Model to Develop a Synchronous, Inter-Institutional Course Using Distance Technologies

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Abstract

Developing and teaching a course using distance technologies can be a daunting task. It requires advance planning and the development of new technical skills. It brings the users to the edge of feasibility and creates as many new opportunities as obstacles to overcome. Faculty at Kansas State University and the University of Nebraska-Lincoln teamed to develop and deliver a synchronous, upper-level plant nutrition course using two-way compressed video during the Spring 1999 semester and high-speed videostreaming during the Spring 2001 semester. During this process, we recorded our experiences and from these have developed a 10-step model for the development of a synchronous, inter-institutional course that we hope will be of value to others who accept this challenge. The essence of this model is presented in this manuscript, and details are available from the web site http://www.oznet.ksu.edu/dp_hfrr/PlantNutrition/index2.htm. Also presented are some of the main concerns, myths, and advantages surrounding synchronous distance education. Student reactions to the course and the technologies used to deliver it, as identified through their evaluations of the course, are also discussed.

Introduction

Distance technologies, such as two-way compressed video and high-speed videostreaming, now allow universities to share in the development and delivery of synchronous courses; i.e., two-way audio and video are used at multiple sites which allows live-time lecture-discussion periods to be shared across institutions. An experimental course in Plant Nutrition and Nutrient Management was developed and delivered using distance technologies by faculty at Kansas State University (KSU) and the University of Nebraska-Lincoln (UNL) for several reasons: First, why should each of us independently spend time to create the same course? Second, our interests and strengths were complimentary, and each of us was more comfortable teaching certain subject areas than others. Third, both of our institutions were already part of a network that advertised their ability to accomplish this kind of interaction.

The more we investigated the available distance technologies, the more we recognized some of the potential benefits. Guest experts could be included outside of the scheduled class periodhypothetically, there were no geographical limits to the availability of the expert, and thus students would have opportunities to interact with more faculty and be exposed to a wider range of viewpoints. In addition, alternative teaching techniques such as threaded message boards and chat rooms could be tested. Plus, our course would be positioned to provide excellent coverage of the wide range of topics that fall within the subject of "plant nutrition" more so than any of the instructors could accomplish on their own. We were initially concerned, like many faculty unfamiliar with the use of distance technologies, about whether the technology would diminish the quality of interaction in the educational process (Clark, 1993). However, research showed that there is no significant difference in learning outcomes between traditional and live televised instruction (Cyrs, 1997). We were convinced that we had the ingredients necessary for creating a course of the highest educational quality.

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Use of distance technologies and inter-institutional collaboration seems to be a wave of the future. An example of another course that has been developed to connect experts through videoconference partnerships is Phytochemicals in Fruits and Vegetables to Improve Human Health (http://phytochemicals.tamu.edu). The objectives of this paper are to present a model for development of a synchronous, inter-institutional course as a simple "how to" guide to assist other faculty in determining whether such distance courses could be adopted for use in their curriculum. Secondly, student evaluations from the Plant Nutrition and Nutrient Management course are presented and analyzed as an example of the application of the course development model.

Methods

The course Plant Nutrition and Nutrient Management was developed for upper-level undergraduate and graduate students. Three instructors collaborated on its development and delivery, two with horticultural (the authors) and one with agronomic (Jerry Maranville, UNL) plant nutrition backgrounds. Thirteen students enrolled during the Spring 1999 semester. During this semester, two-way compressed video over CODEC lines allowed the course to be delivered between KSU's Educational Communications Center and UNL's Communications and Information Technology Center. During the Spring 2001 semester, seven students were enrolled and high-speed videostreaming (Internet 2) was used to simultaneously deliver video and audio to the two participating sites. Students earned three credit hours from their home institution for the course.

In addition to the required course/teacher evaluations for KSU (TEVAL) and UNL (CIEQ), students were given a pre- and post-course technology survey that was designed to determine their comfort level with the various technologies used in the course, as well as an overall course evaluation. By the final evaluation, students had thorough and multiple opportunities to express their opinions.

The Model for Course Development

During the creation of this course, we identified 10 steps that helped us see and report our progress. Once you begin a step, part of it may continue running, like an escalator, as you progress through other steps. Details, rationale, and examples from our course for each step are listed in the web site. Below are a few additional comments. In the results and discussion section, we consider specifically how technology can be used to strengthen a course by presenting results of the course and technology evaluations.

The following section of the manuscript should be read along with the web site version, which contains much more detail. At this point, we recommend that you open the course model from the web site http://www.oznet.ksu.edu/dp_hfrr/PlantNutrition/index2.htm (click "Flow Chart Model for Course Development" in the sidebar menu) and follow along through the Steps identified below.

