

An Experiment in Pseudo-Asynchronous Course Delivery

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Abstract

This paper describes an experiment in delivering a graduate level course in a pseudo-asynchronous manner using modern digital communication technology. The purpose of this effort was two-fold. One was to reduce the logistics and increase flexibility in an existing distance educational delivery system for engineering graduate courses. The second goal was to improve the efficiency and academic effectiveness of graduate course offerings for both on-campus and off-campus students. The mechanism employed was to place all knowledge content normally presented by live lectures on a CD ROM. This CD included graphics, text, and mathematical content with accompanying audio presentations in a book format. With the classical lectures delivered by the CD the class meeting schedule was reduced from three to one weekly meeting. Assessment of the acceptance and value of this form of delivery and the resulting educational experience was performed by administering pre and post-survey instruments to all the participants. The results of the evaluation were positive but not dramatically conclusive in the opinion of the students. However, the performance of the class was significantly better than experienced with previous classes that took the course in the standard offering delivery format.

Background

The College of Engineering at North Carolina State University implemented a program in the late 1970's to deliver graduate level credit courses to non-resident students to pursue Masters degrees in Engineering. Courses were initially delivered live by faculty who traveled to a select number of state sites where the students met for classes. Regular university credit was provided for these offerings to fulfill graduate degree requirements. As the demand for university accredited off-campus educational course offerings rapidly grew across the state this method of delivery became cumbersome and unworkable.

A more convenient delivery method was needed that would satisfy academic requirements for university credit. Video taping of on-campus courses was turned to as the answer. This has grown into the VBEE (Video Based Engineering Education) program in the College of Engineering that now serves some 400 students each semester across the state and through the National Technological University. Video tapes of regular graduate courses taught

to students enrolled on-campus are sent weekly to non-resident students enrolled in a general engineering masters program. Off-campus students complete all the work assigned to the on-campus students and take the same examinations under proctored conditions. Interaction between faculty and off-campus students is handled by email, fax and phone. Completion of all course requirements results in full course credit for the course applicable to a graduate degree in engineering.

The program has worked well, been enthusiastically received by the off-campus students and produces significant number of graduates each year. However, the logistics of the program are staggering. The cost and manpower required to video tape three classes a week, mail tapes to some 400 students in as many as 20 different courses and having the tapes returned at the end of each semester is not insignificant. To overcome these problems several experiments are being conducted that will simplify the delivery logistics while at the same time improve the academic effectiveness of the program. The experience and results of one such experiment that employs a pseudo-asynchronous delivery method is reported here. This technique presents all course lecture materials including graphics and audio in a formalized format for delivery on CD ROM. The course structure and delivery on-campus was also reorganized to take advantage of this change in knowledge content presentation method.

Typical Course Offerings

A typical graduate course offering in engineering consists of the instructor meeting with the students three times a week for 50 minute class periods over the term of a semester. These meetings generally consist of the instructor lecturing to the students from previously prepared notes, providing examples of the application of the theory being presented, assigning exercises for the students to practice on out of class and dealing with questions that may arise. The student on the other hand is feverously trying to understand what is being presented while reproducing notes that can be referred to at a later time. The instructor may provide copies of transparencies or other material used in conjunction with the lecture. This reduces but does not necessarily eliminate note taking. Generally there is no way for the live presentation of the class to be repeated for the students who misses a presentation or becomes confused or lost in the normal progress of the class. There is no way in this live format for a student to rehear or review what is said in the classroom short of the course being taped.

This aspect of the graduate education process is neither very efficient nor does it make for a very effective learning environment. However, it is generally accepted that when this lecture course format is supplemented with one-on-one personal research project interaction with a faculty advisor the total graduate educational experience appears to work quite well and produces acceptable results. But just because it works quite well is no reason why the process shouldn't be informed to be even better.

The VBEE program addresses one of the shortcomings of this typical course delivery process by taping the in class lectures. This does permit both on and off campus students to go back and listen to some portion of the presentation they would like to hear again. This feature is by Off-campus students frequently cited as the value of this feature. However, all classes aren't taped and the live lecture captured on video includes all the flaws of a normal class room presentation. The experiment described and reported on here was directed to change this part of the course offering.

