The Value of Using Synchronous Conferencing for Instruction and Students

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Abstract

This study examined the effectiveness of video and audio conferencing in hybrid classes. Using both quantitative and qualitative data, the technical difficulty, instructional quality, attention and distraction of location were compared. The results revealed that both conferencing types made positive impacts on instruction. However, there were significant differences between those conferencing in the perception of the technical and instructional quality. The differences were attributed to technical difficulties in the video conferencing session, but the one-to-one video conferencing not having technical problems provided similar impact on instruction to the audio conferencing. In addition to the various comparisons, this research suggests critical factors to implement successful instruction with synchronous conferencing tools.

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Introduction

In technology-enhanced learning environments, learners' expectations toward e-learning have been growing toward on-demand, anytime/anywhere and high-quality instruction (Ely, 2003; Khan, 2005). In order to fulfill these demands, e-learning should be well-designed to provide learner-centered, engaging, affordable, flexible, meaningful, and facilitated learning environments (Khan, 2005). The advancement of technologies makes it possible for distant learners to access more effective and inexpensive instruction (MacIntosh, 2001). For example, the stability, usability, and affordability of recent technologies provide learners with richer media and support (Coventry, 1994; Smyth, 2005).

One of the rapidly growing instructional media in distance learning is audio and video conferencing, which has potential for new methods of interaction among instructors and students (Anderson, 1996; Chan, Tan, & Tan, 2000). Conferencing tools simulating face-to-face learning purport to enhance communication, collaboration, and social presence (Pittman, 2003; Townsend, Demarie, & Hendrickson, 2001; Wilkinson & Hemby, 2000). However, the promise of these tools has emphasized efficiency and not necessarily effectiveness.

Despite the possibilities for application, the research results with virtual conferencing have been contradictory. For example, learning outcomes via synchronous conferencing were no better and no worse than traditional face-to-face classroom (e.g., Alexander, Higgison, & Mogey, 1999; Greenburg, 2004; Knipe & Lee, 2002), while students valued the virtual conferencing and interaction was increased (e.g., MacIntosh, 2001; Townsend et al., 2001). While most research has focused on virtual conferencing in completely online courses, few studies have examined hybrid, or blended classes, where face-to-face class meetings are combined with online conferencing (c.f., El Mansour & Mupinga, 2007; Motteram, 2006; Teng & Taveras, 2004-2005).

Purpose and Research Questions

The purpose of this study was to examine how synchronous conferencing technology affects teaching and learning. Based on the purpose, this study explored the factors bearing on the success and failure of synchronous conferencing in hybrid classes in higher education. Accordingly, the evaluation will allow greater knowledge for how to appropriately integrate technologies into the class. The research questions were:

- What is the value to instruction and students of using synchronous conferencing?
- Is video necessary for synchronous conferencing?
- Do technical problems prevent synchronous conferencing from being effective for instruction?
- Do distractions prevent synchronous conferencing from being effective for instruction?

An Overview of Synchronous Conferencing

There are two types of virtual conferencing: asynchronous conferencing and synchronous conferencing. Asynchronous conferencing is both time and location independent (Greenberg, 2004; Wilkinson & Hemby, 2000). It provides learners with flexibility of accessing large amounts of learning materials. In addition, collaboration and feedback can be implemented by email or discussion board. In contrast, synchronous conferencing makes distance among instructor and learners variable, but time is still crucial (Coventry, 1994). Synchronous conferencing can support spontaneous interaction and immediate feedback involving audio and text, as well as video (Pittman, 2003; Wilkinson & Hemby, 2000).

Video conferencing participants are able to see and hear each other and to share information by means of different types of visual aids. The first video conferencing system, PicturePhone, was implemented by AT&T in the mid 1960s (Pittman, 2003). Video conferencing tools have evolved with innovations in telecommunication technologies such as Integrated Services Digital Network (ISDN) and compressed video data transmission. Now Internet Protocol (IP)-based two-way video conferencing is available for distance education.

Classifications of synchronous conferencing vary. According to media used in synchronous conferencing, there are audio conferencing (audio only) and video conferencing (voice and picture). Another classification can be found based on the number of access points: point-to-point and multi-point conferencing (Pittman, 2003). In point-to-point conferencing, there are only two computers connected—one on each end. In multi-point conferencing, two or more computers can be connected with one another.

