Experiences with Video Enhanced Collaborative Learning

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Abstract

An ever-present problem with freshman-level courses is the diversity of student backgrounds. During the Spring 1998, a project was funded by the University to develop a different instructional approach which was later piloted in the first required Technical Mathematics course. The intent of the project was to address a wide diversity of student backgrounds and problems associated with commuting students. The proposed approach involved alternative use of homework and classroom time; i.e., lectures were taped for home viewing while the classroom time involved group processes, tutoring, attention to individual difficulties, cooperative learning experiences, and attention to problems associated with math anxiety. The course was also tied to a Web site, and tapes utilized Power Point and MathCad. In developing an alternative format for instruction, we addressed some of the weaknesses associated with the traditional lecture approach and also preserved some of the strengths of this approach. This paper summarizes the development and initial implementation of this program.

Introduction

An ever-present problem with freshman-level courses is the diversity of student backgrounds. This problem is particularly acute in the applied college algebra course taught for technology students at the University of Houston. This course must meet the needs of commuting students, traditional freshmen, and working adults, and although it has a prerequisite of intermediate algebra, the students have very diverse backgrounds. In order to address the problems created by diversity, a pilot program partially funded by an internal University of Houston (UH) grant, was developed in the Spring of 1998 and implemented during the following summer. The pilot instructional approach involved alternative use of homework and classroom time. Lectures were taped for home viewing, while classroom time was devoted to cooperative group processes, tutoring, and attention to problems associated with mathematics anxiety. Specifically, this approach was developed for a unit on solutions of systems of linear equations.

The Setting

The existing course, TMTH 1335, Basic Technical Mathematics, is offered at the University of Houston, a large urban university that enrolls more than 30,000 students. The students completing the course have majors in diverse fields including Electrical Power Technology, Computer Engineering Technology, Manufacturing Systems Technology, Construction Management, Industrial Supervision, Computer Information Systems, Industrial Distribution, and Human Nutrition and Foods. The course provides instruction in applied college algebra such that the content and approach emphasize conceptual understanding, problem solving, and applications related to the various technology curricula. Students completing the course should develop the concepts and skills that will not only enable them to continue in the mathematics sequence appropriate for their major, but also will assist them in making the transition from mathematics courses to major courses with mathematical content.

Typically, TMTH 1335 is taught using traditional lectures in classes that average approximately 30 to 40 students per course. Despite the fact that students who enroll in the course represent a diversity of backgrounds and abilities, this traditional approach does have strengths. Strengths include the following.

- Students are familiar and comfortable with a traditional lecture approach; many believe that if they do not hear a lecture, they cannot come to understand the material.
- Instructors also are familiar and comfortable with a traditional lecture approach.
- All necessary course content can be covered (which does not necessarily infer that students understand or master all of the content).
- In course sections with small enrollment, there are opportunities to gauge student responses and provide alternate explanations when apparent misunderstandings occur. These alternate explanations are delivered to the entire group, which is efficient.
- Answers to questions posed by individual students have the potential to benefit all students in the class.

These strengths are limited and can be achieved by alternate approaches that can provide the same benefits. Furthermore, a traditional lecture approach also results in problems inherent to the process including the following.

- Many students are not actively engaged in the lesson during a lecture. Understanding of mathematical concepts and problem solving require students to actively participate; merely observing problem solving does not always lead to understanding.
- Although it is possible to cover content rapidly and efficiently in a traditional lecture environment, students do not necessarily understand the concepts until they have attempted to work problems themselves. This activity generally takes place while the students are isolated at home without the benefit of an instructor, tutor or peer to help them. The result is often frustration rather than motivation to complete the work.
- The lecture approach does not accommodate the wide diversity of student backgrounds. Although all are required to pass a placement test or take a prerequisite course, the variation in background and ability is vast. Traditional lectures do not

provide opportunities to address this diversity because even when specific problems related to an individual student's understanding are known, there are limited opportunities to deal with the deficiencies in class. Many times students with problems do not seek individual help during the professor's office hours.

Program Elements

The intent of the project was to develop an alternative instructional format that addressed some of the weaknesses with the traditional lecture approach while preserving its strengths. Specifically, the following elements were incorporated into one unit of the course:

- Cooperative learning activities that actively engage the students with the course content during class time.
- Video-taped presentations of the material to be learned, to move the passive activity of listening to a lecture to the student's out-of-class time.
- Assistance with the development of more effective mathematics study skills, organizational strategies and test taking techniques through instruction provided by Learning Support Services (a UH student service department).
- One-on-one instruction for students ill-prepared for the course provided by Learning Support Services.
- Instructional activities designed to increase the students' level of comfort with the subject.

