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Web-Conferencing Based Education: An Empirical Comparison with Face-to-Face Education

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ABSTRACT

The advancement of technology and the widespread availability of the Internet have enabled web-conferencing based education. This research examines the relative efficacy of a web-conferencing based learning environment using Adobe Connect versus the traditional face-to-face classroom learning environment. Two instructional strategies – interactive versus direct – in these learning environments and their effects on perceived learning and satisfaction are studied. Our findings suggest that there is an interaction effect of learning environment and instructional strategy. In the interactive instructional sessions, students in a web-conferencing based learning environment experienced a higher level of classroom interactivity than those in a face-to-face classroom environment. Also, in the interactive instructional sessions, students in the web-conferencing based learning environment experienced higher perceived learning and satisfaction than those in the face-to-face learning environment. No significant difference is observed between the direct instructional sessions of the two environments.

Keywords

Web-conferencing, Adobe Connect, instructional strategies, perceived learning, satisfaction, classroom interactivity.

INTRODUCTION

On-line education, especially Internet-based distance education, has increased dramatically over the years among higher education institutions (New Media Consortium 2007). Companies and organizations today use web conferencing in many aspects of their organizations. Higher education institutions have also started to explore the use of web-conferencing for delivery of education. In this research, we define web-conferencing as web-based collaboration where support for video, audio, instant messaging communications and slide show presentations is provided.

Students in today's higher education belong to a whole new generation of learners – a virtual generation of students (Proserpio 2007). The Pew research center released a survey report in 2007 that highlights the key characteristics of "Generation Next": (i) they use technology and the Internet to connect with others; (ii) they frequently use social networking sites; and (iii) they embrace new technologies. Students from "Generation Next" are keener to use technology to interact with others than the older generations.

Five categories of instructional strategies can be found in the education literature: 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). Among the five, direct instruction and interactive instruction strategies are the most important and widely-used instructional strategies. Direct instruction is a teacher-centered instructional approach (Gallen and Bold 1989; Kroesbergen and Van Luit 2003) that emphasizes structure, drilling, and content. 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 information 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 approach is class discussions (Weston and Cranton 1986).

This research studies the efficacy of two main instructional styles in a web-conferencing based learning environment versus a face-to-face learning environment. The findings of this study inform educators on the benefits and drawbacks of offering

education in on-line learning environments that is supported by web-conferencing. For web-conferencing vendors, the results of this study help to identify areas of improvements and provide suggestions to better design education software.

LITERATURE REVIEW

Interactivity is a critical 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. 2006). Although many technological features in web-conferencing based learning environments are not new or unique, they are more closely integrated in the on-line education environment. Web-conferencing technology, like other online collaboration tools, provides additional channels (e.g., instant messaging) to support and enhance interaction among participants. Nevertheless, our understanding on how this new technology enhances interaction and learning performance in an educational context is still very limited. More research is warranted. As such, it is good that a number of studies on on-line education have been conducted and published in recent years. For example, in a study that simulated three levels of interaction in multimedia learning environments, Haseman et al (2010) found interactivity leads to favorable attitude formation, but not so much to improved learning outcomes. Although interactivity has been identified as a key to learning in traditional classroom, the role of interactivity on learning outcome in an on-line education context has not been extensively studied. Jestice and Kahai (2010) compared learning outcomes in virtual worlds versus other less resource-intensive media. They found that learners consistently reported higher perceived learning and satisfaction with learning in the virtual world. But their study also found that simply using a virtual world without certain conditions won't increase learning outcomes. The unanswered question is what other conditions can help increase learning outcome in an on-line education context. Despite increasing research activities in the area, our literature review on on-line education shows that although some studies have been carried out on on-line education, there is a paucity of empirical studies on the relative efficacy of web-conferencing based learning environment versus traditional classroom learning environment and on the role of interactivity in an on-line education context. Studying the relative efficacy of these two environments is an important step to provide theoretical support or denial for using this new web-based technology in education. This research aims to do that.

Similarly, a review of the literature suggests that there is a paucity of empirical research on how different instructional styles that are afforded and supported by on-line educational environments impact learning outcomes and satisfaction. This research aims to study the two most popular instructional strategies – direct and interactive instructions – and assess if there is an interaction effect between learning environment and instructional strategy.

RESEARCH QUESTION

In this research, we investigate ***the relative efficacy of web-conferencing based learning environment and traditional face-to-face learning environment when different instructional strategies are used.*** This research is a part of our stream of research to compare technology-enabled education environments with traditional face-to-face education.

