TEACHING AN ONLINE GRADUATE MATHEMATICS EDUCATION COURSE FOR IN-SERVICE MATHEMATICS TEACHERS

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Online education at the graduate level has increased in recent years, offering students, instructors, and universities new opportunities and challenges for teaching and learning. This action research examined 17 in-service mathematics teachers' perceptions of taking an online course in a master's degree program. During 1 semester, survey data were collected to identify what participants believed to be successful aspects of the graduate level mathematics education online course as well as areas for improvement. Using the data obtained, areas of strengths and weaknesses are categorized, and recommendations are made to help support teaching and learning in online graduate teacher education courses.

INTRODUCTION

As the use of online instruction has significantly increased over the past decade due to technological expansions in the course management system and Internet (Beqiri, Chase, & Bishka, 2010; Wang, 2009), many scholars have attempted to compare web-based courses and face-to-face courses in mathematics. Love, Keinert, and Shelley (2006) compared student learning outcomes on discrete mathematics between the traditional classroom students and web-based students. They discovered that web-based students performed better on discrete mathematics exams than did traditional classroom students. Similarly, Hughes, McLeod, Brown, Maeda, and Choi (2007) examined algebra achievement of secondary mathematics students and their perceptions in both online and traditional classrooms. They found online students' scores on an algebra understanding achievement test were higher than traditional students' scores.

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Several researchers also explored the activities employed in online learning environments in mathematics (Choo, Eshaq, Samsudin, & Guru, 2009; Sendag & Odabasi; 2009). Choo et al. (2009) applied an activity called "diary of discovering geometry" to engage secondary school students participating in online collaborative learning in Malaysia. The authors examined the online interaction and factors affecting students' readiness for online collaborative learning, especially for teaching and learning geometry, while applying the diary activity. They reported that the diary activity could promote students' positive perception in sharing knowledge among students as well as enhancing students' interests in geometry. In addition, Sendag and Odabasi (2009) explored the online problem based learning approach when utilized in an online learning environment and found it influenced critical thinking skills of undergraduate students who majored in mathematics. They reported that learning in the online problem based learning group could enhance the critical thinking skills of students.

Delivery Modes

Distance education has allowed educators to provide new opportunities for students to pursue higher education. However, educators are also faced with challenges of selecting suitable learning tools to ensure students perceive positive learning outcomes and maintaining similar quality of learning as in traditional face-to-face settings. It is evident that the integration of technology in distance education is changing the face of classrooms. Synchronous and asynchronous communication tools have appeared as optional forms of online communication in teaching and learning and can be supplemented to traditional teaching (Chen & Shaw, 2006). Both synchronous and asynchronous modes have unique features and values to fit certain instructional methods, learning situations, and personalities of students.

Jolliffe, Ritter, and Stevens (2001) described a synchronous communication environment as one that "takes place in real time where those involved in the communication process are present all at the same time, but not necessarily in the same place" (p. 9). In a synchronous class, students are communicating at the same time using text chat, audio-conferencing, videoconferencing, or online white boards (Chen, Chen, & Tsai, 2009; Romiszowski & Mason, 2004). A synchronous environment allowed students to adjust their paces continuously, to address their concerns immediately, and to immerse in problem-solving and decision-making processes (Murphy & Collins, 1997). Additionally, Patillo (2007) discovered synchronous audio conferencing could boost the communications between instructor and students. Davidson-Shivers, Muilenburg, and Tanner (2001) asserted that even though students enjoyed the interaction with their peers in the synchronous portion of the course, it was difficult for them to follow the messages or dialogue in the chat box. However, it appeared that students responded to more messages, which directly related to the topic in the chats than one in the threaded discussions.

