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Adoption of 3-D Virtual Worlds for Education

L'Adoption des Environnements Virtuels en 3-D pour l'Enseignement

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Abstract

As an emerging phenomenon, virtual world education is rarely researched in MIS literature. With stiff competition among institutions using virtual worlds for education, a legitimate research question is: What factors influence students' intention to adopt 3-D virtual world environment for their education needs? Drawing on existing technology acceptance models and studies in other IS contexts, we developed a model to predict students' acceptance of a 3-D virtual world education environment and plan to empirically test the model using survey data collected from college students. From the academic research perspective, studies on the use of the new technology for education will provide insights on how virtual world environment contributes to virtual education that is now part of the mainstream of education. From the practitioner perspective, the study provides useful insights to educational institutions and assists institutions in evaluating whether investing in virtual world education is a sound strategy.

Keywords: 3-D virtual worlds, Second Life, technology acceptance, social presence, telepresence, perceived enjoyment, perceived learning, and intention to use.

Résumé :

À partir des études et des modèles existants portant sur l'acceptation de la technologie, nous développons un modèle pour expliquer l'acceptation des étudiants d'un environnement virtuel (en 3-D) d'enseignement. Nous planifions de confronter ce modèle aux données collectées auprès d'élèves de collèges. Les implications académiques et pratiques sont présentées et discutées.

Adoption of 3-D Virtual Worlds for Education

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Abstract

The use of virtual worlds for education has been rising in popularity among end users (students) and educational institutions. However, the factors affecting students' adoption of virtual world education have not been studied in MIS research. In this study, we developed a model to predict students' acceptance of 3-D virtual worlds for education and will empirically test the model using survey data to be collected from college students.

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Introduction

With the rapid maturity and increasing popularity of Web technology, web-based education delivered over the Internet attracted attention from both academics and industry in the late 1990s and early 2000s. Education in virtual worlds is a new phenomenon that is currently receiving much attention in the industry and educational institutions, especially in higher education (Schultze et al. 2008). Nevertheless, there is lack of research studying the potential of virtual world for education in MIS literature. Prior research studies on computer-mediated education in MIS literature focus mainly on web-based education. The research on web-based education includes distance learning (Sherry 1996), online learning (Hiltz & Turoff 2005), and Web-based learning (Tsichritzis 1999). Alavi and Leinder (2001) called for greater depth and breadth of research in technology-mediated learning and Hiltz and Turoff (2005, p. 60) indicated that “online learning is a new social process that is beginning to act as a complete substitute for both distance learning and the traditional face-to-face class.” Very few studies are published on education conducted in a virtual world, which is defined as a richly immersive and highly scalable 3-D environment that provides more features than regular websites. The recent proliferation of online courses and programs in virtual worlds, especially in institutions of higher learning, has shown that virtual world-based education and web-based education is now part of mainstream education. Therefore, research on virtual worlds for education in MIS is becoming more and more important and urgent.

The 2007 Horizon Report found that “the use of virtual worlds in education has grown considerably over the past year” (p. 18). The report shows several examples of virtual 3-D education classes in Second Life from various universities, including Trinity University, University of Texas at Austin, University of Wisconsin-Madison, Bradley University, and Seton Hall University. With competition among various institutions in offering virtual education and the increasing popularity of virtual worlds among students and institutions, we are interested in examining students’ interests to adopt 3-D virtual worlds for education and to find out what makes the virtual 3-D environment different from the web-based environment for higher education classes. Hence, our research question is: *What factors influence students’ intention to use 3-D virtual worlds for education in higher education? The aim of this research is to find a structure model that can explain students’ intention to adopt an online 3-D-based virtual class.*

Literature review

We are trying to study the factors that affect students’ acceptance of virtual world education. In the following, we review literature on technology related to virtual world and virtual education.

Technology acceptance models

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 virtual world for education. In studying user adoption of virtual worlds for education, it is important to examine user acceptance of specific media of delivering virtual education. In this paper, we focus on studying user acceptance of adopting 3-D virtual worlds for education.

