Enhancing the Distant Classroom Experience using NUVIEW

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Abstract

The authors set out to create a synchronous distance learning platform to facilitate interactive learning, and diminish learner remoteness in the contiguous and distant classrooms. This platform would encourage student to student interaction, and student to instructor interaction between classrooms. The researchers based their concept of the multi-site platform on the pedagogical concepts of social presence, cooperative learning, and classroom interaction. The first function of the classroom is the application of technologies to include the projection of students onto the sidewall of its classroom counterpart extending the feeling of an inclusive classroom. The second function is to broadcast everything occurring in the teacher/content area of the contiguous classroom directly to the front of the distant classroom while maintaining a one-to-one video image. This video image delivers to distant learners an inclusive presence as being located in the same room as the instructor. Audio captured from each room was simultaneously broadcast to the each room with the intention of re-creating a cohesive classroom. This case study reveals the obstacles and successes the authors encountered in development and implementation of their system in an experimental classroom conducted at a Midwest university during the spring of 2012 to determine the legitimacy of the system in fostering interactivity.
Keywords: interaction, distance learning, synchronous, social presence, cooperative learning

Introduction

Contrary to popular misconception, distance education has been around for over 160 years. The Phonographic Institute of Cincinnati, Ohio conducted the first distance education class in 1852 (Casey, 2008[1].) It was a Pitman Shorthand program, which was delivered via the United States Postal Service. During the next 160 years, distance education grew in popularity and the delivery systems went through a number of innovative iterations. In 1921, Universities in Salt Lake City, Wisconsin, and Minnesota were granted radio broadcasting licenses from the Federal Communications Commission (FCC) to deliver classes to students in remote locations (Casey, 2008[1].) In 1934 the University of Iowa delivered the first televised class to students (Casey, 2008[1].) The FCC followed this by creating a band of 20 television channels (known as the Instructional Television Fixed Service) to deliver low cost courses to the nation in 1963. New technologies have enabled the development of many new synchronous and asynchronous methods.

With the new technologies available for delivering distance education, there is relatively no limitation to the development of delivery systems that can cater to all learning and teaching styles. During the summer of 2011, the dean of the engineering college of a Midwest university approached the other authors with an idea to develop a distance-learning platform that would eliminate the students' feeling of being remote. Because of the authors' preference for an interactive learning environment they decided to develop a synchronous, audio/video delivery system that would utilize the conventional classroom set up of instructor in front, since this model is still so widely used. The authors do not contend that this type of delivery system is better than current synchronous and asynchronous distance delivery systems. The intention in creating this platform was to provide a system that would support

students and instructors who prefer live, interactive classrooms with little to no transactional distance. What ensued was the development of a system the authors call the Nebraska University Video Interactive Education Window-wall (NUVIEW.)

NUVIEW was designed with the express purpose of facilitating interaction and creating social presence amongst the students in multiple locations, and the interaction between the instructor and the students in each location, both remote and contiguous. However, it was designed to be easily adaptable to any classroom teaching style, and easily used by even the most technologically novice instructors. For the purpose of this paper, an interactive classroom is one where the professor encourages student participation and guided discovery in the teaching/learning process through continuous dialog amongst the students and the instructor. Therefore, the development of NUVIEW was contingent on the creation of a platform, which enables and encourages that interaction, regardless of locations for students and instructor. The authors decided this interaction would be best facilitated if all of the students and instructors were visible to each other at all times. And not only visible, but also life-size and positioned where visually it would appear as if everyone were in the same room together. These concepts and conditions led to the development of the student sidewall projection and the full size front wall projection of the professor (see Figure 1).