Conversely, Jolliffe et al. (2001) defined an asynchronous communication environment as "one where communication between learners and the facilitator is done via a computer forum of some description at different times" (p. 9). In asynchronous online classes, students can access and work on their assignments at different times as they are not required to log on the online class at the same time (Tallent-Runnels et al., 2006). Examples of the online asynchronous media are web pages, file download, e-mail, newsgroup, forum, and response pad (Chen & Shaw, 2006). Rovai and Grooms (2004) argued that asynchronous communication is "a powerful tool for group communication and cooperative learning that promotes a level of reflective interaction often lacking in a face-to-face, teacher-centered classroom" (as cited in Penny & Murphy, 2009, p. 804). Similarly, Offenholley (2006) stated that "Threaded discussions help build a sense of community, encourage higher order thinking, and provide opportunities for peer collaboration" (p. 1). The asynchronous discussion board

allowed students to have enough time to read, to reflect, and to reply their messages to other students' postings as well as to participate whenever students would like to do so (Davidson-Shivers, Muilenburg, & Tanner, 2001; Poole, 2000).

Benefits of asynchronous communication tools for students have been confirmed by several literature sources (Hara, Bonk, & Angeli, 2000; Johnson & Green, 2007; Kanuka, 2005). Hara et al. (2000) examined discussions via an asynchronous communication tool called *FirstClass* that complemented a face-to-face psychology graduate level course. Their research showed that on the comments required per week, students seemed to post messages with a high level of cognitive skills (i.e., judgment and inferencing) and metacognitive approaches to reflect on experience and self-awareness. Johnson and Green (2007) applied the online discussion to promote mathematical discourse. They revealed asynchronous dialogues facilitated the students' knowledge construction. The authors recommended assessment criteria should be created around the learning process rather than the factual knowledge because students learned differently (Johnson & Green, 2007).

Kanuka (2005) investigated various instructional strategies by implementing a text-based Internet learning environment into a class via WebCT in order to promote higher levels of learning. She reported that asynchronous communication tools can support effective learning environments through the use of brainstorming, debates, and WebQuests, by encouraging students to achieve higher levels of learning or to learn in deeper ways. Moreover, Ng, Cheung, and Hew (2009) disclosed factors that influenced students to participate in sustained asynchronous online discussion which were interesting topics, familiarity with the topics, and peer facilitation techniques.

Student Satisfaction and Perception

Some educators argue better academic success results in higher student satisfaction or higher student satisfaction results in better academic success (Pascarella et al., 1996). Because of the growth of computer-mediated communication, several studies have researched factors influencing students' satisfaction in online learning environments (Chiu, Hsu, Sun, Lin, & Sun, 2005; Drennan, Kennedy, & Pisarski, 2006; O'Dwyer, Carey, & Kleiman, 2007; Ouzts, 2006; Sher, 2009).

Chiu et al. (2005) discovered that perceived usability, perceived quality, and perceived value had effects on satisfaction in online classes where class contents were delivered via a blend of synchronous and asynchronous communication tools. Furthermore, Drennan et al. (2006) studied the factors that affected undergraduate student satisfaction with flexible online learning in a management course. The authors identified two aspects of student satisfaction: (1) positive perceptions of technology in terms of ease of access and use of online flexible learning material and (2) autonomous and innovative learning styles. They reported that positive perceptions toward technology and an autonomous learning style were important factors that affected student satisfaction with a flexible learning mode. At the same time, the perceived usefulness of flexible learning and the students' locus of control affected the course satisfaction.

In addition, O'Dwyer et al. (2007) reported student satisfaction in an online algebra I course was negatively affected by a perceived lack of interaction with the online teacher. Furthermore, Sher (2009) studied students' characteristics, perceptions of learning, satisfaction, student-instructor interactions and student-student interactions, and assessed the relationship of those two interactions to student learning and satisfaction within web-based online learning programs. The author found student-instructor interaction and student-student interaction were significant contributors to the level of student learning and satisfaction, a finding supported by other researchers (Ouzts, 2006).

Program Overview

The National Science Foundation funded a Mathematics Teacher Leadership Center (Math TLC) grant (NSF Award # DUE-0832026) to improve mathematics achievement in middle, secondary, and post-secondary education in the northern Rocky Mountain region to two state universities in 2009. In spring 2010, in-service mathematics teachers who were admitted to the virtual master's degree program were required to take a teaching geometry online course as indicated in the virtual master's degree program curriculum. The course was offered in an online environment using both synchronous and asynchronous aspects to facilitate learning.

