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3-D VIRTUAL WORLD EDUCATION: AN EMPIRICAL COMPARISON WITH FACE-TO-FACE CLASSROOM

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3-D Virtual World Education: An Empirical Comparison with Face-to-Face Classroom

Abstract

3-D virtual worlds are increasing in popularity as a means of pedagogical delivery in higher education. In this research, we assess the relative effectiveness of a 3-D virtual world learning environment, Second Life, and traditional face-to-face learning environment. We also assess the efficacy of instructional strategies in these two learning environments and their effects on interactivity, perceived learning, and satisfaction. Our findings suggest that there is an interaction effect of learning environment and instructional strategy. Pair-wise comparisons indicate that when interactive instructional strategy is used, there is no significant difference for perceived learning and satisfaction between 3-D virtual world and face-to-face learning environment. However, there is a significant difference for those constructs when a direct instructional strategy is used. Further, in interactive instructional sessions, students experienced higher level of classroom interactivity in Second Life than in face-to-face classroom.

Keywords: 3-D virtual world, Second Life, instructional strategies, perceived learning, social presence, classroom interactivity, perceived ease of use, perceived usefulness
Introduction

Education delivered over the Internet is increasing in popularity. The popularity of distance education, especially Internet-based distance education, has increased dramatically over the years among higher education institutions (Hew and Cheung 2010; NMC 2007). Higher learning in 3-D virtual worlds is a relatively new phenomenon. NMC survey (2010) shows that “many (educators) are starting to see very practical and effective uses for virtual worlds.” In the last several years, virtual world education has attracted huge attention among researchers and higher education institutions. Pioneering research on 3-D virtual worlds has started to appear in conferences and journals.

A 3-D virtual world is a rich, immersive, and highly scalable environment. A class conducted in a 3-D virtual world differs from a traditional Web-based class due to the following features: 3-D visualization, use of avatars to represent class participants, sense of presence for the learners, and creation of context-specific learning (Calongne 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 Web sites a dozen years ago.

Proserpio (2007) argues that we are teaching a whole new generation of learners who is called a virtual generation of students. The Pew research center released a survey report in 2007 that highlights the characteristics of “Generation Next.” The top features of the next generation are that they are highly technology-oriented: (i) they use technology and the Internet to connect with others; (ii) they frequently use social networking sites; and (iii) they embrace new technologies. These surveys suggest that “Generation Next” is more keen to interact with others using technology than the older generations. It is critical to investigate how learners and instructors interact with each other and how interactivity in virtual world education influences learning performance to fully realize the benefits enabled by the virtual world environment. Not only is interactivity a key in education, but it is also tied to all three key theories of education.

The three key theoretical paradigms in learning are behaviorist, cognitivist, and constructivist (Haseman et al. 2002; Sims 2003). Studies in education research have shown that Internet-based learning environments can help to achieve the goals advocated by constructivists by actively involving students in the learning process, promoting interactions among learners and with their learning environments, and increasing student collaboration (Tsai 2001). Constructivist learning is a main stream idea in education in the 21st century (Kirschner 2004), and 3-D virtual worlds can potentially be used by educational institutions to help to promote constructivists’ assertions and increase learning performance.

Education literature has shown that traditional 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). Two of the most important and widely-used instructional strategies are the direct instruction and interactive instruction. Direct instruction is a teacher-centered instructional approach (Kroesbergen and Van Luit 2003) and is a strategy that emphasizes rich structure, drilling, and content. In direct instruction or teacher-centered instruction, the teacher is primarily responsible for delivering knowledge to students and communication direction tends to be one-way (Weston and Cranton 1986). Students in a direct instruction session are usually passive rather than participative. The most widely used direct instruction method is the lecture, in which one instructor speaks directly to a group of students. Interactive instruction is an instructional strategy that relies heavily on discussion and sharing among participants (Seaman and Fellenz 1989). In interactive instruction sessions, students actively participate, interact, and/or discuss topics that are presented to them. The most commonly used interactive method is the class discussion (Weston and Cranton 1986), which involves interactions among students, as well as between instructors and students.

Although many educators have started to set up learning environments in virtual worlds, there is no guideline available to help them design effective instructional strategies in virtual worlds because there has been little research on the relative effectiveness of virtual worlds for learning, and how the interaction of the learning environment in virtual worlds and instructional strategies affect learning performance.

