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Lessons Learned from Teaching in Hybrid Learning Environments for In-Service Mathematics Teachers

Abstract: This article presents middle and secondary in-service teachers' attitudes towards participation in a graduate level probability and statistics course in a hybrid learning environment. Analysis of quantitative data from a survey administered to the teachers led to ranking participant responses and to recommendations for improving this hybrid environment. Additionally, the qualitative data drawn from the open-ended survey response items which were comprised of teacher generated suggestions to improve the hybrid learning environment are considered. In particular, recommendations for instructors, teaching assistants, course designers, and technology support personnel are put forth in accordance with the research findings from both types of data. The goal of these recommendations is to improve community building in this environment, the efficacy of technology in teaching and learning, and the structure of the hybrid learning environment.

Background

Over the past decade, distance education has become a fast-growing delivery method in higher education in the U.S. (Dunlap, Sobel, & Sands, 2007). The growth of distance education in higher education has necessitated utilization of hybrid learning environments which provide the resolution for "the conflicting pressures on distance educators –students prefer to learn in a classroom, but demand to be permitted to learn at a distance" (Simonson, Smaldino, Albright, & Zvacek, 2009, p. 6).

A hybrid learning environment offers a combination of online and face-to-face delivery (Doering, 2006) in which "30% to 79% of the course's content is delivered online" (Simonson et al., 2009, p. 5). For traditional face-to-face learning experiences, learners and instructors are required to be in the same location, while for online learning experiences, learners and instructors can be in different places by employing the information and communication technologies (ICT) to communicate each other (Spector, Merril, Merriënboer, & Driscoll, 2008). The aim of hybrid learning is to improve students' educational experiences by combining benefits of web-based environments while preserving benefits of traditional classroom environments to promote active learning (Garnham & Kaleta, 2002). The hybrid learning environment has greatly increased in popularity in higher education (Young, 2002) because of enhancing students' learning outcomes (Tuckman, 2002) and maintaining high-quality student-instructor interaction (Riffell & Sibley, 2003).

The National Science Foundation funded a grant to improve mathematics achievement in middle, secondary, and post-secondary education in the northern Rocky Mountain region to two state universities. This grant allows in-service mathematics teachers to partake in a hybrid

master's program offering a degree in mathematics education. During the semester studies, students primarily took three courses: Applied Probability and Statistics, Teaching Probability and Statistics, and Continuous Mathematics as indicated in the virtual master's degree program curriculum. These three courses are offered in a hybrid environment. A hybrid learning environment is defined as a combination of face-to-face and online instruction which allows synchronous and asynchronous interactions and encounters with other participants in this study. The purpose of this study is to investigate in-service mathematics teachers' experiences in a hybrid learning environment and provide recommendations to the grant leadership team on how to improve in-service mathematics teachers' experiences in the hybrid learning environment.

Research Questions

The research questions for the study are as follows:

1. What were in-service mathematics teachers' attitudes regarding taking a graduate level mathematics course in a hybrid learning environment?
2. What were in-service mathematics teacher's suggestions to improve the hybrid learning environment?

Method

Participants

The participants for this study included 27 students who were in-service mathematics teachers at the middle and secondary school levels. Although they are in-service teachers, during the sessions we interact with them, they are graduate students. Therefore, we will use the word *student* to refer the participants for the remainder of the paper. These students participated in three of the hybrid setting graduate level mathematics courses at two universities in the Rocky Mountain region of the United States during the summer of 2010.

Context: Hybrid Course Format

The *Probabilities and Statistics* course was offered in the summer 2010 semester. This course used Blackboard (a web-based course management system), two-way video conferencing tool, and Elluminate (an online synchronous tool) to deliver course content. There were a total of 35 students who took these three courses during a six-week period. Among these 35 students, 24 students were gathered in the same classroom at one university, while 11 students were located in the same classroom at a different university. Three instructors delivered lectures by using the two-way video conferencing tool and facilitated student discussion by using Elluminate. All instructors also used either Blackboard or eCompanion to post announcements, course materials, and student grades.

