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ABSTRACT

Conducting education in three-dimensional (3-D) virtual worlds is an emerging phenomenon in the educational arena. The objective of this research is to investigate the factors influencing students' intention to adopt the 3-D virtual worlds for delivery of education. Drawing on existing technology acceptance models as well as studies in traditional and distance education, we developed a model to study students' acceptance of using a 3-D virtual world for education and propose to test the model empirically using survey data collected from college students. We also study the use of two instructional methods in the 3-D virtual world. This study contributes to both academic research and practice. Studies on the use of this new, emerging technology for education can help to increase our understanding on the use of 3-D virtual world environment for delivery of higher education.

Keywords

3-D virtual worlds, Second Life, technology acceptance, social presence, telepresence, perceived enjoyment, perceived learning, classroom interactivity, instructional method, intention to use.

INTRODUCTION

With the rapid maturity and increasing popularity of Web technology, education delivered over the Internet attracted attention from both academics and industry since the late 1990s (Erickson and Siau, 2003). Education in 3-D virtual worlds is a new phenomenon. A three-dimensional (3-D) virtual world is a rich, immersive, and highly scalable environment that provides more features than regular Web sites. A class conducted in 3-D virtual worlds differs from a traditional Web-based class due to the 3-D graphical setting, the use of avatars to represent class participants, and the sense of presence that puts the learners within the scene (Calongne, 2008). Classes conducted in a 3-D virtual world environment are currently receiving much attention in the industry and among educational institutions, especially in higher learning (Schultze et al., 2008).

The 2007 Horizon Report found that "the use of virtual worlds in education has grown considerably over the past year" (p. 18). With increasing competition among various institutions in offering education through 3-D virtual worlds and the increasing popularity of 3-D virtual worlds among students and institutions, we are interested to examine students' interests in adopting 3-D virtual worlds for delivery of higher education. Hence, our research question is: *What factors influence students' intention to use 3-D virtual worlds in higher education?*

LITERATURE REVIEW

Three areas of literature are relevant to our research – technology acceptance models, virtual education, and human-computer interaction.

Technology Acceptance Models

The Technology Acceptance Model (TAM) (Davis, 1989) has been tested in MIS research on a variety of information technologies. Venkatesh and Davis (2000) extended TAM into TAM2 to include constructs on social influence and cognitive instrumental processes as determinants of perceived usefulness and intention to use. Davis et al. (1992) introduced another construct, perceived enjoyment, into the TAM model. Perceived enjoyment is defined as "the extent to which the activity of using computers is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated" (Davis et al., 1992). Virtual world education involves the application of information and communication technology to core institutional functions (Farrell, 2001); therefore, information technology is a key enabling technology in the use of virtual worlds for education. In studying adoption of virtual worlds for education, it is important to examine user acceptance of specific media of delivering virtual education.

Virtual Education

Virtual worlds have to support core educational activities well in order for virtual worlds to be useful for education. Eschenbrenner, Nah, and Siau (2008) pointed out that 3-D virtual world environment can enhance existing technological capabilities to achieve interactive learning, which could in turn increase learning outcomes. Educational research on virtual worlds show that students are "likely to be more satisfied with their course if they feel involved, and even more so if they develop relationships with other members of the learning community" (Hobbs et al., 2006). This view is also supported by Rovai's (2002) study. In virtual education research, the relationship between social presence and perceived learning was established in a web-based learning environment by Richardson and Swan (2003). Hence, classroom interactivity and social presence are helpful in increasing students' learning.

Dickey (2005) presented two case studies of educational use of a 3-D virtual world environment (i.e., ActiveWorld). Dickey (2005) concluded that the 3-D immersive format has significant potential for "facilitating collaborations, community, and experiential learning." Also, it allows "a learner to become situated and embodied in a computer-mediated learning environment."

Human-computer Interaction

Research in human-computer interaction has presented some empirically tested models that predict the shopping behaviors of online customers. Hassanein and Head (2007) examined the effects of social presence, enjoyment, trust, and constructs from TAM on attitude. The results from their study show that there are significant direct effects of enjoyment, trust, and perceived usefulness on shopping attitude, and significant direct effects of perceived social presence on perceived usefulness, trust, and enjoyment.

