

**2006-2182: INCREASING STUDENT ENGAGEMENT IN ENGINEERING  
ECONOMY CLASS**

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# INCREASING STUDENT ENGAGEMENT IN ENGINEERING ECONOMY CLASSES

## Abstract

There are many strategies that can be used to encourage student engagement for an engineering economy class. Two engagement strategies including weekly quizzes and group problem-solving activities are considered in this paper. Our goal was to experiment with the selected strategies to determine which strategy worked best to promote deeper student learning in an engineering economy course. Student attendance, student achievement, maintaining pace with the class and student learning were the four factors that were measured in this study.

## Introduction

A number of reports show that there are dramatic differences between today's students and those of a few years ago<sup>1</sup>. Nowadays, we see a general decrease in student preparedness, an increase in number of employed students, an increase in number of part-time students, and an increase in the age of students. Although there are some factors that cannot be influenced by instructors, we can enhance students' success rate by increasing student engagement. By engaging students we expect students to move from memorizing concepts, to explaining those same concepts, to using those concepts in real-life problem solving situations, to analyzing under what conditions those concepts apply (or do not apply), and ultimately to making decisions.

Based on the findings of the National Survey of Student Engagement (NSSE)<sup>2</sup>, it is now widely accepted that increasing student engagement is a critical role of engineering educators in our society. This study stresses that student engagement should not be addressed in just a single course in a student's academic career, but rather it should become the pattern of his or her involvement in a variety of activities. It is believed engineering colleges have a vital role to implement effective strategies to increase engagement of students in learning. National experts have also noted "too many students appear content to scratch the surface of assigned course readings and to memorize minimally that which might appear on examinations"<sup>3</sup>. This is a trend that we have also seen. Smith et al discussed classroom-based pedagogies of engagement, such as cooperative learning and problem-based learning<sup>4</sup>. The authors in this paper urge all engineering faculty to consider not only the content and topics that make up an engineering degree but also how students engage with these materials. Review of the literature shows that faculty at many institutions have attempted to determine engagement methods that works best for their student population. With this in mind, it was decided to experiment with student engagement strategies in several sections of an engineering economy course and to implement the strategy that best improves student learning in all sections of the course.

There are many strategies that can be used to encourage student engagement for an engineering economy class. Among these strategies, four were identified<sup>5</sup> as weekly quizzes, weekly journals, group problem-solving activities, and extra-help sessions. For this study the effects of

weekly quizzes and group problem-solving activities are considered. Our goal was to experiment with the selected strategies to determine which strategy worked best to promote deeper student learning in the course. Student attendance, student achievement, maintaining pace with the class and student learning were the four factors that are considered in this study. Students were surveyed to determine the impacts of the engagement strategies.

Classroom research consisted of collecting data from a course section applying the two strategies. Student work was compared to the past student performance to measure overall success in the course. Input from students established a useful basis for determining which of the student engagement strategies worked best. The results of the study are being shared with other engineering economy educators for the purpose of promoting deeper student learning.

### **Why Engineering Economy Class**

Engineering Economy is one of the basic engineering courses in an undergraduate engineering curriculum. At California State University, Northridge the general engineering student population is required to take only one course in economics which is taught within the college of Engineering. The class addresses the need for students to be able to design parts, systems, processes and products which are cost effective. The course is also very important for engineering students, because the underlying fundamental principles of engineering economy may be used in both their personal and professional lives. Students taking the course come from a wide spectrum of engineering disciplines. Students take the course at an upper-division level enabling them to take advantage of life experiences and knowledge acquired from their earlier studies. The course primarily focuses on how to make decisions regarding competing economic alternatives with varying costs and benefits over time. In an earlier paper<sup>6</sup>, we studied the use of common sense applications to improve the comprehension of course materials. Unfortunately, the course is continues to be designated as one of the courses within the engineering discipline that has high failure rate. This is because students typically do not engage well enough to pass the course with satisfactory grade. Although numerous real life examples are used in class, students have difficulties applying the course material in an actual engineering situation. The inability to apply engineering economy to real life situations has also been experienced when students work on their senior design projects. Therefore, this section of the course was selected to study two strategies; weekly quizzes and group problem-solving activities. By using these two strategies, we expect students to move from memorizing concepts to explaining those same concepts, to satisfactorily completing the course, and ultimately to using those concepts in real-life problem solving situations. Furthermore, engineering economic analysis is one of the core engineering competencies addressed by the “Fundamentals in Engineering” exam. This exam is a required step in the process of earning the Professional Engineering (PE) license. By using the engagement strategies, we hope to improve student’s ability to develop cash flows based on real data, formulate the analytical problem to be solved, calculate the rate of return, apply present worth analysis and after tax analysis. Thorough understanding of these methods will enable them to successfully complete the economic portion of the FE exam.

### **Survey Methodology**

Students in one section of engineering economy classes were anonymously surveyed at the end of the semester to determine their perceptions of the course with respect to types of strategies implemented. Students were asked to respond by selecting from a set of given responses. A sample of the survey questions and responses appears in Table 1.

Questions 1 through 6 deal with the strategy of the weekly quiz and questions 7 through 11 deal with the strategy of group problem-solving activities. We will first introduce each engagement strategy and then discuss their results.