The Technology Acceptance Model (TAM) (Davis 1989) has been tested multiple times in MIS research on diverse sets of information technologies. The reliability of the original scale and validity of the constructs have been tested repeatedly. Results show high reliability of the scales and validity of the constructs (Adams et al. 1992; Hendrickson et al. 1993; Szajna 1994). Venkatesh and Davis (2000) extended TAM into TAM2 to include constructs from 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.

Venkatesh et al. (2003) reviewed user acceptance models and proposed a unified acceptance model that includes social influence, effort expectancy, and performance expectancy as the determinants of usage intention that has direct effect on use behavior. The unified model explains a higher percentage of the variance in intention to use than individual acceptance models, but the reliability of scales and validity of constructs have not been tested as thoroughly as those in TAM.

Virtual education

The core of virtual world education is still education. Virtual worlds have to support core activities in education well in order for virtual worlds to be useful for education. Eschenbrenner et al. (2008) pointed out that 3-D virtual world environment may enhance existing technological capabilities to achieve interactive learning, which should in turn increase learning outcomes. Student learning has been widely studied in education research. Some research measures learning directly from exam scores after students take a course (Arbaugh 2000). Others measure learning using indirect items. Wu and Hiltz (2004) developed a scale to measure perceived learning from online discussion. The scale for perceived learning in this study is adopted from Wu and Hiltz (2004)'s scale with modifications to make the scale suitable for a different research context. We classify the task in this study as an extrinsic task to the IT (Second Life).

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 supported by the study from Rovai (2002).

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). It is implied in their study that increased feeling of social presence leads to increased perceived learning.

Dickey (2005) presented two case studies of educational use of a 3-D virtual world (ActiveWorld). One case study of Dickey (2005)'s research found that "visual cues such as buildings representing applications afford distance learners an intuitive interface for course structure as well as provide necessary resources for learning. (p.7)" and students felt like they were "at school". The findings from Dickey (2005)'s second case study shows that a 3-D environment supports many characteristics of situated learning: authentic context and activity, access to expert modeling, multiple roles and perspectives, and scaffolding and mentoring. 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 interactions

Research in human-computer interaction has presented some empirically tested models that predict the shopping behaviors of online customers. Hassanein and Head (2007)'s model examines 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 effect of perceived social presence on perceived usefulness, trust, and enjoyment.

Flow state is defined as holistic user experience (Csikszentmihalyi 1990). Computer-mediated environments that are conducive to flow will yield positive attitudes and outcomes for users, and have broad implication for learning (Guru & Nah 2001).

Hoffman and Novak presented a conceptual model for measuring flow (Hoffman & Novak 1996) 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 strong contribution of 3-D avatars to perceptions of higher levels of telepresence.

From the earlier studies, we can see that human-computer interactions play an important role in improving learning outcomes. In our current study, we focus on one dimension of the human-computer interaction: enjoyment. 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". We choose to focus on enjoyment in our study because earlier studies have established the relationship between enjoyment and the constructs in TAM (Sun & Zhang 2006) and between enjoyment and learning outcomes (Webster et al. 1990; Webster & Martocchio 1993; Wu & Hiltz 2004).

Research questions

Although the potential values of virtual 3-D education have been recognized by organizations and virtual classes have been offered by many educational institutions, especially higher educational institutions, there have been few empirical studies investigating students' attitudes and acceptance of 3-D virtual worlds for education.

