptions in terms of spatial and social illusions of teachers and subject matter, and related these illusions to learning objectives and learning achievement.

2.2 Traditional Models to Guide the VLE

Traditional learning models that have guided the use of less-advanced technologies in the face-to-face classroom over the last fifty years may offer VLE designers, in fact, the most meaningful associations of technologies and teaching strategies with psychological responses from which to grow a more comprehensive psychological scale. While the technologies are changing, in essence, certain fundamental principles of psychological perceptions, sensory stimuli, and learning remain the same. Two general classifications are found throughout the education literature of the twentieth century that relate technologies and teaching strategies to psychological perceptions or illusions of teachers and subject matter:

- one-way sensory: technologies and teaching strategies that are designed to stimulate one or more of the senses to evoke a psychological illusion of seeing, hearing, touching, et cetera, “real” teachers and/or subject matter, such as text, pictures, photographs,
slides, films, TV, audiotapes, videotapes, artifacts, and simulations.  

- **two-way interactive:** technologies and teaching strategies that are designed to stimulate one or more of the senses to evoke a psychological illusion of teachers and/or subject matter that can see, hear, touch, et cetera, the learner, such as a facilitated discussion, a telephone call, an audiovisual conference, interactive text, and interactive simulations.

### 2.3 Absence of Presence in Learning Models

The education literature has traditionally acknowledged that spatial and social illusions of teachers and subject matter are important first steps to learning and that spatial and social illusions stem from sensory perceptions, “[a biophysical] process whereby one becomes aware of the world around oneself” through sensory stimuli (Kemp & Smellie, 1994, p. 13). The quantity and quality of sensory stimuli, therefore, have always been considered important considerations in the design of learning environments, even in those with nonelectronic technologies, such as a book or a photograph (Bloom, Englehardt & Furst, 1956; Dale, 1969; Kemp & Smellie, 1994). Early educators, in fact, forecast the value of future more highly sensory and interactive electronic technologies at evoking more “real” spatial and social illusions of teachers and subject matter (Kemp & Smellie, 1994), yet they have not until recently had available to them a full spectrum of technologies with which to test their hypotheses and to form comprehensive scales that relate these illusions to psychological responses and learning. As VLEs offer the educator and curriculum designer the means to examine multimedia learning systems more completely, presence (Lombard & Ditton, 1997) offers him/her a method to measure the spatial and social illusions more precisely.

Researchers have identified several types of presence, but a growing number of scholars agree that the states generally can be grouped into two overall categories that may be particularly relevant to the VLE: spatial presence, involving perceptions of sensorially “real” environments, and social presence, involving perceptions of social interactions with persons, places, or things. When relevant to teachers, subject matter, and learning objectives, spatial and social presence promise to be valuable indicators of the appropriateness of a technology in the VLE. “We cannot over-stress the importance of the concept of appropriateness when making decisions about information and communication technology applications” (Farrell, 1999, p. 10).

### 3 Research Questions

- **R1:** How do the technologies and teaching strategies in training and educational VLEs relate to classifications of one-way sensory and two-way interactive technologies and teaching strategies in the education literature?
- **R2:** How do the learners’ psychological responses reported in the studies relate to the categorizations of spatial and social presence in the communication literature?
- **R3:** What relationships does the research show among the one-way sensory and two-way interactive technologies and teaching strategies, spatial and social presence, and learning in the VLEs?

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1. The one-way sensory classification of technologies and teaching strategies reflects principles of the operant conditioning (Skinner, 1954), conditions of learning (Gagne, 1985), component display (Merrill, 1983), and information processing (Norman, 1976) learning models.

2. The two-way interactive classification of technologies and teaching strategies reflects principles of the social learning (Bandura, 1986), motivation (Keller, 1983), attribution (Weiner, 1980), and elaboration (Reigeluth & Stein, 1983) learning models.

