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An Exploratory Study of the Impact of a Virtual World Learning Environment on Student Interaction and Learning Satisfaction

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ABSTRACT

Research in online education has demonstrated that social presence and student interaction are important factors in learning. This study extends current research to the new learning environment of virtual worlds and explores their role in student interaction and learning satisfaction. We examined learning satisfaction in an online course using virtual world technology to assess sense of presence, social presence and student interaction. Data on multiple independent variables (measures of presence, social presence, and interaction) and dependent variables (learning satisfaction) were collected and analyzed. Our findings indicate that students did not perceive a high level of presence in the virtual world environment. No significant relationship was found between perception of presence and students' interaction while students' perceived social presence was significantly related to their perceived interaction and learning satisfaction.

Keywords

Virtual world, Virtual learning, Technology-mediated learning, Presence, Social presence, Interaction, Learning satisfaction, Second Life.

INTRODUCTION

Virtual learning environments are gaining interest from both academic researchers and industry professionals, as learning and training with Internet technologies and Web-based distance learning become more and more popular. Virtual learning environments (VLEs) are defined as "computer-based environments that are relatively open systems, allowing interactions and encounters with other participants" (Wilson 1995). In VLEs, students learn through communication, interaction, and collaboration. The learning process in a VLE is "no longer an individual endeavor, but can incorporate and leverage the many-to-many relations among learners and with instructors" (Piccoli et al. 2001).

Virtual worlds are the latest development in VLEs. A virtual world learning environment (VWLE) can be defined as a computer-based simulated environment resembling the real world in which learning takes place through simulation and interaction among avatars and with virtual objects. An avatar can be a two- or three-dimensional graphical representation of a humanoid, which may or may not resemble the actual user. Virtual objects are the artifacts in a virtual world that users create, use, and interact with. We chose a virtual world environment as the context of this study for several reasons. Virtual worlds have become a recent breakthrough technology that has potential to reshape learning and business. They can provide a unique platform for collaborative education and simulation-based instruction, and they have potential for being the delivery mechanism for new methods for learning evaluation.

Second Life is one example of a popular virtual world. Since opening to the public in 2003, Second Life has grown explosively and today is inhabited by a total of more than 9 million residents from around the globe. Second Life has been used as a learning environment by hundreds of institutions but there is little research to support its effectiveness. The educational potential of virtual worlds needs to be examined for people to realize the strengths and challenges of this type of simulation environment for education.

Drawing on previous research in technology-mediated learning and the characteristics of virtual world learning environments, we pose the following research question: *How do VWLEs enable learning processes and outcomes? Specifically, how does the use of a VWLE affect student interaction and satisfaction during learning?* The main contribution of this study is to discover the underlying nature of the relationship between a virtual world learning environment and student interaction and learning satisfaction through analysis based on a theoretical model.

CONCEPTUAL DEVELOPMENT

In a virtual world learning environment, students can have the experience that they are located in an environment where they can find resources to support their learning, including other students and instructors, and also be actually present in that environment. The VWLE has characteristics with potential to affect an individual's perceptions of presence and social presence, which in turn affect interaction and, ultimately, learning satisfaction. Figure 1 shows these relationships. The discussion below provides the conceptual development of the model and the propositions for the study.

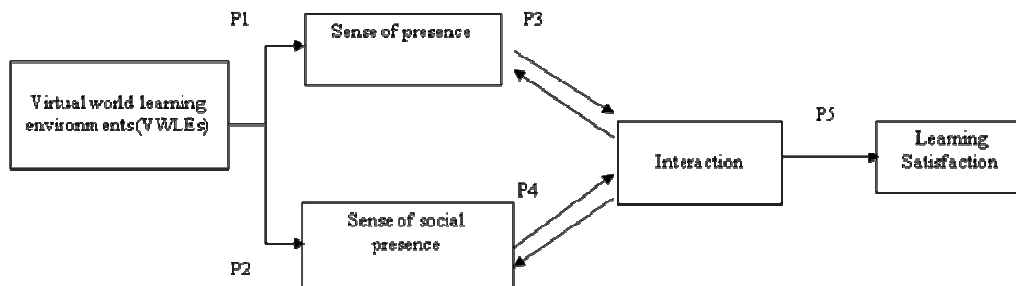


Figure 1. Conceptual Model

Presence

The learner has a sense of “being there,” or the experience of *presence*, in an environment by means of a communication medium (Reeves 1991). Reeves argues that automatic perceptual processes, mindful direction of attention, and conscious processes all contribute to our perceiving mediated experiences as real. A VWLE is a highly vivid and interactive medium, in which learners develop a first-person, rather than third-person, relationship with the mediated environment. Slater et al. argue that “presence is a state of consciousness, the (psychological) sense of being in the virtual environment, and corresponding modes of behavior” (Slater et al. 2000).