The purpose of this study is to investigate in-service mathematics teachers' experiences in an online learning environment and provide recommendations on how to improve in-service mathematics teachers' experiences in the online learning environment. Two research questions were investigated as follows:

1. What were in-service mathematics teachers' perceptions regarding taking a graduate level mathematics education course in an online learning environment?
2. What recommendations can be provided to improve the online learning environment for in-service mathematics teachers?

METHOD

Research Design

Action research has grown in importance in the field of education, due to the promise of the action research for promoting educators' development, improving quality of educators' practice, strengthening the relationship between research and practice, and enhancing the fairness of educational effect on community (Creswell, 2008; Gall, Gall, & Borg, 2007). Mills (2000) defined the action research design as a systematic procedure applied by educators to collect quantitative, qualitative, or both data to improve their teaching and students' learning.

The primary purpose of action research in education is to increase the quality of the educational practice, in which researchers or educators examine their own practices in an educational setting (Creswell, 2008; Gall et al., 2007). Educators, as action researchers, engage in self-reflection regarding the process of inquiry, collaborate with others in the process, and perform a dynamic inquiry process involving recognizing a problem, testing a solution, reflecting on information discovered, and attempting new solutions. Action researchers implement a plan of action to direct the application of a new practice throughout this process. This plan of action is formulated based on what researchers found out from the research problem and shared reports with others (Creswell, 2008).

In this study, we applied action research to improve instructional practices in a technology supported online learning environment by distributing a technology survey to in-service mathematics teachers. Based on what we learned from the survey responses regarding in-service mathematics teachers' perceptions toward the course, we provided recommendations to support teaching and learning in online teacher education courses.

Participants

The participants for the study were 22 in-service mathematics teachers who took the *Teaching Geometry* online course during the spring 2010 semester. Participants were geographically spread across two states, spanning 250 miles, and most had attended different universities for their undergraduate degrees. Teaching experience varied widely, from two years of experience to over 25 years for a few individuals. Ten participants were male, and 12 were female. Although participants were in-service teachers, during the sessions we interacted with them, they were graduate students. Therefore, we will use the word *student*

to refer to the participants for the remainder of the article.

Context: Online Course Format

The teaching geometry online course was offered at two universities in the spring 2010 semester. The instructor of the course was located at one of the universities, but students were enrolled at either university. The course focused on current research and practices of teaching, learning, and assessing geometry and other issues related to the geometry curriculum, such as measurement. The course also addressed the processes of reasoning and proof as they pertain to secondary geometry.

The instructor used Blackboard (a web-based course management system) and Elluminate (a suite of online audio-visual communication tools) to deliver the course. The course met synchronously each week for an hour on Elluminate for the duration of the 15-week semester. During this time, readings would be discussed within small groups of students as well as the entire class. Polling was used to gain feedback from participants, and PowerPoint lectures were displayed for everyone to view within the class sessions. A chat box window and audio/video conferencing facilitated communication during the synchronous sessions. To facilitate the asynchronous portion of the course, the instructor used the Blackboard platform to post announcements, course materials, and grades, as well as to facilitate students' online interaction through discussion boards.

To meet the course requirements, students also participated in weekly threaded discussions and submitted assignments by posted deadlines. Students' participation was evaluated based on their weekly discussions in both synchronous whole group and small group sessions via Elluminate as well as asynchronous small-group and class discussions via Blackboard. A large portion of the participant's grade was determined by papers and other required assignments, both individual and group, that were collected via e-mail or Blackboard drop box. The instructor offered virtual office hours on Elluminate for an hour each week and responded to e-mails to assist participants.

Instruments

The In-service Teacher Technology Survey consisted of 31 questions. We modified the survey items based on two student satisfaction surveys developed by Ehrmann (1995) and Wang (2009). The first 25 survey items asked participants to indicate their level of satisfaction toward technology (e.g., Blackboard, Elluminate, Webcams, and headsets), asynchronous threaded discussion (Blackboard discussion board), synchronous-whole group class session (Elluminate), and synchronous-small group session (Elluminate) that they experienced in the course. These items were Likert-type items that ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). These 25 items included 19 positively worded statements and six negatively worded statements (items 5, 8, 10, 11, 17, and 18).

