
DOES COLLECTING AND GRADING HOMEWORK ASSIGNMENTS IMPACT STUDENT ACHIEVEMENT IN AN INTRODUCTORY ECONOMICS COURSE?

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ABSTRACT

This study asks whether instructor-developed homework assignments need to be collected and graded in order to have an impact on student achievement as measured by exam scores. Earlier studies relying on t-tests concluded with few exceptions that grading homework does not significantly impact exam scores. A more recent study using regression analysis contradicts these results. This paper relies on regression analysis, but concludes that grading assignments does not increase student achievement. Comparing the two regression based studies points to the possibility that inexperienced college students benefit from graded assignments while experienced students do just as well with generalized feedback.

INTRODUCTION

Surveys of academic economists in the United States conducted in 1995 and 2000 by Becker and Watts (2001) find that “instructor-developed problem sets are popular in all courses”. While these problem sets are an important component of teaching strategies employed in economics courses, only little systematic study has been devoted to how these homework assignments have to be administered in order to be effective, a notable exception being the paper by Grove and Wasserman (2006a).

Casual observation suggests that students frequently do not complete voluntary homework assignments. Collecting and grading homework assignments is one method to motivate students to spend more time on task, identified as one of the seven principles for good practice in undergraduate teaching by Chickering and Gamson (1987). The general consensus is that the more time students spend on learning, the greater the amount of learning (Sorcinielli, 1991).

Grading homework assignments also is one way to incorporate a second principle of good teaching, namely giving prompt feedback. This reasoning suggests that collecting and grading homework assignments can be expected to positively impact student learning. However, giving frequent feedback on different types of assessments is very costly in terms of instructor time, especially in larger introductory courses. In particular, the question arises whether homework assignments need to be collected and graded in order to generate increased student learning, or whether it is sufficient to make problem sets and solutions available to students. Does the feedback need to be student specific or is it sufficient to provide generalized feedback accessible to all students? Grading homework assignments is a sure way to increase an instructor's time on task and may positively influence student evaluations of a course (Dudley & Shawver, 1991), but does it succeed in increasing student achievement?

Using the theoretical model of student behavior developed by Becker (1982), one can ask whether collecting and grading homework assignments will succeed in changing the amount of time students allocate to studying economics. A change in instructional technology, here the way in which homework assignments are structured, may not increase the amount of learning if students simply allocate a fixed amount of time to different productive activities so that homework completion simply substitutes for time spent in other activities such as reading the textbook or working through lecture notes. Also, students could simply change the timing of work on a homework assignment. Instead of working on a graded assignment before a due date, students may just access the non-graded homework assignment with solutions before an exam, producing the same effect in terms of exam scores. It is thus conceivable that the practice of collecting and grading homework assignments will not produce a significant gain in student achievement as measured by exam scores. This reasoning is somewhat different from Grove and Wasserman (2006a) who contend that there are two sets of students who would not be affected by a grade incentive for homework assignments: those who would have completed the problem sets without any incentives and those for whom the expected payoff remains too low relative to the value of their time. In either case, the fact remains that grade incentives may not produce any impact on student achievement, but are very costly in terms of instructor time. Thus, it is important to find the optimal mix of feedback and use of instructor time in those classes.

This study seeks to determine whether instructor-developed homework assignments need to be collected and graded in order to have an impact on student achievement as measured by exam scores. By comparing two student groups, a

control group and a treatment group, this study asks whether collecting and grading homework assignments generates a statistically significant impact on exam performance. The hypothesis is that grading homework assignments will increase exam scores. Results of the present study are interpreted in light of previous research on the impact of required versus voluntary homework assignments. The major conclusion is that more inexperienced college students seem to benefit from graded assignments while more experienced students do just as well with generalized feedback.

PREVIOUS STUDY RESULTS

While a large number of studies concerning the impact of homework on student achievement have been conducted for elementary and secondary education levels, fewer studies of post-secondary student achievement exist. A quantitative synthesis of homework research for elementary and secondary students by Paschal, Weinstein and Walberg (1984) concluded that there is a “moderately large average effect of assigned homework that is commented upon or graded” on achievement measures. Cooper’s (1989) meta-study on the use of homework in elementary and secondary schools refines this point. A frequently cited result found by Cooper (1989) is that the correlation between time spent on homework and achievement measures is dependent on students’ grade level. While the correlation between time spent on homework and achievement measures shows a negative correlation for elementary school students, the correlation is small but positive for middle school students, and more strongly positive for high-school students. Based on this evidence one may draw the conclusion that homework should increase achievement measures for college students also, since they are more similar to high-school students in age, but here the evidence is very mixed. Foyle (1988) concludes that at the college level other methods aimed at increasing student achievement work as well as traditional homework that is focused on practice.