Learning is closely associated with a connection with people and the environment. The social aspect of learning needs to be recognized and we can use conversation, interaction with others, and application of knowledge as an integral aspect of learning. A VWLE mimics complex physical spaces, and interactions with three-dimensional representations in such a space provide a greater sense of presence to learners. Numerous researchers suggest that sense of presence may increase with the existence of other individuals or virtual actors (Steuer 1992; Welch et al. 1996). The experience of inhabiting the virtual world and interacting with others in a real-world-like environment brings emotional responses, and consequently greatly enhances the sense of being there. Thus,

P1: A virtual world learning environment provides a high perception of presence.

Social Presence

Social presence is defined as the perception of the degree to which a user feels access to the intelligence, intentions, and sensory impressions of another (Biocca 1997). Biocca argues that the level of satisfaction and productive performance in teleconferencing and collaborative virtual environments is based primarily on the quality of social presence. Social presence “varies among different media, it affects the nature of the interaction and it interacts with the purpose of the interaction to influence the medium chosen by the individual who wishes to communicate” (Short et al. 1976). Social presence theory views social presence as an attribute of the communication medium. VWLEs provide a highly social experience with multi-way interactions. Being able to actually “see” the person (avatar) with whom you are talking in a VWLE can have a great effect on the conversation.

The face-to-face medium is considered to have the greatest social presence, and a VWLE provides “face-to-face” communication through avatars facilitated by multiplicity of cues and immediacy of feedback, enhancing the sense of “being with others.” Social presence theory can provide insights into the nature of nonverbal and interpersonal communication and how this affects learning and learning process. Researchers have found evidence of significant social presence in computer conferencing contexts (Anderson et al. 2001; Rourke et al. 2002). Researchers have also found that students perceive the presence of others in their learning experience as an essential part of learning and that students’ perceptions of satisfaction with an instructor are related to their perceptions of social presence (Christophel 1990; Gorham et al. 1990; Kelly et al. 1988; Richardson et al. 2003; Ruberg et al. 1996).

Students in distance education courses are likely to feel separated from their classmates due to the mediated interface through which the course is delivered (Doss et al. 2000). Hence increasing social presence should be beneficial to technology-mediated learning. Social motivations are also related to the interactive and particularly interpersonal social environment of classes in which much learning takes place (Evans 1986). The goal of technology-mediated learning is to increase the amount of social presence to provide students with the sense and benefits of a traditional classroom (He et al. 2004), to overcome the frustrations that students tend to feel when not being able to interact directly with instructors and classmates (Hara 1998). Thus,

P2: A virtual world learning environment is associated with a high perception of social presence.

Media and Interaction

A common aspect of learning is the social and communicative interaction between student and instructor, and student and student (Picciano 2002). Some studies have been done on interaction as an essential element to learning effectiveness in distance education (Fresen 2007; Sher 2008). In the learning context, collaboration has four aspects – situation, interaction, learning mechanisms, and the effects of collaborative learning (Dillenbourg 1999). Wagner (Wagner 1994) defines interaction as “reciprocal events that require at least two objects and two actions. Interactions occur when these objects and events mutually influence one another” (p. 8).

Media Richness Theory (Daft et al. 1986) argues that the degree of richness of a communication medium depends on the capacity of the medium to process ambiguous communication. Together with similar studies (DeSanctis et al. 1999; Straus et al. 1994), it is suggested that face-to-face discussion is more effective for equivocal, convergent, and complex tasks. With the communication and interaction mediated by the rich virtual world environment, it is expected that a VWLE will provide capabilities of both face-to-face and computer-mediated communication for students to feel ease of interaction and hence satisfaction with their learning experience. Therefore a VWLE will provide an environment in which interaction among students plays a central role in the learning process.

Learning is an active, social process. It involves dynamic interaction between learning content/task, instructor and learner. Learners learn more effectively and efficiently when they are in control of the pace, feedback is a critical part of effective learning, and active involvement leads to more effective learning than passive involvement. From a student’s perspective, high presence and social presence will help increase interaction activities among students, with instructors, and with learning content, which in turn enhances students’ collaboration and participation. With more interaction, on tasks as well as social relationships, students will perceive more sense of “being there” and “being with others,” i.e., presence and social presence. Thus,

P3: A high perception of presence is associated with high levels of interaction among students, instructors, and with learning content.