In addition, there is another classification: room systems, rollabout carts, and desktop videoconferencing used in distance education and virtual conferences (Carvalhoh, 2000). The *room systems* typically are room-equipped stationary designs with multiple cameras, microphones, and a mixer for clear capture of audio and video. The *rollabout system* is a midrange system that is easily rolled on a cart from room to room. The cart usually includes a single display device, audio and video equipments, and a computer. The quality of video and audio is higher than a desktop system. Furthermore, the functionality of rollabout systems has been increased as the cost has fallen. *Desktop systems* enable interactions with other people with a compact camera and microphone. The increasing bandwidth speed and improving software functionality make the desktop systems possible to be used in real distance education. For example, recent video conferencing systems support an interactive whiteboard application sharing and collaboration tools. These three systems can be used in either point-to-point or multi-

point conferencing.

Video conferencing has played important roles in various areas (Carvalhoh, 2000). In telemedicine, urgent expert diagnostics and other medical information can be transmitted to remote areas via the video conferencing. In business, many companies rely on this technology to train employees and communicate with other sites. Furthermore, the technology makes open flexible learning environments with globalization.

Review of Previous Research

Much research offers promise for using synchronous conferencing in distance education. For example, after investigating various types of video conferencing cases, Alexander et al. (1999) stated, "There was little difference between video conference lectures and traditional lectures, and students would not mind having more video conference lectures" (p.14). Jennings and Bronack (2001) used desktop video conferencing as a means of synchronous communication between instructional designers and intern teachers. Jennings and Bronack's study revealed that the goal to stimulate participants' consideration of multiple points of view and contemplation of appropriate courses of action was met. The participants valued the authentic environments that fostered collaboration. Another positive result was that video conferencing in distance learning classes for the nursing program increased students' interaction and engaged the students in the instruction (MacIntosh, 2001). Meanwhile, regarding participants' attitude toward video conferencing, those participants who anticipated the technology in a positive manner were more likely to evaluate it positively and perform well during the conferencing (Townsend et al., 2001). Similarly, Patillo's (2007) participants found synchronous audio conferencing to increase the communications between instructor and students.

On the other hand, negative results have also been reported. Using video conferencing technology, Freeman (1998) found learning activities and interaction were not improved in multi-campus large classes. In this case, time was lost through technical difficulties, and the distractions at the remote site inhibited student engagement in the instruction. In addition, Knipe and Lee (2002) compared the learning experiences of remote site students to local site students in graduate level classes. The qualitative study showed that remote students did not experience the same quality of teaching and learning as local site students. The local site students had more opportunities to learn how to deal with other viewpoints, how to be critical themselves, and how to make decisions by joining different groups.

Advantages and Disadvantages

Much of the literature suggests that the synchronous conferencing tool is cost-effective as well as affords meaningful communication. All literatures, however, indicated that interactivity is the key of synchronous conferencing (Greenberg, 2004). The advantages of using synchronous conferencing include:

- It can be used as collaboration tools for team works or team teaching (Alexander et al., 1999; Coventry, 1994; Townsend et al., 2001).
- It can provide active supports such as prompt feedback (Alexander et al., 1999; Chan et al., 2000; Pittman, 2003).
- It can make it possible for distant people to access expertise or specialists (Alexander et al., 1999; Pittman, 2003).
- It can save travel time and cost (Chan et al., 2000; Coventry, 1994; Wilkinson & Hemby, 2000).

- It can increase interactive communication with engaging discussion and enhancing social presence (Chan et al., 2000; Coventry, 1994; Pittman, 2003; Smyth, 2005).

In contrast, challenges to using synchronous conferencing include:

- Technical difficulties, such as time delay (Freeman, 1998; Pittman, 2003)
- Low quality of audio and video (Wilkinson & Hemby, 2000)
- Lack of training for utilizing new tools (MacIntosh, 2001; Pittman, 2003)
- Distractions and lack of real interaction (Freeman, 1998; Knipe & Lee, 2002)

Interestingly, studies suggested that virtual interaction was still not enough to replace face-to-face interaction. For example, participants felt professional isolation and a lack of human connection (Wilkinson & Hemby, 2000). In addition, it was difficult to know when to interrupt to ask questions (MacIntosh, 2001). As described previously, participation in discussions decreased in a remote site compared to the local site classrooms. The results of studies about effectiveness of video conferencing revealed that students had positive perception toward the video conferencing; however, it could not serve as a direct replacement for face-to-face class (e.g., Alexander et al., 1999; Wilkinson & Hemby, 2000). With these challenges, studies also suggested some critical factors for successful implementation of synchronous conferencing.