CONCEPTUAL FOUNDATION

Learning Theories

Behaviorism, cognitivism, and constructivism are three key theories of learning (Ertmer & Newby 1993; Leidner & Jarvenpaa 1995; Sheng et al. 2010). In behaviorism, learning occurs when a proper response is given following the presentation of a specific environmental stimulus. In cognitivism, the emphasis is on making knowledge meaningful and helping learners relate new information to existing knowledge structures. In constructivism, learning occurs through the active application of ideas or knowledge to problems (instead of passive transfer of facts in behaviorism and cognitivism). Two of the most popular and commonly used educational strategies are the direct instructional strategy which is favored by behaviorism and cognitivism, and the interactive instructional strategy which is favored by constructivism. Interactivity is central 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). With enhanced interactivity, students are not only more motivated to learn, but are also more attentive, participative, and likely to exchange ideas with instructors and fellow students. Interactivity in the classroom will influence the students' learning outcomes, such as attitude and achievement (Siau et al. 2006). Bannan-Ritland's (2002) study suggests that interactivity is a critical factor in learning. In Siau et al.'s (2006) study, they demonstrated that the use of information technology such as a classroom response system could significantly improve classroom interactivity. Siau et al. (2006) also developed and validated an instrument to capture individual and classroom interactivity. An interactive learning process is a key element that would be valued in web-conferencing based education.

Transactional Distance Theory (TDT)

Moore's (1980) theory on transactional distance has been used to explain the effect of geography on pedagogy. Transactional distance can be defined as the cognitive space between instructors and learners in a distance education setting. 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. To enhance learning outcome in distance education, it is important to reduce transactional distance between learners and instructors. According to 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). In this study, we used TDT to understand the relationship between interactivity and learning performance.

Media Richness Theory (MRT)

Media richness is defined as "the ability of information to change understanding within a time interval" (p. 560) (Daft and Lengel 1986). The ability of the medium to transmit multiple cues and immediacy of feedback are the two most important factors that affect media richness (Dennis and Kinney 1998; Kraut et al. 1992). Media Richness Theory (MRT) was first proposed as a media selection theory: for better performance, use richer media for equivocal tasks and leaner media for non-equivocal tasks. But MRT has been widely used to explain media effects in online collaboration.

Dennis and Kinney (1998) found that some parts of the theory do not apply 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 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 Mennecke et al. (2000), Shepherd and Martz (2006), and Suh (1999). Nevertheless, Dennis and Kinney (1998) point out that in general, media richness matters and immediacy of feedback and multiplicity of cues do improve performance in certain circumstances.

Chen et al. (2010) argue that the amount of feedback is an important aspect of measurement of media richness. This argument is also valid in web-conferencing based learning environment. The amount of feedback, 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., students' learning in this study).

RESEARCH MODEL

Our research model is shown in Figure 1.

Figure 1. Research Model
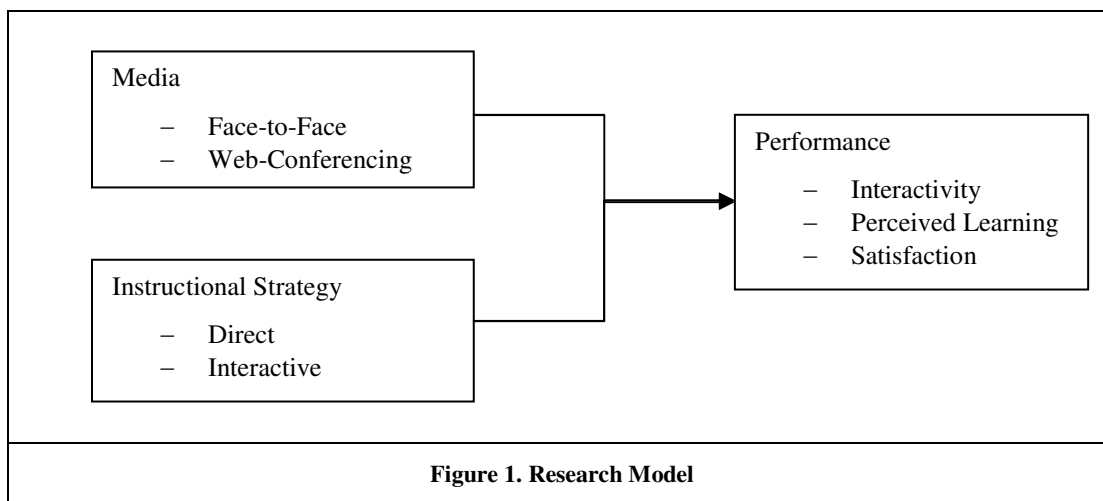
RESEARCH HYPOTHESES