Drawing on the characteristics of “Generation Next” and theories of Media Richness and Transactional Distance, we developed and empirically tested hypotheses on the effectiveness of using two main instructional styles in a 3-D virtual world learning environment versus a face-to-face learning environment. Specifically, we empirically assessed how learning in a virtual world learning environment, Second Life, differs from learning in a traditional learning environment, face-to-face classroom. We examined the effects of two main instructional styles, interactive instruction and direct instruction, on learning in each environment and compared the results to reveal differences and
similarities in terms of learning performance. These comparisons provide insights to educators on what they need to focus on when offering education in virtual worlds. Further, the results inform virtual world designers/developers on where they need to make improvements to make virtual worlds better suited for education.

**Literature Review**

Virtual worlds need to support core educational activities well in order to be an effective means for delivering education. Eschenbrenner et al. (2008) point out that 3-D virtual world environment can enhance existing technological capabilities to achieve interactive learning, which can in turn enhance learning outcomes. Hence, the key strength of 3-D virtual world learning environment should be the capability to facilitate interactions between learners and instructors. This strength can be leveraged to increase learners’ performance because students of the virtual generation embrace technologies to communicate with others (Pew 2007). Education research on virtual worlds has shown that students are “likely to be more satisfied with their courses if they feel involved, and even more so if they develop relationships with other members of the learning community” (Hobbs et al. 2006, p.7). This view is also supported by Rovai’s (2002) study.

Studies on virtual education have been carried out from various educational perspectives in recent years. For example, a special issue of the magazine “CyberPsychology and Behavior” focused on learning in virtual teams. Researchers investigated how virtual education achieves the same level of learning, understanding, and team forming in virtual teams as in traditional face-to-face teams (Kirschner and Bruggen 2004). Dickey (2005) presents two case studies of educational use of a 3-D virtual world environment (i.e., ActiveWorld). Dickey (2005) concludes that the 3-D immersive format has significant potential for “facilitating collaborations, community, and experiential learning,” and also allows “a learner to become situated and embodied in a computer-mediated learning environment.” (p. 449)

In a meta-analysis study of web-based instruction (WBI) versus classroom instruction (CI) for employee training (Sitzmann et al. 2006), it was found that WBI was 6% more effective than CI for teaching declarative knowledge. WBI and CI were equally effective for teaching declarative knowledge when the same instructional strategies were used to deliver both WEB and CI. Also, WBI was 19% more effective than CI for teaching declarative knowledge when Web-based trainees were provided with control. In another meta-analysis study of computer-assisted instruction (CAI) versus traditional instruction (Timmerman and Kruepke 2006), the results showed that when computer-assisted instruction was used in a traditional classroom, performance gained was larger than traditional instruction without computer-assisted instruction. However, Timmerman and Kruepke’s study does not directly compare virtual education and traditional face-to-face education.

Although some studies have been done on virtual education, there is a paucity of empirical studies on the effectiveness of 3-D virtual world learning environment in enhancing the interaction between learners and instructors or among peer learners when compared with traditional learning environment that does not use technology for interaction. We believe that studying the relative effectiveness of 3-D virtual world learning environment and traditional face-to-face learning environment is an important step to provide theoretical support or denial for using 3-D virtual worlds for education. This study helps to address the question of whether 3-D virtual world environment is more or less effective for education when compared to traditional face-to-face classroom setting.

Interactivity is a very important component in teaching and learning. Studies have shown that interactivity is a key to learning in traditional classrooms (Bannan-Ritland 2002; Fulford and Zhang 1993). Siau et al.’s (2006) empirical study supports the claim that technologies, when embedded in instruction to support the cognitive and social processes of learning, can provide unique opportunities for educators (Roblyer and Wiencke 2003). Although many technological features in 3-D virtual worlds are not new or unique, they are more closely integrated in the virtual worlds so educators can leverage them for interactive teaching, which is the heart of the constructivist approach in learning. We argue that different teaching styles in virtual world education environment can generate different levels of classroom interactivity and high classroom interactivity will positively correlate with students’ learning performance.

A review of the literature suggests that there has been no empirical study on how different instructional styles that are afforded and supported by 3-D virtual world educational environment impact learning outcomes and satisfaction. We are interested in understanding the effectiveness of instructional styles in virtual world learning environment for education compared to traditional face-to-face learning environment. By applying the two most popular instructional
strategies, direct and interactive instruction, in this study, we can specifically test whether or not there is an interaction effect between learning environment and instructional strategies.

**Research Question**

The main focus of this study is to investigate the relative effectiveness of 3-D virtual world learning environment and traditional face-to-face learning environment when different instructional strategies are used.