With the maturity of 3-D technology and the high rate of penetration of high speed Internet connections in the U.S. market, virtual reality attracted much interest from various groups. Educational institutions are now adopting the 3-D virtual environment for conducting virtual classes and companies are adopting the environment for employee training. One 3-D virtual reality community, Second Life (SL), is attracting a lot of attention among users,

organizations, and the media. Some universities (e.g., Rockcliff University) and companies (e.g., IBM) have set up various virtual classrooms in SL. The potential value of SL is being recognized by different organizations. Will learners like it or does a 3-D virtual world afford learners more or better educational experiences than regular web-based virtual courses? Hence, the research question is: What factors influence learners' intention to adopt 3-D virtual worlds for classes?" We developed a model that uses the constructs from technology acceptance models, and other research in education and HCI to explain learners' intention to use a 3-D virtual world for their classes.

Theoretical foundation

Technology acceptance models

The topic of user acceptance of information technology gained widespread attention among researchers in the late 1980s, 1990s, and early 2000s along with the availability of personal computers, email, decision support systems, and the World Wide Web. Several acceptance models have been developed to explain factors influencing user acceptance of information technology. Davis (1986) introduced the Technology Acceptance Model and developed a measurement scale to measure perceived usefulness (PU) and perceived ease of use (PEOU) on user acceptance of information technology (Davis 1989). In a later study (Davis et al. 1992), another construct, Perceived Enjoyment, was introduced into TAM. The constructs were classified into extrinsic and intrinsic motivations. Davis et al. (1992) classified perceived enjoyment as intrinsic motivation to use an information system and perceived usefulness as extrinsic motivation to use.

Davis' classic TAM and augmented model specify that PU directly affects user's intention to use information systems and PEOU has effect on PU. A large body of MIS research has found that PU is the strongest predictor of user acceptance across a diverse area of research settings and the effect of perceived enjoyment is consistently weaker than the effects of PU and PEOU (Heijden 2004). However, Heijden (2004) pointed out that a number of exceptions have been reported and the exceptions seem related to the type of information systems used in these studies. Heijden (2004)'s study indicates that perceived enjoyment is a stronger predictor than PU in so-called hedonic systems that "aim to provide self-fulfilling value to the user, in contrast to utilitarian systems, which aim to provide instrumental value to the user" (Heijden 2004, p. 696). Many studies that tested TAM did not differentiate the task types. Gefen (2000) argued that the significance of PEOU on intention to use information systems depends on the nature of task. Gefen (2000)'s study found that PEOU has significant effect on intention to use when the task is intrinsic to IT but no significant effect on intention to use when the task is extrinsic to IT.

New constructs added

Our focus of this study is education in 3-D virtual worlds. From the literature review, we found several constructs that are of interest to this study. *Perceived learning* is a construct to measure the learning outcome from adopting the virtual worlds for education. It is the goal of educational institutions to increase students' learning performance using technology innovations. Research has found that *social presence* and *telepresence* have significant effect on perceived learning (Richardson & Swan 2003). Therefore these three constructs are selected for the research model in this study.