Critical Factors

Based on previous research, there are four critical factors to consider when implementing synchronous conferencing: (a) the quality of video and audio, (b) training time, (c) teaching strategies, and (d) opportunities for face-to-face meeting.

The first factor is related to technical issues. As mentioned in the previous section, the quality of audio and video is a fundamental factor. Although video offers visual aids, audio is still essential for conferencing (Jennings & Bronack, 2001). In audio-only interaction, the lack of visual is compensated for by clearer enunciation and more thoughtful communication (Coventry, 1994). Higher video quality requires higher speeds of bandwidth and more robust computer processors. It is also necessary to consider the equipment, as well as to prepare alternative ways for expected data traffic.

Training time to be familiar with conferencing systems was also suggested as a critical factor (e.g., Chan et al., 2000; Reinhart & Schneider, 2001; Townsend et al., 2001). The new technology is attractive for both instructors and learners, but it also requires them to be proficient in the technology. A simple exercise at the beginning of the course can provide learners with positive experience and increase self-efficacy in order to develop their own personal styles of interaction (Chan et al., 2000; Reinhart & Schneider, 2001). Furthermore, educators should be comfortable with the technology so they can adapt the instruction to the class objectives and learners' demands.

The third factor is teaching strategies for effective instruction. Technology alone is unable to ensure a meaningful learning experience (Coventry, 1994; MacIntosh, 2001). The success of instruction is more dependent on teaching methods rather than the technology. New approaches to instruction must accompany new technologies, adjusting to the changing teacher's role, motivating learners, and preparing learning materials to fit the synchronous conferencing.

The last suggestion is that a face-to-face meeting is a good opportunity for learners to make social connections. MacIntosh's (2001) learners indicated that an on-site visit by the instructor was extremely valuable in establishing a relationship that could then be continued via video conferencing. It implies that the video conferencing in hybrid classes will be more

effective than distance only classes. However, we struggled to locate any recent studies that examined synchronous conferencing in hybrid classes, where students have expectations for face-to-face instruction. Instead, the most recent research has examined synchronous conferencing, where text chat and instant messaging were used, or hybrid courses, where asynchronous discussion forums were employed (c.f., Anderson et al., 2006; Baggaley & Klaas, 2006; DeNeui & Dodge, 2006; El Mansour & Mupinga, 2007; Motteram, 2006; Tremblay, 2006).

Methodology

This study followed an evaluation methodology. The instructor wanted to critically examine the potential of both audio and video conferencing for use with students in higher education. As a result of the significant technology resources required to use synchronous conferencing (i.e., higher bandwidths, faster computer processors, specific equipment), the instructor felt this investigation moved beyond a simple media comparison study.

Participants and Courses

The participants for the study were graduate students in Instructional Design and Technology (IDT) program at the University of Memphis, Memphis, TN. The students in two IDT classes using synchronous conferencing evaluated their use of technology after each conferencing session. There were two groups of participants. One group used video conferencing exclusively, and the other group used only audio conferencing. Approximately 11 students in one class were in the video conferencing group. The audio conferencing group consisted of approximately eight students.

The course that used video conferencing exclusively was organized into a weekend format. The course met four weekends (a Friday evening and all-day Saturday) during the semester. The video conferencing was used to replace the whole class, on-campus Friday evening meeting. The whole class conferencing typically lasted 1 ½ to 2 hours. Video conferencing was also used to supplement the regular course meetings with one-on-one sessions to mentor, scaffold, and check course progress with individual students.

The course that used audio conferencing was a 5-week summer session course. The course met twice per week for approximately 1 ½ to 2 hours. Audio conferencing was used almost half the time, where each week one course meeting was on campus and the other class meeting was online with audio conferencing.

Procedures

Two hybrid classes used one of two types of online conferencing tools: One class used video conferencing in Spring 2005, and the other class used audio conferencing in Summer 2005. The instructor in the classes was the same. The participants used synchronous conferencing four or five times throughout the semester. The type of both video and audio conferencing was desktop conferencing.