Instruments

In-Service Teacher Technology Survey. The In-Service Teacher Technology Survey consisted of 32 questions. The first 28 questions used the Likert-type response scale with the following responses: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5= strongly agree. The 28-item survey asked students to indicate their level of satisfaction toward technology (e.g., Blackboard, Elluminate, Writing Tablets, Webcams, and headsets), asynchronous threaded

discussion (Blackboard discussion board), synchronous-whole group class session (two-way video conferencing), and synchronous-small group session (Elluminate) that they experienced in the course. These 28 items included 24 positively worded statements and four negatively worded statements (items #4, #7, #10, and #11). The Cronbach's alpha reliability for the survey was .85. In addition to the Likert-type scale items, four open-ended questions were asked in the survey:

1. What do you like best about the technology supported learning environment being used in this course (using Blackboard, Elluminate, two-way video conferencing, etc.)?
2. What do you like least about the technology supported learning environment being used in this course?
3. Please reflect on the possible learning community/communities you have with your classmates (from both campuses).
4. Please provide at least one suggestion on how to improve the technology supported learning environment if the same course is offered again.

Procedure

The students enrolled in the *Probabilities and Statistics* course were contacted by e-mail to indicate their willingness to share information about their learning experiences and to fill out the In-Service Teacher Technology Survey if they chose to do so. The In-Service Teacher Technology Survey was sent to all 35 students in Week 5 of the six-week summer session and 27 students (77%) responded to the survey within one week.

Data Analysis

From the In-Service Teacher 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 four 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

The means and standard deviations for the 28-item In-Service Teacher Technology Survey were calculated. The overall mean score across these survey items was 3.95, a rating indicating positive experiences in this hybrid learning environment. The data from the In-Service Teacher Technology Survey also revealed that students' sense of community was one of the most positive experiences, while issues with technology were the most negative aspects of the course.

The five highest-rated statements on the survey were "I have felt isolated from the rest of the class in this course.*" (M = 4.67), "The small group discussions have been helpful to my learning." (M = 4.52), "I have felt comfortable discussing concepts in this course with other students during small group discussions." (M = 4.52), "The small group discussions have been effective in this course." (M = 4.44), and "When engaged in small group discussions, I have put a lot of thought into my comments." (M = 4.44).

The five lowest-rated statements were “I have felt the small groups were rotated enough so I could work with different individuals.” (M = 2.81), “The orientation session the evening before classes began has prepared me for the rigor of the summer courses.” (M = 2.93), “I have been satisfied with the quality of the audio in the classroom.” (M = 3.19), “I have been satisfied with the quality of the two-way video conferencing in the classroom.” (M = 3.19), and “The technology has not interfered with my understanding of the content of the course.” (M = 3.37). These results are shown in Table 1 below.

Rank	Item#	Statements	Mean	S.D.
1	10	I have felt isolated from the rest of the class in this course (*).	4.67	.47
2	8	The small group discussions have been helpful to my learning.	4.52	.50
2	9	I have felt comfortable discussing concepts in this course with other students during small group discussions.	4.52	.50
4	1	The small group discussions have been effective in this course.	4.44	.50
4	2	When engaged in small group discussions, I have put a lot of thought into my comments.	4.44	.50
6	11	I would have done better if I did not have to collaborate with peers during in-class work (*).	4.41	.73
7	5	I have benefited from active participation in small group discussions that take place during class.	4.37	.48
7	12	I have felt that I can rely on others in this course.	4.37	.62
9	25	I have been satisfied with the quality of the web camera the program purchased for me.	4.29	.82
10	13	The whole-class discussions in this course have facilitated my learning.	4.19	.72
11	4	I have not had a sense of belonging to a community with my peers in this course (*).	4.15	1.11
12	24	I have been satisfied with the quality of the audio headset the program purchased for me.	4.14	.64
13	23	I have been satisfied with the quality of the writing tablet the program purchased for me.	4.13	.70
14	16	The Blackboard course website has been well-organized.	4.11	.63
15	7	In the small group discussions, I have felt my time was wasted communicating with others on topics that are not directly related to my course work (*).	4.07	.90
16	15	My learning experiences to date with this course have been successful.	3.96	.79