Research model development

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

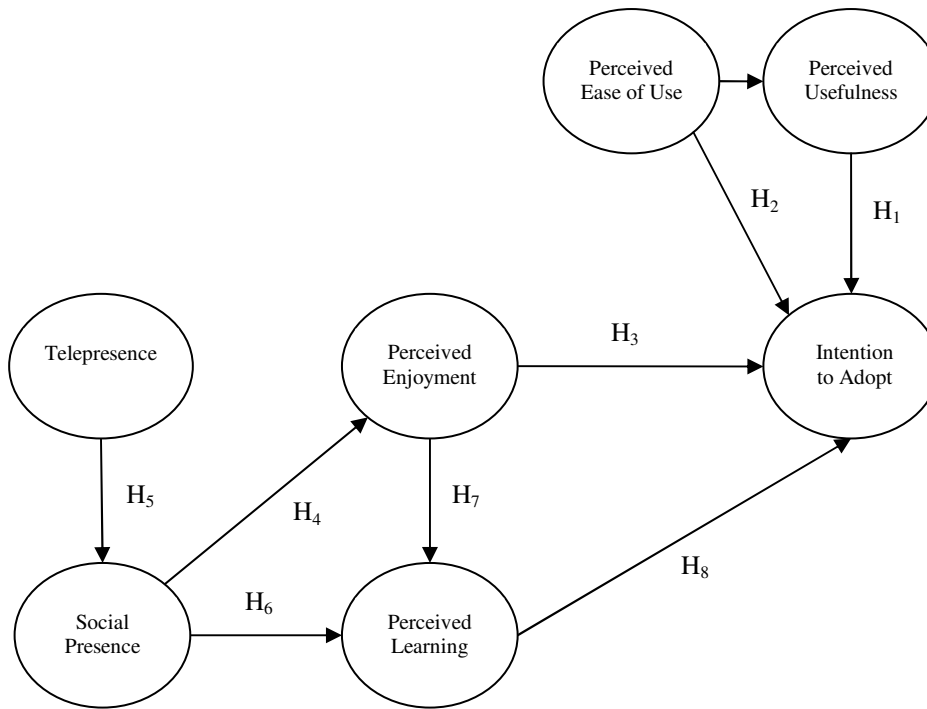


Figure 1: Research model

Two constructs, Perceived Ease of Use (PEOU) and Perceived Usefulness (PU), from Technology Acceptance Model (TAM), will be included in our model since TAM has been applied to a diverse set of technology and holds true for predicting user acceptance of various technology. PU is defined as the degree to which a person believes that adopting a particular system would enhance his or her job performance (Davis 1989). In a virtual education setting, PU refers to whether the technology or medium helps to increase the learners' understanding of course materials. PU has been consistently linked to intention to use diverse sets of information systems. Therefore, our first hypothesis is:

H₁: Perceived Usefulness of 3-D virtual world for education has a significantly positive effect on intention to adopt the 3-D virtual world for classes.

PEOU refers to the degree to which a person believes that adopting a particular system would be free of effort (Davis 1989). Since the nature of task for this study is extrinsic to the IT (see discussion above) and Gefen (2000) found that PEOU has no significant effect on intention to use when the task is extrinsic to IT, our second hypothesis is:

H₂: Perceived Ease of Use of 3-D virtual world for education has no significant effect on intention to adopt the virtual world for classes.

Many studies have measured the customer experience (flow) in computer-mediated environment. We only include the enjoyment dimension of flow state (optimal experience) users experienced in the 3-D virtual world since the vividness and high capacity of interactivity afforded by the 3-D virtual world, Second Life, have been empirically connected to enjoyment dimension of flow (Hassanein & Head 2007). The perceived enjoyment has been shown in research (Koufaris 2002; Hassanein & Head 2007; etc) to have positive impact on intention to use of information technologies. Therefore, our third hypothesis is:

H₃: Perceived enjoyment of taking classes in 3-D virtual world has significantly positive impact on intention to adopt the 3-D virtual world for classes.

Social presence is defined as the ability of learners to project themselves socially and affectively into a community of inquiry (Rourke et al. 2001). It also refers to the feeling of "being with another" (Biocca et al. 2003). Social presence is an important factor influencing learning (Richardson & 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 (Hassanein & Head 2007; Novak et al. 2000; Qiu & Benbasat 2005) have also demonstrated the direct effect of social presence on optimal experience (flow) in a computer-mediated environment. Enjoyment is one of the flow dimensions. Therefore, we hypothesize that social presence will have direct effect on the enjoyment dimension of flow:

H₄: Social presence in 3-D virtual world has significantly positive impact on perceived enjoyment.

"Telepresence has been defined as the sensation of "being there" or as the experience of presence in an environment by means of a communication medium" (Qiu & Benbasat 2005). Although social presence and telepresence were treated as two separate constructs and studies have indicated that both of them have direct effect on flow state, there is no research studying the relationship between telepresence and social presence. From the definitions of the two constructs, we can hypothesize that the feeling of telepresence could lead to the feeling of social presence. Therefore, we include a link between telepresence and social presence in our model:

H₅: Telepresence in 3-D virtual world has significantly positive effect on social presence.

