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A Comparison Between Frequent Out-Of-Class Assignments and Frequent In-Class Assessments Relative to Student Performance in a Sophomore Level Electrical Circuit Analysis Course

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A COMPARISON BETWEEN FREQUENT OUT-OF-CLASS ASSIGNMENTS AND FREQUENT IN-CLASS ASSESSMENTS RELATIVE TO STUDENT PERFORMANCE IN A SOPHOMORE LEVEL ELECTRICAL CIRCUIT ANALYSIS COURSE

Abstract

Two parallel sections of a sophomore level circuit analysis course in Electrical Engineering Technology were structured to provide insight to the marginal utility of out-of-class assignments versus in-class assessments in academic performance. Student distributions for each section, the classroom model, the composition of the common tests and exam, and grading formats are discussed. The data presented and the conditions of the resulting observations indicate the model which favored out-of-class assignments led to improved test scores.

Introduction

Introductory courses taught in undergraduate engineering curriculums generally use combinations of out-of-class assignments (homework) and in-class assessments (unannounced or announced quizzes, tests and final exam) to evaluate student performance.

Modern educational tools often employed include mandatory classroom attendance and group exercises for freshman and sophomore level undergraduate courses. A fundamental difference between university and pre-university (high school) classroom is that attendance has not always been considered mandatory at the university level. The authors of this paper believe the traditional 'optional' attendance policy shifts responsibility to the university student and is a vital objective of a college education.

The faculty within the department also believes the success of a student in a technical profession is predicated upon mastering fundamental concepts and analytical methods taught at the introductory level. As a result, it has been agreed that student performance in introductory courses should be based on individual assessments. Group exercises and team learning environments are integrated in the EET curriculum at the senior level to assist in the successful transition of the student into his or her profession.

The faculty within the department has traditionally used a weighted average comprised of graded homework assignments, quizzes, tests, and a final exam to determine an overall grade. The effect of graded versus non-graded homework in an introductory undergraduate engineering course has been investigated [1], and previous research has illustrated the effectiveness of homework assignments for pre-university academic levels.[2,3] Observations regarding the marginal effectiveness of graded homework assignments versus in-class quizzes in overall student performance, although informally discussed between members of faculty, are not readily available.

An opportunity to investigate the two reinforcement techniques afforded itself at the beginning of the fall semester, 2005. Increased student enrollment combined with classroom size

limitations allowed for two sections of the sophomore level AC circuit analysis course to be scheduled for the fall semester, 2005. Students were ranked and then distributed as a function of their performance in the pre-requisite DC circuit analysis course.

The instructors assigned to the sections agreed to vary the weighting of graded homework assignments vs. in-class quiz schedule during each half of the semester. Both sections of the course were given common tests and a common final exam. The composition and grading of the four tests were alternately performed by the two instructors.

The following sections of the paper describe the methods employed by the instructors to vary two parameters of a traditional undergraduate engineering course without disrupting the learning process. The intention of the study was to compare the effects of the two techniques without compromising the student's opportunity to learn the material and improve his or her probability of success in junior and senior level courses.

Forming of the Sections

The goal in the formation of the individual sections was to provide equal performance potential between the two. Since the goal of the study was to evaluate class performance rather than that of the individual student, it was decided to rank the entire group of students with respect to previous academic performance and allocate students based upon that criterion. More specifically, the prerequisite course in DC circuit analysis, offered the previous term, was used as the metric. In those cases where a student had satisfied the prerequisite for the course through other means (transfer credit or prerequisite taken two semesters or more prior), the student's overall grade point average was used to rank them with respect to the other students in the group. An alternating selection process was used to distribute the students to achieve a balance of demonstrated academic performance. In the event that a student had no grade point average, as would be the case when the student transfers into the college and is in there first semester of on-campus study, there is no clear way to rank these students. Due to classroom size restrictions these students were arbitrarily assigned to the larger section.

The Assessment Models

It was decided that both assessment models would employ homework, unannounced quizzes, announced quizzes and tests. The difference between the two models would be in the weighting and emphasis of quizzes versus out-of-class work. It was imperative that neither section would have an advantage over the other, so it was decided that the model would allow for equal time for each class in each of the two models.

The first model was structured to emphasize homework assignments. Quizzes would be administered, however at a relatively lower frequency. The second model would emphasize quizzes, both announced and unannounced, with fewer out-of-class assignments being issued. There would be homework assigned, however the assignments would be somewhat larger to provide adequate coverage of the material, but fewer assignments in total. Approximately at the mid-point of the term the models would be switched as to not put one section at a distinct

academic advantage if indeed one existed between the two models. A breakdown of the models for the two sections is offered in Tables 1 and 2.