Video conferencing. Video conferencing began in Fall 2004 with Polycom ViaVideoII units and an H.323 conferencing bridge hosted by the university. ViaVideoII units were purchased for students by the instructor as part of an internal instructional improvement grant. The cameras were for use at off-campus sites, such as home or office. The conferencing system was inadequate. Of 13 students who participated, only 2 were able to connect because of incompatibilities with remote systems. For example, a number of local Internet Service Providers had blocked the ports for H.323 video conferencing, presumably to prevent the large bandwidth traffic. Multiple attempts to troubleshoot technical issues were made. In addition the system was

only compatible with Windows-platform computers. Due to the inconsistent connections and poor overall results, the ViaVideo II units were abandoned and no data were collected.

After seeking an economical and cross-platform solution for video conferencing, iVisit (http://www.ivisit.com) was chosen for class sessions in the spring semester of 2005. The iVisit system worked with a variety of inexpensive Internet video cameras (web cams) with cross-platform compatibility. Given the flexibility in video camera, new camera units and the subscription rate for iVisit were purchased. Logitech QuickCams were used for students using Windows-platform computers, while Apple iSights were chosen for Macintosh computers. Students took the web cameras to their homes and participated four video conferencing: two sets of one-on-one sessions and two sets of whole class sessions. The iVisit system worked similarly to a chat room, where participants logged into a common system. As each person joined the video conferencing session, a postage stamp video stream was added to the screen. The students and instructor referred to this as the "Brady Bunch effect." In addition to audio and video, text chat was available. A job aid was created for students to follow in order to download the client software, log in to the site and manage the iVisit interface.

Audio conferencing. For audio conferencing, Horizon Wimba Direct Powerlink for WebCT was used in the summer semester in 2005. Each participant used his or her own microphone and speakers. Students followed a diagnostic tutorial to download any additional software plug-ins or drivers in order to use the system. Unlike the video conferencing system, the audio conferencing was not full duplex (i.e., where participants can talk over one another). Only one conference participant could speak at a time, and "the floor" had to be released before another participant could speak. Text chat was also available with the audio conferencing.

In both classes, students were asked to visit a webpage and complete an evaluation form after each conference. An overall evaluation was given to students at the end of the conferencing.

Data Collection

The data source was an online evaluation questionnaire. The questionnaire was comprised of five sections: technical quality, instructional quality, attention, distraction of location, and comments. The evaluation questions for both conferencing were similar but some questions were different depending on the conferencing method. For example, the questions for video quality, video size, and feeling as being live were added to the technical quality section for the video conferencing group. On the other hand, the students using audio conferencing were asked to answer the question, "Would video have improved the instructional quality?" The four sections used five-point Likert scales moving from strongly disagree to strongly agree, while the comments section was open-ended questions in order to gather diverse ideas and thoughts. Students completed anonymous evaluations after each session. There were 49 data entries for video conferencing and 36 data entries for audio conferencing even though 11 students participated in the video conferencing and 8 students participated in the audio conferencing. The questions in each section were developed based on the study of Kies, Williges, and Rosson (1997). All responses and comments were accumulated in a secure database.

Data Analysis

Data analysis for this study proceeded through a quantitative as well as qualitative research method. The preliminary test indicated that the reliabilities of questions in the technical quality (Cronbach's Alpha = .782) and instructional quality (Cronbach's Alpha = .855) were appropriate to be used as a construct. In addition to the two constructs, two individual questions

for attention and distraction of location were added to the dependant variables. Since we were interested in comparing two types of synchronous conferencing on four dependent variables simultaneously, a two-group Multivariate analysis of variance (MANOVA) was performed to test our hypothesis. Multivariate analysis of variance is used when there is more than one dependent variable, taking correlations among variables into account and keeping the overall α level under control (Stephens, 2002). If the overall multivariate test is significant in MANOVA, the specific dependent variables that contribute to the overall effect can be identified by the univariate *F* tests. By the statistical analysis, we found which type of conferencing had more positive effects and which category impacted instructional quality. Meanwhile, the open-ended comments were coded and classified following a content analysis approach.

Results

The quantitative and qualitative results of this study are organized by the four research questions. These are presented below.

What is the Value to Instruction and Students of Using Synchronous Conferencing?

