AC 2011-414: USING FINAL EXAMS AS AN INCENTIVE TO INCREASE STUDENT MOTIVATION TOWARD HOMEWORK

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Using Final Exams as an Incentive to Increase Student Motivation Toward Homework

Abstract

A study is presented to determine whether student motivation to do homework in a course can be significantly increased using the final exam as an incentive. Traditionally, students are encouraged by an instructor to do homework problems in a course as a means to enhance mastery of course topics. Homework assignments are a common method used to help students prepare for course exams. Instructors typically prepare exams to adequately assess how well students understand course topics. These exam problems may be similar to homework problems, but are typically varied sufficiently to test for conceptual understanding rather than simply recitation of solutions. In this study, all of the course mid-term exams are prepared using the traditional methodology. The final exams, however, consist of multiple choice questions which are taken directly from the assigned homework problems with only the numerical values changed.

Two introductory mechanical engineering courses, dynamics and thermodynamics were selected for this study which involved classes at a large public university. During one semester, a control group was established for each course, followed by a study group the next semester. Differences in the incoming grade point averages of the two groups were not statistically significant. Students were assigned homework problems and encouraged to work them in preparation for all of the course exams. The control group was unaware that the final exam problems would be drawn from the assigned homework problems. However, students in the study group were informed during the first week of the semester that exam problems would be drawn from the homework problems. The final exams administered to both groups were identical. The performance of students on the final exam in the control group and study group were compared. Differences in the performances of the two groups will be discussed along with implications of the differences.

Introduction

It has been well established in the literature[1-3] that homework assignments are an essential pedagogical component of learning in engineering education. The traditional approach begins when an instructor introduces students to a course topic by producing notes on a board or projector. The instructor then assigns homework aimed at reinforcing the content presented in the lecture. Student performance is subsequently evaluated by the instructor in some form (homework, quizzes, exams, etc.). Considerable debate has emerged in recent years as a result of the engineering education research as to the approach taken in assigning homework. Many argue that a learning-centered approach is preferable to the traditional, teacher centered approach. Teacher-centered learning has the teacher at the center in an active role and students in a passive, receptive role. Student-centered learning requires students to be active, responsible participants in their own learning. Several scholars support a team approach to homework activities[REF], while others stress instructor innovation in course development by promoting curiosity and enthusiasm through greater student participation[REF].

The authors of this paper have all been actively engaged in improving engineering education through research since they joined their respective universities[REF]. In 2007, the authors participated in a joint study to determine if the use of online learning objects would help students master the required course competencies[REF]. In addition, one author is currently serving as the chief editor of the Journal of Online Learning and Teaching (JOLT) while all of the authors have served as reviewers and contributors for both MERLOT[REF] and ASEE. All of the authors use technology in the classroom, have adopted some level of student centered learning, and use peer-reviewed learning tools as needed. In spite of the many course improvements, grade weighting schemes, and changes in paradigm adopted by all of the authors over time, they have noticed little change in student participation in homework assignments in their respective courses. In the authors' experiences, continued innovation, technology, online learning, hands on learning, and the many tools suggested by scholars to engage students were insufficient to motivate the students to complete homework assignments once they left the classroom. Given the importance of homework in the learning process, the authors sought to focus on a way of motivating more students to complete their homework assignments.

The authors' perceptions are that students tend to weigh the impact of homework on their course grade in deciding how to prioritize their assignments. However, one author has changed the weighting of homework assignments in the calculation of the total grade from 0%, 10%, 20%, to 30% over time with no significant improvement in student participation. It becomes pedagogically questionable to allow homework to represent a significantly large portion of a course grade in a fundamental engineering course such as dynamics, thermodynamics, or mechanics of materials. Therefore, it seemed logical to seek out a connection between the homework component and another course grade component which carried more weight in the overall course grade. Exams or quizzes typically represent a larger portion of the overall course grade as compared to other components such as graded homework, projects, etc. Instructors generally note an increase in student enthusiasm and attentiveness when instructors link content in a lecture or worked example with an upcoming exam. Given all those observations, the authors hypothesized that it may be possible to increase student participation in assigned homework by explicitly linking the homework with the exam component of the course.

The difficulty with explicit linking of the homework to the course exams is that it leads to a regurgitation of homework solutions on the exams. This is not an effective approach in evaluating the student's understanding of the principles covered in the class. The trick, then, is to give the students incentive to participate in the homework assignments through an explicit linkage to the exam component without compromising the instructor's ability to properly evaluate the student's understanding of the principles. The authors all follow a traditional approach of course grading which consists of several regular exams dispersed throughout the semester and a comprehensive final exam. It was agreed that the comprehensive final exam was the optimal exam component to explicitly link the assigned homework in an attempt to increase student participation in homework and ultimately improve exam performance. Regular exams could be administered as usual by selecting problems designed to evaluate the student understanding of the basic principles. Students would be told at the beginning of the semester that problems on the comprehensive final exam would be selected from the overall set of homework assignments made throughout the course with only the numerical values changed in the hope that this would offer students an incentive to complete the course homework assignments.