CD ROM Preparation

The graduate offering selected for this experiment was a course that deals with the principles and methodology used in mechanical product design to insure ease of assembly in the manufacturing process. This course was selected for the experiment since it is a requirement in the on campus Master of Integrated Manufacturing Systems Engineering program and is of popular general interest among practicing engineers enrolled in the VBEE program. This provided a balanced enrollment of both on and off-campus students for assessing the acceptance and academic effectiveness of this delivery approach. In addition, formal text books are limited which required students to be more dependent on the CD for the subject knowledge content.

The presentation of the lectures on the CD was organized into chapters (or modules) that covered one week of normal course content. Eight such chapters were created each of which contains 20 to 30 individual pages of graphics, text and mathematical content. The package also includes a “start” module and “exit” module that provide for initiation and termination of the CD program as well as navigation instructions. The eight modules contain some 250 pages.

Each page of a module is accompanied by a recorded audio presentation that has been carefully scripted to succinctly and completely describe and explain the visual material. These audio presentations play automatically as the student selects a page to view. All audio files have been filtered and modified to insure a professional media consistency that contains no hesitations, mispronunciations, unnecessary repetitions or other typical live lecture presentation flaws. Graphic and text materials are programmed to appear with appropriate audio segments on each page. The capability to replay the audio with the visual material on any page before proceeding is provided and the audio will replay completely if a page is revisited once passed over.

An introduction and index permitting access to any page by hyperlink is provided at the beginning of each chapter. Students are advised to proceed sequentially through the pages but the choice is theirs. An interactive exercise with immediate visual and audio feedback is provided at the end of each chapter to assist the viewer in determining their understanding of the material covered. Appropriate hyperlinks are provided to return the student to that section of the chapter relating to the exercise if needed. Each chapter also includes an off-line exercise to be completed as a homework assignment that is submitted for the instructor’s review. These exercises are submitted at the class meeting following the week in which the chapter is assigned.

Four navigation buttons are provided on each page. This permits the viewer to go to the next page, the previous page, the last page in the chapter and the first page in the chapter. The main menu in the “start” module offers hyperlinks to each chapter as well as a link to the “exit” module for ending the program. The last page in each chapter is equipped with a link to the main menu and the “exit” module permits returning to the main menu as well as exiting the program completely.

The entire eight chapter course package is a complete unit on the CD that requires no other software or application to run. A setup program on the CD automatically loads the eight chapters on the user’s hard disk and creates shortcuts in the Windows program listing to each chapter. Only the program run software and graphic pages of the chapters are downloaded to the user’s hard drive. The audio files remain on the CD to save space on the user’s hard drive.

The course modules were generated using Asymetrix Toolbook II Assistant™. This commercial application was created for the development of training modules. It provides a very user friendly and icon click and drag process that permits simple development of all the graphics, text, navigation, hyperlinking, audio recording and interactive exercise features already discussed. Syntrillium's "Cool Edit" was used to filter and modify all the wave files recorded with Toolbook II Assistant™. The final product was both robust and compatible. Only one of twenty students enrolled in the first offering of the course experienced any problems installing and/or running the program using a set of written instructions. The entire package required some 400-500 hours to create over a period of about eight months

Course Schedule Reorganization

A copy of the CD was made available to each student at the beginning of the course. With the course knowledge content on CD ROM there was no longer any need to schedule three weekly meetings with the class. To provide some periodic interaction with the on campus students the class met once each week. Students could access the lecture material at their convenience but still met with the instructor on a regular scheduled basis. Hence the classification of this delivery format as pseudo asynchronous.

The once a week class meetings immediately reduced the amount of taping and mailing of videos to the off-campus students. The CD format also made accessing the lecture material more convenient for the off campus students. Videotapes require access to a VCR that is not always as conveniently available as a PC. With a laptop access could be anywhere. One student on a three-week work assignment to Australia took the CD with him and kept up on schedule via email. The on-campus students could also review the lecture presentations any time they wished just as off-campus students did previously with the videotapes.

