USE OF A STUDENT-AUTHORED STUDY GUIDE TO TEACH

ECONOMICS AND BUSINESS STATISTICS AND APPLIED ECONOMETRICS

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**Abstract**

This paper represents a very preliminary analysis of how the incorporation of a student-authored study guide project influences learning and student perceptions in an introductory economics and business statistics course as well as a graduate applied econometrics class. Results from three separate sections of the statistics course show that student scores on quizzes and examinations improve most when an active project requiring students to publish example questions is incorporated into the course material. Later use of the published study guide does appear to positively influence quiz and examination performance when compared to a section that does not utilize the study guide. Results using a student-authored study guide do not appear to have a significant impact on student examination performance in the graduate applied econometrics course. This suggests that any cognitive gain is likely made at the middle to lower end of the normal grade distribution.

**I. Introduction**

The literature in economic education over the past decade is rich with information on various techniques and materials useful in making introductory economics courses more interesting to students. The common thesis in this area of research is that, presumably, a more interesting method of imparting course material beyond the standard lecture format will motivate students to learn more effectively. While it has not been empirically proven that any of the various approaches enhance student learning of the basic subject material in economics or related empirical fields, the proliferation of alternative learning vehicles in the literature and in the textbooks available to instructors suggests that there is a growing belief that these methods are effective.

The general claim that a combination of lecture and another alternative information delivery device, especially one that involves the active participation of students is not new to the literature in the education discipline (Rich, 1988). Becker and Watts (1995, 1998) are papers most often credited in the economic education literature with first incorporating the use of nontraditional techniques to teach economics. Cameron (1998) extended this line of analysis showing that students typically learn in different ways and that the use of varied learning tools can improve effective thinking in an introductory economics classroom. The development of this general educational strategy at the collegiate level in economics courses is relatively new. Likewise, analysis of an alternative teaching technique in quantitative areas of economics, such as business statistics and econometrics, is a relatively new area of exploration.

Strategies used to teach basic concepts in economics range from the use of simulation games (Raehsler, Haggerty, and Caropreso, 1996) and the incorporation of experimental bargaining games (Raehsler, 1999) to a more abstract use of Shakespeare to teach monetary economics (Kish-Goodling, 1998). This paper will primarily look at the impact the inclusion of a student-authored study guide has on learning in an introductory economics and business statistics course (ECON 221). Use of a similar project incorporated in a graduate applied econometrics course will also be analyzed. The rationale behind the belief that an active project like this can aid in student learning is that it forces students to read more deeply into the material presented in the course and the process of developing study guide questions is actually a way to study for examinations. In addition, the prospect of a student seeing his or her name as an author of a study guide to be used by other students in subsequent classes should lead students to put greater effort in the project. The concept of solving problems in an active learning environment seems to match the general pedagogical strategy observed in courses that involve a great deal of quantitative analysis.

**II. Study Guide Project and Course Sections**

Much of the analysis in this paper is limited to using information derived from three sections of my introductory economics and business statistics course (ECON 221) taught in two separate semesters: fall semester of 2012 (two sections) and spring semester of 2013 (one section). Students enrolled in this course typically are business majors, however, a good number of students enrolled boast a variety of liberal arts and education college academic majors. In the fall semester of 2012, one section of 28 students in ECON 221 was given the study guide project outlined below. That same semester, a section of 33 students were not assigned the project and did not utilize the study guide developed by the other section. Quizzes and examinations for the two sections, however, were identical so that direct comparisons could be made regarding academic performance. In the spring semester of 2013 a section of 30 students was not assigned the project of developing a new study guide. Instead, that section was given the study guide developed by students the previous semester and used as a resource for the course. Again, students in the spring semester section were given the same quiz and examination questions as students the previous semester in order to make direct comparisons.

