Modifying the Learning Environment to Improve Student Retention

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Abstract

This paper addresses the modification of the classroom-learning environment, from the traditional lecture format to a learner-centered approach, in order to increase student retention. Historically the trend is that a significant number of students who register for the first course in a two semester, circuit analysis sequence do not complete the sequence and consequently do not go on to take upper division courses. The first course in the sequence is DC Circuit Analysis (DCA) and the second is AC Circuit Analysis (ACA). This retention problem leads to reduced class size and potential cancellation of second year course sections. Additionally the National Science Foundation[1], National Research Council[1] and ABET[2] are calling for educational reforms that focus on student learning outcomes instead of the traditional material coverage.

Introduction

For this paper, "retention" is defined as the percentage of students who either take the next course in the sequence, ACA, or repeat the first course, DCA. Several factors lead to low retention. Based on faculty perspective, student performance feedback, and analysis of the college student database, a number of causes have been identified. First, students do not have a sufficient math background for DCA nor do they obtain mastery of the fundamental DCA topics. Additionally, students do not feel connected with their classmates, and do not find the material interesting and relevant to the "real world." A significant number of students inconsistently attend early morning classes and are focused on obtaining grades, not learning the course material. Based on these issues, modification to the classroom environment was implemented beginning with the Fall 2001 semester.

Classroom Modifications

The following techniques and changes to the traditional lecture-oriented classroom were incorporated into the DCA course.

- Grade homework based on effort, not the number of correct answers

The goal of the homework is to provide students with experience in solving circuit problems with increasing levels of difficultly. Students need to understand that the assignments are to help them practice important concepts, not to provide justification for a course grade.

There are some students who will copy correct answers, resulting in little or no understanding of the presented material. In order to reward out of class effort, homework assignments are graded based on the number of problems attempted and not on the accuracy of the solutions. Time is set aside at the beginning of each class to discuss and solve homework problems on the board. Sometimes problems are worked by the instructor and at other times are worked by a single student or group of students.

- Clearly explain the objectives of upcoming exams[3]

Exams are given periodically to allow students to demonstrate their ability to solve DCA problems. Throughout the course, important information and types of problems are highlighted for students. For example, solving for total resistance of a series circuit is necessary while information such as the date of birth of Georg Ohm is not required for solving circuit problems.

- Allow student input on the types of problems that will be on the exam

When preparing and reviewing for an exam, students are queried on the essential material and types of problems that should be on the exam. They will usually identify the most important topics and types of problems. In addition, with guidance by the instructor, a complete exam structure can be developed. A further benefit is that students have ownership of the exam material and become a valued part of the educational process. Students can use their study time more productively when they clearly understand the test format and the essential types of problems they must be able to work.

- Allow students to rework missed problems to improve their exam grade[4]

In the traditional classroom environment, students can develop an attitude that once the test has been taken, the material can be forgotten. A student may receive a passing grade without truly understanding the fundamental concepts. Furthermore, if partial credit is given, students may not be able to work multistep problems to completion. By allowing students to earn back a portion of missed points, this problem can be reduced. Students are able to rework an entire problem after first explaining why the original solution was incorrect. They then solve it correctly on a separate paper, thus maintaining documentation of the original error as a reminder. The number of points that can be earned back is based on the percentage of small group quizzes and the number of homework assignments submitted. A sliding scale is used to encourage students to attend class and turn in homework assignments. Many students are willing to rework missed problems; those students who are focused on grades are interested in improving their grade, and those students focused on learning are interested in improving their understanding of the material.

- Have students work in small groups[3]

Students are divided into small groups at the beginning of the semester. Groups are formed based on the laboratory section in which the student is enrolled. Group size depends on laboratory enrollment, and ideally three to five students are assigned to each group. The group

remains intact throughout the semester unless attrition requires regrouping. The groups work together on daily quizzes and problems on the board. No group work outside the classroom is required due to the commuting nature of the college however, some students choose to study and work together with some group members outside of class.