As shown in Table 1, both quantitative and qualitative data from open-ended questions showed that the participants had positive perceptions in using synchronous conferencing, but technical difficulties were still the largest barrier to both types of synchronous conferencing. In addition, the students offered several suggestions to improve instruction.

Table 1: *Means and Standard deviation for two types of virtual conferencing*

Criteria	Question summary	Video Conferencing				Audio Conferencing		
		2 one-to-one sessions (n=18)	2 whole class sessions (n=20)	Overall evaluation (n=11)	Total	5 whole class sessions (n=31)	Overall evaluation (n=5)	Total
Technical quality	1. Video quality was acceptable	4.33 (0.970)	3.70 (1.129)	3.73 (0.905)	3.94 (1.049)			
	4. The audio quality was acceptable	3.44 (1.294)	2.00 (1.170)	2.36 (0.924)	2.61 (1.320)	4.61 (0.715)	4.40 (0.548)	4.58 (0.692)
	2. Video size was adequate	4.39 (0.979)	3.90 (0.788)	4.09 (0.54)	4.12 (0.832)			
	3. Video was good as being live in the same room	3.61 (1.145)	2.10 (0.912)	2.36 (1.120)	2.71 (1.242)			
	5. The audio was good as being "live" in the same room	3.00 (1.283)	1.55 (0.945)	1.82 (0.982)	2.14 (1.258)	3.97 (0.912)	4.00 (0.707)	3.97 (0.878)
	13. Distraction of system [b]	3.78 (1.003)	1.95 (0.999)	2.00 (0.894)	2.63 (1.302)	4.29 (0.864)	4.60 (0.548)	4.33 (0.828)
	Sub Total	3.76 (0.844)	2.54 (0.641)	2.73 (0.651)	3.03 (0.909)	4.29 (0.625)	4.29 (0.625)	4.30 (0.606)
		3.11 (0.961)						

Instructional Quality	6. Encouraging critical thinking	3.61 (1.037)	3.35 (1.137)	4.45 (0.522)	3.69 (1.065)	4.58 (0.502)	5.00 (0.000)	4.64 (0.487)
	7. Not obstructing my understanding	3.89 (1.132)	2.40 (1.353)	2.91 (0.831)	3.06 (1.329)	4.42 (0.620)	4.20 (0.447)	4.39 (0.599)
	8. Media was an appropriate means for meetings	4.39 (0.979)	3.60 (0.883)	3.64 (0.674)	3.90 (0.941)	4.45 (0.624)	4.20 (0.447)	4.42 (0.604)
	9. I was able to interrupt and ask question easily	4.11 (0.963)	3.30 (1.380)	3.27 (1.009)	3.59 (1.206)	4.55 (0.568)	4.40 (0.548)	4.53 (0.560)
	10. Adding video would improve the instruction					2.00 (1.265)	2.80 (0.837)	2.11 (1.237)
	Sub Total	4.00 (0.947)	3.16 (0.926)	3.57 (0.462)	3.56 (0.916)	4.50 (0.470)	4.50 (0.470)	4.49 (0.449)
		3.56 (1.016)						
Attention	11. I paid attention	4.33 (0.970)	3.90 (0.968)	4.18 (0.603)	4.12 (0.904)	4.52 (0570)	4.20 (0.447)	4.47 (0.560)
		4.11 (0.981)						
Distraction	12. Distraction of location [b]	4.06 (0.802)	3.85 (1.040)	3.73 (1.104)	3.90 (0.963)	4.35 (0.755)	4.20 (0.837)	4.33 (0.756)
		3.95 (0.928)						

[a] Standard deviations are given in parentheses

[b] The two values of the distraction of location and the distraction of conferencing system were recoded so that higher number represents positive perception.

Regarding the value of using virtual conferencing for students, the participants were interested in using virtual conferencing tools, and they valued convenience and flexibility of virtual conferencing. For example, the most frequent response (28 out of 43 in video conferencing and 9 out of 25 in audio conferencing) mentioned taking a class at home or office and saving travel time. For example, one student said, "I like being at home and being able to attend a class at the same time. The technology is exciting!" In addition, eight responses from audio conferencing evaluation showed that they were relaxed and had more freedom.