The study guide project used in the fall 2012 section of ECON 221 was fairly simple. Students were assigned to one of five groups and each group was required to develop study guide questions for three separate chapters in the course. Chapters as associated group assignments were as follows:

Descriptive Statistics Groups A, B, and C

Probability and Discrete Groups D, E, and A

Probability Distributions

Continuous Probability Groups B, C, and D

Distributions

Sampling Distributions Groups E, A, and B

Estimation Groups C, D, and E

It is worth noting that the group names A, B, C, D, and E are not the same as Groups 1, 2, 3, 4, and 5 described in the data analysis section below. Also, it is clear that with the rotation above, groups are responsible for working on three of the five chapters during the semester. Since the course covers more than five chapters, students do not begin work on this project for a little over a week in the beginning and are not required to work on the project the last two weeks of the semester.

For the active project, each group was required to submit fifteen multiple choice questions for each chapter assigned. Since two other groups were assigned to each chapter, a total of 45 multiple choice questions were available for all students in the class for study and review. Altogether, students in the section developing the study guide were exposed to 225 multiple choice questions generated by students in the class. Since questions were due prior to the beginning of lectures on chapter material, students in the three groups responsible for questions in each chapter were required to study the material prior to classroom discussion. Each group elected a representative to serve on the editorial board for the final version of the study guide. Students were told that the guide would be published with their names included as authors and that it would be used by subsequent classes. Assessment of work done on the project would be based on an overall group grade, a grade from others in the class using the study guide questions, and a score from each colleague within each group.

Analysis on the impact of this project is based on performance on examinations and quiz questions coming directly from the study guide questions, additional examination questions related to the material each group studied, and remaining questions not directly linked to each group’s work. Two multiple choice quizzes were administered for each of the five units under consideration in the course. Each quiz consisted of three questions chosen from each of the three groups and one question from the instructor (a ten question quiz). Again, since each group was responsible for three of the five chapters, every student would see 18 questions derived from their own group and 36 derived from other groups working on the same chapters. Only ten questions were generated by the instructor with the remaining 36 questions coming from other groups working on other chapters. Performance on the essay (or problem) questions on the midterm and final examinations are also used in the analysis. A survey was provided at the final examination and responses are studied in addition to taking a look at how student evaluations compare for two different sections of the course (one with the study guide project and another excluding the project).

In the applied econometrics course, a similar approach was used with some important variations. First, multiple choice quizzes were not given to students in this graduate course. Examinations consisted entirely of quantitative problems and computer exercises. As a consequence, groups were required to provide tem problems for two of the eight chapters in the course (there were only four groups given the lower enrollment numbers). The structure of the project was not as well-developed as that seen in the undergraduate course and problems on examinations were not exact duplicates of study guide problems. Comparisons are made between a section without the study guide that pre-dated a section where the study guide was first introduced. In order to do this, only like questions are compared between the two sections. This aspect of the student-developed study guide is not as far along as the analysis for the undergraduate course.

**III. Empirical Results**

The bottom line when introducing any class assignment involves considering how student learning is influenced. This is best measured by looking at class performance on quizzes and examinations. This section will begin by looking at performance on quiz material in the class that utilized the study guide from a separate group-level to an overall course performance. Results will then concentrate on how academic performance compares across classes when the primary difference relates to the inclusion of the study guide project. While not as closely linked to learning outcomes, the analysis of the undergraduate course will conclude by looking at the results of a student survey on the project and student evaluations across two different sections of courses with varying characteristics.

*Academic Performance in the Fall 2012 Section With the Project*

As stated above, one section of the ECON 221 course in the fall semester of 2012 included the study guide project. Table 1 below outlines important statistics related to academic performance and the group project. Figure 1, which follows, provides a visual representation of quiz results across groups in this particular section. There are some very clear patterns that can be observed concerning quiz performance across groups. To begin, Table 1 lists results from the best performing group to the worst group in the section with regard to overall group score. In addition to the overall quiz score, performance on the different types of quiz questions is presented. The own group question category refers to questions directly prepared by the group which show up on quizzes. The other group related questions category refers to multiple choice quiz questions prepared by other groups in the same assigned chapter (for example, groups B and C prepared questions on the same material as group A in the first chapter assigned). Instructor questions are quiz questions not available in the study guide and prepared by the instructor (me). All other questions are study guide questions prepared by student groups in other chapters (for example, groups D and E were not assigned the first chapter so questions from that unit would be included in this category for those two groups).