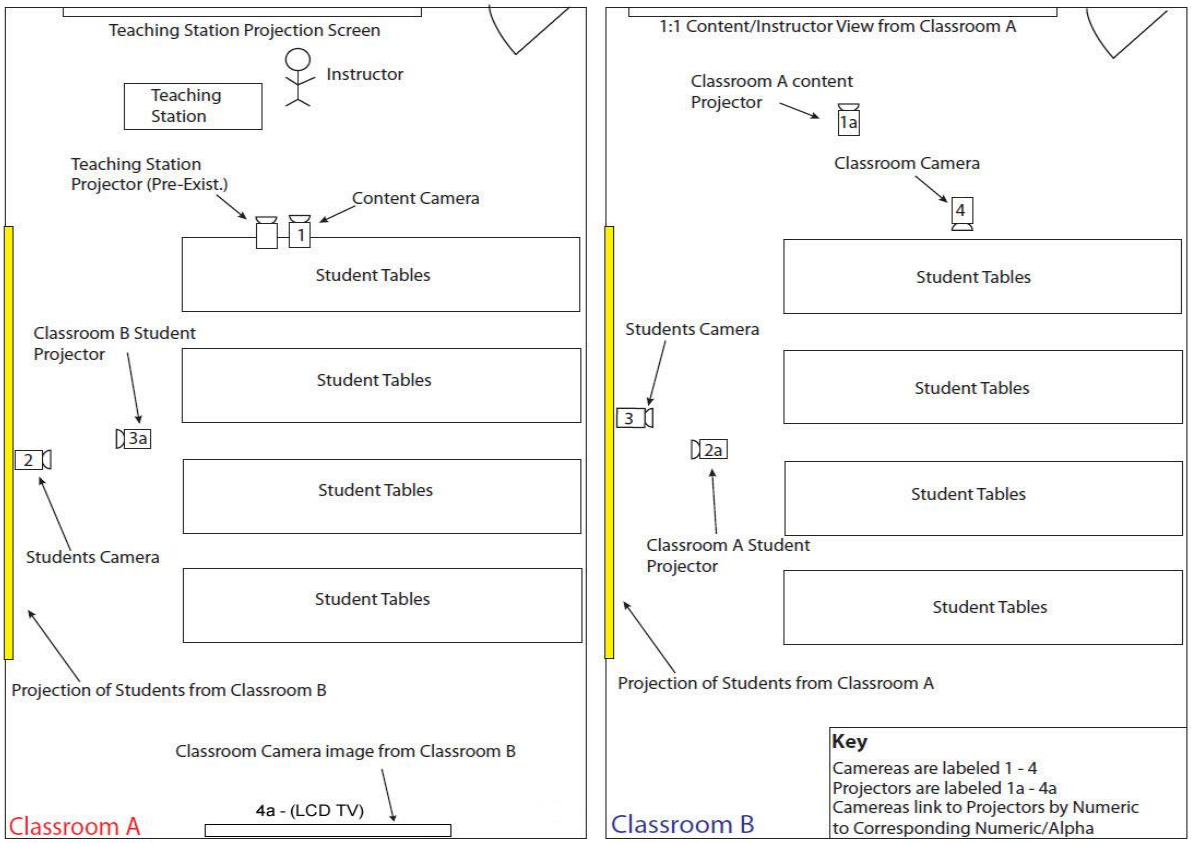

Figure 1: NUVIEW Classroom Schematic

This paper will review the development of NUVIEW from inception through initial alpha testing (phase I) and into the lessons learned and applied to the development of the beta testing (phase II.) It will discuss the process the authors went through to develop the concept, work with vendors to determine the components necessary to deliver the concept, how it was received by the students in the class where it was implemented, and what changes the authors have in mind for phase II of NUVIEW.

Development of NUVIEW

Developing something new that differs from mainstream ideology can be both exciting and frustrating. The excitement starts with the vision of the end product - the "eureka" moment that occurs when you can see the end product in your mind successfully accomplishing its intent. The excitement continues as you brainstorm the options needed to make that happen. The frustration for the authors began when they tried to figure out how to actually accomplish their end goal using existing, affordable technology and it became even more frustrating as they tried to explain their vision to vendors who were mostly interested in selling components based on the status quo of their comfort zone, instead of working outside their circle to make the author's vision possible. Part of the frustration for the authors was in not being able to clearly and adequately convey that final vision, with all of the specific caveats necessary to create the correct environment, to the vendors. Once the authors were able to find a few vendors who were able to glom onto the concepts, and were willing to help engineer the system, the difficulty became trying to find the right hardware that would accomplish the goal and still be affordable in an educational setting.

The NUVIEW project began when the dean envisioned a multi-site classroom where no student would experience the feeling of being remote. His vision was to create an environment that would be similar in feel to Cisco's TelePresence room where users feel they are in the same room as their distant counterparts. TelePresence is designed to accommodate face-to-face teleconferencing for relatively small groups of people. It does not adequately accommodate the conventionally set up classroom with groups of more than 15 students in each room who are facing forward focusing on the instructor. Working with the dean's concepts, the authors reconfigured the idea, adding a sidewall projection (see Figure 2) of the students in each classroom to create the illusion that the students from the corresponding sites would appear to be side by side within the same classroom, leaving the front of the classroom open for instruction.