- Give frequent small group quizzes[3]

Group quizzes are given at the beginning of most class sessions. The goals are to practice solving simple problems and to work cooperatively with group members. All students in the group must agree on answers prior to submission. This leads to some conflict that must be resolved by the group, discussion of different methods of solution, and students teaching students. The problems are kept simple enough to allow completion in less than five minutes. On occasion quizzes are handed out a day or two early allowing learning-oriented students to learn the material on their own.

- Encourage ongoing student written and oral feedback[3]

An environment of open communication is encouraged. Students are requested to provide written feedback after each exam, concerning whether the exam was fair and whether it covered the indicated material. A portion is provided for self analysis on exam preparedness and other comments. This written feedback is given in the form of an individual quiz, and students receive full credit for answering the questions. Honest comments are encouraged with the understanding that no retribution will occur. Almost universally students indicate that exams are fair, and cover the indicated format and material. They also indicate their unpreparedness as one of the reasons they did not perform as well as desired. Oral feedback is encouraged at the end of each class period to determine which techniques the students find most and least helpful in comprehending the material.

Student Retention Data Analysis

The student body at Stark State College is similar to many two-year colleges in that the average student age is 29, and over half of them have part-time or full-time employment. Daytime students tend to be slightly younger and less likely to be working full time than evening students. The DCA course typically consists of a mix of traditional college-aged students and older students who often have work experience in the field. This mix of students has made teaching the course difficult since few students fall into the average category. Teaching to those with a circuits background leaves those new to the field behind, whereas, teaching to the beginning students does not challenge those with a circuits background. A result of this combination of students is often a reverse bell-shaped grading curve.

Data beginning in the Fall 1998 semester when the current DCA and ACA course format was designed, has been analyzed and compared to the Fall 2001 data to determine preliminary impact of the mentioned modifications. Prior to Fall 1998, DC, AC, and semiconductor circuits were previously studied in a two-course sequence that was a carry over from when the college

used the quarter system. Due to the different nature of the previous course structure, no data from these courses was included in the analysis.

Analysis of the Fall 2001 DCA data has indicated some preliminary results. A positive improvement can be seen in the grade distribution data in the 10:00 am section where the grades indicate a more normal distribution compared with the previous semester (Spring 2001). No similar improvement is indicated in the 8:00 am section. Inconsistent student attendance is a significant problem in 8:00 am DCA sections. Data showing the retention of the students who took DCA in a particular semester is presented both as a percentage of students and total number of students. The database indicated that many students do not take ACA or retake DCA during the subsequent semester but elect to in a later semester.

Figure 1 shows an inverse bell curve grade distribution for Spring semester 2001 midmorning section. Figure 2 shows a more normal grade distribution for the Fall semester 2001 midmorning section. The percentage of A and B's is similar to the previous semester but many of the lower students have shifted upward to the C range.