Within each group, average quiz scores on questions created by the group are the highest. As anticipated, scores on questions in the same chapter as the group assignment are generally higher than results for unrelated questions created by other student groups, however, this result is more significant among the two lower-achieving groups. This might indicate that study gains are more pronounced among lower-achieving students in

**TABLE 1: Summary Performance Data by Group**

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Category Group 1 Group 2 Group 3 Group 4 Group 5

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Group Score 30 28 25 24 17

Group Size 6 5 6 6 5

Average GPA 3.286 2.945 2.986 2.499 2.307

Standard Deviation of 2.947 3.396 3.118 3.095 6.721

Colleague Scores

(Group Cohesion)

Own Group Questions 92.593 91.111 88.889 79.630 82.222

Percent Correct

Other Group Related 84.259 84.444 80.556 71.296 70.000

Percent Correct

Unrelated Questions 83.796 82.963 82.099 68.056 63.669

Percent Correct

Instructor Questions 77.778 70.667 71.111 62.222 53.333

Percent Correct

All Quiz Questions 83.778 82.400 81.222 68.556 64.667

Percent Correct

Essay Questions 83.556 79.867 77.167 66.056 64.467

Percent Correct

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Groups where work is equally shared will have a lower standard deviation of how points are assigned to

colleagues in each group.

the course involved in the group project. Interestingly, Group 3 in the table shows a better performance on unrelated group quiz questions than on questions developed by other groups in the chapter related to their assigned chapter. As anticipated, average scores are lowest on quiz questions developed by the instructor and not available in the study guide.

Between groups it appears there is a strong correlation between quiz scores, scores on examination problems, and overall average grades of groups. Better students appear to do well on all assessment aspects of the course. The strong linkage between quiz performance and performance on essay examination questions is supported in Figure 2. The table also presents the standard deviation of scores assigned to each student in the group by colleagues. This is used to loosely identify the level of cohesion or shared work load by group members. The idea is that if every group member contributed equally to the final group product, each student would receive the same score and the standard deviation of scores would be zero. The higher this standard deviation becomes, the less equal are work shares among students in the group and this is regarded as being a less

**Figure 1: Quiz Performance by Groups in Statistics Course With Project**

**Figure 2: Average Essay and Quiz Scores Across Groups**

cohesive group (a few leaders and a good number of free riders). It was initially believed that this might explain how well groups do and how well students learn. This does not appear to be entirely the case. When Group 5 is included in the analysis, it appears that group score declines when there is a lack of cohesion as displayed by a high variation in group self-assessment scores. When Group 5 is removed, however, a strong negative relationship between group scores and the cohesion measure is not evident in the plot presented in Figure 3. The quality of the study guide material, therefore, might be a result of the work presented by a few talented members of each group. Clearly, this analysis is very weak and needs additional investigation.

**Figure 3: Group Score and Group Cohesion Measure**

A similar analysis is made when plotting the group cohesion measure against average group performance on quiz questions specific to the group. As above, when Group 5 is included in the analysis it is evident that less cohesion (a higher standard deviation) indicates a lower average performance on quiz questions developed by groups. Removal of Group 5 eliminates this expected linkage between the two measures. It is worth noting that Group 5 included two students who did not participate actively in the project; the only group in the class that reported this adverse behavior.