In addition to the Likert-scale items, six open-ended questions were asked: (1) Please describe your experience with the asynchronous threaded discussion or Blackboard discussion board; (2) Please describe your experience with the synchronous whole group course session or Elluminate whole class session; (3) please describe your experience with the synchronous small group session or Elluminate professional learning community session; (4) What do you like best about taking this course in the technology supported learning environment this semester; (5), What do you like least about taking this course in the technology supported learning environment this semester; and (6) Any suggestions on how to improve the technology supported learning environment if the same course is offered next semester.

Procedure

The 22 in-service teachers who took the teaching geometry course in an online setting were contacted by e-mail in Week 10 to indicate their willingness to share information about their online learning experiences. We developed the In-Service Teacher Technology Survey and asked both the teaching assistant and instructor of the course to review the survey to ensure its validity. We used the SurveyMonkey software tool to develop the survey as an online survey in Week 13. The online survey was sent to all participants in Week 15 and a follow-up email reminder was send to all participants in Week 16. Among 22 participants, 17 of them (77%) completed all survey items. The Cronbach's alpha reliability for the survey was .70.

Data Analysis

From the Teacher In-Service Technology Survey, student responses were calculated by using descriptive statistics and ranked for each survey item. The data on survey items that contained negative worded statements were reversely coded. For the six open-ended questions, a thematic analysis was conducted to identify emerging themes and patterns for responses to each question.

RESULTS

In-Service Teacher Technology Survey

A total of 17 participants completed the In-Service Teacher Technology Survey designed for this study. The means and standard deviations for the 25 survey items were calculated and the overall mean score across the survey items was 3.92; a rating indicating student had very positive experiences in the online learning environment.

The four highest-rated ($M > 4.30$) and four lowest-rated statements ($M < 3.50$) on the In-Service Teacher Technology Survey are shown in Table 1. The four highest-rated statements on the survey were "My learning satisfaction is not undermined because I did possess adequate typing skills" ($M = 4.71$); "I am satisfied with the quality of the online synchronous conferencing tool (Elluminate)" (M = 4.41); "I am satisfied with the quality of the QuickCam Communicate Webcam that the program purchased for me" ($M = 4.36$); and "I prefer to have clear rubrics for scoring assignments prior to the due date" ($M = 4.31$).

On the contrary, the four lowest-rated statements were "I did not waste too much time sorting through messages to find the few that are useful" ($M = 2.41$); "In threaded discussion, my answers to the questions and comments on peers' messages helped me to understand the contents/readings of the course better" ($M = 3.18$); "I am satisfied with the quality of the Notebook Headset that the program purchased for me" ($M = 3.41$); and "I enjoyed studying for this course because my interaction with other students was effective" ($M = 3.41$). These results are summarized in Table 1.

Open-Ended Questions

In addition to the 25 Likert-type survey questions, the evaluation also contained six open-ended questions. The purpose of these questions was to gain a greater understanding of the students' needs with regard to their success in Math TLC courses, professional learning communities (PLCs), and support for courses taught completely online.

For the overall improvement of the online aspects of the Math TLC courses, the first open-ended question asked the participants to describe their experiences with the asynchronous threaded discussion or Blackboard discussion board. Three students (18%) had positive experiences with the asynchronous threaded discussion, six students (35%) had neutral opinions (contained both positive and negative responses), and eight students (47%) had negative responses with the Blackboard discussion board.