Richardson and Swan (2003)'s study found the direct relationship between social presence and perceived learning. We use that finding as the basis for our next hypothesis:

H₆: Social presence has direct effect on perceived learning from a class conducted in 3-D virtual world.

Wu and Hiltz (2004) studied the relationship between enjoyment and perceived learning in the context of online discussion group. Their results showed the positive impact of enjoyment on perceived learning. Based on their results, we hypothesize:

H₇: Perceived enjoyment has significantly positive impact on perceived learning from a class conducted in a 3-D virtual world.

There is no research studying the relationship between perceived learning and the intention to use information systems. However we believe that it is logical to hypothesize the direct effect from perceived learning to intention to adopt:

H₈: Perceived learning has significantly positive impact on intention to adopt the 3-D virtual world for classes.

Research procedures

Subjects

We will recruit college students to participate in virtual classes conducted in the 3-D virtual world, Second Life. The expected sample size will be between 100 – 150 students.

Operationalization of 3-D virtual world for education

Virtual worlds have grown in popularity considerably in recent years. One such virtual world environments is Second Life. Data from the vendor and developer of Second Life, Linden Labs, indicate that the total number of residents in Second Life has grown from around 1000 in 2003 when it was first available to the public to over 13 million as of April 2008. The 2007 Horizon Report states that campuses and businesses have established virtual locations in virtual worlds for learning and exploration, much like they were creating websites a dozen years ago.

Second Life is a 3-D virtual world created by its residents (Linden 2006) and supported by the software from Linden Research. It is a general purpose 3-D environment without predefined goals, is open to how it may be used and offers a neutral framework for the creativity of its residents (Hobbs et al. 2006). Linden Research has a Second Life Grid that provides a platform for education and non-profit organizations who are interested in distance learning. Several universities have set up their classrooms in Second Life for virtual classes. Attendees in a virtual classroom can see the classroom setting, where the instructor is and other students are, the slides show, etc. and hear what the instructor is talking and chat with peer students in several supported ways.

Research procedure

A section of an introduction class to Management Information Systems will be used for this study. Prior to their participation in the virtual class, we will conduct a short tutorial session to familiarize the subjects with the basics of using Second Life, including user account creation, basic functions, such as walking, talking, interacting with fellow community members, joining groups, getting to destinations in the virtual world, and the use of video and audio in the environment. After the tutorial training, a class session will be conducted in Second Life in a distributed setting,

which means that the instructor and students will not be in the same location. The students are required to participate and carry out some interactions using chatting tools with the instructor and with fellow students.

A survey will be conducted after the virtual class session. The survey will include indicators for several constructs: perceived ease of use, perceived usefulness of the technology, perceived social presence, perceived telepresence, enjoyment from taking the virtual 3-D class, perceived learning, and intention to adopt the 3-D virtual world for education. The dependent variable of the model is intention to adopt 3-D virtual world for education.

Measurements

The measure for Perceived Usefulness will be adapted from Davis (1989). Sample items that measure Perceived Usefulness include “Taking classes in Second Life enables me to accomplish learning tasks more efficiently” and “Classes conducted in Second Life could make education easier to manage”. The measure for Perceived Ease of Use will also be adapted from Davis (1989). Some adapted items include: “Learning to take classes in Second Life would be easy for me,” “I would find it easy to get the Second Life system to do what I want it to do,” and “It would be easy for me to become skillful at using Second Life.” Prior research has shown the direct positive influence of PU and PEOU on IU (Davis 1989). Our research model includes the two links to reflect established MIS models. Perceived Usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance (Davis 1989).

Perceived Learning is defined as the overall perception of the virtual 3-D class. The items used to measure Perceived Learning are derived from Gunawardena & Zittle (1997) and Wu & Hiltz (2004). Some sample items are “The quality of learning via Second Life was excellent” and “Classes conducted in Second Life increase quality of education by providing access to more information and knowledge available on the Internet.”