The state of flow is defined as a holistic user experience (Csikszentmihalyi, 1990). Computer-mediated environments that are conducive to flow will yield positive attitudes and outcomes for users, and have broad implications for learning (Guru and Nah, 2001). Hoffman and Novak (1996) presented a conceptual model for measuring flow and empirically tested it using a structural modeling approach (Novak et al., 2000). Their studies show the direct effect of telepresence on the flow state of customers' online experience. Qiu and Benbasat (2005) conducted a study on the effects of text-to-speech voice and 3-D avatars on the perception of presence and flow in a mock online shopping website. Their study shows a strong effect of 3-D avatars on perceptions of telepresence. In our current study, we examine the effect of 3-D virtual world environment on enjoyment, which is a characteristic of flow, and its effect on learning (Hoffman and Novak, 1996). Davis et al. (1992) defined perceived enjoyment as "the extent to which the activity of using computers is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated."

RESEARCH QUESTION

Our research question is: What factors influence learners' intention to adopt 3-D virtual worlds for classes? Specifically, we are studying college students' intention to use a 3-D virtual world for their education. We examine factors that influence students' intention to take a class conducted in the 3-D virtual world when the option is available.

THEORETICAL FOUNDATION

Several acceptance models have been developed to explain factors influencing user acceptance of information technology. Davis' classic TAM and its augmented model (Davis, 1989) specify that perceived usefulness directly affects a user's intention to use information systems, and that perceived ease of use has an effect on perceived usefulness.

A large body of MIS research has found that perceived usefulness is the strongest predictor of user acceptance across a variety of research settings and the effect of perceived enjoyment is consistently weaker than the effects of perceived usefulness and perceived ease of use (Heijden, 2004). However, Heijden (2004) also pointed out that a number of exceptions have been reported and the exceptions seem to be related to the types of information systems used in these studies.

Gefen (2000) argued that the significance of perceived ease of use on intention to use information systems depends on the nature of the task. Gefen's (2000) study found that perceived ease of use has significant effects on intention to use when the task is intrinsic to IT (i.e. where the IT itself is the primary target) but has no significant effect on intention to use when the task is extrinsic to IT (i.e. where the IT is just a means to achieve the primary service or product). In the educational context, perceived learning (PL) is synonymous to perceived usefulness; therefore, we only include perceived ease of use and perceived learning in our research model.

Research has found that *social presence* and *telepresence* have significant effects on perceived learning (Richardson and Swan, 2003). In addition, Bannan-Ritland (2002) found *interactivity* to be critical to learning. Interactivity in classrooms has been recognized as a key factor influencing education (Siau, Sheng, and Nah, 2006). Classroom interactivity is defined as the active involvement and participation of students in a class (Bannan-Ritland, 2002; Sims, 2003). Despite the virtualness of the education process, we believe that an interactive learning process is still a key element in virtual education.

The literature has shown that education utilizes 5 categories of instructional strategies: 1) direct instruction; 2) indirect instruction; 3) interactive instruction; 4) independent study; and 5) experiential learning (Gallen and Bold, 1989; McNeill and Wiles, 1990; Seaman and Fellenz, 1989). Each category of instructional strategies contains multiple instructional methods. Two of the most important and common instructional strategies are the direct instruction and interactive instruction. Given that these are two common forms of instructional strategies and high applicable in a virtual world context, we would like to analyze learners' perceptions of using these two instructional methods in the virtual world setting of delivering education.