**Figure 4: Own Quiz Question Performance and Cohesion Across Groups**

*Academic Performance Across Classes in ECON 221*

Table 2 below presents data on academic performance across classes for both quizzes and essay problems on examinations. Figures 5 and 6 provide a graphical representation of ECON 221 results across sections. In addition, the table presents t-statistics for differences in means tests using the section including the study guide project as the reference class. In the fall semester of 2012, it is clear there are significant differences in the average quiz scores and the average essay or problem scores on examinations. While it appears that the study guide project significantly helped students on the common multiple choice quiz questions, the significant difference in performance

**TABLE 2: Summary Data of Performance Across Business Statistics Classes**

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Fall 2012 Data Spring 2013 Data

Fall 2012 Data (Without Project) (Without Project)

Category (With Project) (No Study Guide) (With Study Guide)

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Sample Size 28 33 30

Average Quiz Percentage 76.310 62.788 71.356

(Common Questions)

Average Essay Percentage 74.369 65.848 73.067

(Common Questions)

t-statistic for Difference in 5.848 2.095

Quiz Average Scores Relative to

Fall 2012 With Project

t-statistic for Difference in 3.685 0.551

Essay Average Scores Relative to

Fall 2012 With Project

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**Figure 5: Quiz Performance Across Sections of ECON 221**

**Figure 6: Essay Performance Across Sections of ECON 221**

across the same two sections on essay examination questions may be attributed to the study guide project. The difference might also be due to a difference in the overall competency of students in each section. This avenue of thought has not been explored by looking at past average academic success of students, but it does not seem plausible that such a significant difference in average scores is solely due to variations in student composition with regard to academic success across classes.

The Spring 2013 results for the section using the study guide developed in the previous semester show similar characteristics on essay examination questions and quiz results that are significantly lower (albeit at the 0.05 level rather than the 0.01 level) than those observed in the section that developed and used the study guide. Assuming that there is relative continuity in student profiles and teaching methodology across all three sections of ECON 221, results seem to be quite favorable for the impact the project has on learning outcomes. It appears that the study guide itself not only assisted in improving performance on multiple choice questions directly from the study guide, but that it also helped improve performance on problem-based examinations; a much more significant result. It also appears that the active role students have in developing questions for the study guide significantly improved quiz scores but not examination performance. The assumption that group work translates to student study group formation to improve examination performance is not substantially supported (although examination scores are higher). These results are encouraging and suggest that larger samples are needed for further analysis.

*Student Survey*

At the conclusion of the final examination, students were asked to fill out a survey on the study guide project. The following eight questions were asked of each student:

*Question 1: This was an enjoyable project to work on during the semester.*

*Question 2: I thought the study guides helped me prepare for the exams.*

*Question 3: I would have preferred having quizzes and homework in place of the study guide project.*

*Question 4: This was a difficult project to work on.*

*Question 5: This project helped us form a study group to prepare for examinations.*

*Question 6: Our group worked well together.*

*Question 7: This project should be continued in future sections of this course.*

*Question 8: Do you believe it is important that the study guide will be published with your name included.*

For each question a rating of 1 (Strongly Disagree) to 5 (Strongly Agree) was answered and students were given an opportunity to comment on the project.

Overall averages for questions provide very encouraging results for this initial endeavor. In particular, students thought the project helped them prepare for examinations and should be continued in future sections of the course. Students, on average, did not view the project as being too difficult and believed that their groups worked well together. Students did believe that it was important to know that the completed study guide would be published with their names included for future students to see.

**TABLE 3: Student Survey Results**

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Standard t-statistic

Measure Average Deviation for significance

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Question 1 3.357 0.951 1.679

Question 2 4.036 0.962 4.817

Question 3 2.893 1.257 -0.381

Question 4 2.429 0.879 -2.907

Question 5 2.893 1.100 -0.435

Question 6 3.857 0.971 3.950

Question 7 3.714 0.937 3.409

Question 8 3.607 0.737 3.682

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*Student Evaluations*

Student evaluation results for the two fall semester sections are included. The relevant questions on the student evaluations are as follows:

Question 1: The quality of instruction was

Question 2: The amount of effort in this course compared to others is

Question 3: Materials used helped achieve course objectives.