The synchronous conferencing also made positive impacts on instruction. For example, the overall means for instructional quality (3.56 for video conferencing; 4.49 for audio conferencing; see Table 1) were positive. In addition, the means for the attention revealed that both synchronous conferencing types succeeded in capturing students' attention. Furthermore, the open-ended responses revealed that the synchronous conferencing provided immediate feedback and enhanced critical thinking. Interestingly, three students in the audio conferencing stated that the audio delivery tool caused them to pay "more attention," so the discussion went well.

In contrast, 30 responses out of 38 in the video conferencing (78.9%) and 12 responses out of 19 in audio conferencing (63.1%) indicated that they disliked technical problems. Moreover, in the video conferencing group, even when asked to describe what they liked, the participants still mentioned and described technical issues 16% of the time. The students in the

video conferencing complained about poor sound quality. During the video conferencing, it was difficult to hear other students' voices. The class started late because they spent a long time troubleshooting. As a result of the technical problems, some students preferred face-to-face classes. For example, one student commented, "I believe the concept is good for those who cannot travel to class; however, I would like to be able to come to class and be there so I would not have to worry about missing things because of technical difficulties." The audio conferencing also had minor technical errors. For example, a participant could be inadvertently removed from a session at times. We attributed this to a network error either globally because of the amount of Internet traffic or locally because of the students' set up. Throughout the experiences of synchronous conferencing, the students made some suggestions: a backup plan, additional materials, and a training session. One student commented, "It was fun and realistic, but technology is not guaranteed to be successful every time. You always need a plan B." It implies that instructors should consider a substitute plan when synchronous conferencing does not work. Meanwhile, one person wrote, "Technical difficulties and troubleshooting caused a late start and several delays. I think a deadline for the troubleshooting should be set before starting a class." Last, participants suggested a handout or additional materials should be provided before class to help students prepare for classes, so then they could engage in discussions actively.

Is Video Necessary for Synchronous Conferencing?

To answer the question for the necessity of video in synchronous conferencing, two different data (answers for a close-ended question, responses for open-ended comments) and a comparison of audio and video conferencing were analyzed. First, the attitudes for the question "Adding video would improve the instruction" for students using audio conferencing was negative (mean = 2.11). Second, four comments from audio conferencing said that visual would have been helpful. Last, various comparison analysis of two types of synchronous conferencing were conducted as follows.

In order to examine whether video conferencing and audio conferencing differ in perception of instructional quality, technical quality, attention and distraction of location, a two-group MANOVA was conducted. The independent variables were two different synchronous conferencing groups, and the dependent variables were two scales representing technical quality and instructional quality, and two individual variables. Three two-group MANOVA were conducted to determine differences among the data from all individual sessions, an overall evaluation, and both individual and overall evaluations. The results are shown in Table 2.

Table 2: *Univariate Analysis of variance for three comparisons of synchronous conferencing*

	Session Evaluation (Video : 4 sessions, n = 38) (Audio : 5 sessions, n = 36)	Overall evaluation (Video: n = 10) (Audio: n = 5)	All data (n = 89)
Technical quality	F = 27.384 ** Effect size = 1.266	F = 19.041 * Effect size = 2.353	F = 43.042 ** Effect size = 1.440
Instructional quality	F = 22.596 ** Effect size = 1.151	F = 14.610 * Effect size = 2.062	F = 31.569 ** Effect size = 1.234
Attention	F = 4.261	F = .004	F = 4.195
Distraction of location	F = 3.877	F = .718	F = 5.063

* $p<0.0125$ ** $p<0.001$

The results revealed that there were differences in technical quality and instructional quality between two groups in all three comparisons. In addition, the effect sizes in the three analyses were extremely large. The students in audio conferencing exhibited higher levels of perception of technical quality and instructional quality than did the students in video conferencing. The means for individual items in the Table 1 also demonstrate the results of the MANOVA. For example, in the item asking the quality of each media, the mean for audio quality in audio conferencing was 4.58 while the mean for video quality in video conferencing was 3.94. Furthermore, the audio quality in video conferencing was low (mean = 2.61). It reflects that the sound quality of the video conferencing was poor. The media qualities comparing the face-to-face meeting also showed that audio quality in audio conferencing was higher than in video conferencing. For example, the mean for item number 5 "The audio was good as being live in the same room" in audio conferencing was 3.97, but the mean for the question in video conferencing was 2.14. In addition, the video quality comparing the face-to-face meeting in video conferencing was low (the mean for item number 3 = 2.71). Regarding instructional quality, all means for each item in audio conferencing were higher than video conferencing.