The virtual or new generation of students identified by Proserpio (2007) has different characteristics from the earlier generations such as the T.V. generation identified by Gioia and Bras (1986). This research focuses on this new generation of students since the teaching methods that are suitable for the T.V. generation may not be suitable for the newer virtual generation. In this study, we examine how different teaching styles in 3-D virtual worlds can affect learning. Further, the study investigates possible interaction effects between different instructional strategies and course delivery media on learning performance and satisfaction. By comparing the results of learning performance and satisfaction between the virtual world learning environment and traditional face-to-face learning environment, we assess the relative effectiveness of the virtual world learning environment for pedagogical purposes. We also study how different instructional strategies in these two environments may influence learning.

**Theoretical Foundation**

**Education Theories**

The three key theories of learning are behaviorist, cognitivist, and constructivist. Behaviorists emphasize the importance of feedback and student self-assessment in learning, which can be achieved through increased interactivity in instructional design. Cognitivists focus on knowledge transfer from instructors to students. Questioning and answering, informative feedback, and explanations are effective ways to improve knowledge transfer, which are different aspects of interactivity in the classroom. The constructivist model of learning requires the process of equilibration, that is, the internal process of a learner to organize pieces of information into a system of knowledge. The constructivist learning model suggests that learners’ engagement and attention are important in learning.

Interactivity is tied to all three key theories of learning. Classroom interactivity is defined as the active involvement and participation of students in a classroom (Bannan-Ritland 2002; Sims 2003). When interactivity is present in the classroom, students are not only more motivated to learn, but are also more attentive, participative, and likely to exchange ideas with instructors and fellow students. Moreover, interactivity in the classroom will influence students’ learning outcomes, such as attitude and achievement (Siau et al. 2006). Bannan-Ritland (2002) shows that interactivity is a critical factor in learning. Siau et al.’s (2006) study of a classroom response system illustrates that the use of information technology such as a classroom response system can significantly improve classroom interactivity. Siau et al. (2006) also developed a reliable and validated instrument to capture individual and classroom interactivity. An interactive learning process is a key element in virtual education.

**Transactional Distance Theory**

Transactional Distance Theory (TDT) (Moore, 1980) has been used to explain the effect of geography on pedagogy. Martindale (2002) states that "transactional distance requires a learner, teacher, and a communication channel" (p. 4) and different instructional techniques can generate different transactional distances. In distance education, including virtual world education, it is important to reduce transactional distance between learners and instructors. Based on TDT, interaction between learners and instructors is an important way to reduce the transactional distance and increase learning and satisfaction (Dron et al. 2004; Stein et al. 2005).

Different instructional strategies can produce different learning performance in virtual world education. TDT can be used together with media richness theory to explain why the amount of interactivity can lead to different learning performance. TDT is used in this study to understand the relationship between interactivity and learning performance. The comparison of learning performance across different media is assessed through the lens of media richness theory, which is discussed next.
Media Richness Theory

Media Richness Theory (MRT), developed by Daft and Lengel (1986), has been commonly used to explain media effects on online collaboration. Daft and Lengel (1986) define media richness as “the ability of information to change understanding within a time interval” (p. 560). Dennis and Kinney (1998) summarize the key points of MRT: 1) media differ in “richness”, with face-to-face communication being the richest; 2) four factors influence media richness: the ability of the medium to transmit multiple cues, immediacy of feedback, language variety, and the personal focus of the medium; 3) performance improves when richer media are used for equivocal tasks and when leaner media are used for non-equivocal tasks. The two factors, the ability of the medium to transmit multiple cues and immediacy of feedback, are the most important factors that affect media richness (Dennis and Kinney 1998; Kraut et al. 1992).

Numerous studies in the MIS literature have applied MRT to understand online collaboration (Cooper 2003; D’Ambra et al. 1998; Dennis and Kinney 1998; Kahai and Cooper 2003; Mennecke et al. 2000; Suh 1999). MRT was assessed in a laboratory setting by Dennis and Kinney (1998) and the results indicate that parts of the theory were not supported when applied to “new” media: computer-mediated and audio-video-mediated. Specifically, feedback and multiplicity of cues were not shown to be more important for equivocal tasks than for non-equivocal tasks. Dennis and Kinney (1998) conclude that media richness matters but it does not interact with task equivocality, and matching media richness to task equivocality does not improve performance for the new media. This claim is supported by subsequent studies such as Shepherd and Martz (2006), Mennecke et al. (2000), and Suh (1999).

Hence, past studies suggest that some parts of the MRT may not be applicable to specific contexts. Nevertheless, as pointed out by Dennis and Kinney (1998), in general, media richness matters and immediacy of feedback and multiplicity of cues do improve performance in some circumstances. For example, Dennis and Kinney (1998) argue that “if high feedback is needed to rapidly converge on a decision, then the use of media providing high feedback should improve performance” (p. 270). Interestingly, they used the term, high feedback, not the construct of immediacy of feedback in this statement.