In a computer-mediated environment, the new generation of students may have the opportunity to ask more questions and hence receive clarifications from instructors. There are three reasons that support the statement. First, the new generation of students (so called virtual generation students) (Proserpio 2007) 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. And third, Group Decision Support System (GDSS) literature has shown that there is more equal participation among members in group meetings 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 learning environment will be higher than in a face-to-face environment.

H_1: There will be an interaction effect of instructional strategy and learning environment on classroom interactivity.

> *H_{1a}: In direct instructional sessions, classroom interactivity will be the same in web-conferencing based virtual learning environment and FTF learning environment.*
>
> *H_{1b}: In interactive instructional sessions, classroom interactivity will be higher in web-conferencing based virtual learning environment than in FTF learning environment.*

As discussed earlier, interactivity is a critical component in learning. Interaction among learners and between learners and instructors are ways to reduce transactional distance. When a learning environment can facilitate/encourage more interactions, it will help learners achieve higher performance (Dron et al. 2004; Stein et al. 2005). The amount of feedback (measured by classroom interactivity in the educational context) is another important factor. TDT is used to explain why higher interactivity should lead to better learning performance. Transactional distance is also affected by interaction between the learner and the instructor in a face-to-face learning setting (Lowe 2000). Therefore, we can compare learning outcomes from the two learning environments to assess how interactivity affects learning performance. With TDT, we argue that the ability of a medium to facilitate/encourage feedback can reduce transactional distance, which in turn improves learning and satisfaction.

When the amount of feedback is controlled as in the direct instructional sessions, we can argue that based on MRT, multiplicity of cues becomes the key factor that can influence learning. Hence, in direct sessions, students perceive more cues in the FTF learning environment than in the web-conferencing based environment, which increase their perceived learning and satisfaction. Thus, the following hypotheses:

H_2: There will be an interaction effect of instructional strategy and learning environment on perceived learning.

> *H_{2a}: In direct instructional sessions, students' learning will be lower in the web-conferencing based virtual learning environment than in the FTF learning environment.*
>
> *H_{2b}: In interactive instructional sessions, students' learning will be higher in the web-conferencing based virtual learning environment than in the FTF learning environment.*

H_3: There will be an interaction effect of instructional strategy and learning environment on satisfaction.

> *H_{3a}: In direct instructional sessions, students' satisfaction will be lower in the web-conferencing based virtual learning environment than in the FTF learning environment.*
>
> *H_{3b}: In interactive instructional sessions, students' satisfaction will be higher in the web-conferencing based virtual learning environment than in the FTF learning environment.*

RESEARCH METHODOLOGY

Research Design

For this research, we designed an experimental study to assess the effects of learning environment (web-conferencing based virtual learning environment versus face-to-face) and instructional strategy (interactive versus direct) on performance. Learning environment is a between-subjects factor and instructional strategy is a within-subjects factor. One of the advantages of using within-subjects repeated measures design is the reduction of the error variance associated with individual differences. This, in turn, reduces the sample size requirement. The between-subjects design was used to assess face-to-face versus web-conferencing based (Adobe Connect) learning environments. As shown in Figure 2, each subject was assigned to either face-to-face or web-conferencing based learning environment and experienced both the direct and interactive instructional sessions, which were counter-balanced to control for possible ordering effects.

	Direct Session	Interactive Session
Face-to-Face	◄———	———►
Adobe Connect	◄———	———►
Figure 2: Experimental Design		
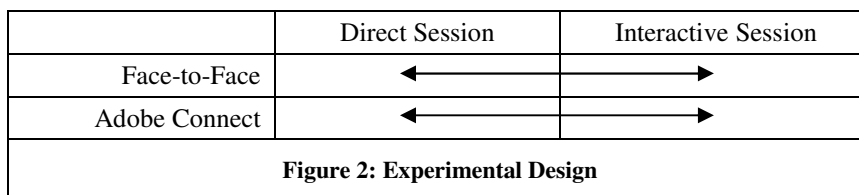
To operationalize direct and interactive instructional strategies, two similar topics, input design and output design were used. The two topics were similar in content nature, structure, and difficulty. These two sessions had the same number of PowerPoint slides. The order of the topics was counter-balanced among the subjects along with direct and interactive instruction strategies. Out of the four class sessions 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 class sessions, output design was presented first, using the direct instruction strategy in one and interactive instruction strategy in the other. In other words, the content of the sessions was also controlled in the study.