P4: A high perception of social presence is associated with high levels of interaction among students, instructors, and with learning content.

Learning Satisfaction

Learning is contextual, and a VWLE is a unique cultural context in itself. Cognitive learning theory indicates that the ways in which knowledge, skills, and attitudes are learned affect the extent to which these abilities can be used in other contexts. If knowledge, skills, and attitudes are learned in the context of use, they will be used in that and similar contexts. Otherwise, learners need to generate connections between problems and solutions by themselves. A unique characteristic of VWLEs is their resemblance to the real context in which learned abilities apply; therefore VWLEs can provide support for the transfer of knowledge and skills.

Students can benefit both instructionally and socially in such contexts. With an appropriate instructional design, a small group of learners working together via technology may accomplish more than an isolated learner because the interactions among the learners and between the learners and learning content mediated by technology are important for learning.

We expect that students in VWLEs with high interaction will have significantly better perceptions of the course and course delivery technology, which in turn enhances learning satisfaction. Thus:

P5: The learning process enabled by VWLEs with high interaction and collaboration enhances learning satisfaction.

RESEARCH METHOD

We designed an exploratory study to examine the propositions and to assess implications for learning in a virtual world environment. The study was a longitudinal educational field study conducted over a period of six weeks in an undergraduate course at a Midwestern university.

Participants

Participants were 22 undergraduate and 2 graduate students enrolled in a completely Internet-mediated course in introductory statistics in Fall 2008. Table 1 shows the percent of respondents for each demographic question on the post-survey.

Gender		Age		Year in School		Online Experience	
Female	21.1	19-24	63.2	Freshman	0	First online course	31.6
Male	78.9	25-30	15.8	Sophomore	5.3	Have taken two or more online courses	63.2
		> 30	21.0	Junior	42.1	Had experience with online games	42.1
		Average age = 25 years		Senior	36.8	Had experience with Second Life or other virtual worlds	15.8
				Graduate	10.5	Had NO experience with Second Life or any other virtual worlds	15.8
				Other	5.3		

Table 1 Student Demographic Information (N = 19)

Procedure

The course was structured around lecture videos, readings, weekly individual assignments, and two group projects. Students were randomly assigned to groups, with two to three students in each group. Second Life was adopted for class/group meetings and the group projects. At the beginning of the course, students were given a Second Life introduction, tutorial documents, and tutorial video links to assist them in signing up for Second Life accounts, downloading the Second Life client to their own computers, and going through the Orientation Island that is required by Second Life for new visitors. Approximately mid-way through the semester, two question-and-answer sessions were conducted in Second Life via both text and voice chat. The students who attended reported that these sessions were important and helpful for them to be able to ask questions about course material and become familiar with the instructor and fellow students.

The group projects consisted of a “warm-up” project and a term project. The warm-up group project required each group to first locate a specific island in Second Life, and then visit a business or other place in Second Life. Groups submitted a report documenting their journey with snapshots and chat logs. The term group project required students to analyze a case related to one of the issues discussed in the course and submit a group report on their analysis. Data for the study come from the term group project.

Data Collection and Analysis

An online post survey was given after the term group project. The post survey contained demographic questions, Likert-scale questions adapted from validated survey instruments about constructs in the conceptual model, and open-ended questions. Students were asked about their: 1) perceptions of presence, social presence, interaction, and learning satisfaction, 2) attitude toward online course and Second Life, 3) experience with Second Life, 4) media preference for different technologies used in online courses, and 5) opinions and beliefs about the course and Second Life. Nineteen students completed the survey, 79% of the 24 students who finished the course. We used descriptive statistics and correlation analysis to analyze quantitative data generated by the Likert-scale questions. We conducted a content analysis of student comments in the four open-ended questions, sorting and grouping the comments, and then labeling the major themes and categories that emerged.

RESULTS

Cronbach’s alpha was used to assess the internal consistency of the results across items within a scale. Alpha values were calculated for each multiple-item scale. Table 2 shows the calculated alpha values, all of which were above 0.86, indicating that all four scales loaded well and are reliable. Table 2 also shows the minimum and maximum values, and mean and standard deviation of each construct in the study from the Likert-scale items. A mean score was calculated for each construct

based on the individual survey responses. The construct mean score was calculated by taking the average score of all items for each construct.