16	22	The use of the document camera (Elmo) to communicate in this class has been working well.	3.96	.69
18	21	The use of the Smartboard to communicate in this class has been working well.	3.93	.77
19	20	I have been satisfied with the quality of the online course management system (Blackboard).	3.81	.90
20	18	Blackboard has effectively facilitated my learning in this course.	3.67	.82
20	28	I have been satisfied with the technology's role in promoting learning in this course.	3.67	.86
22	17	I have been satisfied with the quality of the online conferencing tool (Elluminate).	3.63	.67
23	6	I have felt that this course is like a family.	3.52	.88
24	27	The technology has not interfered with my understanding of the content of the course.	3.37	1.02
25	19	I have been satisfied with the quality of the two-way video conferencing in the classroom.	3.19	1.06
25	26	I have been satisfied with the quality of the audio in the classroom.	3.19	1.19
27	3	The orientation session the evening before classes began has prepared me for the rigor of the summer courses.	2.93	.77
28	14	I have felt the small groups were rotated enough so I could work with different individuals.	2.81	.86
Overall			3.95	.75

Note. Reponses ranged from 1 (Strongly Disagree) to 5 (Strongly Agree).

(*) Recoded scale items: Items #4, #7, #10, and #11.

Table 1. In-Service Teacher Technology Survey Results

Open-Ended Questions

To dig more deeply into participant perceptions of technology and professional learning communities for students in the hybrid graduate course, we asked four open-ended questions. These related to what participants liked most and least about the technology used, perceptions of professional learning communities (PLCs), and suggestions for improving future iterations of the same course.

While there were several technology components used, students specifically mentioned three classroom technologies by name, two favorably. First, 22% of students commented on the use of Blackboard, with one student capturing these views in his/her interview:

"The Blackboard interface allows students easy access to course materials, assignments, grades, and other resources. This access reduces the need for students to contact the professor

and wait for a response. I'm sure this also reduces the strain of responding on behalf of the professor."

Students also mentioned the Smartboard as helpful (15%). However, when Elluminate was mentioned, it was not in the same vein: three students mentioned they had not used Elluminate due to the inconvenience of the software, noting that challenges included "lugging" the hardware needed to use Elluminate (e.g., computer, camera, headset) to a classroom. As might be expected from other reports of e-learning, students commented that ready access to course materials and other resources was valuable while also indicating that some technology use did not seem to be worth the inconvenience or inequity it introduced into the learning process (Dede, 2006).

Although students praised some common aspects, they also shared some dislikes. Eighty-five percent of the students indicated that the unreliability of technology that linked the two universities during synchronous class meetings caused several problems. For example, some mentioned missing important information or content during class and taking class time to fix technological issues, saying it "became a major hurdle for both teaching and learning." This opinion was echoed by another participant, who said "the technology is unpredictable and seems to break/stop working at inopportune times" and by the student who also noted, "I think that the site that the teacher is at has a clear advantage of creating relationships with the professor and does not miss out on important details about the course."

Additionally, the graduate students' experiences of community building were most positive when group projects and group discussions came into play and – as has been noted in the literature – when local and distant interactions were *both* part of the professional learning community (Schlager & Fusco, 2003). Working in both small and large groups within and across campuses facilitated them to get to know each other. Moreover, students stated that being together on the same campus and having face-to-face class meetings during the first week of the course helped them build relationships:

"The week of classes face to face at one campus was a positive move! I know that there are probably difficulties with keeping folks together for the week, but it really helped to develop a better sense of overall community through both sites. Group projects across both sites would be more feasible; however, only one class of the summer sessions focused on PLC's. It is tough to arrange meetings with different groups (even if all are located on one campus)."

