THE EFFECTS OF CLASS SIZE ON STUDENT ACADEMIC PERFORMANCE IN A PRINCIPLES OF MICROECONOMICS COURSE

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ABSTRACT

This study investigates the possible effects of class size on student academic performance in a Principles of Microeconomics course taught at UW-River Falls during Spring Semester 2001. The study was motivated by the recent need to increase the section size (from about 50 to almost 100 students) for introductory economics courses in the College of Business and Economics. However, some faculty members have expressed concern that large class sizes will have a negative effect on students' learning. Previous studies on the effects of class size on student achievement show mixed effects on student learning.

This study utilizes data from a student survey conducted at the beginning of the semester, along with University records, instructors' grades, and attendance records to estimate a multiple regression model. The estimated model includes a measure of student academic performance (total exam points) as the dependent variable, with selected independent variables that are important predictors of student learning, plus a measure of class size. Statistical analyses were carried out to test the hypothesis that student academic performance is higher in the normal ('small') class size, controlling for the other predictors of student learning. This allowed us to determine whether or not large class sizes have a negative effect on our students' learning.

The results of this study will be used to make future policy decisions with regard to offering larger sections of introductory economics courses. Further investigations will be conducted for other introductory courses offered by the College of Business and Economics.

INTRODUCTION

The Faculty Development Committee of the College of Business and Economics (CBE) at the University of Wisconsin-River Falls (UWRF) has proposed combining the 'normal' sections of various introductory courses into larger sections to both reduce the "backlog" in certain courses and reduce the number of preparations for faculty members. This is also necessary to enable faculty members in CBE to increase their research and scholarly activity output, a requirement for the AACSB accreditation of the Business Administration Program at UWRF. The alternative, a one-course release to each faculty member, would require additional resources to hire part-time (adjunct) instructors. This is not considered feasible given current resource constraints.

However, some faculty members have expressed concern that combining the normal ('small') sections into larger sections may have significant negative effects on student learning or performance. The purpose of this study, therefore, is to further investigate the effects of class size on student academic performance in the Principles of Microeconomics courses taught in Spring 2001 at UWRF.

OBJECTIVES OF THE STUDY

The objective of this study is to further investigate the possible effects of class size on students' academic performance in a Principles of Microeconomics course at UW-River Falls. Several previous studies showed mixed effects of class size on student learning. The issue has thus remained unresolved, implying that more research is needed. Optimal class size, given institutional budgetary constraints, has remained a problem that requires further research.

Some researchers have used data from large-size institutions where some of the courses are taught by graduate assistants, while others have compared courses taught by several instructors at different institutions. This study investigates the effects of class size on student academic performance in a Principles of Microeconomics course offered during Spring Semester 2001 at UW-River Falls, a medium-size state university. The data covers two sections of the course; a 'normal' size section (about 50 students) and a 'large' section (a combination of two 'normal size' sections) taught by the same instructor.

The study estimates a regression model with a measure of student academic performance as the dependent variable. Independent variables include selected factors that affect student learning and a measure of class size. Statistical analyses were carried out to test the hypothesis that student academic performance is higher in the 'normal-size' (smaller) class. This will enable us to determine whether a larger class size has a negative effect on student learning at UW-River Falls.

Implications of the Study

Many studies on the effects of class size on student learning have been in response to budgetary pressures that led to increases in class size at many institutions and subsequent concern about possible negative effects on student learning. The results of this study will be made available to the Dean and Curriculum Committee in the College of Business and Economics. These results will be used to make decisions regarding the current practice of combining sections of introductory courses and to search for alternative resources to provide faculty with the needed reassigned time for research. The authors also plan to conduct studies in other introductory courses to provide further evidence on this issue.