Past research on MRT seems to have ignored an important aspect of measurement of media richness: the medium’s capacity to generate feedback/interaction among communication users. Dennis and Kinney (1998) state that “feedback is important to the speed and effectiveness of communication…” (p. 260). When presenting the four criteria that affect media richness, Daft and Lengel (1987) also list feedback as one criterion (p. 358). When discussing effective organizational structural design for collaborative communication, Daft and Lengel (1986) state that “specific structural mechanism can be implemented by the organization to facilitate the amount of information needed to cope with uncertainty and achieve desired task performance” (p. 559). These statements suggest that the amount of feedback or information exchange is also an important aspect of media richness. As Proserpio (2007) points out, we are teaching a new generation of learners. This generation of learners embraces new technology and use technology and the Internet to connect with others (Pew 2007). It is important for a medium to not only provide a means for rapid feedback but also help in facilitating interactions in an educational context. However, the amount of feedback or information exchange was not formally incorporated in MRT research. In an educational environment, the amount of feedback or information exchange is an important factor influencing learners’ learning performance (Bannan-Ritland 2002; Siau et al. 2006). We, therefore, argue that in an education context, the amount of feedback or information exchange (measured by classroom interactivity) or more specifically, the ability to facilitate such interactions, and multiplicity of cues can affect media richness; and media richness can in turn affect student learning. The amount of feedback (measured by classroom interactivity), along with multiplicity of cues, is used in this study to develop our hypotheses and explain how these constructs interact with learning environments to affect performance (i.e., student learning in this study).

Hypotheses Development

From Proserpio (2007)’s study and the survey of Pew Research Center (2007), we believe that in a computer mediated environment, students may have the opportunity to ask more questions and hence, receive clarifications from instructors. First, the new generation students are virtual generation students (Proserpio 2007) and are more comfortable in using new technology for communications (Pew 2007). Second, communicating via a computer mediated environment is less threatening than being the center of attention when asking questions in a face-to-face environment. Group Decision Support System (GDSS) literature has shown that there was more equal member participation in a group meeting when the meeting was conducted via computer than via face-to-face (McLeod and
Liker 1992; Straus and McGrath 1994). Thus, we argue that interaction in an interactive instruction session in a virtual world environment will be higher than in a face-to-face environment.

$H_1$: An interactive instructional session conducted in a 3-D virtual world learning environment will generate higher interactivity than an interactive instructional session conducted in a traditional face-to-face learning environment.

Studies have shown that interactivity is a critical component in learning (Bannan-Ritland 2002; Fulford and Zhang 1993) and interactivity in classroom will influence students’ learning outcomes, such as attitude and achievement (Siau et al. 2006; Stein et al. 2005). In education research, Transactional Distance Theory (TDT) states that geography has critical effects on pedagogy and transactional distance can influence learning performance. According to TDT, interaction among learners and between learners and instructors is one way to reduce transactional distance when the other two factors, content structure and learner’s autonomy, are held constant. When a learning environment can facilitate more interactions, it will help learners achieve higher performance (Dron et al. 2004; Stein et al. 2005). We argued above that the amount of feedback and exchange (measured by classroom interactivity in the education context) is an important factor. In education context, because classroom interactivity can help to reduce transactional distance, it can improve student learning. TDT is used to explain why higher interactivity should lead to better learning performance. In a face-to-face setting, transactional distance is also relevant to learning performance. Muhammed Betz states in Lowe (2000): “The term transactional distance refers to, first and foremost, the learning transaction (much like a business transaction or a client-customer transaction, to allude to TQM jargon) between the learner and the instructor (i.e., teacher, author/designer, whatever is politically correct!). Transactional distance is referring to the quality of the learning transaction with the quality dependent on both participants in the transaction as well as variables of media.” Transactional distance is also affected by interaction between the learner and the instructor in a face-to-face learning setting. With a short transactional distance between the learner and the instructor with other relevant factors such as content structure and learner’s autonomy held constant, learners should achieve higher learning outcomes. Therefore, we can compare learning outcomes from the two learning environments to assess how interactivity affects learning performance. Combining the MRT and TDT, we argue that the ability of a medium to facilitate feedback and exchange can reduce transactional distance which in turn facilitates learning. Thus, we hypothesize that learning performance and satisfaction in a virtual world environment in an interactive class session will be higher than in a face-to-face environment because of the higher interaction in the virtual world environment.

$H_{2a}$: Students will learn more in an interactive instructional session conducted in a 3-D virtual world learning environment than in a traditional face-to-face learning environment.

$H_{2b}$: Students will be more satisfied in an interactive instructional session conducted in a 3-D virtual world learning environment than in a traditional face-to-face learning environment.