3. The spatial categorization of presence reflects conceptual and operational definitions of spatial, sensory, social realism, and engagement presence, whereas the social categorization refers to definitions of social, social actor within the medium, copresence, and medium as social actor presence, as provided in the International Society for Presence Research Concept of Presence: Explication Statement (www.temple.edu/mmc/ispr/explicat.htm).
3.1 Methodology

This systematic evaluation of a set of seventeen original research studies on VLEs uses a systematic qualitative approach to identifying subject matter, technologies, teaching strategies, spatial and social presence, and learning described in the studies. Researchers coded VLE subject matter according to definitions of training and educational learning objectives, technologies and teaching strategies according to the one-way sensory and interactive classifications, presence responses according to the spatial and social presence definitions, and learning responses according to the quantitative and qualitative test scores reported in the studies. The researchers then looked for patterns among these indicators to analyze the need for and to direct the research toward a consideration of presence in future VLE research and design.

3.1.1 Sample for Analysis. The sample for this evaluation was found through a search of a major university’s electronic resources: ProQuest, Communication Abstracts, Science Abstracts, and the Google search engine. After testing several search terms, including “virtual,” “distance,” “training,” “learning,” “perception,” “satisfaction,” and “presence,” the authors collected and reviewed titles and abstracts and selected those studies in which they found evidence of learning environments that fit their definition of the VLE. Works that provided literature reviews without empirical findings were excluded from the sample. Studies that offered methodologies identifying case studies, content analyses, surveys, experiments, interviews, and observations were included in the sample. The final sample consisted of seventeen studies published between 1986 and 2001.4 (See Appendix 1.)

Three coders, including two authors, tested an initial coding instrument informally as a group by coding three studies from the final sample together. In this test coding, problems and discrepancies were discussed and evaluated. This process was repeated three times, and the coding instrument was revised according to majority rule. Intercoder reliability, measured by Cohen’s kappa coefficient (the proportion of the units in which the coders agreed divided by the proportion of units of agreement expected by chance), exceeded 0.80 for all variables; types of technology (0.83) and teaching strategy (0.90) and presence state (0.87).

3.2 Results

This systematic evaluation identifies potentially important patterns among technologies, teaching strategies, spatial and social presence, and learning in VLEs. The findings primarily relate high levels of learner satisfaction experienced through one-way sensory technologies and teaching strategies to the achievement of spatial presence and lower-level learning objectives, and high levels of learner satisfaction experienced through two-way interactive technologies and teaching strategies to the achievement of social presence and higher-level learning objectives.

Of the seventeen VLEs studies reviewed, twelve were coded as educational VLEs that focused on higher-level learning objectives, such as, evaluating communication and educational leadership, and five were coded as training VLEs that focused on lower-level learning objectives, such as developing motor skills and memorizing travel routes. It is important to note, however, that nearly all of the VLEs in the educational and training categories included some emotional objectives, for instance, “to persuade” a learner to communicate or practice walking. This was attributable, in part, to the VLE course topics that valued the importance of learners’ attitudes and impressions.

3.2.1 Educational VLEs. 3.2.1.1 Technologies and Teaching Strategies. Technologies in six of the twelve educational studies were coded in the two-way interactive classification based on descriptions of their primary function to permit interaction among learners and instructors. (See Table 2.) Technologies in the two-
way interactive classification were namely instant chat software, audiovideo conferencing systems, and real-time interactive video networks. Technologies in four of the studies (structured Web sites, a one-way TV broadcast, and an audiovisual text software program) were coded in the one-way sensory classification based on their primary purpose to present textual, visual, or verbal cues to evoke spatial illusions of teachers and/or subject matter. Technologies in two other studies (a multimedia Web site and an interactive group software program) emphasized both one-way sensory and two-way interactive stimuli and were coded jointly in the one-way sensory and two-way interactive classifications. Teaching strategies were reported in seven of the educational VLE studies and were generally coded as two-way interactive (for example, to promote an intercultural communication exchange) consistent with the technologies (say, an audio-video conferencing system). The teaching strategy in one of the studies was coded as one-way sensory (to facilitate the visualization of science content) consistent with the technology (an animated software program).