TABLE 1
In-Service Teacher Technology Survey Results

Rank		*Survey Items*	*Mean*	*SD*
1	17.	My learning satisfaction is undermined because I did not possess adequate typing skills.*	4.71	.47
2	23.	I am satisfied with the quality of the online synchronous conferencing tool (Elluminate).	4.41	.51
3	24.	I am satisfied with the quality of the QuickCam Communicate Webcam that the program purchased for me.	4.36	.63
4	21.	I prefer to have clear rubrics for scoring assignments prior to the due date.	4.31	.77
5	20.	I felt comfortable when asking for clarification or questions online with the instructor.	4.24	.83
6	1.	The course website was well organized.	4.18	.53
6	23.	I am satisfied with the quality of the online asynchronous course management system (Blackboard).	4.18	.39
8	7.	I felt comfortable discussing the ideas and concepts taught in this course with other students during the synchronous small group session.	4.12	.60
8	9.	I prefer to receive responses from the instructor promptly.	4.12	.86
8	13.	Synchronous whole group course sessions in this course facilitated my learning.	4.12	.33
8	16.	In terms of interaction and collaboration, I would rate synchronous small group session discussion as "effective."	4.12	.49
12	4.	I benefited from active participation in the scheduled synchronous small group session discussions about given topics.	4.06	.43
12	10.	I will post the same number of messages as I actually did over the semester if these postings were optional, not required and graded.*	4.06	.66
12	15.	The synchronous small group session discussion is helpful because we collaborate more with each other and support each other.	4.06	.90
15	2.	The course website layout was clear.	3.94	.56
15	3.	I like to have class sessions recorded so I can review the lessons later on.	3.94	.66
17	6.	When engaged in synchronous small group session discussions, I put a lot of thought into my comments.	3.88	.49
18	8.	In the synchronous small group session, I wasted too much time communicating with others on topics that are not directly related to my course work.*	3.71	.59
18	14.	I want to work with different people in a synchronous small group session every few weeks because we can learn from other students.	3.71	.77
20	5.	I would have done better if I did not have to collaborate with my peers in my group for discussions.*	3.65	.70
20	18.	The synchronous small group session discussion mode didn't fit well with my other life responsibilities.*	3.65	.70
22	19.	I enjoyed studying for this course because my interaction with other students was effective.	3.41	.71
22	25.	I am satisfied with the quality of the Notebook Headset that the program purchased for me.	3.41	1.06
24	12.	In threaded discussion, my answers to the questions and comments on peers' messages helped me to understand the contents/readings of the course better.	3.18	.81
25	11.	I wasted too much time sorting through messages to find the few that are useful.*	2.41	.87
Overall			3.92	.65

Note: Responses ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). *Recoded scale item.

One participant stated: "I very much enjoy this form of on-line communication. It seemed that very little effort was wasted with tangential concepts or conversation. Postings were relevant, well thought out, and insightful." While this participant's comments were positive, we also identified comments that were neutral in nature. That is, "I like the question and answer sessions to be live rather than asynchronous. It is easier for me to voice my thoughts rather than writing them out. However, I don't always have the time to sift through several postings."

In addition to the positive and neutral comments, there was an overwhelming amount (47%) of negative responses. Two students' comments that we felt were most representative of the negative responses about the asynchronous threaded discussion or Blackboard discussion board are "I dislike the Blackboard threaded discussions because Blackboard doesn't alert you to new postings when you login. I also feel that it is a way to check up on whether or not we are doing the assigned reading, which for many is unnecessary." and "I hate threaded discussions. I feel they are a waste of my time. You have to come up with some new original thought that you probably are not passionate about. You have to read through a bunch of other peoples' conversations and usually they are not applicable to me. I feel like it is not an actual conversation—it is just getting in the necessary number of posts by the due date."

Participants were then asked to describe their experiences with the synchronous whole group course session or Elluminate whole class session, 12 students (71%) had positive experiences with the synchronous whole group course session, 5 students (29%) had neutral experiences, and none of them reported negative experiences with the Elluminate whole class session. Students felt they benefited from the synchronous whole groups sessions. One student commented that "I think the sessions are run well. The whole class/break-out sessions keep class interesting. It is not just the instructor always doing the teaching." Another student stated that "The whole class sessions have been productive and well planned." Overall, many students thought the whole group aspect of the synchronous sessions were valuable which allowed them to voice their opinions and hear ideas from others.