Assessment Event	Frequency During First 7 Weeks	Frequency During the Second 7 Weeks
Test	2	2
Announced Quiz	1	3
Unannounced Quiz	1	2
Homework Assignment	5	2

Table 1: Assessment Model for Class A

Assessment Event	Frequency During First 7 Weeks	Frequency During the Second 7 Weeks
Test	2	2
Announced Quiz	3	1
Unannounced Quiz	2	0
Homework Assignment	3	3

Table 2: Assessment Model for Class B

As can be seen in Tables 1 and 2 there are differences in the exact quantities of homework and quizzes, however the emphasis should be apparent.

Classroom Management

Both sections were informed during the first meeting of the semester, both verbally and by syllabus, of the structure of the graded assessments for the course. It was emphasized that attendance was important and that there would be unannounced quizzes administered during the term. It was made clear that the four in-class tests and the final examination would be common to both sections. No indication was made that a study was being conducted, and the classes were informed that final grades would be assigned at the discretion of the individual instructor. The

final student averages for both sections would be determined based upon the distribution shown in Table 3.

Assessment	Component of Final Student Average
Test	35%
Homework Assignment	15%
Quiz (both announced and unannounced)	15%
Final Examination	35%

Table 3: Graded Assessment Weighting for Final Course Average

All students in both sections were allowed to drop their lowest homework grade, lowest quiz grade, and lowest test grade in the calculation of their final average.

Impact upon Attendance

The attendance records for both sections are presented in Figures 1 through 4. The data presented in Figures 1 and 2 represent the actual attendance on each of the regular class meeting times. The gaps between the data points, where it appears as though a connecting line is missing, represent an instance where the class did not meet. Rolling three session averages of the attendance data for both sections are presented in Figures 3 and 4. This representation is often employed to present a more easily interpreted trend in data that is not well behaved. The vertical lines indicate those meetings where tests or the final examination were administered.

Looking first at Figures 1 and 3, the observation can be made that the attendance level starts at a higher point and then decreases during the first half of the course. In Figure 1, spikes in attendance are evident when the tests and the final examination were administered, however the attendance trend during the first half of the course is apparent as shown in Figure 3. After the first half of the course had been completed, Class A was informed that the frequency of quizzes, both announced and unannounced would increase. At this point the data indicates that attendance increased significantly and maintained this increased level throughout the duration of the semester. The attendance spikes did not disappear, however the rolling average in Figure 3 indicates an overall improvement in attendance.

Figures 2 and 4 present the data collected for Class B. This section was not informed of the frequency of quizzes other than by general statements that were made in the syllabus and verbal statements made during the initial class meeting. The students knew that quizzes would be given, but there was no indication that the frequency of these events would be variable. The attendance was relatively steady during the period leading up to the first test, after which it began to drop significantly as shown in Figure 4. The minimum attendance is reached during this first period, when the frequency of quizzes was at a high for the term. After the second test the

attendance increases to a relatively steady level which was maintained throughout the remainder of the term.