Figure 2: NUVIEW Concept

To create the feeling of the instructor actually being in the distant classroom, the authors envisioned a full size projection of everything that was occurring at the front of the contiguous classroom. The goal was to capture the instructor as he moved around the front of the room, everything being written on the whiteboard, and any content that was being conveyed via the contiguous classroom projector, which would include the ELMO, the computer, or a video device. The trick was in determining the proper camera placement so that when the instructor's image was broadcast in the remote classroom he would appear to be looking directly at the student(s) to whom he was speaking, as opposed to being a floating torso speaking vacuously to a distant room (see Figure 3).

Figure 3: NUVIEW Remote Classroom Front View

The authors began testing camera placement by using a hand held video camera to simulate what they were trying to achieve. They videotaped colleagues' class presentations to determine camera placement for best projection interaction. The placement of the camera capturing the instructor was of utmost importance to the authors. They wanted to achieve a video projection in the remote classroom that would create the illusion of the professor looking directly at the students to whom they were speaking. When facilitating an interactive classroom, this personal one-to-one exchange is critical (Madden & Carli, 1981[2]; Powers & Rossman, 1985[3].) It was equally as important that the content being conveyed by the instructor be delivered to the students in a manner that would project the image and feeling of being in the classroom with the instructor and one's peers. There was a great deal of debate about the best equipment to use (monitors versus projectors, for example), where they should be located in each room, and how the images would be captured and transmitted via the Internet (how many codecs would be needed, what type of blending software to use, etc.)

Due to the constraints of time, schedules of classes at different universities, and the desire to conduct tests that would not be hampered by breakdowns in distance technologies, the decision was made to conduct the alpha test of NUVIEW by simulating a distance classroom. The simulation was accomplished by splitting one construction estimating class of students into two groups, with each group located in a separate classroom within the same building, and physically side-by-side. This allowed for direct connection of audio and video equipment between rooms reducing the possibility of losing feed between locations. Since neither class was technically distant, for the purpose of this study the room from which the

instructor taught will be referred to as the contiguous classroom and the classroom that received the instructional transmission will be referred to as the remote classroom.

Methodology

It was determined that the research for this project would be conducted to determine whether the sidewall and front wall projections facilitated interaction and social presence amongst the students and the instructor in the specific class being observed. The authors conducted what they refer to as the alpha test, as this was the initial testing of the NUVIEW system. In this alpha test, they were interested to see if the students would accept and use the sidewall projection to communicate with their peers and whether the students felt the front wall projection provided the illusion of being in the classroom with the instructor. As this was more a test of the equipment and the concept, the authors decided not to test learning outcomes to try and determine the system's effectiveness. It is anticipated that effectiveness will be tested during the beta test. Information was gathered through responses to questions sent to students throughout the semester, interviews with students at the end of the semester, journals kept by the authors, and interviews with various people who observed the classes in session.

The alpha test was conducted using a construction estimating class, which was taught by one of the authors. There were thirty-one students registered for this class, which is required for the construction management degree. The course is only offered once a year and is part of a sequence of courses, so while the students did not have to take this particular class, not taking it would throw them drastically out of sequence for graduation. To eliminate any concern that the students' level of participation in the research would affect their grades, it was decided to employ a classroom liaison to collect data from the students. One of the authors, agreed to serve in that capacity. He also agreed to serve as the classroom observer providing direct feedback to the instructor. All questions and interview protocol were approved by the university's Internal Review Board (IRB.)

When the equipment was installed, there were eight weeks of classroom instruction remaining in the semester. As part of the protocol, it had been predetermined that the students would be split into two random groups. Each group of students would spend four continuous weeks in each of the two classrooms. Prior to separating the students, the classroom observer explained the project to them, explained what his role in the research was, and most importantly explained that their participation in the research was completely voluntary and would have no effect on their grade or their relationship with the instructor. The protocol created by the authors for the IRB assured that the instructor would at no time ever know which students agreed to participate and would not see any of the data collected from the students until after the semester was over and the grades were posted.