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<tr>
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<th>Presence</th>
<th>Subject matter</th>
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<tbody>
<tr>
<td>One-way sensory</td>
<td>Cable TV broadcast; Web site with text and audio; audiovisual text software, visual, and textual Web sites</td>
<td>High spatial presence (students said the enhanced TV made them sort of feel like they were in a class); Low spatial presence (students felt a sense of physical isolation because of the obtrusiveness of the cameras)</td>
<td>Educational technology leadership, communication, neuroscience</td>
</tr>
<tr>
<td>Interactive</td>
<td>Computer conferencing systems; real-time full motion interactive audiovideo networks; desktop audio and video conferencing; Web group software</td>
<td>High social presence (students expressed a sense of being together with teachers and fellow students through the Web group software); Low social presence (students felt separate from the class because of the ineffectiveness of the audiovisual equipment)</td>
<td>Management, science, and humanities; computers in society; language; art and communication</td>
</tr>
<tr>
<td>One-way sensory/interactive</td>
<td>Structured Web site with communication system and face-to-face lecture; multimedia Web site with real-time virtual interaction</td>
<td>High spatial and high social presence (students expressed a sense of “being together” with teachers and interacting with them in real time)</td>
<td>Calculus, management and leadership</td>
</tr>
</tbody>
</table>
3.2.1.2 Presence. Although the studies in the educational VLEs did not specifically identify a learner’s misperception of technologies as spatial or social presence, expressions of learner satisfaction and dissatisfaction with the technologies and teaching strategies al- luded to positive (high) and negative (low) feelings of spatial and social presence; for example, students felt very “close to the subject matter” (high spatial) or as though they were “with the subject matter” and “talking to [the] instructor in the classroom” (high spatial, high social) through use of an effective Web site and email exchange, or students felt “a sense of isolation” from the teacher and subject matter (low spatial, low social) because they were bothered by the “camera . . . seeing themselves on TV monitors, and . . . delays in the audio system” of an ineffective videoconferencing system. Notably, this research found the highest and lowest levels of spatial presence when technologies and/or teaching strategies were coded in the one-way sensory classification, and the highest and lowest levels of social presence when technologies and/or teaching strategies were coded in the two-way interactive classification. Finally, this evaluation found the highest levels of spatial and social presence when technologies and/or teaching strategies were coded jointly in the two-way interactive and one-way sensory classifications.

3.2.1.3 Learning Achievement. Learning assessments, although generally not offered in detail, were high when indications of social presence were high and highest when indications of both spatial and social presence were high.

3.2.1.4 Summary. The findings in the educational VLE studies indicate that expressions of satisfaction and dissatisfaction with technologies and teaching strategies alluded to experiences of spatial and/or social presence, although researchers rarely tested specifically for presence. The results suggest that indications of social presence were associated with technologies and/or teaching strategies coded in the two-way interactive classification, and that indications of spatial presence were associated with the technologies and/or teaching strategies coded in the one-way sensory classification. Notably, the results associate the highest levels of learning with the highest levels of combined spatial and social presence.

3.2.2 Training VLEs. 3.2.2.1 Technologies and Teaching Strategies. Technologies and teaching strategies in all five training VLE studies—highly sensory and interactive VR applications used primarily to achieve lower-level cognitive objectives of motor skill development—were coded primarily in the one-way sensory classification based on reports of their primary objectives to immerse patients in illusions of subject matter, for example, a computerized treadmill with a head mount displaying virtual objects, and to increase the learner’s awareness, use, and recognition of her surroundings through sensory immersion in a structured virtual hospital unit. (See Table 3.) The training technologies and teaching strategies were secondarily coded in the two-way interactive classification based on indications that the virtual objects were to a lesser extent expected to respond to the patients.