When the amount of feedback or exchange is controlled, multiplicity of cues including non-verbal cues becomes a key factor that can influence learning performance. Face-to-face learning environment comprises more cues than 3-D virtual world learning environment because gestures and facial emotions are lacking in the 3-D virtual world environment. In direct sessions, students were not encouraged to interact with the instructor and peer students; therefore very few interactions occurred in those direct instructional sessions. When interactions are limited in both environments, based on MRT, multiplicity of cues becomes a key factor that will influence learning performance and satisfaction (Dennis and Kinney 1998; Kahai and Cooper 2003). Therefore, we hypothesize that learning and satisfaction are higher in the face-to-face environment than the virtual world environment for direct instructional class sessions.

$H_{3a}$: Students will learn more in a direct instructional session conducted in a face-to-face learning environment than in a 3-D virtual world learning environment.

$H_{3b}$: Students will be more satisfied in a direct instructional session conducted in a face-to-face learning environment than in a 3-D virtual world learning environment.

Our research model is as shown in Figure 1.
Research Methodology

We carried out an experimental study to assess the effects of learning environment (3-D virtual world versus face-to-face) and instructional strategy (interactive versus direct) on performance. Instructional strategy is a within-subject factor whereas learning environment is a between-subject factor. In other words, each subject experienced either the 3-D virtual world environment or the face-to-face environment for learning but was exposed to both the direct and interactive instructional strategies. The 3-D virtual world environment was operationalized using Second Life.

The within-subjects repeated measures design was used to assess interactive strategy versus direct instructional strategy to reduce the error variance associated with individual differences and hence, reduce sample size requirement. However, the between-subjects design was used to assess the face-to-face versus virtual world (Second Life) learning environments. As shown in Figure 2, each subject was assigned to either face-to-face or Second Life learning environment and experienced both the direct and interactive instructional sessions, which were counter-balanced to control for possible order effects.

Two topics, input design and output design that were similar in content nature, structure, and difficulty, were used to operationalize direct and interactive instruction strategies. The two sessions had the same number of PowerPoint slides. The order of the topics was counter-balanced along with direct and interactive instruction strategies. Out of the four classes conducted in each of the two learning environments, input design was presented first in two of the classes, using the direct instruction strategy in one and interactive instruction strategy in the other. In the other two classes, output design was presented first, using the direct instruction strategy in one and interactive instruction strategy in the other. Therefore, the content of the sessions was also controlled in the study.

Subjects

College students participated in virtual classes conducted in a 3-D virtual world, Second Life, and face-to-face classes conducted in a traditional classroom. For education related studies, students are the appropriate and ideal subjects. Students from the college of business from a large Midwest U.S. university participated in this study.
Attendance was voluntary and compensated with extra credits for their classes. A total of 182 students participated in the study.

**Research procedures**

**Virtual World Environment**

Students in a virtual world class used the university computer labs to participate in the virtual class sessions. All students in each class session were in the same computer lab and the instructor was in a remote location. Before the session began, the instructor conducted a short tutorial session (5 minutes) to familiarize the subjects with the basics of using Second Life. The short tutorial session includes performing basic functions such as walking, talking, interacting with fellow students, use of the headphone, and use of instant messaging. There were four class sessions in Second Life, each had about 20 students, for this study.

After the tutorial, two class sessions, direct and interactive sessions, were presented to students by the same guest lecturer in a counter-balanced order for different classes. The direct session is a lecture session, in which the lecturer taught the class content exclusively without allowing students to discuss what were taught or to ask questions about the content. The interactive session was a discussion session, in which the lecturer encouraged students to ask questions, present their ideas to share with the entire class, and answer questions by students or the instructor. The topics of the sessions were “Designing effective input for an information system” and “Designing effective output for an information system” where one of them was conducted using the direct instructional strategy and the other using the interactive instructional strategy. Each student filled up a survey form after each instructional session. The survey consisted of questions related to interactivity, perceived learning, and satisfaction.

In a direct instruction session, the guest lecturer used the audio function in Second Life to lecture. Students listened to the lecture and could ask clarifying questions using instant messaging. In an interactive instruction session, the focus is on discussion. The guest lecturer led students to discuss issues and asked students to present their ideas and solutions using the instant messaging feature in Second Life. Students were encouraged to ask and respond to questions during the interactive session. The instructor conducted the lecture using Microsoft PowerPoint in Second Life and the students could see the PowerPoint display.