An electronic link to the questions relating to the specific performance of the equipment on each particular day were emailed to all of the students who had agreed to participate in the research after each class by the liaison. The first question asked each time was "Which classroom were you in today?" This was followed by one or two questions that related specifically to how the equipment facilitated interaction and communication on that particular day. The authors were looking for student reactions to the equipment that could be contributed to the type of instruction (discussion, problem solving, group project work, etc.), the medium used (whiteboard, PowerPoint, Internet, etc.), and who was presenting (there were three guest presenters and the instructor conducting classes during the semester.)

After the final class of the semester, the student liaison arranged to meet with eight students who volunteered to be interviewed about their experience with and opinions of NUVIEW. Since the focus of the alpha test was to study the effectiveness of the equipment in facilitating immediacy, presence, and interaction, questions used in the interviews focused on the students' opinions of the equipment effectiveness and not on their opinions of the actual content of the course, or the impacts of the technology on instructor effectiveness.

Alpha Testing of NUVIEW

The equipment required to conduct the alpha testing of NUVIEW was installed in March of 2012. It was not installed in time for the beginning of the semester, which was acceptable to the authors, as it would give the students an opportunity to get used to the interactive teaching style of the professor before having to get used to the NUVIEW system. It was decided that the students would be randomly separated into two groups and that each group would be cycled through each of the classrooms for half of the remaining eight instructional class periods.

The lenses on the cameras used to video the students were not sufficiently wide angle to capture all of the desks in either classroom. The students in each room had to be shifted into the rows furthest from the camera to insure they could be seen on the sidewall projection. This left a space of ten feet between the projection wall and the nearest students, which may have visually and psychologically become a chasm between the two groups (see Figure 4).

Figure 4: Contiguous Classroom Sidewall Image

The lighting in each of the classrooms was not designed for the type of work the authors were attempting. With the room bright enough to capture a good image it would be too bright to

see the projection. There was also a tremendous glare on the whiteboards at the front of the classrooms rendering much of the upper part of the boards unusable. Because the cameras were mounted in vulnerable locations, it was decided to remove them after each class period. Focus and position were locked into place, but each time they were reinstalled they needed to be readjusted. Obtaining near perfect alignment and focus each time was extremely difficult and very frustrating. Therefore, visuals were often less than desired.

The authors decided to capture the ambient sound in each room to facilitate the feeling of being together, as opposed to having it whitewashed. In testing the placement and audio level of the two microphones in each classroom, the sound came across very well. Speaking in normal tones from everywhere in each room could be heard from everywhere in the corresponding room. For some reason, though, once the students were in their seats and class was progressing, students found they had to speak above their normal tones in order to be heard in the opposite classroom. There were occasions when students in the remote classroom became frustrated because they could not be heard and felt they were not being paid attention to.

Student Feedback

Students who volunteered to participate in the research were given a Pre-evaluation survey to gain an understanding of their opinions of interactive learning and their anticipation for NUVIEW, which had only been explained to them. A Likert Scale of 1 to 5 was used for all questions. The first question asked how interactive the students preferred their instructors, with 1 being all lecture and 5 being Very Engaging. No students selected 1 or 2. Eight students selected 3, 11 students selected 4, and 4 students selected 5, indicating that they preferred the instructor to be interactive. The second question asked students whether they felt NUVIEW would facilitate interaction between students in both groups. 74% of the students responded with a 3 or higher. The third question asked about the interaction between the instructor and the students. 70% of the students responded with a 3 or higher. They were then asked if they felt the sidewall projection of their peers would be a distraction or not. With 1 being Very Distracting and 5 being Really Looking Forward to Seeing It, 79% of the students rated it 3 or higher. The final question was open ended and asked the students to describe their expectations for NUVIEW. The responses ranged from expressing slight apprehension to "I'm stoked!" Overall, their responses indicated a sense of anticipation to using this new technology.

This research project was designed around the collection of data from the students regarding their opinions of NUVIEW and how it facilitated interaction amongst themselves and between them and the instructor. The intention of the instructor and the classroom observer was to introduce different teaching methods into the classroom to determine if the methods had any effect on student opinions of NUVIEW. Unfortunately, the technology did not work up to expectations and student responses to most situations related directly to the poor quality of the delivered audio and video. Prior to the first demonstration to the students, the audio and video were thoroughly tested by the installing technicians, the instructor, and the classroom observer. The first observation was that the cameras focused on the students did not have wide enough angle lenses to actually pick up more than a few students in the classroom. The video quality, while clear, was not crisp. The audio was set to the maximum volume allowable without feedback. With two people in each room, sound was tested by talking at normal speaking volumes from every part of each room and there was no issue in being able to hear. However, once the students were seated in the rooms, it became difficult

for students to hear each other from room to room, and difficult for the instructor to hear the students in the remote room without them raising their voices.