With few exceptions, the studies directly comparing graded (compulsory) versus non-graded (voluntary) homework tend to conclude that grading homework does not significantly impact achievement measures. For the public school setting, Cooper (1989) states that only one study has compared these effects and has reported non-significant differences. On the college level, Stephen (1977), Milligan and Reid (1971), Wiebe (1982), Vruwinkle and Otto (1987), and Peters, Kethley and Bullington (2002) all find that grading homework does not increase achievement measures compared to a control group that does not have to turn in

assignments for grading. Only Weems (1998) finds that college algebra students perform better with collected and graded homework. All these studies share a common methodology. They all perform t-tests to compare control and treatment groups. The study by Grove and Wasserman (2006a) is the only other study that finds improved student performance on exams in response to a grade incentive for homework assignments. Their study differs from previous work in the empirical methodology used. Grove and Wasserman (2006a) use an educational production function approach to control for student characteristics such as academic aptitude and demographic characteristics, and to establish whether students in the experimental group, where assignments count towards the course grade, outperform students in the control group on exams. They find that the grade incentive to complete assignments throughout the semester boosts "the exam performance of freshman and did so by at least one-third of a letter grade in Economics 101 compared with control-group students who received identical assignments but no direct grade incentive to complete them" (Grove & Wasserman, 2006a).

The present study uses a methodology and experimental set-up that is very similar to the one employed by Grove and Wasserman (2006a), but confirms the results of earlier studies, showing no significant effect of graded assignments on exam scores. The paper will highlight differences with Grove and Wasserman's results (2006a). This should be helpful for instructors in making the decision when to require graded homework assignments which count towards a final course grade, and when voluntary homework assignments are sufficient.

EXPERIMENT AND DATA

This study compares student performance in four sections of a Principles of Macroeconomics class at Weber State University, a regional university in the Utah state system. Data was collected for four sections taught during the fall of 2003 and during the spring of 2004 with an enrollment of about 40 students in each section. Thus, there was no difference in class size that could have had an impact on student performance (Caviglia-Harris, 2004; 2005). A total of 162 students completed the course in all sections. Two sections of the course, meeting back to back at the same days during the morning, were taught by the same instructor using identical instructional materials and assessments during each semester. The common course requirements consisted of four exams throughout the semester, an attendance grade carrying 5% of the overall course grade, and a writing project. Students in all sections had access to an on-line course page on which the instructor posted

assignments. There were five assignments, the same number of assignments for the semester as in the Grove and Wasserman (2006a) and Miller and Westmoreland (1998) studies. In one section students were told (in the syllabus and orally) that they were required to turn in the homework assignments at a specified due date and that the homework would be graded and carried a 15% weight in computing the final course grade. In a parallel section of the course, students were told that the assignments were available and that they should work on them before the due date, after which the solution sheet would be available, but the assignments would not carry any weight in computing the final course grade. The instructor made it clear to both sections that the assignments should be considered good preparation for the exams because each of the four exams conducted over the course of the semester contained a number of essay-type problems, along with multiple-choice problems, that would draw upon the homework assignment. This point was underscored by making practice exams available on the course page. Both assignments and exams were graded by the instructor one problem at a time to ensure maximum consistency with respect to the grading practice.

The ideal experimental set-up to compare instructional techniques would have relied on randomizing test subjects within each section taught so as to control for section-level and instructor effects. Due to the difficulty of setting up such an experiment, this study did not use such a set-up, thus presenting the possibility of selection bias (Pozo & Stull, 2006). To best avoid this bias, students in each section were not made aware of the fact that they were part of an experiment. Later in the semester, students commented on the fact that the other section did not have to turn in assignments, making it clear that the different instructional techniques had not caused them to choose one section over another. Also, students did not switch sections after the syllabus was handed out and the different course requirements were revealed. The most common consideration in terms of signing up for sections of one class tended to be the instructor and scheduling issues, since virtually all students work at least part-time off-campus and take courses in a block during a few days during the week. Based on this evidence it is reasonable to assume that selection bias is not a huge concern.