Telepresence is defined as “a user’s experience of seeming to be present in a remote environment by means of a communication medium” (Qiu & Benbasat 2005). The scale to measure telepresence is adapted from Qiu and Benbasat (2005). Sample items include “I felt that I was in the virtual classroom Second Life created,” “I felt that I was talking with the instructor or my peer students face-to-face.”

There are different perspectives to social presence. One perspective focuses on the social presence of a medium as its capacity to transmit information about facial expressions, posture, dress and non-verbal cues (Hassanein & Head 2007). The other perspective stresses the psychological connection, where social presence is concerned about the “warmth” (Hassanein & Head 2007). We follow Hassanein and Head (2007)’s approach for social presence where the medium gives the user a sense of human warmth and sociability. The instrument for social presence is adapted from Hassanein and Head (2007).

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). The scale for measuring perceived enjoyment is adopted from Davis et al. (1992). Sample items include “I find (would find) using Second Life to be enjoyable” and “I have (would have) fun using Second Life.”

Data analyses

Exploratory Factor Analysis (EFA) will be performed first to see how scale items load on each construct. This process will help to determine the reliability of each scale used in this study.

Path Analysis will be conducted second to test the hypotheses proposed in Section 3 of this study. The constructs will be converted to manifest variables. The score for each manifest variable will be the average of the measuring items for each construct scale. The significance of paths depicted in the model of this study will be tested to see if the underlying hypotheses are supported or not.

Last, the structural regression model test will be conducted to see whether or not the model fits the data. A two-step method recommended by Anderson and Gerbing (1988) will be used for the structural regression model. The analysis from structural regression model can help to determine which constructs do or do not contribute to the overall model fit. As an alternative to the Structural Equation Modeling, we may also conduct Partial Least Square analysis on the data since this method emphasizes prediction rather than fit and makes estimates that have minimal demand on the data.

Expected outcome and contribution

Expected outcome

The research is on-going. 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. Exploratory Factor Analysis, Path Analysis, and the Structural Regression Model test will be performed on the collected dataset for different purposes.

Theoretical contribution

This study will be one of very few quantitative studies to examine the adoption of 3-D virtual world for education to support learning and 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 that are essential in the virtual education setting such as perceived learning and social presence. MIS research on technology acceptance was conducted on information technologies that are largely utilitarian. Recent studies start to differentiate hedonic systems from utilitarian systems because they have different characteristics (Heijden 2004). Even hedonic systems, including the World Wide Web and systems used at home or for leisure purposes, studied by Heijden (2004) and others (Atkinson & Kydd 1997; Moon & Kim 2001; Venkatesh 1999) are quite different from the systems supported by virtual world environments. Theoretically, it is important to see whether the previous MIS technology acceptance models are still valid for the new environment.

With growing popularity of virtual world environments, many universities have or plan to have virtual campuses set up in the virtual world, such as Second Life, to experiment with virtual classes and virtual campus life. The virtual education world provides unprecedented experiences for students who have only taken virtual classes in a web-based environment. Study on the interaction between the new technology (virtual world) and education will provide insights on how virtual world contributes to virtual education that is now part of the mainstream of education. Students' intention to adopt the virtual world for education for course delivery from this study will expand our understanding of the factors that influence students' decision to adopt this whole new environment for education. Our study not only contributes to MIS research but also to education research.

Practical contribution

The value of this study to academic institutions that are interested to start or expand virtual world for education will include providing insights into which aspects of 3-D environment are most important for adoption in such a highly competitive educational environment. The study provides guidelines to educational institutions to prepare themselves for innovation in the educational environment and to decide whether an investment in virtual world for education is a sound strategy.