The technicians returned with wider angle lenses. This increased the number of students visible in each room, but was still not adequate. Students had to be moved over to the far side of each room leaving approximately ten feet between the nearest student and wall, which projected the image of the students from the other classroom. Even after playing with a combination of the existing lighting in the room, the image at the front of the room was not perfectly clear. The instructor went from full clarity to inky shadow depending on where he stood and whether he had the content projector on in his classroom. Providing enough light for a clear projection of the instructor created a glare on the upper part of the whiteboard making it difficult for the students to read everything that was being projected. The audio could not be raised because of the feedback, and remained an issue. Because of the shortcomings of the equipment, the answers to the questions the students were asked each day became a litany of complaints about the glare, the poor quality of the video, and the problem with hearing the students (the remote classroom had no problem hearing the instructor, though.) This clouded the intent of the questions.

At the end of the semester, eight students volunteered to be interviewed by the classroom observer. The students were asked open-ended questions relating to their feelings about NUVIEW. While the poor quality of the audio and video continued to be a major theme for all of those interviewed, there were a number of very positive responses relating to the potential of the system, along with some good suggestions for future development. Disregarding the negative comments relating to the audio and the glare in the video, most of the students felt that NUVIEW possessed great potential for distance learning and that they would recommend it to their friends who were taking a distance learning course. Many of the students expressed the opinion that after the first few minutes of class they would forget they were in the remote classroom and began to feel they were in the classroom with the instructor. One student mentioned that he tested the instructor by leaving his hat on in class knowing the instructor's dislike for hats in the classroom. He was only a bit surprised when the 2-D image of the instructor at the front of the remote room looked him in the eye and asked him to remove his cap.

Implications for Pedagogy and Practice

If the potential of NUVIEW is to enrich classroom learning and enable learner investment in the learning process, then there are significant implications for pedagogy and practice. As the technology incorporated in NUVIEW continues to improve, instructors can spend less time modifying teaching techniques needed for distance education classrooms and more time developing lessons incorporating interaction and cooperative learning activities. NUVIEW allows instructors the ability to promote the three types of interaction (Moore, 1989[4]) found in the traditional classroom setting. Because the NUVIEW classroom setting allows for open discussion and content presentations, instructors can incorporate interaction focused on learner-content using a content projection device, such as a whiteboard, ELMO, or computer enabled presentation. Instructors can also develop content taking advantage of subject matter experts using learner-instructor interaction, or learner-learner interaction, where students can be grouped together for open discussion and group project work time (Moore, 1989).

This distance education platform also has the potential to empower successful learning due to the clarity of the ‘face-to-face’ communication, subsequently leading to the development of trust between learners and the instructor. This trust is an enabler of supportive learning

groups, where learners can find a variety of positive engagement throughout their classroom time together (Smyth, 2005[5]). In addition, this classroom supplies an open platform to accommodate unique personalities and individual learning styles. This openness of the room eliminates the "pinhole" view of personal computers used in some distance educational settings, giving learners the full spectrum of interaction and communication that is occurring in multiple locations. For example, learning groups can watch as an individual approaches an instructor, witness potential non-verbal communication, then listen in as the instructor addresses the classroom, all in a real-time, immediate feedback learning environment. This relationship between student–teacher interactions and learning outcomes has been well documented in traditional classrooms (Madden & Carli, 1981[2]; Powers & Rossman, 1985[3]). Of particular importance in the face-to-face communication is the immediacy of learner feedback and the impact it has on learning. 'Immediacy' refers to the 'psychological distance between communicators' (Weiner & Mehrabian, 1968[6]). Educational researchers have found that teachers' verbal (i.e. giving praise, soliciting viewpoints, humor, self disclosure) and non-verbal (i.e. physical proximity, touch, eye contact, facial expressions, gestures) immediacy behaviors can lessen the psychological distance between themselves and their students, leading (directly or indirectly, depending on the study) to greater learning (Kelley & Gorham, 1988[7]; Gorham, 1988[8]; Christophel, 1990[9]; Rodriguez et al., 1996[10].)