Measures of presence applied only to the Second Life environment. Results show that students did not perceive a high level of presence in the Second Life environment (mean = 3.68, i.e., between “felt somewhat” and “felt very little”). Other measures assessed other technologies used throughout the course and the results suggest that students generally perceived a reasonable level of social presence from the course (mean = 3.24, i.e., toward “somewhat agree”). The mean of perception of interaction was 2.41 (toward “agree”), which implies that the students perceived a good level of interaction in this course. Student reported they were satisfied with learning (mean = 2.02).

Study Construct	Instrument Source	N of Items	Cronbach's Alpha	Min	Max	Scale Range	Mean	Standard Deviation
Presence	(Schubert 2001)	14	0.933	2.84	4.32	1 to 5	3.68	0.75
Social Presence	(Picciano 2002)	11	0.867	2.05	4.26	1 to 7	3.24	0.97
Interaction	(Johnson et al. 2000)	10	0.872	1.90	3.16	1 to 5	2.41	0.53
Learning Satisfaction	(Chou et al. 2005)	8	0.914	1.74	2.26	1 to 5	2.02	0.65

Table 2 Descriptive Statistics (N = 19) of Study Constructs

To test the strength of the relationship between each construct, a non-parametric test (Spearman's correlation) was conducted. The continuous variables included students' perceived presence, social presence, interaction, and learning satisfaction. Correlations were also run between these variables and the demographic variables.

Study Construct	Presence	Social Presence	Interaction	Learning Satisfaction
Presence				
Social Presence	-.27			
Interaction	-.20	.80**		
Learning Satisfaction	-.11	.63**	.76**	

** : Correlation is significant at the 0.01 level (2-tailed).

Table 3 Correlations Among Study Constructs

Table 3 shows that perceived social presence yielded a correlation of .80 with interaction and .63 with learning satisfaction ($p < 0.05$) respectively; perceived presence did not yield any correlation with social presence, interaction and learning satisfaction. Perceived interaction had a correlation of 0.76 with learning satisfaction. These results suggest that:

1. Students reporting higher perceived social presence also perceived higher level of interaction and satisfaction with the course and learning experience. This finding is consistent with prior research on the relationship of social presence and perceived learning, interaction and learning satisfaction in online courses (Picciano 2002; Richardson et al. 2003).
2. Perceived presence in the virtual world environment did not correlate with perceived social presence, interaction and learning satisfaction in the course.

A standard direct entry regression was used to further analyze the relationship between perceived social presence and interaction, and the relationship between interaction and learning satisfaction. Results indicated that a significant predictor equation was established between both relationships. Table 4 shows the regression analysis results.

Dependent Variable	Predictor	R square	F	Sig.
Interaction	Social Presence	0.68	36.558	.000
Learning Satisfaction	Interaction	0.64	30.190	.000

Table 4 Regression Analysis Results

The correlation between perceived social presence and interaction was established with R^2 value of .68 ($F = 36.558$; $df = 1, 17$; $p < .05$). A similar correlation between perceived interaction and learning satisfaction was established with R^2 value of .64 ($F = 30.190$; $df = 1, 17$; $p < .05$). The results demonstrate that students' perceived social presence was a significant contribution to perceived interaction; and interaction was a significant contributor to learning satisfaction.

Students' perception of presence and social presence were also examined in terms of demographic information from the post survey. Correlations were calculated for each of the demographic items (age, gender, class ranking, and online experience). The analysis result yielded no correlation between the demographic information with perceived presence or perceived social presence.

Content analysis of four open-ended questions showed that a few students liked the experience with Second Life and considered the virtual world experience to be unique, interesting and entertaining. However, about 60% of the respondents reported that they did not like Second Life and did not think it added value to the course. Table 5 shows the major problems that students reported in their term reports.

Problem Owner	Type of Problem	Selected Responses
Second Life	Hardware	Personal computers are not updated or adequate enough to run such a large graphics program
	Software design	Hard to control and navigate
	Environment	Difficult to find other people to talk to; difficult to find highly populated areas devoted to education
Students	Learning curve	Hard to get started in the site
Instructional Design	Learning tasks	Second Life project added little value to the course

Table 5 Content Analysis of Open-Ended Survey Questions

Students' responses showed that most of their frustration came from unfamiliarity with the technology. The system requirement to run such a large graphics program is demanding and freezes and crashes were not uncommon. The user interface design of Second Life was not very intuitive and students reported a steep learning curve. The instructor had been aware of these difficulties and provided extensive tutorial and help documents, along with review sessions in Second Life. Still, the majority of the students seemed not to enjoy Second Life very much. Some students' comments suggested that the learning curves were not directly related to those with little online experience but more with motivation. One student commented that "As a Computer Science junior, it seems a little weird, but I just never enjoyed the software at all." This implies that students with more technical experience were more sensitive and judgmental about the technical flaws of new tools and more resistant to the use of new tools.