As pointed out by Miller and Westmoreland (1998), if homework assignments are poorly conceived, then the completion of homework assignments might not improve test performance. A cursory way of testing whether the homework assignments in this study can be reasonably expected to correlate with exam performance is to use Cooper's (1989) classification of types of homework assignments. Cooper (1989) distinguishes between different purposes of homework,

namely practice, preparation, extension and integration. Assignments that focus on practice and integration of course material previously covered through lectures, class discussions and readings, should be better suited to serve as preparation for exams that focus on core course material. Assignments with the goal of preparing students for new material and showing extensions of core material may help in improving class participation and lead to a deeper understanding of newly covered material, but may be less directly related to test performance. For the present study, the instructor roughly classified each assignment problem according to its major purpose and then compared the assignment problems to the essay questions students had to complete on each exam. The majority of assignment problems fell into the practice category and about half of all the essay questions on the exams were directly related to a question found on a previously assigned homework. This suggests that it is reasonable to expect a positive impact of thorough homework completion on test performance for the present study. On the other hand, students may have used the solution sheets as a study guide and could have gained the same information necessary to improve exam performance.

Within the graded group, 75% of all students handed in all five assignments, 95% handed in at least four assignments, and 5% handed in less than four assignments. This compares favorably with the rate of homework completion in Grove and Wasserman (2006a). As would be expected, the section that was required to turn in assignments generated more in-class questions and discussion concerning the homework. In order to control for this difference, the instructor made sure that similar discussions took place in both sections.

The students enrolled in the principles of macroeconomics course typically have a junior standing and are business or accounting majors, completing part of the required business core courses. All students enrolled in the course have completed the principles of microeconomics course and college algebra. Student data on class performance and absences were collected and recorded by the instructor. Data on students' GPA and the course grade for the prerequisite principles of microeconomics course were compiled from university records so as to avoid student reporting errors (Emerson & Taylor, 2004). More than 70% of the students are male.

Table 1: Student Characteristics

Variable	Mean values for Control Group (non-graded) N = 86	Mean values for Experimental Group (graded) N = 76	t-statistic
Gender (1 for males)	.756	.68	1.06
Cumulative # of credit hours completed before taking macro	75.1	72.9	.56
GPA	3.26	3.22	.56
Previous semester GPA	3.34	3.193	1.62
Principles of Microeconomics grade (prerequisite)	3.07	2.92	1.16
Mean Exam Score	77.7	76.8	.54
Absences	4.47	3.77	.99
Majors (1 for majors within the school of business)	.756	.813	-.89
Age	23.95	23.19	1.30

For all the characteristics described in Table 1 no statistically significant difference in the means of the control and experimental groups exists.

Instruction in the class was mostly in the form of lectures, supplemented with some in-class group exercises that were similar to homework assignments. About two-thirds of all assignment problems were of the practice type, based on the lectures and in-class exercises. Exams contained multiple-choice, as well as essay-type questions that required some problem solving and graphing.

METHODOLOGY AND RESULTS

The method used to estimate the effect of grading assignments on student achievement follows the commonly-used practice of formulating a reduced form educational production function (Emerson & Taylor 2004). Such a function defines student achievement, the output, as a function of various inputs, here academic

ability, student characteristics, number of absences, and membership in an experimental group.

$$\textit{Student achievement} = f(\textit{academic ability}, \textit{student characteristics}, \textit{number of absences}, \textit{membership in the experimental group}).$$

The dependent variable student achievement is measured as the mean exam performance of all four exams taken over the course of a semester. This variable can take on values between 0 and 100. The minimum value observed in the sample is 50.5 and the maximum value observed for one student is 98.5. The next highest score of 96.5 is achieved by two students. The dependent variable does not exhibit characteristics of a censored sample with observations clustered at an upper threshold. This warrants use of the simple ordinary least squares method in favor of more complicated estimation methods such as a tobit regression.

The dependent variable that is the focus for this study is membership in the experimental group. Students in the experimental control group, enrolled in the course sections that do not collect and grade assignments, are assigned the dummy variable 0. Students in the experimental treatment group, enrolled in the course sections where graded homework assignments are part of the course requirements, are assigned the dummy variable 1. The hypothesis is that membership in the treatment group will have a statistically significant, positive impact on the exam performance of these students.