While considering their experiences, participants also discussed their experiences with synchronous small group sessions or Elluminate PLC sessions. Twelve participants (71%) had positive experiences with the synchronous small group session, five participants (29%) had neutral experiences, and none of them had negative experiences with Elluminate PLC sessions. One student shared her/his experience by saying: "These are great. I love that you can communicate easily and see the people you are talking with. It is nice you can meet in a small group from home." Another student related her/his experience declaring: "The small groups are awesome. They really help me to bring out my thoughts and be able to hear what some of my classmates are thinking. We take our ideas and are able to bring it back. Like any meeting, it is more productive when fewer people are involved." In contrast, one neutral comment made to the researchers was: "The small group outside of class sessions was okay but it is tough to build a bond with folks and tough to coordinate schedules. Differences in learning styles and approaches to sharing work seem to magnified when working via Internet."

When participants were asked what they liked best about this course, the majority of the students appreciated the benefit of the Blackboard and Elluminate functions. For example, conveniences, Elluminate whole-class and small-group discussions, organized interface of Blackboard, and class discussions, were all mentioned as advantages to these technologies. Since this question is more general, there were a variety of answers responding to the questions. One student verbalized: "I like that I get to take the course from the comfort of my own home and that I don't have to spend extra time away from my family commuting to a class." As this student relayed his/her experi-

ences related to his/her family, another student reflected on the cognitive preparation of the instructor. "The best aspect of on-line learning is that the instructor must make conscious decisions to provide interaction. This is in contrast to 'live' classes in which the instructor may mistakenly believe that the class is interactive simply because he/she is present. During this online class, students were encouraged to interact with one another and engage with the instructor."

Subsequently, we asked about what students' least favorite experiences were in this course. Several students indicated that they lacked opportunities to interact with their instructor and felt uncomfortable with the classroom due to impersonality of this online environment. For example, two students mentioned that "The class seems to go slower. To me it seems that one hour of online discussion could have been established in 30-40 minutes in an actual classroom." and "The group projects are really hard when working with remote classmates. Just the compiling of documents and formatting has taken a considerable amount of time that really did not enhance my learning." Additionally, other students encountered various technology issues. One student commented that "Some people's microphones were not working properly because they would fade in and out and it was difficult to follow their conversation."

Finally, participants were asked whether they had any suggestions on how to improve the technology supported learning environment if the same courses are offered next summer. Participants recommended that the interface of Blackboard needed to be reorganized for easy navigating and better quality of headsets or microphones should be provided to students. The participants also suggested that having students to work in the same PLC groups during small group discussions was better than being always randomly assigned to groups. Some participants thought that having interactions with other students and the instructor via Elluminate sessions were helpful for building online professional learning communities. Some participants also mentioned the technology (i.e., Internet connection, computer, tools) should be more reliable. One student mentioned that "the headsets do not seem to be that high of quality. Many students are hard to understand because their headsets cut in and out. I think that it would be nice to have a better quality headset to use." Another participant references the mode in which students communicated with one another by saying "I would rather have discussions through Elluminate rather than discussion board as I feel that it is a more effective way to communicate ideas."

DISCUSSION AND RECOMMENDATIONS

According to the research findings, we provide recommendations to the course instructor and the Math TLC leadership team. Using both Likert-type questions and open-ended questions, we categorized the results to provide recommendations in the areas of sense of community, technological assistance, and instruction. By summarizing the findings for each of these areas, we hope to provide guidance for online course designers, instructors, and program coordinators.

Sense of Community

Similar to other studies within online environments, we found students' sense of community to be an important factor within the program. Participants considered the PLCs to effectively foster a sense of community, thus the efforts the program put towards promoting the communities seem to have worked from the perspective of the student. Given the importance of community within online teacher programs (Clarke, 2002; Thurston, 2005), we recommend the continuation of the communities to support community in the hope of reducing feelings of isolation among students, which has been linked to attrition in online teacher programs (Garrison & Kanuka,

2004; Owston, Sinclair, & Wideman, 2008). We also note students' suggestions regarding splitting PLCs into smaller groups based on content interest and geographical location which may help increase sense of community within the group.