Step 1: Identify a Need. Good reasons must exist before adopting the use of distance education. Technology provides tools to enhance teaching efforts, but these tools are not best for all instructional situations. From the faculty view, the primary reason to carefully "identify a need" before diving into distance education is that the first course effort will take at least 300% time on the part of the instructors (Cyrs, 1997) and the learning curve is steep!

Step 2: Identify Collaborators. This step can be tougher than it sounds. Certainly, the expertise of the collaborators should be complimentary. But also, everyone involved needs to be enthusiastic about the undertaking. They must be willing to do their share of the work in a timely manner. An overall leader is essential, but in addition, a collaborator should be identified to take the lead at each institution and for various course activities (e.g. web site development, grade compilation, etc.) so that the workload is spread over the faculty team.

Step 3: Inventory Available Distance Technologies at Collaborating Institutions. You may find that each collaborating institution has invested in different technologies and has a different administrative structure to support it. Are the technologies between institutions compatible? This step will determine how much "technological cooperation" is even possible. Deal with the technology and production costs up front. These issues of cost(s) and administrative support can either stop the process or spur it successfully forward.

Step 4: Create the Class on Paper. There are two key differences between creating a "traditional" course and a "synchronous, inter-institutional" course. First, the latter involves several instructors with different ideas at different locations, so effective and timely communication is essential. Use email, conference calls, and chat rooms to discuss the topic at hand. Make sure that all issues are thoroughly discussed and that each team member feels free to voice concerns and offer input. Second, the tools that technology offers require additional

thought and planning to incorporate them into the course structure. For example, chat room discussions led by experts may be integrated into the course, but how will they be graded? How should they be structured so as to enhance the learning process and not burden it?

Step 5: University Must-Do's. There are quick ways to get courses on the books, but keep in mind that this step can also be an effective continuation of defining the nuts-and-bolts of the course and can serve as an advertisement to colleagues and potential students.

Step 6: Advertise the Class. There is nothing more rewarding than teaching to a full room of students, especially considering the costs of the technology and investment of faculty and staff time to offer the course.

Step 7: Distance Class Technology Requirement. Other teaching tools/techniques, such as web site development and electronic discussion forums (e.g. chat rooms and threaded message boards), require that you organize more than just the actual lecture-discussion periods that you lead. Do not fall into the trap of trying to do too many things the first time through.

Step 8: Get Distance Training. Teaching at a distance is different from traditional classroom teaching (Cyrs, 1997). It requires some additional skills to supplement traditional teaching, from the simple (looking good on interactive television) to the complex (involving students at remote sites and managing their learning activities). It is important to attend a workshop or to read up on "tricks" to make your distance teaching more effective. Seeing yourself on videotape is especially enlightening.

Step 9: Teach and Go! This is the fun part. Hopefully you will find, as we have, that teaching with other colleagues is synergistic and energizing. In addition, the opportunity to work with a more diverse group of students is very rewarding.

Step 10: Rewarding the Participants. We believe that one of the greatest impediments to distance education is recognizing the initial and continuing effort involved in the process. The learning curve for undertaking the development and delivery of a synchronous, inter-institutional course can be very steep and time consuming. Past research suggests that faculty motivation to teach at a distance results from intrinsic rather than extrinsic incentives (Dillon and Walsh, 1992). However, the mere "love of teaching" does not usually justify the energy required to sustain the effort long-term. Administrators should identify a rewards system that can be quantified for faculty who tackle such a project.

Results and Discussion

Comparing the overall course evaluations from the Spring 1999 and Spring 2001 courses suggested that student perception of the course improved during the second offering. For example, about half of the students agreed that the lecture topics were interesting and meshed together well despite delivery by multiple instructors during Spring 1999, while all students felt this way during the second offering in Spring 2001 (Table 1). This outcome may have been because the students were more motivated during Spring 2001; the Internet 2 technology allowed the class to flow more smoothly; and/or the instructors were more comfortable with the technology and the material during the second course offering. Students did not object to having multiple instructors if the material was structured cohesively (Table 1).

Table 1. Overall evaluation of *Plant Nutrition and Nutrient Management* by students for Spring 1999 (n=13) and Spring 2001 (n=7).