Each weekly class meeting began with a five-minute quiz on the CD material assigned the previous week. Off-campus students were also requested to take these short quizzes prior to viewing the video of that day's class meeting. This activity helped keep everyone on schedule. To make it meaningful the quizzes were graded and included in the final course grade. The homework assignments included at the end of the chapter lecture material were collected at the weekly meeting from on campus students. Off campus students submitted their homework assignment either by email or fax to stay current with the on campus classes. The rest of the weekly meeting of the class was used to review highlights and answer questions about the previous week's lecture material, discuss and go over typical solutions to the assignments just turned in and cover appropriate supplementary materials that complemented the just completed lecture material.

This class meeting format was followed for the first two thirds of the semester. This covered about 10 weeks, one for details on how the course would be delivered, eight for covering the modules on the CD and one week for a midterm exam. After all lecture material on the CD was covered the remainder of the semester was used for group projects for on-campus students and individual projects for off-campus students. The purpose of the project was provide students with an opportunity to apply what they had learned to an existing commercial product to improve its design. Off-campus students were encouraged to select projects related to products produced by their employer where appropriate. In the last five weeks of the semester weekly meetings were used to discuss project activity progress and additional related course material not included on the CD. The last meeting of the on campus students was used for formal on campus group

presentations of the results of project work. The activity schedule for the entire semester is presented in Table 1.

Materials developed and used in the class meetings were placed on the NCSU VBEE web site for access by all students. This included instructions for installing and playing the CD, the activity schedule calendar, home work solutions, the weekly quizzes, supplementary course material and the project requirements.

Course Assessment Process

The effectiveness of this experimental course delivery system was evaluated using an assessment survey instrument created for both pre and post course implementation. This instrument consisted of a series of statements dealing with a variety of issues associated with the course and its conduct on which the student's opinion was requested. Each student was asked to respond with a ranking from 5 to 1 depending on whether they strongly agreed, somewhat agreed, neither agreed nor disagreed, somewhat disagreed or strongly disagreed with the statement. The instrument used at the beginning of the course sought opinions about anticipated outcomes. The instrument administered at the end of the course covered the same issues in terms of experienced outcomes. An example of these two approaches follows.

Pre course survey example:

Knowledge content on CD ROM with audio will be as effective a learning environment as classroom lectures by an instructor.

Post course survey example

Knowledge content on CD ROM with audio was as effective a learning environment as classroom lectures by an instructor.

The opinion statements included in the post-survey instrument are presented in Table 2. The first thirteen of these statements were included in the pre-survey document. Other information requested of the students included:

- Reasons for course enrollment.
- Why was the course attractive.
- Opinions on course level.
- What you liked best.
- What you liked least.
- What changes should be made.

Twenty students completed the pre-course survey while only 17 responded to the post course survey. The responses of the off campus and on campus students were kept separate to permit comparison of the two groups.

Assessment Evaluation

The initial class average for Statement 1 (CD as effective as class lectures) was 3.76 with both the on and off campuses responses within 0.25. At the end of the course the on campus ranking increased by 0.36 while the off-campus value increased by 0.54 for a final class average

of 4.18. This would indicate that there was better than somewhat agreement that the CD lectures were as effective as the class lectures particularly on the part of the off-campus students.

There was general agreement both before and after the course that one weekly meeting (Statement 2) was about right with the knowledge content delivery system used.

Surprisingly, the off-campus students were somewhat more skeptical about the delivery method not impacting their study schedule (Statement 3) but both groups were more in agreement that this was not the case at the end of the course (class average: 4.18).

There was an obvious initial concern (Statement 4 – class ranking value: 2.82) as to whether one weekly class meeting during the project period would be sufficient. After completion of the course this value increased to 4.65 indicating that one meeting was probably about right for this part of the course. The opinion of the off-campus students increased twice the amount of the on-campus students on this issue.

The class average for Statement 5 (delivery will not effect keeping up) received the highest final ranking of 4.70. This issue received the highest ranking of both groups.

Initially the class average for Statement 6 (course will require less time) received a ranking of 3.13 with the off-campus responses at just 2.56. At the end of the course the class average increased to 4.00 due to a 0.6 point increase for on-campus students and a 1.2 increase for off-campus students.