RESEARCH MODEL AND HYPOTHESIS DEVELOPMENT

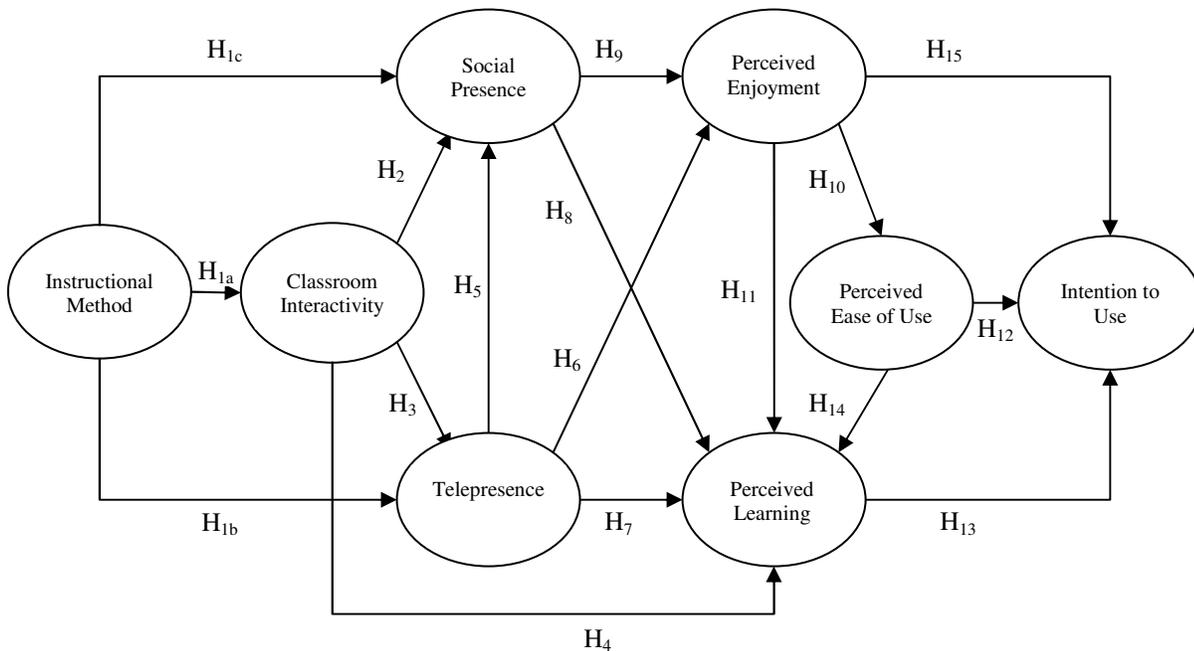The research model for this study is shown in Figure 1.

Figure 1: Research Model

Transactional Distance Theory (Moore, 1991) has been used to explain the effect of geography on pedagogy. Martindale (2002) stated that "transactional distance requires a learner, teacher, and a communication channel" (p.4) and different instructional techniques can generate different transactional distances. There are three variables that affect transactional distance: structure, dialogue, and learner autonomy. Structure is determined by the actual design of the course, the organization of the instruction, and the use of various communication channels. Dialogue also has different forms: (i) two-way, real-time communication between learners and instructors, and (ii) between learners. When there are higher amounts of dialogue and less structure, a distance learner is likely to perceive a smaller degree of transactional distance. In a 3-D virtual world environment, dialogue is facilitated by several means, such as video, audio, instant message, and the ability to talk to neighbors and these features will shorten transactional distance between learners and teachers. Researchers have found that a person's perception of social presence is highly related to others' intimacy behaviors such as physical proximity. Thus, we postulate that when conducting education in 3-D virtual worlds, a small degree of transactional distance will increase perceived social presence substantially.

Instructional methods can create a learning environment that promotes or fosters classroom interactivity because different methods use different structure and require more or less dialogue in activities. Gunawardena and Zittle (1997) found that

different types of communication media have different capabilities to affect one's perception of social presence. A virtual world can provide richer cues than traditional Web-based environment for education. Combining integrated communication tools, such as audio, video, and instant messaging, simulated classrooms in virtual worlds can deliver additional cues that are not available in a Web-based educational environment. Different instructional methods provide different levels of cues and therefore can generate different levels of feeling of being in the mediated environment (i.e., telepresence). Hence, we hypothesize that interactive instructional method will generate higher levels of classroom interactivity, perceived social presence, and telepresence:

H_{1a}: Interactive instructional method will generate higher classroom interactivity than direct instructional method in 3-D virtual world education environment.