While students appreciated the bonding at the individual universities, they also discussed how informal interactions with their peers, such as lunch discussions and living in the dormitories during the local sessions were beneficial. The majority felt there was a sense of community, through interactions in person, online, professional learning communities, small and large group work; however, 15% of the students thought there was still a disconnect with the university that was not their home university.

The final open-ended item asked participants whether they had suggestions on how to improve the technology supported learning environment if the same course was offered again. Comments made when asked about the less successful aspects of the hybrid classes were again mentioned in the fourth open-ended question of the survey. A majority of the students mentioned resolving the online video network connection, microphone, and audio problems as a top priority. Students noted the importance of the instructor making sure the technology worked properly before class started and of ensuring support services were promptly accessible on both campuses

whenever technical issues occurred. What is more, while participants valued the technology training session, they also said it would be improved by including some kind of video-conference-etiquette session. Finally, students noted the worth of capitalizing on the immediacy of feedback to students from the instructor that is possible in a technology-rich environment:

"When courses are not face to face, it is important that there is an adequate amount of feedback from the professor. This is where timely grading and feedback on Blackboard are extremely important. For the most part, this has been good but I think it could be improved in the future."

Recommendations

According to the research findings, we provide recommendations to the grant leadership team that they consider the following modification:

Instructor:

1. Provide more activities to support student learning through Elluminate in order to build a strong sense of community for both campuses as well as foster the use of Elluminate. For example, requiring a project where students have Elluminate sessions with small groups including students from both sites or providing optional Elluminate study groups at a fixed time each evening are two possible suggestions.
2. Provide the virtual office hours once a week via Elluminate chat, discussion group on Elluminate, or telephone.
3. Set up an Elluminate session in every class so students can ask questions at the end of the class.
4. Create a "technical problem/issue board" for students who have technical problems to report those issues on the board.
5. Provide more activities to facilitate students rotating small groups during class so that they can work with different individuals across two campuses.
6. Assign the new Math TLC students randomly to groups with students from the previous cohort for mentoring purposes.
7. Provide an orientation session (instructor's expectations, a Q&A session, etc.) to students at beginning of the class so students feel prepared for the rigor of online learning.
8. Communicate with technology personnel their expectations of how the technology is to be used and the plans the instructor has to use it.

Teaching Assistant:

1. Ensure that technology (two-way video conferencing, audio, microphone, etc.) works properly before class starts so technology would not interfere with students' understanding of the content of the course.
2. Assist instructors set up an Elluminate session in every class so students can ask questions at the end of the class.

Course Designer:

1. Design course activities to promote student learning through Elluminate in order to build a strong sense of community for both campuses and to foster the use of Elluminate. For example, requiring a project where students have Elluminate sessions with small groups

including students from both sites or providing optional Elluminate study groups at a fixed time each evening are two possible suggestions.
2. Create a “technical problem/issue board” for students who have technical problems to report those issues on the board.
3. Design more activities to facilitate students rotating small groups during class so that they can work with different individuals across two campuses.

Technology Personnel:

1. Test out technology and tools used in the classroom at each site at least 30 minutes before class begins.
2. Provide training sessions not only for Elluminate, Blackboard, eCompanion, and Smartboard, but also for a video-conferencing "etiquette" training session.
3. For teaching courses via the two-way video conferencing tools, technology personnel should make sure that two images being sent to two different screens, one to show the Smartboard/computer/document camera image being discussed, and another to show the professor or the student who is speaking.
4. Pay attention and focus the camera on the person speaking and zoom in as soon as possible.
5. Ensure that technology (two-way video conferencing, audio, microphone, etc.) works properly before class starts so technology would not interfere with students’ understanding of the content of the course.

These recommendations have practical significance to help the two universities in offering guidelines and providing suggestions to other universities that are interested in offering a master’s degree program in a hybrid environment. Furthermore, it may also help instructors or other course designers to have a more systematic understanding of the pedagogical, technological, and administrative approaches to hybrid learning (Challis, 2005; Ricketts & Wilks, 2002). However, 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."

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