3.2.2.2 Presence and Learning Achievement. Four out of five of the studies indicated some patient satisfaction with technologies or teaching strategies, which were sometimes referred to as presence and which the authors of this evaluation coded as spatial presence. In each of the studies, high levels of spatial presence were associated with high levels of achievement of lower-level learning objectives; for example, patients felt like they were in a virtual food market and, therefore, their shopping skills improved in real food markets.

3.2.2.3 Summary. The findings in the training studies indicate, notably, that expressions of patient satisfaction referred generally, and sometimes specifically, to feelings of spatial presence, and that there was consistency among levels of spatial presence and lower-level learning achievement. The findings further suggest a relationship between the patient responses coded as spatial presence and the technologies and teaching strategies coded primarily as one-way sensory.
3.3 Discussion

This systematic evaluation offers data suggesting, first and foremost, that, although the psychological nature of presence may be elusive, the testing for spatial and social presence must be concerted, as measures of presence may be key to understanding to what extent a VLE technology and teaching strategy may help to evoke spatial and/or social illusions of teachers and subject matter that enhance learning. The results indicate that researchers studying educational VLEs were less deliberate in their evaluation of presence than researchers of training VLEs, but that both sets of researchers, nonetheless, identified certain potentially important relationships among high spatial presence, one-way sensory technologies, and the achievement of lower-level learning objectives, and high social presence, two-way interactive technologies, and the achievement of higher-level learning objectives.

This evaluation found, first, that, when technologies and teaching strategies fell in the one-way sensory classification, satisfaction responses could generally be described as spatial presence, and that, when technologies and teaching strategies fell in the two-way interactive classification, satisfaction responses could generally be described as social presence. The evaluation then found that levels of spatial presence were generally consistent with the achievement of lower-level learning objectives in the training VLEs, and that levels of social presence were generally consistent with the achievement of higher-level learning objectives in the educational VLEs. Finally, when levels of both spatial and social presence were high, the achievement of higher-level learning objectives was highest in the educational VLEs.

This research suggests potential benefits of developing a spatial and social presence technology and teaching strategy scale specifically relevant to the one-way sensory and two-way interactive educational classifications. Future research studies, therefore, should test more deliberately for responses of spatial and social presence to one-way sensory and two-way interactive technologies and teaching strategies in VLEs to compile such a scale. Research should then test more specifically for the relationship of spatial presence to the achievement of lower-level learning objectives as found in the training VLEs, and the relationship of social presence to the achievement of higher-level learning objectives as found in the educational VLEs. Educators may then uniquely tailor a technology and teaching strategy to enhance learning in any VLE.

3.3.1 Limitations and Direction for Research. Whereas, because of its small sample size, this evaluation does not offer sufficient evidence to support or refute cause-and-effect relationships or correlations, it does suggest certain distinct patterns that can help direct future research in the development of a scale that associates educational and training technologies and teaching strategies with learning objectives, presence,

<table>
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<tr>
<th>Learning model</th>
<th>Types of technology</th>
<th>Presence</th>
<th>Subject matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-way sensory/interactive</td>
<td>Computers, sensory 3D equipment, virtual computer monitor, computerized treadmill, overhead harness, etc.</td>
<td>High spatial and low social presence (patients were satisfied with “engaging” simulation and interacting with objects)</td>
<td>Mobility training, computer-access training, memory enhancement, shopping training</td>
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</table>

Table 3. Results of Training VLE Studies
and learning achievement. This evaluation further identifies a need for future VLE research to explore a greater range of VLE topics because most of the courses found for this review focused on communication, education, and technology instruction. Importantly, the research should probe in greater detail the reliability and validity of the methods used in VLE studies.

References


Appendix I

Studies Included in Systematic Evaluation


Chadwick, S. A. (1999). Teaching virtually via the Web: Comparing student performance and attitudes about