Subjects

A total of 179 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. For education-related studies, students are the appropriate and ideal subjects.

Research Procedures and Results

Web-Conferencing Based Learning Environment

The web-conferencing based learning environment was operationalized by Adobe Connect. Students in a web-conferencing based class used the university computer labs to participate in the class sessions. All students in each class session were in the same computer lab and the instructor was in a remote location. Adobe Connect has three main windows on a computer screen: video window, instant messaging window, and slide show window. The lecturer used the video/audio and the slide show window to lecture. Students used the instant messaging tool to ask/answer questions.

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 instructor conducted the lecture using Microsoft PowerPoint in Adobe Connect and the students could see the PowerPoint display. The direct session is a lecture session in which the lecturer taught the class content without allowing or encouraging students to discuss or ask questions about the content. The interactive session was a discussion session in which the lecturer encouraged students, using the instant messaging tool, to ask questions, to present their ideas to share with the entire class, and to answer questions. Each student filled up a survey questionnaire after each instructional session. The survey consists of questions related to interactivity, perceived learning, and satisfaction.

Face-to-Face Environment

For students in a face-to-face class, the same guest lecturer conducted the same two sessions 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 web-conferencing based learning setting was used.

In both the web-conferencing based and face-to-face learning environments, the order of interactive and direct sessions and the class topics were counter-balanced to control for possible ordering effects.

Measurement

We developed the measurement items for perceived learning after Richardson and Swan (2003) and Wu and Hiltz (2004); for classroom interactivity after Siau et al. (2006); and for satisfaction after Piccoli et al. (2001) and Richardson and Swan (2003). The measurement items for each scale are listed in the appendix where 1 refers to strongly disagree and 7 refers to strongly agree with the statements.

Data Analysis

Media	Adobe Connect	Direct	88
		Interactive	88
	Face-to-Face	Direct	87
		Interactive	87
Instructional strategy	Direct Instruction	Adobe Connect	88
		Face-to-Face	87
	Interactive Instruction	Adobe Connect	88
		Face-to-Face	87
Table 1: Sample Size of Different Conditions			

A total of 179 sets of questionnaires were collected, but some questionnaires contained missing data points. These questionnaires were dropped. The resulting sample size is shown in Table 1.

GLM Repeated Measure in SPSS was used to test the hypotheses. The dependent variables are Classroom Interactivity (CI), Perceived Learning (PL), and Satisfaction (SAT). The between-subjects variable is Media (1=Adobe Connect; 2=Face-to-Face) and the within-subjects variable is instructional strategy (1=Direct Instruction; 2=Interactive Instruction).

CI was first analyzed. Figure 3 shows the means of CI in each condition. The F-test for the interaction shows a significant interaction effect of media and instructional strategy on CI, $F(1, 173) = 25.18$, $p < .01$ (see Figure 3). Using Least Significance Difference (LSD), $LSD_{mmd} = 0.41$, we assessed the simple effects in the interaction. The interaction pattern for CI is as follows: in direct sessions, $CI_{adobe\ connect} = CI_{face-to-face}$; in interactive sessions, $CI_{adobe\ connect} > CI_{face-to-face}$. Thus, hypotheses H_1, H_{1a}, and H_{1b} are supported.