Somewhat disappointingly the class average on Statement 7 (CD more useful than text) dropped from 3.51 initially to 2.88 at the end of the course. This drop was the result of a 2.6 point decrease (with rankings ranging from 1 to 5) for the on campus response compared to a 0.33 point increase for the off campus students. The on campus result was confirmed by several student comments suggesting changes to permit finding specific material on the CD more easily. This may also be a consequence of not having a textbook for the course that has been such an important part of past course experiences.

Somewhat supportive of the results of Statement 6 the responses to Statement 8 (requires greater discipline) decreased from the initial survey to the end of course opinion (3.84 to 3.12).

The responses as to whether this delivery system is more educationally effective were somewhat inconclusive. The initial class response was only 3.39 and only increased to 3.59 by the end of the course. Both groups responded in a similar fashion.

There was general agreement that the project would promote understanding (Statement 12) and that the quizzes assisted in keeping on schedule (Statement 13) but the opinions on both of these issues dropped a little by the end of the course. Perhaps the regiment of the quizzes, which were quite easy, was considered somewhat of an affront to the maturity of a graduate student. The slight drop in the project value may have been a consequence of the project basically being a compilation of the individual chapter homework assignments applied all together to a single product. This may have lead to the feeling that not as much was learned from the project as first anticipated. However, there was still general agreement as to its value particularly by the off campus students.

Two positive comments frequently repeated by a number of students was that they liked the flexibility the CD ROM provided in covering the lecture material and the fact that the class only met once a week. The flexibility issued was a particular favorite of the off campus students. Suggestions for improvement included expanding the CD to cover more material and to provide greater depth on some of the subject areas covered.

Conclusions

Although the assessment results were not dramatically conclusive there were other factors that together with the formal evaluation indicate the experiment was successful. The student's performance appeared to be measurably better than that of other similar groups of students the author has taught in previous offerings using classical classroom delivery techniques. This improved performance was observed in three areas.

The home work assignments at the end of each chapter were completed before any of the knowledge required was discussed in class or any instructions given as to how the assignment was to be carried out other than what was provided on the CD. It was observed that the submitted work was as good and in most instances better than that turned in by students taking this same course in the past. Performance on the midterm and final examinations resulted in higher class averages than experienced with previous classes. Finally the content, quality and depth of the project reports were substantially better and more professionally prepared than previously experienced. Since there is no evidence that these students as a group were any more exceptional than those in past offerings of the course it might be assumed that this improved performance was a consequence of a more effective educational experience not necessarily totally recognized by the students.

There remain a number of questions about the academic and cost effectiveness of this delivery method that require further investigation. The development of the CD takes a lot of up front investment in time and energy particularly the first time through. However, there are production shortcuts that could reduce the initial cost of creating or modifying the product. For classical knowledge content updating of materials like exercises would be relatively simple. The final product certainly has text book value to students who can keep it in their library like other resources. The real value of the increased schedule flexibility introduced as a consequence of reduced class meetings for both students and instructors still need further evaluation.

It is clear, however, that the use of the CD and reducing class meetings has reduced significantly the overhead burden of videotape production and distribution as practiced by the VBEE program for off campus students. Once the class meetings have been recorded their content can be placed on CD for subsequent use completely eliminating the need for videotapes for a second offering of the course. This has in fact been done for two subsequent offerings of the course.

It would appear that the improved performance of the students in this experimental offering and their general acceptance and successful use of the CD as a replacement for classical class room lectures are sufficient incentives to continue to experiment with the delivery technique. For example might not this delivery mechanism be of value in offering certain undergraduate courses particularly to potential transfer students enrolled in community college systems.

There are of course those that would raise concerns about what will become of the classic classroom teacher if their lectures are “canned”. Might they not become obsolete? That was originally a significant concern with the institution of video taping in the VBEE program that now is looked at as a non issue since courses are of necessity updated on a regular basis. Unfortunately, these individual are not looking ahead to the potential advantages of the advances in communication technology that can and will lead to more effective educational processes. Opportunities and advancements in which they will become the developers of effective means to deliver information and knowledge content and serve as coaches and mentors to students rather than classroom lecturers.