As the result of comparison between two groups, the audio conferencing was more effective than video conferencing. However, there were two types of video conferencing: one-on-one and whole class. In the open-ended answers, students were frustrated by technical problems especially in a whole class video conferencing. Therefore, two different two-group MANOVA were conducted whether one-on-one video conferencing and whole class video conferencing differed and whether whole class video conferencing and whole class audio conferencing differed. The dependent variables were the same as the previous analysis. The results of two different two-group MANOVA are provided in Table 3.

The result of the comparison of the two types of video conferencing indicated that one-on-one and whole class conferencing groups differed in technical and instructional quality. The perceptions of technical and instructional quality for the one-on-one video conferencing were higher (means = 3.76 and 4.00, respectively) than those for the whole class video conferencing (means = 2.54 and 3.16, respectively). The effect sizes for both differences were large, and the effect size for the difference in technical quality (Cohen's d = 1.648) was much higher than the

difference in instructional quality (Cohen's d = .894) as shown in Table 3.

Table 3: *Univariate Analysis of variance for two comparisons with whole class conferencing in video conferencing*

	One-on-one conferencing and whole class conferencing in video conferencing (one-on-one n = 18) (whole class n = 20)	Whole class conferencing in audio and video conferencing (whole class video n = 20) (whole class audio n = 31)
Technical quality	F = 25.712 ** Effect size = 1.648	F = 76.864 ** Effect size = 2.515
Instructional quality	F = 7.586 * Effect size = .894	F = 46.515 ** Effect size = 1.955
Attention	F = 1.895	F = 8.210 * Effect size = .822
Distraction of location	F = .458	F = 4.032

* $p<0.0125$ ** $p<0.001$

Also, the result of comparison of different conferencing methods revealed that students participating in whole class audio conferencing had higher perceptions than those in whole class video conferencing regarding technical quality, instructional quality, and attention. The effect sizes for the technical quality (Cohen's d = 2.515) and the instructional quality (Cohen's d = 1.955) were almost twice higher than the other comparison. In addition, the effect size for attention, which was lower than the other effect sizes, was also high (Cohen's d=.822).

Accordingly, the comparison of all sessions indicated that students' perceptions of two different synchronous conferencing types were statistically different in technical quality and instructional quality, and the other comparison of only whole class sessions revealed that students' perceptions toward attention was also different in addition to the both technical and instructional quality.

Do Technical Problems Prevent Synchronous Conferencing from Being Effective for Instruction?

A multiple regression analysis was used to determine whether the technical quality, conferencing method (audio or video conferencing), attention, and distraction have any influence on student perceptions of instructional quality. The four independent variables were entered into the regression equation simultaneously: conferencing method, technical quality, attention, and distraction of location.

Preliminary examination of the results indicated there was no extreme multicollinearity in the data. The regression results indicated that the set of independent variables explained 71.8% ($p < .001$) of the variance in the perception of instructional quality with three of four variables as shown in Table 4. In order of importance, they were technical quality ($\underline{\beta} = .510$), attention ($\underline{\beta} = .389$), and conferencing method ($\underline{\beta} = .153$). In the result, the technical quality had the greatest impact on students' perceptions of instructional quality while distraction of the remote site did not affect instruction using synchronous conferencing.

Table 4: *Results of Regression of instructional quality on synchronous conferencing*

	B	β	t
Independent Variables			
Technical Quality	.588	.510	6.317 **
Conferencing method	1.089	.153	2.052 *
Attention	1.734	.389	5.689 **
Distraction of location	-.199	-.051	-.814
R-square = .718			

* $p < .05$; ** $p < .001$

Do Distractions Prevent Synchronous Conferencing from Being Effective for Instruction?