Figure 3: Means of Classroom Interactivity and Interaction Effect of Media and Teaching Strategy
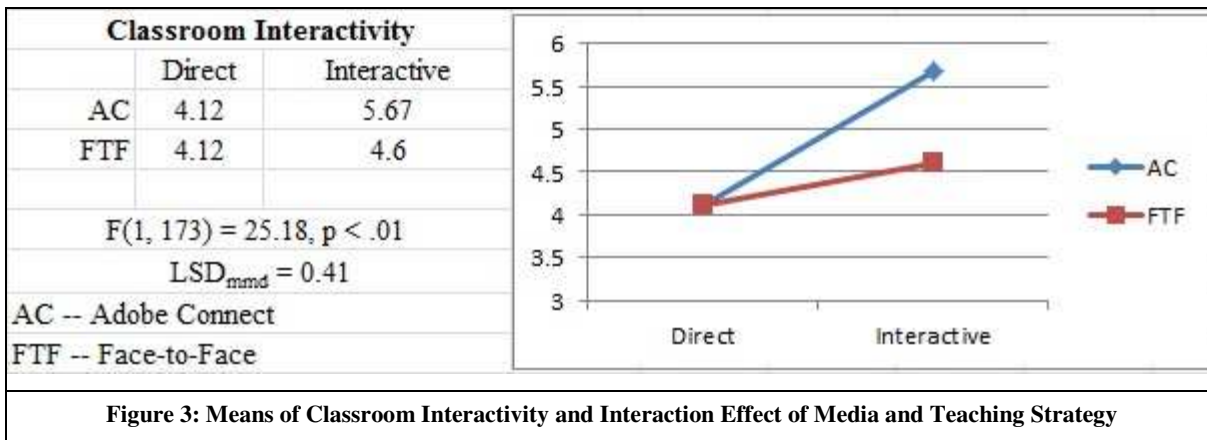
Figure 4 shows the results for Perceived Learning (PL). There is a significant interaction effect of media and instructional strategy on PL (see Figure 4). $LSD_{mmd} = .30$ is calculated for this analysis to assess the simple effect in the interaction. The interaction pattern for PL is as follows: in direct sessions, $PL_{adobe\ connect} = PL_{face-to-face}$; in interactive sessions, $PL_{adobe\ connect} > PL_{face-to-face}$. Thus, our hypotheses H_2 and H_{2b} are supported, but hypothesis H_{2a} is not supported.

Figure 4: Means of Perceived Learning and Interaction Effect of Media and Teaching Strategy
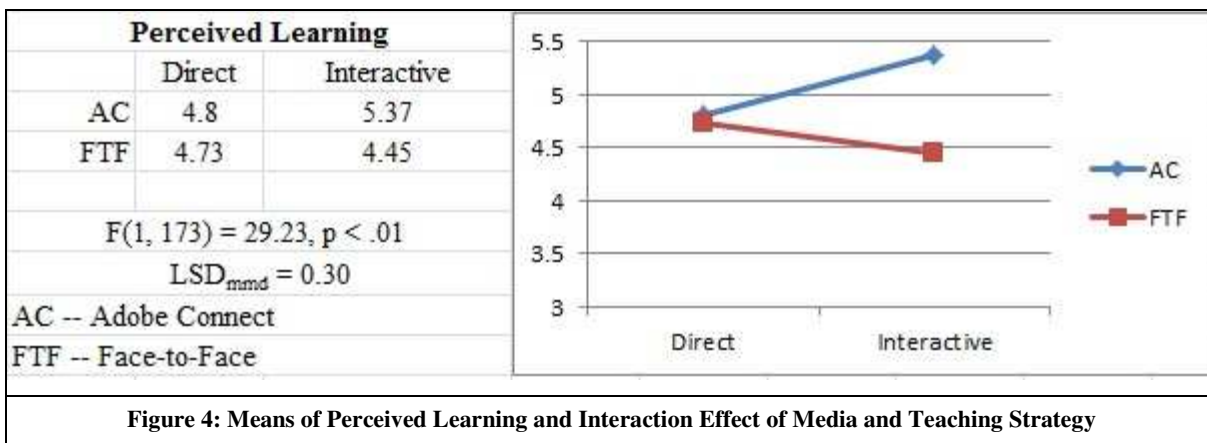
Figure 5 shows the results for Satisfaction (SAT). There is a significant interaction effect of media and instructional strategy on SAT (see Figure 5). $LSD_{mmd} = .27$ is calculated for this analysis to assess the simple effect in the interaction. The interaction pattern for SAT is as follows: in direct sessions, $SAT_{adobe\ connect} = SAT_{face-to-face}$; in interactive sessions, $SAT_{adobe\ connect} > SAT_{face-to-face}$. Thus, our hypotheses H_3 and H_{3b} are supported, but H_{3a} is not supported.