For the purpose of the pilot program, the content addressed by the enhanced approach was solution of systems of linear equations. The topic included the following modules:

Graphical Solution of Two Linear Equations

Solving Systems of Two Linear Equations Using Substitution

Solving Systems of Two Linear Equations Using Addition

Applications of Systems of Two Linear Equations

Solution of Systems of Two Linear Equations Using Cramer's Rule

Solution of Systems of Three Linear Equations Using Cramer's Rule

Introduction to Matrices

Solution of Systems of Linear Equations Using Gaussian Elimination

For each module, the following components were developed: (1) objectives, (2) twenty to thirty minutes of video-taped instruction, (3) group activities, and (4) web resources available through a course internet web site. Objectives were defined and distributed to the students; they were also available on the web site developed for the project.

A twenty to thirty minute presentation was video-taped for each topic. The presentations were

placed, in sequence, on a single tape, copies of which were made available to the students for viewing at home or in the UH library. Students were expected to view appropriate presentation(s) in advance of a particular class period.

Cooperative group activities were developed. Each included problems designed to be effective in a group setting that were written or selected by the instructors. The problems were assigned to be solved by student groups of size 3 or 4. The instructor formed the groups to include a range of abilities and the instructor assigned the problems to each group. The following instructions applied to each group activity.

1. All members of the group work to solve the problem and are responsible for ensuring that other members of the group understand the solution of the problem well enough so that he or she can present it effectively to the class.
2. One person per group is designated as the recorder. The recorder is responsible for putting the problem in written form to submit for a group grade. All members of the group are responsible for checking the written response.
3. Problem solutions will be presented to the whole class. The group should decide on the strategy for presentation and make sure that all group members understand it. The instructor randomly selects an individual from the group to present the problem.
4. The grade on the assignment consists of two parts: (1) the written solution and (2) the oral presentation of the solution. Part of the oral presentation grade will consist of how well the group answers questions posed by other students or by the instructor. Questions may be posed to any member of the group, not just the individual who has been selected to make the presentation.

In addition to the objectives, video-taped presentations and group activities, a course internet web site was developed. The web site contains the following 'pages'.

Course Units & Resources includes references to homework assignments and web resources related to the unit content.

Grading Policy describes how students will be evaluated.

Important Dates presents the course schedule, including test dates.

Prerequisites identifies prerequisites to the course.

Selected Text Solutions provides solutions to textbook problems not included in the answer section of the textbook.

Guidelines suggests study approaches.

Textbook identifies the required text.

Web Resources presents general information regarding the use of the web.

Syllabus is a site where the course syllabus can be downloaded as a Microsoft® Word document.

Results

The program was initially implemented in the second summer of 1998 with a class of 20 students. The implementation of the program produced a variety of interesting responses and reactions from participating students and instructors. Using this approach, students had the opportunity to develop their understanding in class while the instructor was available to answer questions and trouble shoot misconceptions on a one-on-one basis. Furthermore, the approach optimized the use of time for many of the students. Out-of-class homework time was partially devoted to the passive process of listening that usually occurs during a lecture, while class time engaged the learner with the cooperative learning experiences and provided the instructor an opportunity to address individual problems.

The instructors indicated that most, but not all, students used the tapes. They felt that the students who needed the most help truly appreciated the step-by-step presentation format used in the tapes. The tapes were notably useful for students who were absent. Instructors felt the tapes were useful as advance organizers, and they appreciated that they did not have to “start from scratch" during class time. They also indicated that the tapes facilitated group processes.

When tested over the content, students scores reflected a mean of 73 with a standard deviation of 22. Student reactions were mixed on the use of taped lectures and included the following comments.

> I am weak in math and the video tapes allowed me to go back and review material that was not clear.
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> We need to have more video tapes on all material.
>
> The tape on Cramer’s Rule was excellent.
>
> The videos were particularly useful for word problems.
>
> The video exercise would have worked better using one instructor.
>
> I prefer that a human always be available to teach.
>
> I did not like using the tapes.

The instructors believed that the cooperative learning assignments were valuable. One believed that it worked best to give all groups the same problems because it resulted in maximum participation by the students; in this instance different groups were called on to present the results of a given problem.

The information on study skills was useful to new freshmen but some of the more experienced students indicated that it was not as helpful to them. In general, instructors noted that the total approach required students to spend more time than might be required by a traditional approach, but most students benefited from the experience and from the extra time spent.

Conclusions

The investigators unanimously agree that the tested approach deserves further development and study. They believe that one unit of content is not enough to fairly assess the total impact of the altered instructional approach. Thus, planned future efforts include developing additional tapes and cooperative learning activities for one additional content area, perhaps focusing this time on a topic that is known to be difficult for most students. The basis for the reported results is primarily anecdotal information gathered via the normal course and instructor evaluation process that is standard for the College of Technology at UH. The investigators believe a carefully planned and more controlled evaluation that can validly compare the new approach to the traditional approach is warranted. This will require the development of evaluation instruments specific to the approach and content being examined.

The investigators also believe the approach used is readily adaptable to content courses in the various technology disciplines. They invite readers who would be interested in launching a parallel pilot effort in a technology discipline area to contact them regarding the possibility of a joint investigation.

Bibliographic Information

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