The authors continued to expand the research of the video platform by introducing cooperative learning opportunities periodically throughout the testing phase. Cooperative learning has been defined as a classroom learning environment in which students work on academic tasks in small, heterogeneous groups (Parker 1985). There has been a great deal of research completed in the area of cooperative learning, and there can be little doubt about these techniques' effectiveness in improving academic achievement (Brophy 1987[11], Parker 1985[12], Slavin 1984[13]). In one exercise, learners were split into groups within each class setting. Learners in the contiguous classroom were grouped together, with learners in the distant classroom grouped together. These groups worked independently in each room. Toward the end of the activity, both groups came together as a unified classroom to report their findings. This exercise worked very well using both the front and side walls of NUVIEW.

Grouping students across the physical distance, proved to be problematic, as groups were unable to get close enough due to the limited capture angle of the video camera. In addition, the increased volume level required to project audio from one room to the other, created an environment where cooperative learning quickly failed. In an effort to solve the counter-effect of open cooperative learning across the distant education medium, the students incorporated individual learning devices where they could work cooperatively, sharing content in a real time, collaborative, online environment. Learners use of Apple's Facetime application, or a synchronous chat client, such as Google Talk, allowed group members the ability to communicate with each other across the physical distance. Once communication was established, learner groups used Google's Document sharing client to work collaboratively online extending the cooperative learning and student to student interaction into a mixed media learning environment using NUVIEW and the secondary communication platforms.

Creating opportunities of interactive learning (Moore, 1989[4]) and infusing a cooperative learning environment (Parker, 1985[12]) were unified to give learners a greater sense of community in the classroom. John Dewey (1959[16]) felt that community was at the core of educational philosophy and practice leading him to believe that learning results from experience that is contextually based and socially situated. Lipman (1991[14]) argued that "the

reflective model is thoroughly social and communal" (p. 19). As a result, social presence felt in the classroom can have a direct impact on student learning. According to Swan (2005[15])

> In traditional, face-to-face classrooms, educational researchers found that certain teacher immediacy behaviors, such as making eye-contact, smiling, approaching, and touching students (nonverbal immediacy), and calling students by name and using humor and self-disclosure (verbal immediacy), could lessen the psychological distance between teachers and their students, leading to greater learning.(p.20)

While touching and teacher proximity are not possible in the distance classroom, NUVIEW recreates the feel of a unified traditional classroom, across a geographical distance, using traditional classroom methodologies and pedagogical characteristics such as instant feedback between all individuals regardless of location, non-verbal communication through the use of body language and direct eye contact, and real time interactivity. Together these characteristics promoted a sense of immediacy and social presence in the distance classroom.

Swan's research implies that with social presence, learner satisfaction increases, while demonstrating the need for an instructor to be seen, and heard. Shea and Bidjermo (2008), support these findings after learning that the development of social presence was contingent on the establishment of teaching presence. In other words, social presence alone does not affect a learner's cognitive presence, but instead served as a middle ground between the presence of the instructor and the cognitive presence. As a result, Shea and Bidjermo[17] concluded that the "teaching and social presence represent the processes needed to create paths to epistemic engagement and cognitive presence for online learners." (p. 14) While this video platform does not limit learning in an online environment, Shale (1990[18]) comments:

> In sum, distance education ought to be regarded as education at a distance. All of what constitutes the process of education when teacher and student are able to meet face-to-face also constitutes the process of education when teacher and student are physically separated. (p. 334)

Future Research

This study faced some limitations. First, the quality of the projected images, which include both sidewall projections and the teacher/content project, ended up not being high definition images. This limited the eye contact of the instructor, and at times caused difficulties with viewing content in the distant classroom. The next research phase will use high definition video cameras and projectors with images on surfaces no lower then 720p. In addition to ending up with standard video, each classroom contained only two microphones and two speakers used for audio transmission from the other room. Coupled with their improper placement, learners oftentimes encountered situations where they were unable to hear what was being said by the students in the other classroom, although the instructor's voice was clear at all times. This occurred in both classrooms and was made worse the further back to the room the students sat. For phase II, the authors are requesting better quality speakers and microphones with a minimum of four in each classroom.

Second, the size of the room in relation to the type of cameras used created issues related to the video capture of students in each room. Since replacement lenses were not readily available, learners were moved to the far half of the classroom to ensure no learner was left out of view. Even with replacement lenses, the full capture of the classroom proved difficult resulting in only one half of the classroom being used. The authors are working with new vendors to find better cameras with wider angle lenses or to provide more cameras whose images can be blended through the use of software and hardware. Together they are also exploring different types of no-glare whiteboard materials, short throw projectors, and Smart

Boards. Alternatively, they are looking at using a bank of monitors. Each of these technologies will vastly improve the video quality providing the students and the instructor a near life like image that will enhance the interaction and presence.