**Face-to-Face Environment**

For students in a face-to-face class, the same guest lecturer conducted the same two sessions -- “Designing effective input for an information system” and “Designing effective output for an information system” where one of them was conducted using the direct instructional strategy and the other using the interactive instructional strategy, both in the traditional face-to-face classroom setting. After each session (interactive or direct), the survey was administrated. The same set of PowerPoint slides as that used in the virtual world learning setting was used. There were four class sessions in face-to-face classrooms, each had about 20 students, for this study.

In both the virtual world and face-to-face learning environments, the order of interactive and direct sessions and the class topics were counter-balanced to control possible order effects.

**Measurement**

The items used to measure perceived learning are derived from Richardson and Swan (2003), and Wu and Hiltz (2004). The scale for measuring classroom interactivity is adopted from Siau et al. (2006). The scale for measuring satisfaction is adopted from Piccoli et al. (2001), and Richardson and Swan (2003). The question items for each scale are listed in the appendix where 1 means strongly disagree and 7 indicates strongly agree with the statements.

**Data analyses**

Although the survey instruments were adopted from published and tested instruments, we first tested the reliability of the instruments because they were being applied in a new context. The reliability of the instruments was assessed using Cronbach’s alpha coefficient. The results are depicted in Table 1.
These legends are used in the following tables and text:
PL = Perceived Learning; CI = Classroom interactivity; SAT = Satisfaction

<table>
<thead>
<tr>
<th>Table 1: Cronbach’s Alpha Coefficient</th>
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<tr>
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<tr>
<td><strong>Second Life</strong></td>
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<td>Direct Session</td>
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<td>Interactive Session</td>
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<td><strong>Face-to-Face</strong></td>
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<tr>
<td>Direct Session</td>
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<td>Interactive Session</td>
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Classroom interactivity (CI) was first analyzed. Figure 3 shows the means of CI in each condition. In general, CI is significantly higher in interactive instructional sessions than in direct instructional sessions as reflected by the main effect of instructional strategy: $F(1, 347) = 41.48, p < .01$. The F-test for the interaction shows that there is a significant interaction effect of media and instructional strategy on CI, $F(1, 347) = 9.73, p < .01$ (see Figure 3). Using Least Significance Difference (LSD), LSD_{mind} = 0.406, we assessed the simple effects in the interaction. CI is significantly higher in interactive session than in direct session in Second Life; CI is significantly higher in interactive session than in direct session in Face-to-Face classroom. These results show that the manipulation in the study was working as intended. The LSD comparison also shows that CI is significantly higher in interactive session in Second Life than in interactive session in face-to-face classroom. Thus, hypothesis 1 is supported.
Figure 3 shows the results for perceived learning. There is a significant interaction effect for media and instructional strategy (see Figure 4). LSD_{mmd}=.43 is calculated for this analysis to assess the simple effect in the interaction.

For Second Life, there is significantly higher level of perceived learning in interactive session than direct session. On the other hand, for face-to-face, there is no significant difference for perceived learning between interactive and direct sessions.

For interactive sessions, there is no significant difference for perceived learning between interactive sessions of Second Life and face-to-face. This result does not support hypothesis H_{2a}. For direct session, there is significantly higher level of perceived learning in face-to-face classroom than in Second Life. This result supports hypothesis H_{3a}.

Figure 4 depicts the results for satisfaction. There is a significant interaction effect for media and instructional strategy (see Figure 5). LSD_{mmd}=.363 is calculated for this analysis to assess the simple effect in the interaction.

For Second Life, there is significantly higher level of satisfaction with interactive session than with direct session. For interactive sessions, there is no significant difference in satisfaction between interactive session in Second Life and interactive session in face-to-face classroom. This result does not support hypothesis H_{2b}. For direct sessions, there is also significantly higher satisfaction with direct session in face-to-face classroom than with direct session in Second Life. This result supports hypothesis H_{3b}.
**Discussion**

In this section, we discuss the hypotheses and the empirical results.

**Discussion on hypothesis 1:**

We used a classroom interactivity measure adopted from Siau et al. (2006) to determine whether or not the two instructional strategies create different levels of classroom interactivity. Interactivity is the key component that differentiates the two strategies: direct instruction and interactive instruction. The classroom interactivity measure is also used to test whether or not the virtual world learning environment can help to create more interactions for the new generation learners.

The result indicates that the interactive instructional strategy generates significantly higher level of classroom interactivity than direct instructional strategy in both Second Life and face-to-face learning environments. Further, the interactive instructional strategy creates significantly higher level of classroom interactivity in Second Life than in face-to-face learning environment; therefore hypothesis 1 is supported.