References

- Adams, D. A., Nelson, R. R., & Todd, P. A. "Perceived Usefulness, Ease of Use, and Usage of Information Technology: A Replication," *MIS Quarterly* (16:2), 1992, pp.227-247
- Anderson, J.C. & Gerbing, D.W. "Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach," *Psychological Bulletin* (103:3), 1988, pp. 411-423.
- Alavi, M. and Leidner, D.R. "Research Commentary: Technology-Mediated Learning—A Call for Greater Depth and Breadth of Research," *Information Systems Research*, 12(1), 2001, pp. 1-10.
- Arbaugh, J.B. "An Exploratory Study of the Effects of Gender on Student Learning and Class Participation in an Internet-based MBA Course," *Management Learning* (31:4), 2000, pp. 503-519.
- Atkinson, M, A., and Kydd, C., "Individual Characteristics Associated with World Wide Web Use: An Empirical Study of Playfulness and Motivation," *Data Base for Advances in Information Systems* (28:2), 1997, pp. 53-62.
- Biocca, F., Harms, C., and Burgoon, J.K. "Towards a More Robust Theory and Measure of Social Presence: Review and Suggested Criteria," *Presence: Teleoperators Virtual Environment* (12), 2003, pp. 456-480.
- Csikszentmihalyi, M. *Flow: The Psychology of Optimal Experience* Harpers Perennial, New York, 1990.
- Davis, F.D. "A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results," *Doctoral Dissertation, Sloan School of management*, Massachusetts Institute of Technology, 1986.
- Davis, F.D. "Perceived usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* (13:3), 1989, pp. 319-339.
- Davis, F.D., Bagozzi, R.P., and Warshaw, P.R. "Extrinsic and Intrinsic Motivation to Use Computers in the Workplace," *Journal of Applied Social Psychology* (22:14), 1992, pp. 1111-1132.
- Dickey, M.D. "Three-Dimensional Virtual Worlds and Distance Learning: Two Case Studies of Active Worlds as a Medium for Distance Education," *British Journal of Educational Technology* (36:3), 2005, pp. 439-451.
- Eschenbrenner, B., Nah, F.F-H, and Siau, K. "3-D Virtual Worlds in Education: Applications, Benefits, Issues, and Opportunities," *Journal of Database Management* (19:4), 2008.
- Farrell, G.M. "Introduction to Virtual Education," in *The Changing Faces of Virtual Education*, G.M. Farrell (ed.), The Commonwealth of Learning, Vancouver, British Columbia, Canada, 2001, pp.1-10.
- Gefen, D. "The Relative Importance of Perceived Ease of Use in IS Adoption: A Study of E-Commerce Adoption," *Journal of the Association for Information Systems* (1:8), October 2000, pp. 1-28.
- Gunawardena, C.N. and Zittle, F.J. "Social Presence as a Predictor of Satisfaction within a Computer-Mediated Conferencing Environment," *American Journal of Distance Education* (11:3), 1997, pp. 8-26.
- Guru, A., and Nah, F.H.F. "Effect of Hypertext and Animation on Learning," in: *Managing Internet and Intranet Technologies in Organizations*, S. Dasgupta (ed.), Idea Publishing Group, 2001, pp. 50-61.
- Hassanein, K. and Head, M. "Manipulating Perceived Social Presence through the Web Interface and its Impact on Attitude towards Online Shopping," *International Journal of Human-Computer Studies* (65), 2007, pp. 689-708.
- Heijden, H. V.D. "User Acceptance of Hedonic Information Systems," *MIS Quarterly* (28:4), 2004, pp. 695-704.