Third, no formal back-up solution was prepared for the cooperative learning groups. Once it was determined the interaction within groups separated by distance was not acceptably successful using only the NUVIEW platform, students were compelled to come up with viable solutions using the technology they had on hand, including cell phones, laptops, and iPads. Since encountering this obstacle, new methods for cooperative interaction have been discussed, and solutions will be presented to learners and tested during phase II. It has often been said that the development of engineering occurred through failed projects. The authors see the successes of phase II occurring as a direct result of the obstacles faced during phase I and are looking forward to testing new solutions.

Fourth, the number of participants was limited to the class size of 31. Groups were not created based on learning styles, intelligence, or skill. They were completely random. Future studies will involve a greater number of participants and group selection will be based on heterogeneous learning styles and other factors. Phase I intentionally ignored the effectiveness of NUVIEW. The authors anticipate setting up protocols in Phase II that will provide data that will show whether NUVIEW is effective in delivering learning outcomes to the students.

Future research will incorporate actual, long ranged distances between the contiguous and distant classrooms. For this research study, the classrooms were located next to each other and therefore the audio and video signals between classrooms did not need to be packaged for transmission using Internet Protocol. With the introduction of a true extended physical distance, future research will face potential obstacles related to the packaging of large data signals over the Internet creating the potential for lost transmission packets, resulting in pixilation and noticeable delays in communication. These issues will have to be dealt with. Phase II will incorporate the delivery of at least one course between two separate campuses in the fall of 2012. Discussions are already ongoing with a university in another state to exchange courses in the spring of 2013.

Improvements with speaker and microphone quality, along with proper quantities and placement of each, should result in improved classroom audio. New cameras, camera types, camera placement, and video picture blending are currently being researched in an effort to select a solution that works best for classroom size, number of learners, and image quality. With improved technology, the authors will be able to properly research the students' opinions of how NUVIEW facilitates interaction, social presence and cooperative learning.

The ❸ findings from this study suggest the presence of verbal immediacy behaviors that may support interaction and behavior modification among course participants. In this type of hybrid learning environment, support for students' interactions with content, instructors, and, each other, deserves the attention of instructional designers, distance educators, and further investigation by the educational research community. The authors welcome the research and opinions of others.

Conclusions

This project has been a tremendous growing and learning experience for all of the

authors. They have learned important lessons regarding the contracting of vendors to engineer and install the equipment. Not being familiar with all of the different technologies available, the authors determined it would be more advantageous to issue a performance specification to the vendors allowing them creative latitude to engineer a solution. Some of the vendors refused to submit a bid because they did not want to take the time to engineer a solution or did not understand the intent of the system well enough to do so. Other vendors provided submittals that did not meet the performance the authors expected for the room. Of those submittals which did meet the performance specified for the rooms, the bids ranged from $30,000 to $125,000. It was difficult not to accept the lowest bid, and that proved to be a major mistake as the equipment did not perform as expected.

Moving into phase II the authors now have a much better understanding of their equipment needs. They were also able to invite new vendors in for demonstrations of the existing NUVIEW platform. Seeing the demonstrations made it much simpler for the vendors to understand the outcomes the authors were looking for and to suggest a well engineered system. The authors still prefer issuing a performance specification to the vendors to allow for some creativity in engineered solutions.

After observing students and instructors in the current iteration of NUVIEW, the authors also have a better understanding of how the students and the instructors interact with each other using the technology. With this fundamental understanding of participant interactions, the authors now feel comfortable in designing teaching/learning methodologies that will take better advantage of the NUVIEW technology. They are also looking forward to experimenting with other digital devices (i.e., iPads) that could be used by the students and the instructor to enhance the learning experience.

While the data from the students is strictly anecdotal it is clear that the students felt the instructor projection in the remote classroom was almost as close as being in the contiguous classroom. During the interviews, the students commonly stated that after a minute or so of being in the remote classroom they began believing they were in the same room as the instructor. Since creating a classroom community was a major goal of NUVIEW from the outset, the authors feel phase I was a success and look forward to moving into phase II of the research.

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Biographical Information

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