Question 4: Found course content to be

Question 5: The instructor effectively used examples/applications/illustrations in this course.

Survey responses range from 1 to 5. In questions 1 and 4 a value of 5 is associated with excellent while a value of 1 is poor. For question 2 a value of 1 means less effort while a value of 5 means more effort. For the remaining questions, 1 is assigned to highly disagree while 5 corresponds to a highly agree. For each question, a larger average is better than a smaller average. It appears that overall instructor performance, student opinion about course content and the use of applied examples to teach the course are all higher in the section that utilized the study guide project. Students did report that, on average, more effort was required in this section. While it is unclear whether the use of the study guide project alone can take credit for this increase, it certainly did not negatively impact ratings; an important feature when applying for tenure and promotion. Interestingly, students in the section utilizing the study guide project reported a lower average on the question that measured how course materials helped meet course objectives. This runs counter to the perception that the study guide project assisted students in preparing for examinations. One explanation is that student evaluations and the student survey were given at two different times in the course (student evaluations are given approximately one month before final examinations). In addition, students are likely including other homework and examinations among materials meant to meet course objective and, often, students do not always like examinations!

**TABLE 4: Student Evaluations for ECON 221 With and Without Study Guide Project (Fall 2012)**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Average Reponses:

Section With Section Without

Student Evaluation Question Study Guide Project Study Guide Project

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1. Quality of Instruction 4.52 4.20
2. Effort Compared to Other 4.25 4.06

Courses

1. Material Helped Achieve Course 3.91 3.77

Objectives

1. Found Course Content to Be 4.09 3.84
2. Used Example/Applications/ 4.83 4.52

Illustrations Effectively

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*Academic Performance Across Classes in Applied Econometrics*

Table 5 below provides results across two semester sections of the graduate applied econometrics courses along with a graph providing the same results visually in Figure 7. As stated above, the Summer 2011 section of the course did not utilize a student-published study guide project. The spring semester 2012 section of the course did include the study guide

**TABLE 5: Summary Data of Performance Across Applied Econometric Classes**

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Summer 2011 Data Spring 2012 Data

Category (No Study Guide) (Study Guide)

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Sample Size 15 22

Average Exam Percentage 71.650 73.784

t-statistic for Difference in 0.308

Average Scores Relative to

Summer 2011

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**Figure 7: Examination Performance Across Sections of Applied Econometrics**

project where groups were required to submit solved problems in two of eight chapters. The low t-statistic in the table clearly indicates that there is no significant gain in the average examination scores in applied econometrics as a result of including the student study guide project. The project, as stated earlier, was not as well-developed and examination questions did not precisely mimic study guide questions. In addition, a graduate-level course is unlikely to have student academic preparation vary as much as one might see in a lower-level undergraduate course.

## IV. Conclusion

As stated in the introduction, this paper is still a very preliminary analysis. A great deal of work needs to be done in terms of improving the statistical analysis and the development of the study guide project. Nevertheless, it appears that there is some support for using this type of project to teach ECON 221. Use of the study guide appeared to positively influence academic performance on both multiple choice quizzes and problem-based examination questions. Active participation by students in developing the study guide significantly improved multiple-choice quiz performance but had only a slight and insignificant improvement in examination scores compared to the section that used the study guide but did not incorporate the active project. This aspect of the study deserves more detailed analysis.

Based on survey and student evaluation results, it appears that the project was viewed favorably by students. Individual student evaluations were not carefully analyzed and it would be interesting to see how perceptions of the project differed across the grade distribution. The impact on learning using the modified project for applied economics did not provide encouraging results. This indicates that gains for this approach among graduate students are far less or that more work needs to be done to refine the project. The project, however, does involve a great deal of work by the instructor to manage and grade the work turned in. Future work will look to improve the delivery of the study guide questions to an online format and to increase the use of questions from the study guide in quizzes and examinations.

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