These results support the results from previous studies of Proserpio (2007) and Pew (2007). Those prior studies found that the “Generation Next” is different from the earlier generations, such as the T.V. generation identified by Gioia and Bras (1986), in that “Generation Next” embraces technology and uses new technology to connect and interact. In the interactive session in Second Life, students perceived higher interaction with the instructor and peer students than in a face-to-face classroom, which is a very interesting finding. The “Generation Next” was more comfortable interacting with the instructor and peer students in Second Life than in a face-to-face classroom.

**Discussion on hypotheses 2a and 2b:**

Perceived learning and satisfaction with a class session were compared between sessions in the same learning environment as well as between sessions using the same instructional strategy. Hypotheses H2a and H2b, which argue that interactive sessions conducted using Second Life will lead to higher perceived learning and satisfaction than interactive sessions conducted using face-to-face, are not supported by the results.

For the interactive session, there is no significant difference for perceived learning between Second Life and face-to-face classroom, therefore H2a is not supported.

For the interactive session, there is no significant difference for satisfaction between Second Life and face-to-face classroom, therefore H2b is not supported.

One possible reason for the lack of significant results is that we use perceived learning. Future studies may consider using actual learning achievement measures, such as a quiz or an exam, to assess learning. Other than the possible effect in the measurement of learning performance, we believe TDT and MRT may shed some lights on why H2a and H2b are not supported in this study. MRT and subsequent research using MRT indicate that feedback and multiplicity of cues do matter for media richness. Based on MRT research, in certain circumstances, feedback and multiplicity of cues do matter for media richness.
Virtual worlds are gaining in popularity and importance in education. An experimental study was conducted to investigate the effects of two different instructional strategies, direct and interactive instructions, on perceived learning and satisfaction with the classes in a virtual world learning environment, Second Life, and traditional face-to-face learning environment.

This study presents a pioneering effort in investigating the effects of different instructional strategies on education, measured by perceived learning and satisfaction with classes in virtual world environments. In this study, we examined two of the most important and relevant instructional strategies, direct and interactive instructions, in the 3-D virtual world environments. We compared the results from the virtual world learning environment, Second Life with the results from a traditional face-to-face learning environment (i.e., physical face-to-face classroom). Future studies can investigate other instructional strategies such as independent study and experiential learning in the 3-D virtual world environments. Other variables that are important to education such as enjoyment should also be looked at in future studies. In this study, learning is measured subjectively using perceived learning and it is self-reported by the subjects. Actual exam scores can be assessed in future research. The perceived learning scale used in this study may have limitations in measuring actual learning in different environments. In this study, we use the very popular virtual world, Second Life. Future studies can replicate this study using other virtual education technologies or other virtual world environments such as Active World.

These findings have significant practical implications. Educators who are interested in developing education in virtual world learning environments should be aware that technology that enhances interaction is critically important. From this study, we found that perceived learning and satisfaction with a class is significantly lower in Second Life, a virtual world learning environment, than in a face-to-face classroom when direct instructional strategy was used. However, when interactive instructional strategy was used there is no difference in perceived learning and satisfaction with a class in Second Life versus face-to-face classroom. Therefore, when developing education in virtual world learning environments, educators need to focus on designing interactive education that can leverage the new technologies supported by virtual worlds. This is especially important when the target audience is the “Generation Next” (Proserpio 2007). A direct instructional class in virtual world environments will dissatisfy the new generation of learners as the direct instructional strategy does not capture the full potential of the virtual environment to enhance interaction. This study also shows that multiplicity of cues is important in virtual world education. Lacking multiplicity of cues could lead to dissatisfaction toward a class as well as lower learning performance in virtual world learning environments compared to face-to-face learning environments when other factors are controlled. Although cues are available in virtual worlds, the use of avatars inherently limits gesture cues can influence performance. In interactive sessions, interactivity is higher in Second Life than in face-to-face learning environment. Based on TDT, higher interactivity should lead to shorter transactional distance. Therefore in the education context, higher interactivity should lead to better learning performance, which is also supported by other MIS and educational research. However, multiplicity of cues is greater in face-to-face than in Second Life learning environment. Therefore, based on the factor of multiplicity of cues, the learning performance should be higher in face-to-face than in Second Life learning environment. That probably is why we don’t see the significant difference of learning performance between the two environments in interactive sessions. We may have underestimated the effect of multiplicity of cues on performance. In direct sessions, interactivity is limited in both sessions, and hence, transactional distance should be the same for both sessions. Therefore, the other element, multiplicity of cues, in MRT will influence the learning performance.