H_{1b}: Interactive instructional method will generate higher telepresence than direct instructional method in 3-D virtual world education environment.

H_{1c}: Interactive instructional method will generate higher perceived social presence than direct instructional method in 3-D virtual world education environment.

Studies have shown that interactivity in a virtual environment is one of the important antecedents for telepresence (Qiu and Benbasat, 2005). Interactivity is also a critical factor in learning (Bannan-Ritland, 2002). Based on Transactional Distance Theory (Moore 1991), virtual classroom interactivity will help reduce transactional distance between learners and teachers, and the perceived transactional distance affects the perception of social presence. Empirical studies also show that interactivity enhances perceived social presence (Young et al., 2007). Therefore, we hypothesize that:

H_2: Classroom Interactivity has a positive impact on social presence.

H_3: Classroom Interactivity has a positive impact on telepresence.

H_4: Classroom Interactivity has a positive impact on perceived learning.

Telepresence is defined as "a user's experience of seeming to be present in a remote environment by means of a communication medium" (Qiu and Benbasat, 2005). Telepresence has been found to be one of the antecedents that can lead to a flow state (Hoffman and Novak, 1996). In addition, telepresence has a positively impact on perceived learning (Novak et al., 2000; Shin, 2006). There are no studies about the relationship between telepresence and social presence. Social presence is defined as the ability of learners to project themselves socially and effectively into a community of inquiry (Rourke, Anderson, Garrison, and Archer, 2001). It also refers to the feeling of "being with another" (Biocca et al., 2003). A feeling of "we are together" can also be used to measure social presence. Given that telepresence is a sense of being in a mediated environment, telepresence will have a direct positive impact on social presence. Hence, the following three hypotheses are proposed:

H_5: Telepresence has a positive impact on social presence.

H_6: Telepresence has a positive impact on perceived enjoyment.

H_7: Telepresence has a positive impact on perceived learning.

Social presence is an important factor influencing learning (Richardson and Swan, 2003; Rovai, 2002). Short et al. (1976) regard social presence as the most important perception that occurs in an environment for any person-to-person interaction. Social presence contributes to the social climate for learning, and thus influences one's intention to adopt the 3-D virtual world for learning. Studies (e.g., Hassanein and Head, 2007; Novak et al., 2000; Qiu and Benbasat, 2005) have also demonstrated the direct effect of social presence on optimal experience (flow) in a computer-mediated environment. Given that enjoyment is a characteristic of flow, we hypothesize that social presence will have a direct effect on enjoyment and perceived learning:

H_8: Social presence has a positive impact on perceived enjoyment.

H_9: Social presence has a positive impact on perceived learning.

The causal relationship between perceived enjoyment and perceived ease of use has been studied, but the results are controversial (Sun and Zhang, 2006). Sun and Zhang's research (2006) found that in a utilitarian system, the causal direction of perceived enjoyment affecting perceived ease of use (i.e., PE -> PEOU) outweighs the direction of perceived ease of use

affecting perceived enjoyment (i.e., PEOU->PE). Since the virtual world environment for education is a utilitarian system for the purpose of education, we hypothesize that:

H10: Perceived enjoyment positively influences students' perceived ease of use of 3-D virtual world education environment.

Wu and Hiltz (2004) studied the relationship between enjoyment and perceived learning in the context of online discussion groups. Their results demonstrate the positive impact of enjoyment on perceived learning. Thus, we hypothesize that:

H11: Perceived enjoyment has a positive impact on perceived learning in the 3-D virtual world education environment.

Perceived ease of use refers to the degree to which a person believes that adopting a particular system would be free of effort (Davis, 1989). Perceived ease of use has been found to be a critical predictor to intention to use by numerous studies; therefore, we included perceived ease of use in our research model. However, Gefen (2000) found that perceived ease of use has no significant effect on intention to use IT when the task is extrinsic to IT. In the educational context, we believe that the task is learning and hence, is extrinsic to the virtual world environment. Therefore, perceived ease of use of the virtual world environment is not expected to have any effect on intention to adopt the 3-D virtual world education environment.