	Spring 1999			Spring 2001		
	Mean[z]	SD	%3 or 4[y]	Mean[z]	SD	%3 or 4[y]
The lecture topics were interesting to me.	2.5	0.52	53.8	3.4	0.49	100
The lecture topics merged together well.	2.6	0.65	53.8	3.1	0.35	100
It was difficult to become comfortable with the lectures because there were multiple instructors.[x]	2.2	0.60	30.8	2.1	0.35	14.3
The discussion/question/answer periods after the lectures should be expanded.[x]	2.5	0.52	46.2	2.4	0.49	42.9
The textbook was a valuable resource.	1.8	0.87	25.0	2.4	0.73	57.1
Overall, I learned a great deal in this course.	2.7	0.63	61.5	3.6	0.49	100
Overall, this was an excellent course.	2.8	0.51	38.5	3.4	0.49	100
I would recommend this course to others.	2.2	0.73	38.5	3.3	0.45	100
I had a great interest in taking this course before I enrolled.	3.0	0.60	83.3	3.1	0.35	100
My interest in the course subject has increased as a result of taking this course.	2.5	0.88	61.5	3.1	0.35	100
I would like to take another course that uses video-conferencing technology.	2.2	0.83	30.8	2.9	0.64	71.4

[z]Scale: 1=Strongly Disagree; 2=Disagree; 3=Agree; 4=Strongly Agree

[y] "%3 or 4" refers to the proportion of responses that were "3=Agree" and "4=Strongly Agree" out of the total number of responses

[x]A low mean and a low "%3 or 4" is preferable

Chat rooms were used to allow students to interact with several plant nutrition experts. During Spring 1999, a total of 10 chat sessions were led by various experts in the field (Paparozzi and Williams, 2000). Students were asked to complete a reading

assignment in preparation for each one-hour session, but grading was based solely on participation in the chat. Based on student evaluation, about half of the students felt that the chat rooms were a waste of their time (Table 2), and instructors felt that student preparation and depth of interaction with the expert was generally inadequate. In an effort to improve the breadth and depth of student interaction with the experts and quality of the learning experience associated with the chat rooms, their format was changed during Spring 2001. The number of chat rooms was reduced to three, and each session required a pre-chat assignment, such as posting a question for the expert to an electronic discussion board; the one-hour live-time chat with the expert; and a post-chat assignment, such as taking an electronic quiz or responding via the discussion board to a question generated from the chat. Seventy-one percent of Spring 2001 students said that chat rooms should be continued when the course is taught again; however, the class was split on their value: about half agreed and half disagreed with the statement that the chat rooms were a waste of their time (Table 2). This was not a substantial improvement in student evaluation of the chat room experience compared to Spring 1999.

Table 2. Chat Room and Case Study evaluation by students in *Plant Nutrition and Nutrient Management* for Spring 1999 (n=13) and Spring 2001 (n=7).

	Spring 1999			Spring 2001		
	Mean[z]	SD	%3 or 4[y]	Mean[z]	SD	%3 or 4[y]
The chat rooms were a waste of my time.[x]	2.9	0.95	53.8	2.4	1.18	42.9
The training given at the first chat session was necessary/useful.	2.7	0.75	84.6	2.6	0.73	71.4
I prepared thoroughly for the chat sessions by reading the pre-chat readings assigned by the chat leader.	2.1	0.95	46.2	3.0	0.53	85.7
The case study(ies) was(were) too extensive.[x]	2.4	0.87	30.8	2.3	0.70	14.3
It was valuable to complete case studies outside of my area of study.	NA[w]	NA	NA	2.9	0.35	85.7
The case study(ies) was(were)a good learning experience.	3.1	0.76	92.3	3.4	0.49	100

[z]Scale: 1=Strongly Disagree; 2=Disagree; 3=Agree; 4=Strongly Agree

[y]"%3 or 4" refers to the proportion of responses that were "3=Agree" and "4=Strongly Agree" out of the total number of responses

[x]A low mean and a low "%3 or 4" is preferable

[w]Not asked

The case study component of the course met with very favorable evaluation in both years. In Spring 1999, a unique case study related to a plant nutrition problem in an area of interest to the assigned team of two or three students was conducted as a semester-long project. Ninety percent of these students agreed that the case study was a good learning experience (Table 2), so additional case studies were designed for the Spring 2001 course, which can be accessed from the same web site as the Course Model by clicking "Case Studies" in the sidebar menu. In Spring 2001, students individually solved four "all-class" case studies, two each representing agronomic and horticultural crops. In addition, a unique case study was assigned to a team of two or three students to solve and present to the class at the end of the semester (which gave each student the opportunity to experience the process of being televised). One-hundred percent of Spring 2001 students agreed that the case studies were a good learning experience; 85% thought that it was valuable to complete case studies outside of their specific area of interest; and only 14% agreed that the case studies were too extensive (Table 2). Our ability to use case studies as a very effective teaching tool was not limited or inhibited by the inter-institutional, multi-disciplinary nature of the course.