Figure 5: Means of Satisfaction and Interaction Effect of Media and Teaching Strategy
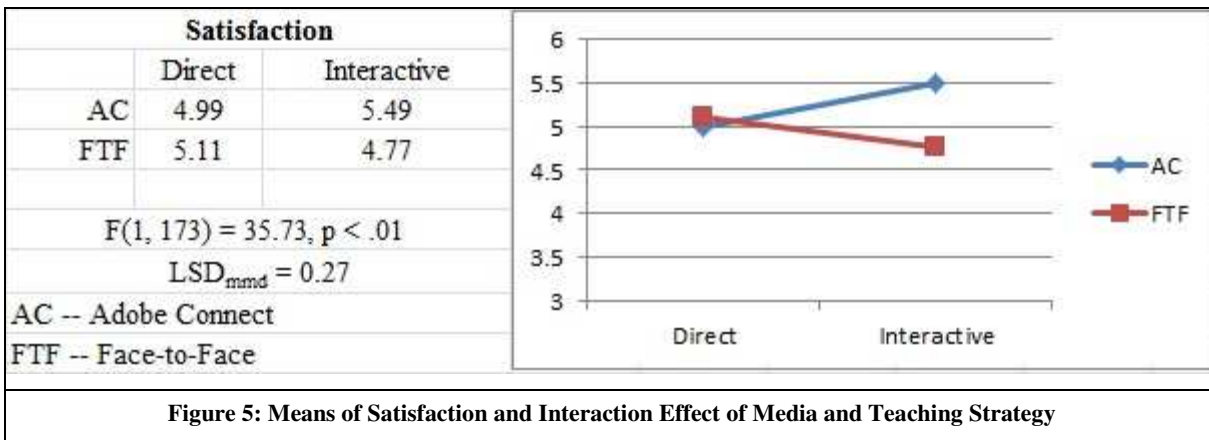
DISCUSSIONS

On Hypotheses H_1, H_{1a}, and H_{1b}

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 "Generation Next" favors technology for interaction.

The result indicates that there is a significant interaction of media and instructional strategy on classroom interactivity. Furthermore, the interactive instructional strategy creates a significantly higher level of classroom interactivity in a web-conferencing based learning environment than in a face-to-face learning environment.

In the interactive session in Adobe Connect, students perceived higher interaction with the instructor than in a face-to-face classroom, which is a very interesting finding. These results support the findings from previous studies of Proserpio (2007) and Pew (2007), which argue that "Generation Next" embraces technology and favors technology to connect and interact. This finding is also consistent with Chen et al. (2010)'s study that compared classroom interactivity between a virtual world educational environment and a face-to-face educational environment. We noticed that in the face-to-face environment, perceived learning and satisfaction are lower in interactive sessions than in direct sessions. But even with the use of LSD, which is more powerful to detect true differences than other pair-wise comparison techniques, the difference is not statistically significant.

On Hypotheses H_2, H_{2a}, and H_{2b}

Perceived learning was compared between the different instructional sessions in the same learning environment as well as between the different learning environments using the same instructional strategy. The data analysis shows a significant interaction between learning environment and instructional strategy. Therefore H_2 is supported.

We argued that in direct sessions, since interaction among the instructor, students, and their peers is limited but multiplicity of cues is higher in the face-to-face environment than in the web-conferencing based environment, perceived learning should be higher in the face-to-face environment than in the web-conferencing based environment based on MRT. However, this hypothesis (H_{2a}) is not supported. We believe the reason for the unsupported hypothesis is due to equivalence or lack of difference in multiplicity of cues between the face-to-face environment and the web-conferencing based environment. In other words, the web-conferencing based learning environment is able to offer facial and gesture cues as in the face-to-face environment. Future studies can investigate the quantity and quality of cues available in the web-conferencing learning environment when compared with the face-to-face learning environment and their impacts on learning.

In interactive sessions, since classroom interactivity in the web-conferencing based learning environment is significantly higher than in the face-to-face learning environment, perceived learning in the web-conferencing based learning environment is expected to be higher than in the face-to-face learning environment. This hypothesis (H_{2b}) is supported.

On Hypotheses H_3, H_{3a}, and H_{3b}

Hypotheses H_3 and H_{3b} are supported in this study, but H_{3a} is not supported. Since student satisfaction is likely related to perceived learning achievement, it is not surprising that these hypotheses have the same pattern of support as the hypotheses

on perceived learning. The results from this research call for modifications to the media richness theory (Dennis and Kinney 1998).

CONCLUSIONS AND CONTRIBUTIONS

This study presents a pioneering effort in understanding the effects of different instructional strategies on learning in web-conferencing based learning environment. The research applied MRT to the new media and the educational context to test if the MRT holds in the new media and context. TDT was also applied and tested in this research. Early studies of TDT indicate that transactional distance may be affected only by interaction; higher interaction leads to reduced transactional distance and reduced transactional distance would increase performance (Dron et al. 2004; Stein et al. 2005). But this study and Chen et al.'s (2010) study indicate that both multiplicity of cues and interaction have an impact on learning performance in the education context. Only when multiplicity of cues is held constant can higher interaction reduce transactional distance and increase learning performance.