Besides the technology issues discussed above, the group project design may have had some drawbacks. The students did not need to navigate Second Life for investigation (simulation) or role playing. Thus Second Life, for the purpose of the group project, served more as a communication tool with avatars (personas of students in Second Life) standing and talking, rather than as an active learning environment. Considering the certain advantages in virtual learning over other information technologies for education, Second Life was used for instructor office hours and Q/A sessions throughout the semester besides the required group project. However, not all students attended the voluntary activities. For those who did not participate in Second Life activities other than the project, their feedback suggested that they may not have perceived the technology to be beneficial if learning activities did not make full use of the advantages of the technology.

DISCUSSION

This section discusses each of the findings of the analyses in the order of the propositions advanced.

PI: *A virtual world learning environment provides a high perception of presence.*

P2: A virtual world learning environment provides a high perception of social presence.

Descriptive statistics indicated that students perceived social presence but did not necessarily perceive a high level of presence from the rich virtual world learning environment. This may imply that the perception of presence is related more to the overall online course environment rather than the virtual learning environment.

P3: A high perception of presence is associated with high levels of interaction among students, instructors, and with learning content.

P4: A high perception of social presence is associated with high levels of interaction among students, instructors, and with learning content.

The findings indicated that students perceived a high level of interaction. A significant correlation was found between perceived social presence and interaction whereas no significant correlation was found between perceived presence and level of interaction.

P5: The learning process enabled by VWLEs with high interaction and collaboration enhances learning satisfaction.

Students reported satisfaction with the learning experience and a significant correlation was found between perceived interaction and learning satisfaction. Students' comments show that the high level of perceived interaction might not be enabled only by the virtual world learning environment since virtual world environment was one of several tools the students used. This finding implies that interaction and learning satisfaction may have been related to other aspects of the course such as the textbook, homework assignments, discussions on Blackboard, or communication with the instructor and with group members through other technologies. We cannot guarantee that students were answering the questions strictly with respect to the virtual world learning environment.

It is clear that convenience and efficiency matter to students. The virtual world environment has its own system and design problems which prevented students from exploring the spaces easily, and students were reluctant to invest time and effort to learn the technology. Responses to open-ended questions showed that the majority of students preferred email, instant messenger, telephone, and Blackboard. Difficulty with scheduling a time to meet with group members in Second Life was also reported. Email and the discussion forum provided more time for reflection and were easy to use, and phone or instant messenger provided immediate feedback. This implies that students valued speed, ease of use, ease of participation, and convenience in learning activities. This also suggests that the integration of various technologies can be used in distance learning course based on the tasks and convenience of most of the students. In general, the choice of technologies for online courses should take learning tasks and activities into consideration, along with convenience for students.

The unique features of a virtual world environment include its capability to provide human-environment, human-object and human-human interaction. Media can be used to their potential and be perceived useful by users if media and learning tasks fit well. However, students may not prefer what is best for their learning. They prefer the biggest cost/benefit ratio, immediate feedback, clarification, and learning results. Our findings do not necessarily contradict Media Richness Theory or Social Presence Theory, since the findings are based on students' self reports and perceptions. This finding does, however, correspond with the socio-cognitive literature that states that learning is a social activity. The analysis results indicate that students' perception of the presence of others in their learning experience is related to their perceptions of interaction and learning satisfaction.

CONCLUSION

Our findings suggest the possibility that students' dissatisfaction with the virtual world technology hinders student motivation and attitudes, but we still have much to learn. The limited amount of empirical research in the area of virtual world technology as a learning environment and lack of empirical research in the area of presence and social presence related to virtual world learning make this study one of the contributions to the literature.

Several limitations apply to the study. The study was based on self-reported perceptions of students; however, self-report is both relevant and common practice for the key constructs. The sample size was small, but the constructs exhibited good reliability. The study provides a preliminary understanding of the impact of a virtual learning environment, but more objective measures of aspects of learning and learning outcomes would strengthen the conclusions.

Ample opportunities for future research exist. A comparative study with the same course structure but a different group project would provide a better understanding of the fit between media and learning tasks. Examinations of the impact of different information technologies used in learning would also help show the extent to which learning technologies impact learning processes and outcomes. We have provided just one look at this new phenomenon, revealing both opportunities and

challenges for moving forward with virtual world learning environments in our continuing attempts to enhance student learning through appropriate application of information technologies.

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