Although the results from a multiple regression already revealed that distraction of location, such as noise or family, did not negatively impact synchronous conferencing from instructional quality, there is another distraction that is derived from the conferencing system. It could be treated as a technical problem, but the distraction may still occur even if the conferencing system worked. For example, the conferencing system interface may prohibit students from paying attention. Therefore, the answers for item number 13 "Distraction with the conferencing system made it difficult to pay attention" were compared. First, a comparison of the distraction of the system from whole class session evaluations was conducted. The mean scores are provided in Table 5. A one-way *t*-test revealed that the means were significantly different (t (49) = -8.884.57, $p < .001$). Second, a comparison of the distraction of the system from overall evaluations also indicated that the difference between video conferencing and audio conferencing was statistically significant (t (14) = -5.947, $p < .001$). The mean scores for overall evaluations are given in Table 6. The students' perceptions of distractions from the video conferencing system were significantly negative, and it affected the perception of instructional quality.

Table 5: *Comparison of distraction of system from whole class session evaluations*

	Mean	SD	N
Whole class sessions in video conferencing	1.95	.999	20
Whole class sessions in audio conferencing	4.29	.864	31

[a] The numbers were recoded so that higher number represents positive perception.

Discussion and Conclusion

From the experimentation over two semesters of using two different synchronous conferencing with hybrid courses, the results revealed that students had positive attitudes toward both video and audio conferencing. The advantages for using virtual conferencing tools in this study are similar to the results from previous studies: (a) active support (Alexander et al., 1999; Chan et al., 2000; Pittman, 2003) and (b) convenience (Alexander et al., 1999; Pittman, 2003).

Table 6: *Comparison of distraction of system from overall evaluations*

	Mean	SD	N
Overall evaluation in video conferencing	2.00	.894	11
Overall evaluation in audio conferencing	4.60	.548	5

[a] The numbers were recoded so that higher number represents positive perception.

However, some participants asserted that the virtual conferencing tools did not serve as a direct replacement for face-to-face class meetings because of technical problems, which corroborates others' findings as well (e.g., Alexander et al., 1999; Wilkinson & Hemby, 2000).

The results showed that audio conferencing was an adequate delivery tool for virtual conferencing. However, even if the comparison of all data revealed that audio conferencing had better technical quality and instructional quality than video conferencing, the significant differences between one-one-one sessions and whole class sessions should be noticed. An additional comparison was conducted to examine whether one-on-one video conferencing and whole class audio conferencing differed. The two-group MANOVA revealed that the differences were not statistically significant, so the one-on-one video conferencing made similar impacts on instruction and students as the audio conferencing. It seems that the technical problems of whole class video conferencing (particularly the second class session) caused lower perceptions of technical quality and instructional quality. Technical quality was the highest contributor to instructional quality because the delivery tools highly depend on technical resources. Therefore, once the technical problems did not occur, using either conferencing tool would be a useful alternative to conduct classes.

Meanwhile, the results confirmed the critical factors for synchronous conferencing that the previous studies have suggested. First, audio quality is the most critical factor for virtual conferencing (Jennings & Bronack, 2001). The participants in the whole class video conferencing sessions rated the audio quality (mean = 2.00) and audio as being live (mean = 1.55) as two of the three lowest perceptions. In comparison, the audio quality of the audio conferencing system (mean = 4.61) received the highest perception of the items associated with technical quality. Second, training time to be familiar with conferencing systems is needed for improving instruction (e.g., Chan et al., 2000; Reinhart & Schneider, 2001; Townsend et al., 2001). Without training session, a class may have pauses and delays because it is difficult to just ignore a person who has a technical problem. Last, additional materials for instruction improve students' understanding, such as online handouts or presentation files.

For future study, more data is necessary for precise analysis. Three more audio conferencing sessions have already been conducted, but we are still looking for appropriate video

conferencing tools. Once more video conferencing sessions have been conducted, rich data will provide us more accurate information for improving synchronous conferencing. Other studies may also attempt to compare the differences in student perceptions between the first uses of the conferencing tools and uses toward the end of the course to determine any net gains or losses in the utility of the tools. Furthermore, additional study is needed to for determine which instructional strategies are effective for synchronous conferencing.

To sum up, synchronous conferencing for hybrid courses offers promise as a valuable tool to overcome many of the barriers of cost and access. Convenience continues to be the most popular perception of synchronous conferencing; however, audio quality is fundamental to technical quality for both audio and video conferencing. With hybrid courses, where students experience face-to-face and virtual sessions, these results suggest once technical quality has been satisfied, synchronous conferencing is an appropriate method for instruction. However, like many other technological tools, synchronous conferencing is not panacea now (Anderson, 1996). Therefore we need more experimentation for developing an appropriate model.

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