Discussion on hypothesis 3a and 3b:

Hypotheses H_{3a} and H_{3b}, which argue that multiplicity of cues will lead to better learning and satisfaction with a class when interactivity is limited, are supported in this study. These results also provide support for the modified media richness theory (Dennis and Kinney 1998), where immediacy of feedback and multiplicity of cues improve performance. Future studies may test whether the levels of feedback measured by interactivity in this study or multiplicity of cues is more important to improve performance and satisfaction. From our study, it shows that an interactive session in Second Life with more interactivity and arguably less cues would not lead to higher performance than an interactive session in a face-to-face classroom with less interactivity and arguably more cues. A direct session in a face-to-face classroom with more cues and the same level of interactivity does lead to higher performance than a direct session in Second Life with less cues and the same level of interactivity.

Contributions and Future Research

Virtual worlds are gaining in popularity and importance in education. An experimental study was conducted to investigate the effects of two different instructional strategies, direct and interactive instructions, on perceived learning and satisfaction with the classes in a virtual world learning environment, Second Life, and traditional face-to-face learning environment. This study may have limitations in measuring actual learning in different environments. In this study, we use the very popular virtual world, Second Life. Future studies can replicate this study using other virtual education technologies or other virtual world environments such as Active World.

These findings have significant practical implications. Educators who are interested in developing education in virtual world learning environments should be aware that technology that enhances interaction is critically important. From this study, we found that perceived learning and satisfaction with a class is significantly lower in Second Life, a virtual world learning environment, than in a face-to-face classroom when direct instructional strategy was used. However, when interactive instructional strategy was used there is no difference in perceived learning and satisfaction with a class in Second Life versus face-to-face classroom. Therefore, when developing education in virtual world learning environments, educators need to focus on designing interactive education that can leverage the new technologies supported by virtual worlds. This is especially important when the target audience is the “Generation Next” (Proserpio 2007). A direct instructional class in virtual world environments will dissatisfy the new generation of learners as the direct instructional strategy does not capture the full potential of the virtual environment to enhance interaction. This study also shows that multiplicity of cues is important in virtual world education. Lacking multiplicity of cues could lead to dissatisfaction toward a class as well as lower learning performance in virtual world learning environments compared to face-to-face learning environments when other factors are controlled. Although cues are available in virtual worlds, the use of avatars inherently limits gesture cues
and facial emotional cues. Therefore, providing multiplicity of reliable cues in virtual worlds is going to be a challenge for virtual world developers/vendors, especially in adopting virtual world environments for education.

In terms of theoretical contributions, this study applies the Media Richness Theory to the new media in education context. This study partially validates the Media Richness Theory in that multiplicity cues may increase the learning performance, but higher interactivity in Second Life in an interactive session did not lead to a higher perceived learning and satisfaction. This is an interesting question that needs to be explored further in future studies. The research also helps to test the relationship between Transactional Distance and learning outcomes as measured by perceived learning and satisfaction. Early studies indicated that reduced transactional distance would increase the performance (Dron et al. 2004; Stein et al. 2005). That proposition is not supported by this study.
Online Community and Group Collaborations

References


Fulford, C.P. and Zhang, S. “Perceptions of Interaction: the Critical Predictor in Distance Education,” American Journal of Distance Education (7:3), 1993, pp. 8-21.


Roblyer, M.D. and Wiencke, W.R. “Design and Use of a Rubric to Assess and Encourage Interactive Qualities in Distance Courses,” *American Journal of Distance Education* (17:2), 2003, pp. 77-98.


Sims, R. “Promises of interactivity: Aligning Learner Perceptions and Expectations with Strategies for Flexible and Online Learning,” *Distance Education* (24:1), 2003, pp. 87–103.


Appendix 1: Instruments for the study in Second Life

1. Perceived Learning
   a. My level of learning that took place in Second Life was high
   b. This class session conducted in Second Life helped in my learning
   c. This class session conducted in Second Life facilitated my learning
   d. This class session conducted in Second Life enhanced my understanding of the material

2. Classroom Interactivity
   a. I interacted with the instructor in the class session in Second Life
   b. I was engaged in the class session in Second Life
   c. I was involved in learning during the class session in Second Life
   d. I was attentive in the class session in Second Life

3. Satisfaction
   a. The class session in Second Life was coordinated
   b. The class session in Second Life was understandable
   c. I am satisfied with the class session in Second Life

Appendix 2: Instruments for the study in Face-to-Face classroom

1. Perceived Learning
   a. My level of learning was high in this class session
   b. This class session helped in my learning
   c. This class session facilitated my learning
   d. This class session enhanced my understanding of the material

2. Classroom Interactivity
   a. I interacted with the instructor in the class session
   b. I was engaged in the class session
   c. I was involved in learning during the class session
   d. I was attentive in the class session

3. Satisfaction
   a. The class session was coordinated
   b. The class session was understandable
   c. I am satisfied with the class session