- Hendrickson, A. R., Massey, P. D., & Cronan, T. P. "On the Test-Retest Reliability of Perceived Usefulness and Perceived Ease of Use Scales," *MIS Quarterly* (17:2), 1993, pp.227-230.
- Hiltz, S.R. and Turoff, M. "Education Goes Digital: The Evolution of Online Learning and the Revolution in Higher Education," *Communications of the ACM*, 48(10), October, 2005, pp. 59-64.
- Hobbs, M., Brown, E., and Gordon, M. "Using a Virtual World for Transferable Skills in Gaming Education," *Virtual World Environments*, 2006.
- Hoffman, D.L. & Novak, T.P. "Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations," *Journal of Marketing* (60), July 1996, pp. 50-68.
- Koufaris, M. "Applying the Technology Acceptance Model and Flow Theory to Online Consumer Behavior," *Information Systems Research* (13:2), June 2002, pp. 205-223.
- Linden Research (2006) What is Second Life? Secondlife.com, <http://secondlife.com/whatis/>.
- Moon, J.W., and Kim, Y.,G., "Extending the TAM for a World-Wide-Web Context," *Information and Management* (38:4), 2001, pp. 217-230.
- Novak, T.P., Hoffman, D.L., and Yung, Y.F. "Measuring the Customer Experience in Online Environments: A Structural Modeling Approach," *Marketing Science* (19:1), Winter 2000, pp. 22-42.
- Qiu, L.Y. and Benbasat, I. "An Investigation into the Effects of Text-to-Speech Voice and 3D Avatars on the Perception of Presence and Flow of Live Help in Electronic Commerce," *ACM Transactions on Computer-Human Interaction* (12:4), December 2005, pp. 329-355.
- Richardson, J.C. and Swan, K., "Examining Social Presence in Online Courses in Relation to Students' Perceived Learning and Satisfaction", *Journal of Asynchronous Learning Networks*, 7(1), 2003, pp. 68-88.
- Rovai, A.P. "Sense of Community, Perceived Cognitive Learning, and Persistence in Asynchronous Learning Networks," *The Internet and Higher Education* (5:4), 2002, pp. 319-332.
- Rourke, L., Anderson, T., Garrison, D.R., and Archer, W., "Assessing Social Presence in Asynchronous Text-based Computer Conferencing", *Journal of Distance Education*, 5(1), 2001.
- Sherry, L. "Issues in Distance Learning," *International Journal of Educational Telecommunications*, 1(4), 1996, pp. 337-365.
- Short, J., Williams, E., and Christie, B. *The Social Psychology of Telecommunications*, Wiley, London, 1976.
- Schultze, U., Hiltze, S.R., Nardi, B., Rennecker, J., and Stucky, S. "Using Synthetic Worlds for Work and Learning," *Communications of the Association for Information Systems* (22), 2008, pp. 351-370.
- Sun, H. and Zhang, P. "Causal Relationships between Perceived Enjoyment and Perceived Ease of Use: An Alternative Approach," *Journal of the Association for Information Systems* (7:9), 2006, pp. 618-645.
- Szajna, B. "Software Evaluation and Choice: Predictive Evaluation of the Technology Acceptance Instrument," *MIS Quarterly* (18:3), 1994, pp.319-324.
- The New Media Consortium *The 2007 Horizon Report*, The New Media Consortium, 2007.
- Tsichritzis, D. "Reengineering the University," *Communications of the ACM*, 42(6), June, 1999, pp. 29-30.
- Venkatesh, V, "Creation of Favorable User Perceptions: Exploring the Role of Intrinsic Motivation," *MIS Quarterly* (23:2), 1999, pp. 239-260.

Venkatesh, V., & Davis, F. D. "A theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," *Management Science* (46:2), 2000, pp.186-204.

Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F.D. "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly*, 27(3), 2003, pp. 425-478.

Webster, J., Heian, J. B. and Michelman, J. E. "Computer Training and Computer Anxiety in the Educational Process: An Experimental Analysis," *Proceedings of the eleventh international conference on information systems*, Copenhagen: ICIS, 1990, pp. 171-182.

Webster, J. and Martocchio, J.J. "Turning Work Into Play: Implications for Microcomputer Software Training," *Journal of Management* (19:1), 1993, pp. 127-146.

Wu, D. and Hiltz, S.R. "Predicting Learning From Asynchronous Online Discussions," *Journal of Asynchronous Learning Network* (8:2), April 2004, pp. 139-152.