H12: Perceived ease of use has no significant effect on intention to adopt 3-D virtual world education environment.

We are not aware of research that has specifically examined the relationship between perceived learning and use intention. However, we believe that it is logical to hypothesize a direct effect from perceived learning to intention to adopt because in the virtual education setting, perceived learning and perceived usefulness represent the same concept and perceived usefulness has been consistently linked to intention to use IT/IS. Thus, we propose that:

H13: Perceived learning has a positive impact on intention to adopt 3-D virtual world education environment.

In addition, research has shown a positive impact of perceived ease of use on perceived learning (Skadberg and Kimmel, 2004). Thus, we hypothesize that:

H14: Perceived ease of use of 3-D virtual world education environment has a positive impact on perceived learning.

Perceived enjoyment has been shown to have a positive impact on intention to use IT/IS (e.g., Koufaris, 2002; Hassanein and Head, 2007). Therefore, we hypothesize that:

H15: Perceived enjoyment of using 3-D virtual world education environment has a positive impact on intention to adopt.

RESEARCH METHODOLOGY

Students from an Introduction to Management Information Systems class will be enlisted for this study. Prior to their participation, we will conduct a short tutorial session to familiarize subjects with the basics of using Second Life, including learning basic functions such as walking, talking, and interacting with fellow community members.

After the tutorial, a lecture, representing direct instruction, will be conducted in Second Life. The students can ask clarifying questions using text chatting tools and audio voice.

A survey will be conducted after the lecture session. The survey will consist of questions related to the research model. The dependent variable of the model is intention to adopt 3-D virtual world education environment.

Following the survey and after a short break, another instructional session, a lecturer-led discussion representing interactive instruction, will be conducted in Second Life. This lecturer-led interactive instruction session will focus on discussion, and provide students the opportunity to discuss topics and to present their ideas and solutions. After the lecturer-led discussion, the same survey instrument will be administered to the students.

The experiment will use within-subjects repeated measures design to reduce the error variance associated with individual differences. Further, the within-subject design requires a smaller number of subjects than a between-group design to achieve the same power.

We will recruit college students to participate in virtual classes conducted in a 3-D virtual world, Second Life.

Measurement

The measure for perceived ease of use will be adapted from Davis (1989). The items used to measure perceived learning are derived from Richardson and Swan (2003) and Wu and Hiltz (2004). The scale to measure telepresence is adapted from Qiu and Benbasat (2005). The instrument for social presence is adapted from Hassanein and Head (2007). The scale for measuring perceived enjoyment is adopted from Davis et al. (1992). The scale for measuring classroom interactivity is adopted from Siau et al. (2006). The scale for measuring intention to use is adapted from Pavlou (2006).

EXPECTED OUTCOMES, CONTRIBUTION, AND FUTURE RESEARCH

The research is ongoing. The expected outcome of this study includes, but is not limited to, a model to explain learners' intention to adopt a 3-D virtual world for education. The value of this study for academic research includes empirically testing a research model that was drawn from established information technology acceptance models in the MIS literature and augmenting it with new constructs such as perceived enjoyment, perceived learning, and social presence that are essential and relevant to the virtual education setting.

With growing popularity of virtual world environments, many universities have acquired or plan to acquire virtual campuses for delivering and supporting education. This study will expand our understanding of the factors that influence students' decisions to adopt a new virtual environment enabled by new technology for education. Our study not only contributes to MIS research but also to education research.

This study also combines information systems research and educational research to provide a unique angle to view how technology can be aligned with educational needs. It also assesses two popular instructional methods, direct instruction and interactive instruction, in the delivery of education in virtual worlds. The findings will help to serve learners better, which is the ultimate goal of technology use in educational environments.

Future research can be carried out to assess other instructional methods to provide a more comprehensive understanding of factors that are relevant and important for specific instructional strategies. The findings from this and future research will provide guidelines for designing and developing a better instructional environment for learners in 3-D virtual worlds.

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