Methodology

A study was undertaken in two introductory mechanical engineering courses, dynamics and thermodynamics. During one semester, a control group was established for each course, followed by a study group the next semester. The incoming grade point averages and hours earned were compared for each group to assess whether the groups were statistically different. Students in both groups were assigned homework problems and encouraged to work them in preparation for all of the course exams. Numerical answers were provided for students to check their homework answers. The control group was unaware that the final exam problems would be drawn from the assigned homework problems. However, students in the study group were informed during the first week of the semester that exam problems would be drawn from the homework problems. The final exams administered to both groups were identical. For the thermodynamics class, the final exam represented 25% of the total course grade and graded homework assignments accounted for 10% of the total course grade. Homework was not graded in the dynamics course and the final exam represented 35% of the total course grade. The performance of students on the final exam in the control group and study group are compared. In addition, the results for both courses are compared to assess whether the differences in weighting increased student performance on the final exam.

Results

The students incoming GPA and hours earned for control groups and study groups in both the dynamics and thermodynamics courses are shown in Tables 1 and 2. In comparing the control

Table 1. Comparison of incoming student GPA (4 point scale) for both the control and study groups in both courses

	Thermodynamics		Dynamics	
	Control Group	**Study Group**	**Control Group**	**Study Group**
Number of Students	42	40	43	38
Average	3.06	2.96	3.13	2.93
Standard Deviation	0.50	0.56	0.69	0.51

Table 2. Comparison of incoming earned hours for both the control and study groups in both courses

	Thermodynamics		Dynamics	
	Control Group	**Study Group**	**Control Group**	**Study Group**
Number of Students	42	40	43	38
Average	98.2	92.4	91.6	97.6
Standard Deviation	33.6	27.7	27.8	35.5

and study groups for each class, a two tailed *t*-test using a 95% confidence interval was employed to calculate a p-value. For the thermodynamics control and study groups, a comparison of incoming GPA and credit hours earned yielded p=0.3957 and p=0.3975, respectively. In both cases, the differences between the two groups were not statistically different. For the dynamics control and study groups, a comparison of incoming GPA and credit hours earned yielded p=0.1463 and p=0.3969. In both cases, the differences between the two groups were not statistically different. A complete one-way analysis of variance (ANOVA) was also performed on all four groups for both courses for incoming GPA and credit hours earned. The p-values for incoming GPA and incoming hours earned for all four groups are 0.370 and 0.686, respectively. Again, the differences amongst all four groups studied are statistically insignificant.

Students in both the study groups and control groups were given a multiple choice final exam which contained problems selected from overall set of homework assignments made throughout both the courses. The numerical values were changed for the final exam problems. The final exams contained other elements, such as conceptual questions, but these questions were not included in the study. For the thermodynamics classes, 15 problems were drawn directly from the homework assignments. For the dynamics classes, 10 problems were drawn directly from the homework assignments. The results from the final exams are presented in Table 3.

Table 3. Results from the final exams

	Thermodynamics		**Dynamics**	
	Control Group	**Study Group**	**Control Group**	**Study Group**
Number of Students	42	40	43	38
Average	55.2	57.7	54.3	57.9
Standard Deviation	17.3	15.1	20.6	19.2

For both classes, a slight increase in the final exam average is noted. A two tailed *t*-test using a 95% confidence interval was employed to calculate a p-value in comparing the control and study groups for both classes. For the thermodynamics control and study groups, a comparison of final exam scores yielded p=0.490. This difference is considered to not be statistically different despite the slight increase in final exam average observed. For the dynamics control and study groups, a comparison of final exam scores using the *t*-test gives p=0.420. Again, by conventional criteria, the differences between the two groups were not statistically different.

A statistical comparison between groups is not possible since the final exam problems were different between the dynamics and thermodynamics classes. A non-statistical comparison of the results shows a negligible change in final exam performance between the groups in both courses. This may suggest that the differences in course administration, such as component weighting and graded homework vs. non graded homework, made little difference in student performance. Further study in both courses would be required to substantiate this conclusion.

Conclusions

The study and control groups for both the thermodynamics and dynamics class showed no significant differences in composition and provided statistically acceptable samples to perform the assessment. In comparing the control and study groups, the results clearly indicate there was no statistical improvement in final exam performance through direct linking of homework assignments to the final exam. The study did not assess whether student participation in homework assignments increased or decreased using the final exam as an incentive. However, even if the participation did increase, the effect of the increase did not result any significant gains in final exam performance.

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