While most students felt they learned a lot in the course (Table 1), when asked if they would like to take another courses that uses video-conferencing technology, the mean response on a scale of one (strongly disagree) to four (strongly agree) was 2.2 in Spring 1999 and 2.9 in Spring 2001 (Table 1). This was an interesting response because the technology survey alone would not have necessarily suggested it (Table 3). By the end of the course in both years, students expressed that they were, in general, "somewhat comfortable" with course

Table 3. Evaluation of Student Comfort Level with Technology from Pre- and Post-Course Survey (Spring 1999; n=13) and Post-Course Survey (Spring 2001; n=7) of students in *Plant Nutrition and Nutrient Management*.

	Spring 1999							Spring 2001		
	Pre-Course Survey			Post-Course Survey			Difference			
	Mean[z]	SD	%4 or 5[y]	Mean[z]	SD	%4 or 5[y]	in Means	Mean[z]	SD	%4 or 5[y]
Using a computer.	4.6	0.77	84.6	4.4	1.12	81.6	-0.2	NA[x]	NA	NA
Posting and reading messages on a discussion board.	NA	NA	NA	NA	NA	NA	NA	4.2	0.90	57.1
Interacting with others in a chat room discussion.	2.8	1.40	27.3	4.0	0.82	69.2	+1.2	3.8	1.46	57.1
Obtaining course information on the Internet/World Wide Web.	4.2	1.24	76.9	4.3	1.11	92.3	+0.1	4.8	0.37	85.7
Participating in video conferences.	2.4	1.21	9.1	3.5	0.88	38.5	+1.1	4.0	0.82	57.1
Appearing in front of a television/video camera.	2.6	1.56	33.3	3.5	1.33	46.2	+0.9	4.2	0.69	71.4
Talking on a speaker phone.	2.8	1.66	33.3	3.2	1.17	38.5	+0.4	4.0	1.00	42.9

[z]Scale: 1=Not at all comfortable; 2=Somewhat Uncomfortable; 3=In-between; 4=Somewhat Comfortable: 5=Very Comfortable

[y]"%4 or 5" refers to the proportion of responses that were "4=Somewhat Comfortable" and "5=Very Comfortable" out of the total number of responses

[x]Not asked

technologies ranging from participating in video-conferences to appearing in front of a television/video camera (Table 3).

Experiences in the course did seem to increase students' comfort level with the technologies of interacting in a chat room discussion, participating in video-conferences, and appearing in front of a camera. Means of student responses increased positively by about one unit when comparing their pre-course responses to their post-course responses in Spring 1999 (Table 3). The first chat room session was an orientation about how to use the software and rules of chat etiquette; 85 and 71% of the students felt that it was necessary or useful in 1999 and 2001, respectively (Table 2). Exposure to these various technologies is a valuable part of the learning experience that this type of course offers. The futures of the students that we are training today will likely include routine use of distance technologies.

Students had no trouble using the technology and perceived that the faculty were also comfortable with it (Table 4). The faculty's comfort was largely due to the training received in a distance education workshop in which we participated. Many of the distance teaching strategies listed in Miller and Powell (1998) were used during our class very successfully.

Table 4. Evaluation of Student Use of Technology in *Plant Nutrition and Nutrient Management* for Spring 1999 (n=13) and Spring 2001 (n=7).

	Spring 1999			Spring 2001		
	Mean[z]	SD	%3 or 4[y]	Mean[z]	SD	%3 or 4[y]
I had difficulty seeing the lectures clearly.[x]	2.3	0.95	30.8	1.6	0.49	0.0
I had difficulty hearing the lectures clearly.[x]	2.0	0.58	15.4	2.0	0.76	28.6
The chat-room was easy to use.	3.0	0.41	92.3	3.0	0.76	71.4
I had trouble getting into the password-protected Web site.[x]	1.8	0.73	15.4	2.0	0.76	28.6
It was easy to navigate through the public Web site.	3.0	0.58	84.6	3.0	0.76	71.4
The technology in this course did not work the way it was supposed to.[x]	2.4	0.65	46.2	2.0	0.53	14.3
I missed important information because the technology didn't work correctly.[x]	2.2	0.60	30.8	1.9	0.63	14.3
The instructors were comfortable using the technology.	3.1	0.51	91.7	3.2	0.69	71.4

[z]Scale: 1=Strongly Disagree; 2=Disagree; 3=Agree; 4=Strongly Agree

[y] "%3 or 4" refers to the proportion of responses that were "3=Agree" and "4=Strongly Agree" out of the total number of responses

[x]A low mean and a low "%3 or 4" is preferable

When asked to compare the traditional classroom to the distance classroom, the majority of students felt that the interaction with the instructors was equal to or greater in the distance class than in a traditional classroom setting during both years (Table 5). Clark (1993) reported that one of the main criticisms of using distance technologies is that it diminishes the quality of interaction in the educational process. This was not our experience nor that of our students.