We also recommend programs are structured to allow multiple ways of communication. From students' comments, we found they wanted more activities that allowed them to communicate, offering suggestions such as additional time to discuss with peers via technologies such as Elluminate or Skype. Also, threaded discussions could also be implemented in a way to develop and support a sense of community, as established by Offenholley (2006). However, the results from two of the four lowest-rated statements (Items 11 and 12) and the first open-ended questions revealed that most students did not have positive experiences with the asynchronous threaded discussion. We recommend the instructor consider offering clear expectations and setting ground rules on how students should interact with each other. In addition, through appropriate approaches, such as asking critical questions from each other, encouraging contribution, and thanking others might improve interaction among students with the threaded discussion and enhance student learning (Weinberger, Ertl, Fishcher, & Mandl, 2005; Ng et al., 2009).

Technological Assistance

One of the main concerns of the participants was more assistance with the technology used for the online course. They mentioned both hardware and software issues they encountered throughout the courses. Some of the students recommended training sessions to use the software as well as regular testing of the hardware. Students requested testing their webcam and headsets and possibly with the assistance of the graduate teaching assistants prior to class meeting time. The goal behind this is to ensure that equipment works properly when the equipment is needed (Choy, McNickle, & Clayton, 2002). Also, some participants suggested implementing a "technical problem/ issue board." In other words, a place to post hardware and software issues with the expectation that the instructors or the graduate teaching assistants would offer suggestions or technical support to assist with the issues quickly or provide real-time technical support. This can ensure class, group, and one-on-one instruction to occur more smoothly.

Moreover, participants are also interested in having the instructors or course designers provide specific tutorials, job aids, or guidelines for accessing and participating in Blackboard and Elluminate PLC sessions. These could come in the form of a "how-to" guides for students to have to access to the information they need as quickly as possible. The ease of usability and access has strengthened online learning (Kidney, Cummings, & Boehm, 2007).

Instructional Recommendations

Equally important, the participants had strong feelings about the instructional methods used in the course. They had specific requests from the instructors and how they felt future teaching methods would benefit them and other Math TLC cohorts. First, students wanted instructors to be more explicit with expectations and should provide the course syllabus that outlines course content, objectives, timeline, clear expectations, and explicit assessment rubrics prior to course. Salmon (2002) and Moallem (2003) reported that when expectations and evaluation formats are clear, students engaged more in an online learning environment because students' confusion and frustration were diminished or prevented. Moreover, sharing the expectations with classes would assist both students and instructors to have a clear understanding of the learning community's expectation (Snyder, 2009). Therefore, informing clear expectations and guidelines would be helpful for online students to prepare themselves when participating in the online learning environment.

Another commonly addressed instructional technique was the use of online office hours. Some students commented they wished additional times with more variety in the scheduling so student-teacher relationships could be more easily formed to address isolation issues in learning, in making sense of material, and in working with technology. The virtual office hours can be offered via Elluminate chat, discussion group on Elluminate, or telephone. Online office hours provide chances for the instructor to give students immediate answers to their questions when an instructor is online; consequently, this opportunity can encourage the instructor and learner interaction (Serwatka, 1999).

We realize that the action research is conducted in the context of focused efforts to improve the quality of an organization but is limited in its generalizability to other settings. The participants of this program are a unique group; as in-service teachers, they had all courses together the previous summer, which included face-to-face components. Therefore, a sense of community was most likely established prior to entry into the online courses detailed in this study. Moreover, we only focus on the use of Blackboard and Elluminate in this study, which might not be applicable to other web-based course management systems and synchronous tools. However, using the invaluable information offered by the participants, the course designers, instructors, and graduate teaching assistants will be able to provide more dependable and richer learning experiences in online environments.

In summary, we believe the research findings provide a basis for future decision-making within the Math TLC program. Online teacher education is relatively new, with best practices still being determined by instructors and researchers. We intend the aforementioned recommendations, which are based on student perspectives through their participation in the course, to guide practice and policy in order to improve education in the online learning environment.

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