Before we discuss the contributions, we note some limitations of this study. First, we only tested the two most popular instructional strategies in education. Comparisons of perceived learning and satisfaction between web-conferencing based learning environment and face-to-face environment should only be interpreted for those two instructional practices, not for other instructional strategies, such as experiential instruction. Second, the interactivity instrument only measured students' perceived interaction with the instructor and their involvement with the class, and the interaction tool in web-conferencing based environment is limited to instant messaging. Future studies may expand the tool arsenal for interaction in web-conferencing based learning environment to include video/audio tools. We believe that with more multimedia tools available, interaction in web-conferencing based learning environments could be increased substantially. Finally, the data set is limited to one college of the studied university. Further research is needed to test generalizability of our findings by using students from other colleges.

This research shows that perceived learning and satisfaction is significantly higher in Adobe Connect, a web-conferencing based learning environment, than in a face-to-face classroom when interactive instructional strategy was used. Therefore, educators need to focus on designing interactive education that can leverage the new technologies supported by web-conferencing based learning environment. This is especially important for the "Generation Next" (Proserpio 2007). This study also indirectly shows that multiplicity of cues is important in web-conferencing based education. Lacking multiplicity of cues could lead to dissatisfaction as well as lower learning performance in web-conferencing based learning environments when compared to face-to-face learning environments. Educators should maximize the use of video/audio/instant messaging and other visual tools (such as slide show) in web-conferencing based learning environments to increase interactivity; and web-conferencing based learning environment vendors should provide visual tools to increase multiplicity of cues and make them easy to use for educational purposes.

Future research can study other variables such as enjoyment in these learning environments, and investigate the quantity and quality of cues from web-conferencing based learning environments compared to face-to-face learning environments to provide more definitive explanations on the effect of these cues on learning.

REFERENCES

1. Bannan-Ritland, B. (2000) Computer-mediated communication, e-learning, and interactivity: A review of the research, *Quarterly Review of Distance Education,* 3, 2, 161-179.
2. Chen, X.F., Siau, K., and Nah, F. (2010) 3-D virtual world education: An empirical comparison with face-to-face classroom, *ICIS 2010 Proceeding*, Paper 260, http://aisel.aisnet.org/icis2010_submissions/260.
3. Daft, R.L. and Lengel, R.H. (1986) Organizational information requirements, media richness and structural design, *Management Science*, 32, 5, 554-571.
4. Dennis, A.R. and Kinney, S.T. (1998) Testing media richness theory in the new media: The effects of cues, feedback, and task equivocality, *Information Systems Research*, 9, 3, 256-274.
5. Dron, J., Seidel, C., and Litten, G. (2004) Transactional distance in a blended learning environment, *ALT-J,* 12, 2, 163–174.
6. Ertmer, P.A., and Newby, T.J. (1993) Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective, *Performance Improvement Quarterly*, 6, 4, 50-72.
7. Fulford, C.P. and Zhang, S. (1993) Perceptions of interaction: the critical predictor in distance education, *American Journal of Distance Education* 7, 3, 8-21.

8. Gallen, V. & Bold, J. (1989) Saskatchewan Teachers' Federation Study of Teaching, Saskatoon: Saskatchewan Teachers' Federation.

9. Gioia, D.A. and Brass, D.J. (1986) Teaching the T.V. generation: The case for observational learning, *Organizational Behavior Teaching Review*, 10, 11-18.

10. Haseman, W., Polatoglu, V., and Ramamurthy, K. (2010) An empirical investigation of the influences of the degree of interactivity on user-outcomes in a multimedia environment, *Information Resources Management Journal*, 15, 2, pp. 31-48.

11. Jestice, R. and Kahai, S. (2002) The effectiveness of virtual worlds for education: an empirical study, *AMCIS 2010 Proceedings,* Paper 512.

12. Kroesbergen, E.H., and Van Luit, J.E.H. (2003) Mathematical interventions for children with special educational needs, *Remedial and Special Education, 24,* 97–114.

13. Leidner, D.E., and Jarvenpaa, S.L. (1995) The use of information technology to enhance management school education: A theoretical view, *MIS Quarterly*, 19, 3, 265-291.