The evaluation also revealed that students during Spring 1999 were somewhat inhibited by the distance classroom when it came to asking questions, being motivated to learn, and in their ability to concentrate on what was going on. The use of television monitors and speaker phones were novel and students had to learn how to use them. Kennedy and Agnew (1998), while teaching a poultry science distance course to on-campus and off-campus students, found that 26% of their on-campus students were distracted by the camera and felt that the interactive video restricted their learning. However, during Spring 2001, student perceptions of the distance classroom as providing a different environment compared to the traditional classroom were not as readily apparent (Table 5).

Table 5. Evaluation to compare *Plant Nutrition and Nutrient Management* to a traditional classroom for Spring 1999 (n=13) and Spring 2001 (n=7).

Compared to traditional classroom courses, how likely were you in the *Plant Nutrition* course to:[z]	Spring 1999			Spring 2001		
	%1 or 2[y]	%3[x]	%4 or 5[w]	%1 or 2[y]	%3[x]	%4 or 5[w]
ask for clarification when you didn't understand something.	46.2	53.8	0.0	14.3	71.4	14.3
apply what you were learning to "real world" problems.	38.8	53.8	7.7	0.0	57.1	42.9
discuss the ideas and concepts taught in this course with other students.	30.8	38.5	30.8	28.6	14.3	57.1
enjoy studying for the course.	38.5	53.8	7.7	0.0	57.1	42.9
interact with the instructor(s).	23.1	53.8	23.1	0.0	42.9	57.1
interact with the students.	7.7	53.8	38.5	42.9	28.6	28.6
feel motivated to learn.	46.2	46.2	7.7	0.0	71.4	28.6
concentrate on what was going on.	46.2	46.2	7.7	0.0	42.9	57.1

[z]Scale: 1=Much Less Likely; 2=Somewhat Less Likely; 3=About the Same; 4=Somewhat More Likely; 5=Much More Likely

[y] "%1 or 2" refers to the proportion of responses that were "1=Much Less Likely" and "2=Somewhat Less Likely" out of the total number of responses

[x] "%3" refers to the proportion of responses that were "3=About the Same" out of the total number of responses

[w] "%4 or 5" refers to the proportion of responses that were "4=Somewhat More Likely" and "5=Much More Likely" out of the total number of responses

So what is scaring faculty away from using distance technology? McNeil (1990) suggests that attitudinal issues, or how faculty perceive and react to the use of technologies in distance education, is much more important than technical obstacles in influencing their use. Faculty who teach using distance technologies have been found to have a positive

attitude toward distance education, and their attitudes tend to improve with experience (Dillon and Walsh, 1992). Nevertheless, extrinsic incentives can make the adoption of distance technologies by faculty more logistically feasible, and thus probable. New course development always takes time, and distance course development is even more time-intensive.

According to Diebel et al. (1998), costs for a satellite course with two-way audio were comparable to an on-campus class. However, a comparison of costs of distance versus conventional courses is a complicated undertaking (Keegan, 1996). Technology costs associated with offering the Plant Nutrition and Nutrient Management course were substantial, and both a grant and the administrative support of two institutions were necessary to make our experimental course a reality. However, one could argue that splitting the teaching between multiple universities should actually save money because, though a substantial investment in technology is required, faculty can be shared across institutions, and hiring a new assistant professor on a 12-month appointment now represents a long-term, multi-million dollar investment for an institution. Inter-institutional courses increase a university's catalog of course offerings and each participating institution collects their own tuition. A problem that must be overcome is that no tuition is recovered for return to the production unit, the faculty member, or their department. Therefore, the question of who will pay for the production costs is on-going. Figuring out the financing is only one of the barriers to distance education that requires the effort and support of upper-division administrators (Moore, 1994).

Summary

Driven by technological advancement, distance education has the potential to revolutionize higher education. Plant Nutrition and Nutrient Management will continue to be offered as a shared course using videoconferencing technologies. Our model to develop a synchronous, inter-institutional course using distance technologies shows that such an undertaking is not only feasible, but offers unique advantages as well as challenges for students, faculty, and administrators.

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