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Carl Zorowski is Reynolds Professor Emeritus of Mechanical Engineering at North Carolina State University. Following thirty years as an engineering teacher, researcher and administrator he served as Director of SUCCEED, an NSF sponsored EEC program coalition of eight colleges of engineering in the southeast with the goal of revitalizing undergraduate education for the 21st century. He now provides leadership for the dissemination of the results of SUCCEED and is involved in the development of distance education delivery methods. Dr. Zorowski received his B.S., M.S. and Ph.D. degrees in Mechanical Engineering from Carnegie Mellon University in the 1950s.

**MAE-742 Mechanical Design for
Assembly
Activity Calendar - Spring 2000**

Week	Dates	Monday	Wednesday	Friday	Reading Assignments	Homework Assignments
1	Jan 10-14	Classes Begin	Introduction		Chapter 1	Off-line Exer - 1
2	Jan 17-21	King Holiday	Discuss Chap.1		Chapter 2	Off-line Exer - 2
3	Jan 24-28		Discuss Chap. 2		Chapter 3	Off-line Exer - 3
4	Jan 31-Feb 4		Discuss Chap. 3		Chapter 4	Off-line Exer - 4
5	Feb 7-11		Discuss Chap. 4		Chapter 5	Off-line Exer - 5
6	Feb14-18		Discuss Chap. 5		None	None
7	Feb21-25		Midterm Exam		Chapter 6	Off-line Exer - 6
8	Feb 28-Mar 3		Discuss Exam & Chap.6		Chapter 7	Off-line Exer - 7
9	Mar 6-10		Discuss Chap.7			
10	Mar 13-17	Spring Break	Spring Break	Spring Break		
11	Mar 20-24		Assign Project			Prepare Proposals
12	Mar 27-31		Present Proposals			Project work
13	Apr 3-7		Supplemental Material			Project work
14	Apr 10-14		Supplemental Material			Project work
15	Apr 17-21		Easter Break	Easter Break		
16	Apr 24-28		Supplemental Material			Project work
17	May 1-5		Present Results	Last day of classes		Submit report
18	May 8-12	Finals	Finals	Finals		
19	May 15-19	Finals	Finals			

**Table I
Semester Activity Calendar**

Post-Course Survey

Opinions on Delivery Method : Circle one answer for each statement as follows – (5) strongly agree, (4) somewhat agree, (3) neither agree nor disagree, (2) somewhat disagree, (1) strongly disagree

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|---|-----------|
| 1. Knowledge content on CD ROM with audio was as effective a learning environment as class room lectures by the instructor. | 5 4 3 2 1 |
| 2. One class meeting each week was sufficient with lectures provided asynchronously on CD ROM. | 5 4 3 2 1 |
| 3. Asynchronous delivery of course content did not significantly impact my normal study schedule. | 5 4 3 2 1 |
| 4. One class meeting each week was sufficient during project portion of the course. | 5 4 3 2 1 |
| 5. Asynchronous delivery and reduced class meetings did not create a problem in keeping up with the course schedule. | 5 4 3 2 1 |
| 6. This course did require less time than similar courses delivered by conventional methods. | 5 4 3 2 1 |
| 7. CD ROM with audio was more useful than a text book as a reference for the course knowledge content. | 5 4 3 2 1 |
| 8. This course did require greater discipline and time management compared to standard offerings. | 5 4 3 2 1 |
| 9. CD ROM method of delivery did provide a better learning environment than usual course offerings. | 5 4 3 2 1 |
| 10. Computer hardware requirements for playing CD ROM were restrictive to enrollment. | 5 4 3 2 1 |
| 11. This course was more educationally effective than a course delivered by standard methods. | 5 4 3 2 1 |
| 12. A practical course project did significantly promote the understanding and application of the knowledge content. | 5 4 3 2 1 |
| 13. Weekly quizzes and exercises did assist my remaining on planned semester schedule of activity. | 5 4 3 2 1 |
| 14. Review of the course material on the CD ROM at the weekly class meetings was useful. | 5 4 3 2 1 |
| 15. The interactive exercises at the end of each chapter were helpful | 5 4 3 2 1 |

Table II
Survey Instrument