Figure 1

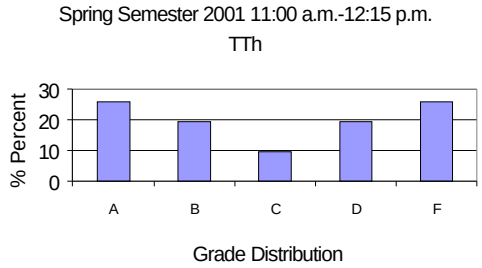


Figure 2

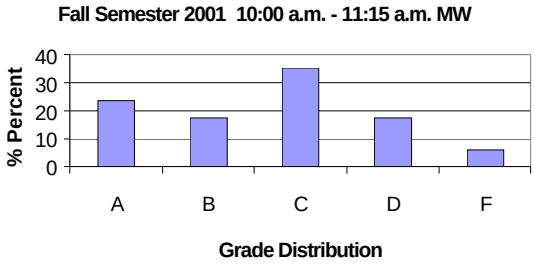


Figure 3

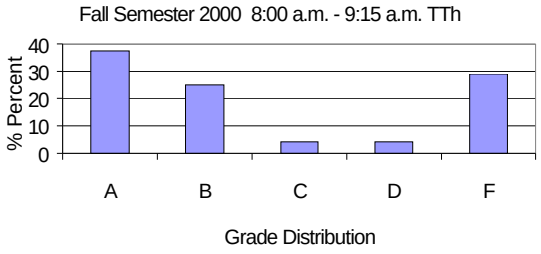


Figure 4

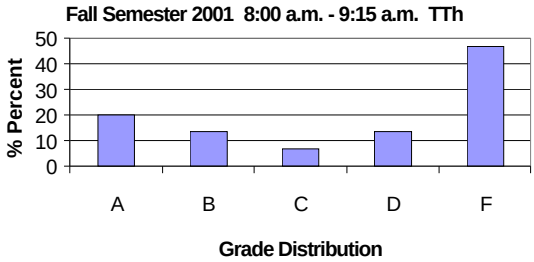


Figure 3 shows data for the Fall semester 2000 8:00 am section and Figure 4 for the Fall semester 2001 8:00 am section. No improvement in the grade distribution is indicated for the early class. Figure 5 shows percentage of students who took DCA in a particular semester who eventually either reenrolled in DCA or enrolled in ACA. Figure 6 shows the total number of

students who took DCA in a particular semester as well the number of students who eventually either reenrolled in DCA or enrolled in ACA.

Figure 5

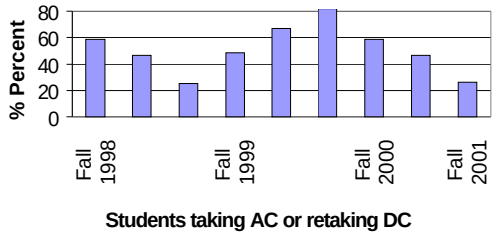
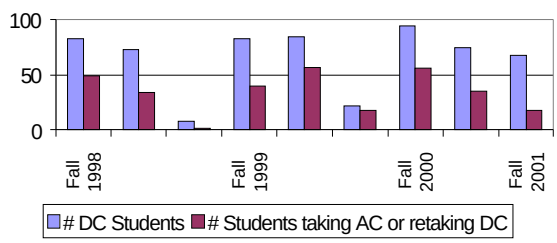


Figure 6



Conclusions

Both expected and unexpected conclusions are drawn from the data. Though only one semester's worth of data is available after implementing modifications, there is evidence that the modifications should be continued and a more statistically significant sample developed for further analysis. Since a number of changes were introduced simultaneously, the effectiveness of each change cannot be measured at this time.

An expected result was that students who would be at the lower end of the grade distribution in a traditionally taught course tended to move upward creating a more normal grade distribution. Students who would be at the upper end of the grade distribution in a traditionally taught course tended to remain there. Initially there was concern that these students might react negatively to the classroom modifications[5]; however, no evidence exists in the written or oral feedback from students. The authors believe that the interactive nature of the course also produced a benefit for those students at the upper level .

A significant and unexpected conclusion is that 8:00 am courses are ineffective for first-year students. Students have not developed time management and study habits, therefore, they frequently miss class sessions. No modification to the classroom environment can benefit students who are not present. Based on this result, future sections of DCA will be offered only after 9:00 am.

Bibliography

1. Towns, Marcy, Kreke, Kelly and Fields, Amanda. "An Action Research Project: Student Perspectives on Small Group Learning in Chemistry". Journal of Chemical Education, January 2000, pp. 111-115.

2. Tooley, Melissa and Hall, Kevin. "Using a Capstone Design Course to Facilitate ABET 2000 Program Outcomes", Proceedings of the 1999 American Society for Engineering Education Annual Conference & Exposition, Charlotte, NC, June 20-23, 1999.

3. Finelli, Cynthia, Klinger, Allen and Bundy, Dan. “Strategies for Improving the Classroom Environment”. Journal of Engineering Education, October 2001, pp. 491-505.

4. Seese, Lillian. “How I Get My Students to Work as Hard as I Do”, 2001 Teaching for a Change: Weaving the Web of Community”, Steamboat Springs, Colorado, June 13-16, 2001.

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