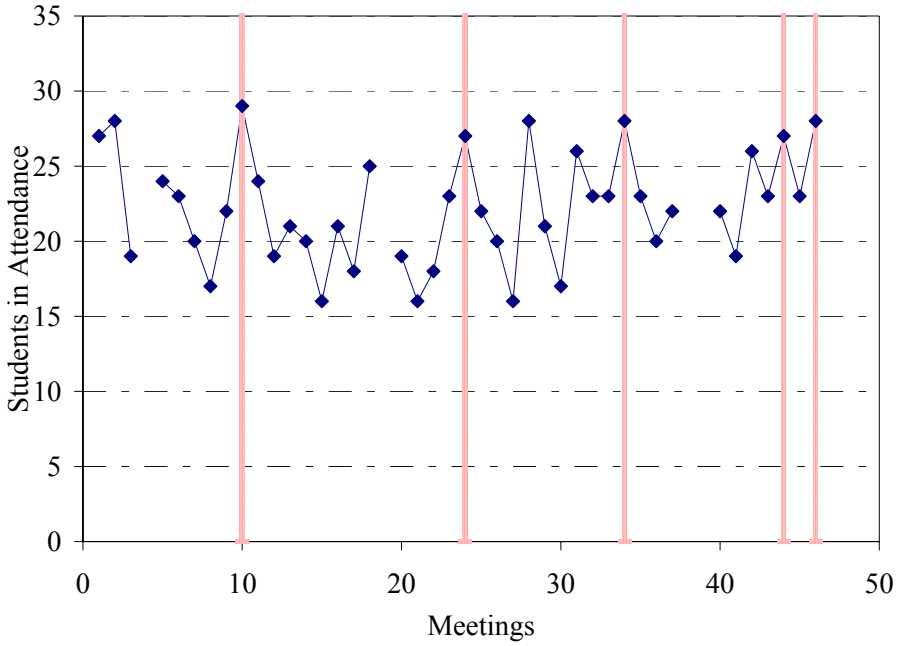

Figure 1: Attendance Record for Class A

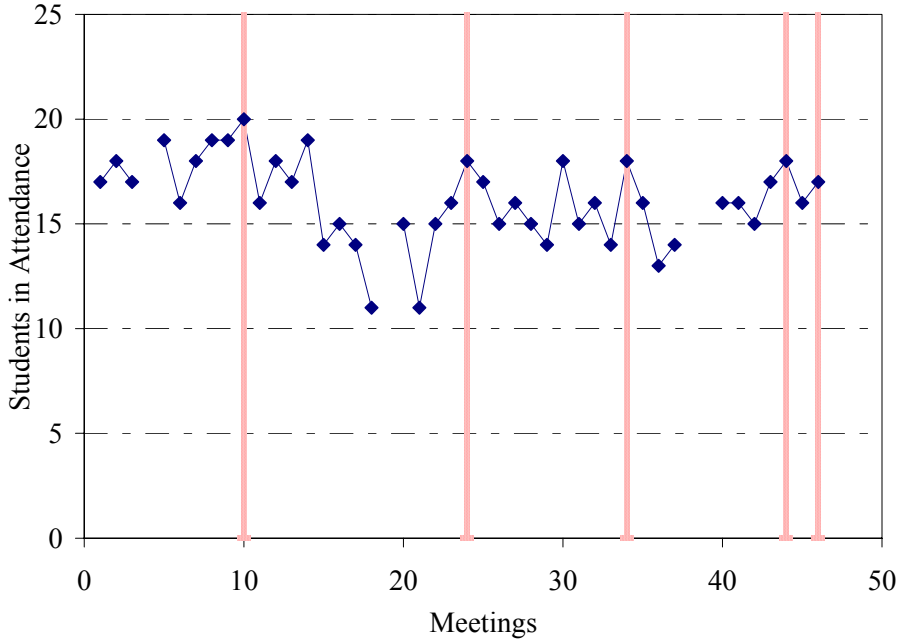

Figure 2: Attendance Record for Class B

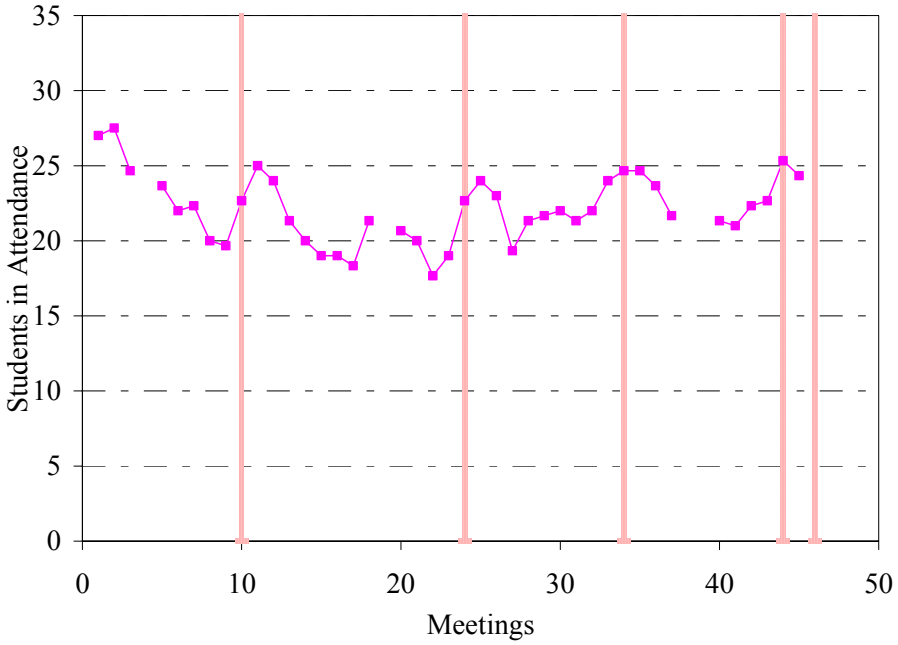

Figure 3: Three Session Rolling Attendance Average for Class A

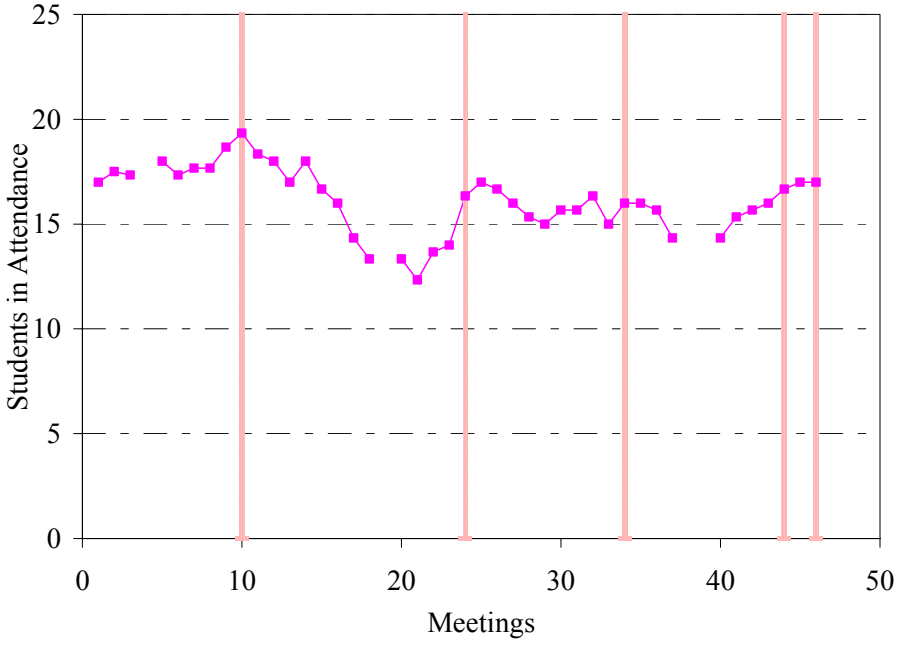

Figure 4: Three Session Rolling Attendance Average for Class B

Impact upon Academic Performance

The class scores for the four tests and the final examination were targeted for comparison whereas the quizzes and out-of-class assignments were not, the reason for this being that the quizzes and homework assignments were not common between the two sections. Table 4 presents the class averages for each of these assessments.

Assessment	Created by:	Graded by:	Class A Average Score (%)	Class B Average Score (%)	Difference (%)
Test #1	Instructor B	Instructor A	73.9	71.8	2.1
Test #2	Instructor A	Instructor B	82.0	78.3	3.7
Test #3	Instructor B	Instructor A	76.4	80.0	3.6
Test #4	Instructor A	Instructor B	76.1	73.5	2.6
Final Examination	Both	Both	63.0	61.8	1.2

Table 4: Average Scores for both Sections

With the exception of the first test, it is apparent that the test performance of each section relative to the other varied with the instructor who created the test. The highest test score for either section occurred in the first half of the course, Test #2, when homework assignments were being emphasized. Likewise, the next highest test average occurred during the second half of the semester, Test #3, when Class B was also stressing the completion of more homework.

Although subtle, the data suggests that test performance was at a higher level when homework was being emphasized and when the instructor associated with that section created the test in question. The difference between the two sections with regard to the final examination was less significant than any of the four tests. This is most probably due to the way the examination created and the way that the grading was performed.

Conclusions