### **Weekly Quizzes Strategy**

The weekly quiz consisted of a five to ten minute quiz based on homework problems. Quizzes were designed to give the instructor feedback on the student's understanding of the material. If the overall student performance on a quiz was poor, the instructor would use the feedback to review the concept to ensure that students master the concepts being presented. Weekly quizzes clearly require extra effort on the faculty member's part; however our results indicate that it is time well spent. Results of quizzes are used in determining the student's final grade in the course, counting for 30% of the final course grade.

### **Group Problem Solving Activities**

Students were invited to participate in group problem-solving activities every two weeks. The problem solving sessions were held thirty minutes before the regularly scheduled class time. Student participation was purely voluntary, yet a majority of the students took advantage of these sessions. Problems were assigned to students to work on in groups. The instructor chose a student to lead each group. This student was usually chosen because he/she was doing poorly on the concept. That student was responsible solving the problem and presenting it to the group. If the selected student was unable to solve the assigned problem, his/her peers would then help solve the problem collaboratively. Finally, students were engaged in a feedback and discussion session led by the instructor, where the problems were solved and explained to the entire class. It should be noted that the student work in the problem solving activities was not used in calculating the student's final grade.

### **Survey Results**

The information used in this discussion was collected by surveying 33 students. Answers of students in this survey were anonymous. A discussion of the student responses to the questions listed in Table 1 follows.

#### **1. Student satisfaction with Each Strategy**

The survey showed that students preferred taking a weekly quiz (71% approval rating) over group solving activities (65% approval rating).

#### **2. Improvements in Learning Course Material**

Students said that they felt that quizzes were more effective (90%) than group solving activities in improving their learning of the course materials (60%).

### 3. Keeping Students Abreast of the Subject

81% of the students felt that weekly quizzes forced them to keep up with the classes while only 48% felt that the problem solving activities achieved similar results.

### 4. Improvement of Mid-Term Exam Scores

The survey results indicated that students felt that weekly quizzes (82.75%) were more helpful in improving their midterm grade than the problem solving activities (48%)

### 5. Attending Classes Regularly

Results show that 86.2% of the students felt weekly quizzes improved their class attendance while only 34% felt the problem solving activities improved class attendance.

Table 1. Survey Questions and Responses of Students

Questions	Answer				
	Yes	No	Unsure		
1. Do you like to take a quiz every week?	71%	25%	4%		
2. Do you feel that taking quizzes has improved your learning?	90%	8%	2%		
3. Does a quiz every week keep you abreast of the subject?	81%	16%	3%		
4. Have the quizzes improved your midterm exam score?	82.7%	15%	2.3%		
5. Have the quizzes kept you attending to classes regularly?	86.2%	10%	3.8%		
6. How many hours do you usually spend before taking a quiz?	0 5%	0.5 19%	1 43%	1.5 21%	2 12%
7. Do you like group problem-solving activities?	65%	33%	2%		
8. Do you feel that the group problem-solving activities have improved your learning?	60%	38%	2%		
9. Do you feel that the group problem-solving activities have kept you abreast of the subject?	48%	41%	1%		
10. Have the group problem-solving activities improved your midterm exam?	48%	40%	2%		
11. Have the group problem-solving activities kept you attending to classes regularly?	34%	64%	2%		

### Improvement in Student's Successful Completion of the Course

Two different faculty members took part in trying the different teaching strategies. One faculty member implemented both group problem solving and weekly quizzes. The second faculty

member simply implemented weekly quizzes. Results for each faculty member's courses before and after implementation of strategies were compared separately to minimize the variation due to different instructors.

The results for the faculty member who simply implemented weekly quizzes, the failure rate (grade of F) was 17% before implementing the quizzes. Following the implementation of weekly quizzes the failure rate dropped to 3.2%.

The faculty member who implemented both quizzes and group problem solving sessions had a failure rate of 9% before implementation. The failure rate dropped to 6% after implementation of the two strategies.

### **Lesson Learned From This Study**

Both of the engagement strategies appear to improve student success in studying engineering economy. The question as to which is the most productive strategy from the faculty members' perspective must take their time and effort into account as well as the students performance. The use of both weekly quizzes and group problem solving activities did not yield a higher success rate than using quizzes alone.

The feedback from the student questionnaire indicates that the students take the quizzes more seriously than the problem solving activities. This appears to be due to the fact that they are being graded on the quizzes. The student survey also indicated a higher level of satisfaction with the quizzes when compared to the problem solving activities. The quizzes had several positive impacts upon the students. Their attendance increased both in terms of their perspective as shown on the questionnaire and as measured by faculty observation. The students also indicated that they spent on average, 1.065 hour per week studying for the quizzes while at home. This was lower than anticipated and explains why a zero failure rate was not achieved.

### **Conclusion**

The purpose of this study was to determine if teaching strategies could improve the success rate and learning of students taking a course in engineering economy. It was clear that faculty teaching strategies do have a positive effect on student success. Weekly quizzes based on homework assignments and readings appear to be the most effective strategy to engage students in this particular case. We believe this to be true because weekly quizzes force students to study on a regular basis and to keep abreast of material in the course as it is being presented. The authors plan to study the effects of weekly journals and extra help sessions on student success in the upcoming semesters while continuing with weekly quizzes to determine if success rate can be further improved.

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