14. Lowe, W. (2000) Transactional distance theory as a foundation for developing innovative and reactive instruction, *Educational Technology & Society*, 3, 1.

15. Martindale, N. (2002) The cycle of oppression and distance education, Athabasca University.

16. McLeod, P.L., & Liker, J.K. (1992) Electronic meeting systems: Evidence from a low structure environment, *Information Systems Research,* 3, 3, 195-223.

17. McNeill, J. & Wiles, J. (1990) The essentials of teaching: Decisions, places and methods*,* MacMillan, New York

18. Mennecke, B.E., Valacich, J.S., and Wheeler, B.C. (2000) The effects of media and task on user performance: a test of the task-media fit hypothesis, *Group Decision and Negotiation*, 9, 6, 507-529.

19. Moore, M. G. (1980) Redefining the Discipline of Adult Education, In *Independent Study,* R. Boyd & J. Apps (Eds.), San Francisco: Jossey-Bass, 16-31.

20. New Media Consortium (NMC) (2007) *The 2007 Horizon Report*, The New Media Consortium.

21. New Media Consortium (NMC) (2010) NMC Two Minute Survey Results for What's Happening in Virtual Worlds, *NMC Publications*, Retrieved April 16, 2010 from http://www.nmc.org/news/nmc/7616.

22. Pew Research Center (2007) A portrait of 'Generation Next' – How young people view their lives, futures, and politics, , last extracted on April 2009 from the Internet at *http://people-press.org/report/300/a-portrait-of-generation-next*

23. Piccoli, G., Ahmad, R., and Ives, B. (2001) Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS Quarterly*, 25, 4, 401-426.

24. Proserpio, L. (2007) Teaching the virtual generation, *Academy of Management Learning & Education*, 6, 1, 69-80.

25. Richardson, J.C. and Swan, K. (2003) Examining social presence in online courses in relation to students' perceived learning and satisfaction, *Journal of Asynchronous Learning Networks*, *7, 1*, 68-88.

26. Roblyer, M.D. and Wiencke, W.R. (2003) Design and use of a rubric to assess and encourage interactive qualities in distance courses, *American Journal of Distance Education*, 17, 2, 77-98.

27. Seaman, D. and Fellenz, R. (1989) Effective strategies for teaching adults, Merrill, Columbus.

28. Sheng, H., Siau, K., and Nah, F. (2010) Understanding the values of mobile technology in education: A value-focused thinking approach, *DATA BASE for Advances in Information Systems*, 41, 2, 25-44.

29. Shepherd, M.M. and Martz, W.B. (2006) Media richness theory and the distance education environment, *Journal of Computer Information Systems*, 47, 1, 114-122.

30. Siau, K., Sheng, H., and Nah, F.F. (2006) Use of a classroom response system to enhance classroom interactivity, *IEEE Transactions on Education*, 49, 3, 398-403.

31. Sims, R. (2003) Promises of interactivity: Aligning learner perceptions and expectations with strategies for flexible and online learning, *Distance Education, 24,* 1, 87–103.

32. Stein, D.S., Wanstreet, C.E., Calvin, J., Overtoom, C., & Wheaton, J.E. (2005) Bridging the transactional distance gap in online learning environments, *American Journal of Distance Education, 19,* 2, 105–118.

33. Straus, S. G., & McGrath, J. E. (1994) Does the medium matter? The interaction of task type and technology on group performance and member reactions, *Journal of Applied Psychology, 79,* 1, 87-97.

34. Suh, K.S. (1999) Impact of communication medium on task performance and satisfaction: An examination of media-richness theory, *Information and Management*, 35, 5, 295-312.

35. Weston, C. & Cranton, P.A. (1986) Selecting instructional strategies, *The Journal of Higher Education*, 57, 3, 259-288.

36. Wu, D. and Hiltz, S.R. (2004) Predicting learning from asynchronous online discussions, *Journal of Asynchronous Learning Network*, 8, 2, 139-152.

APPENDIX 1: INSTRUMENTS FOR THE STUDY IN ADOBE CONNECT

1. Perceived Learning
    a. My level of learning that took place in this class session was high
    b. This class session conducted with Adobe Connect helped in my learning
    c. This class session conducted with Adobe Connect facilitated my learning
    d. This class session conducted with Adobe Connect 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 using Adobe Connect was coordinated
    b. The class session using Adobe Connect was understandable
    c. I am satisfied with the class session conducted using Adobe Connect

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