Electrical circuit analysis courses are similar to other lower level technology courses in that they are rooted in applied mathematics. These courses teach analysis methods that are reinforced through frequent practice and repetition. The model which favored a greater number of homework assignments led to higher test scores taking into consideration the instructor who created the test. This is significant since the creator of the test would tend to incorporate those technical points that they themselves had placed greater emphasis upon in the classroom.

The authors of this paper expected to see certain trends revealed through the data that was collected, and to a degree these expectations were met. It is apparent that in this study there is a relationship between the perception of potential unannounced quizzes being given and overall classroom attendance. This supports the premise that the lowering of a student's average due to

the missing of an in-class assessment does indeed motivate students to attend class more regularly.

The question that now needs to be addressed is which of the two models is the most effective? If the primary goal is to increase test scores, the data presented supports a pedagogical approach which emphasizes out-of-class assignments.

In the case where data is desired regarding relative graded classroom performance, a preferable scenario for conducting a study would be for the same instructor to teach both sections thus ensuring that the same topics were presented in the same order with more or less the same amount emphasis. The problem arises in that teaching two sections at two different times would skew the attendance data to a point where it would most likely be invalid. Also, since the opportunity to perform this study stemmed from a need to create another section of the course, the authors were limited by the need of University to keep the same time slot for both sections.

[1] Trussell, H.J., Dietz, E.J. April 2003. A Study of the Effect of Graded Homework in a Preparatory Math Course for Electrical Engineers, *Journal of Engineering Education*, 92(2):141-146

[2] Pashaal, R.A., T. Weinstein, H.J. Walberg. 1984. The Effects of Homework on Learning: A Quantitative Synthesis. *Journal of Educational Research*. 78(2): 97-104.

[3] Walberg, H.J., R.A. Paschal, T. Weinstein. 1985. Homework's Powerful Effects on Learning. *Educational Leadership*. 42(7):76-79.