The other dependent variables control for student ability, student characteristics and student motivation. For regression (1) academic ability is measured by the collegiate GPA prior to taking the principles of macroeconomics course. For regression (2) academic ability is measured by the grade received in the principles of microeconomics course, a pre-requisite completed by all students prior to enrolling for macroeconomics. Both measures of academic ability cannot be used in the same regression because the two variables are highly correlated and the microeconomics grade is an input for the overall GPA. While the use of GPA as a measure of academic ability is common in the literature (Caviglia-Harris, 2004; Emerson & Taylor, 2004), Grove and Wasserman (2006b) use a standardized measure of semester GPA to account for variability in grading practices. To address this issue, the present paper also uses the microeconomics grade as a measure of academic ability. This grade is less likely to suffer from large variability in grading

practices compared to general education courses and courses taken in other colleges and departments.

The only student characteristics controlled for are gender, major and total credit hours completed before enrolling in the course. There is virtually no heterogeneity with respect to ethnicity, fraternities/sororities are virtually non-existent on campus, and SAT scores are generally not available since Weber State has an open enrollment policy. These variables, included in the Grove and Wasserman (2006a) paper, are thus omitted in the present study. Since attendance was part of the final course grade, the instructor kept records of attendance, and the number of absences enters the educational production function as an explanation for student motivation.

Estimation results are presented in Table 2, with t statistics in parentheses.

Table 2: Estimation Results		
Variable	(1)	(2)
Constant	27.41** (4.63)	53.27** (13.56)
GPA	14.86** (10.34)	n/a
Microeconomics Grade	n/a	8.39** (10.44)
Graded Group	-0.47 (-0.37)	0.04 (0.03)
Absences	-0.07 (-0.07)	-0.15 (-0.98)
Male	1.00 (.07)	-1.05 (-0.74)
Total Cumulative Credit Hours	-0.01 (-0.27)	-0.02 (-0.71)
Business School Major	2.62* (1.67)	1.93 (1.24)
Adjusted R-square	43.1	43.6
* significant at the 10% level, ** significant at the 1% level		

For both regressions, the only variable significant at the 1% level is the measure of student ability, GPA and the grade received for the pre-requisite microeconomics course. In regression (1), a one point increase in GPA increases the mean exam score by almost 15%, the difference between a C+ and an A. The only other variable with a significant impact on student performance (at the 10% level) in regression (1) is a student's major. Being a business major increases the mean exam score by about 2.6%. In both regressions exam performance is not affected

in a statistically significant way by whether students were a member of the graded group or the non-graded group. Thus, the practice of collecting and grading assignments cannot be shown to positively impact student achievement in this study. The hypothesis that grading homework assignments has a positive impact on exam performance has to be rejected.

CONCLUSION

The present study uses a methodology and experimental set-up that is very similar to the one employed by Grove and Wasserman (2006a), but confirms the results of earlier studies that relied on t-tests. Grading homework assignments does not produce any significant effect on exam scores. For the particular classroom setting studied, it can be concluded that the generalized feedback provided on homework assignments was just as good as the individualized feedback on completed assignments in terms of generating increased performance on exams. Compared to the Grove and Wasserman (2006a) study, multiple reasons such as the use of non-standardized GPA, homework design and the nature of the experiment may have contributed to the difference in results. While those differences cannot be explored due to the lack of comparable data, one factor, namely student experience, is measurably different in the two studies. The average age of students in the present study is more than 23 years and the average number of credit hours completed is 74, meaning that the majority of students had at junior standing at the time of the study. The Grove and Wasserman (2006a) experiment included freshman and sophomores only. This difference points to the possibility that something akin to the grade-level effects found in the studies of elementary and secondary education levels exists on the college level. More inexperienced college students are found to benefit from graded homework assignments or more individualized feedback, while more experienced students are able to gather the necessary information from generalized feedback. An instructor deciding how to allocate time should thus choose to grade homework assignments for freshmen and sophomores, but may choose to give generalized feedback to more experienced students without adverse effects on exam performance. This conclusion points to further research based on a larger, multi-section study that includes students from freshmen to seniors, ideally at different institutions. Such a study should carefully consider homework design, a topic not yet explored in the context of teaching economics.

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