LITERATURE REVIEW

The effects of class size on students' performance has been researched in various fields and the results of this research show mixed effects of class size on students' performance. McKeachie (1990) has summarized the theory of the effects of class size on learning, focusing on how instructors and students behave differently in large and small classes. It is noted that discussion time becomes fragmented among students in large classes and instructors may rely on passive lecturing, assign less written homework or fewer problem sets, and may not require written papers. In addition, instructors may find it difficult to know each student personally and tailor pedagogy to individual student needs in a large class.

McKeachie's (1990) survey of the education literature, however, suggests that learning is not affected much by class size largely because instructors do not adjust their teaching methods to class size.

However, Hancock (1996) has indicated that while strong conventional wisdom indicates that class size affects students' learning, most of the earlier studies were not conducted in higher education and report little more that surveyed impressions, thus offering little empirical evidence.

Siegfried and Kennedy (1995), in a study involving 178 classes taught by 121 different instructors at 49 different colleges and universities, found no evidence that teaching strategies employed by introductory economics instructors depended on class size. Students' responses to a survey also suggest that the effectiveness of various pedagogies may not differ much between large and small classes.

Several other related studies have tended to put more emphasis on the various predictors of student learning or achievement. Siegfried and Walstad (1990) found that study effort, age of a student, and a good match between student's learning style and instructor's teaching style have positive influences on student's performance.

Hancock (1996) in a study involving nine sections of a college statistics course (6 'normal' sections and 3 'mega sections' averaging 118 students) found no evidence that grade distribution was affected by class size, supporting the hypothesis that achievement was independent of class size.

Hill (1998) investigated the effect of large sections (120 students) on student performance in an Accounting course and found that the size of the class did not have a significant effect on student performance. Contrary to expectations, the large class outperformed the small classes when controlling for attendance and university GPA. Hill concluded that large class size may be more of an expectations issue rather than a performance issue, since students reported that they felt the class size was too large.

Papo (1999) found that the size of the class taught does not have an impact on teaching effectiveness and the selection of teaching strategies by instructors. He concluded that teaching in large classes is not seen or perceived as a problem by students since the teaching and learning success may depend, in part, on what is taught. What the optimal size of class is for a particular course and teaching task remains a problem for continued research.

Okpala, et al. (2000) used the concept of the 'education production function' to analyze the effects of students' study habits and academic effort on students' performance in a Principles of Macroeconomics course. It was found that academic effort and study habits were significant in explaining academic achievement in four different sections of the course taught by the same instructor.

Skoro and Payne (1993) investigated whether assigning problem sets in economic principles courses increased learning and found no evidence that numerous short problem-set assignments had a direct effect on learning in a college economics course. However, the authors found a strong positive effect for class attendance in the experimental group.

In an earlier study, Siegfried and Fels (1979) found that a student's general aptitude is the most important determinant of learning and that socioeconomic background, prior economic courses, mathematical preparation, class size, textbooks and study effort did not seem to matter very much.

Tay and Kennedy (1994), in a study involving large lecture classes, found that prior economics courses, gender, age, ethnic background, and being well prepared for classes significantly affected performance. Durden and Ellis (1995) found that attendance did not matter for academic achievement in a Principles of Economics course unless a student had missed four (or more) classes during the semester. The results also show no gender-related differences in student performance.

Henbry (1997) examined class schedule as a variable in student performance in a financial management course and found that students had a better chance of passing the course when a class was scheduled to meet more than once a week.

METHODOLOGY

Data Collection

This investigation involves two sections of a Principles of Microeconomics course, a normal-size section (with enrollment of 40 students) and a larger section (with enrollment of 95 students). The two sections were taught by the same instructor during Spring 2001, using the same lecture presentations as the primary method of instruction, and the same textbook. The instructor administered the same exams, all multiple-choice questions, to the two sections, assigned the same homework problem sets, and used the same grading policy.

The instructor has no prior experience teaching a course with more than 55 students. The similar instructor approaches to students and teaching style are used to control for potential instructor quality effects on student performance (Hill, 1998).

The two sections of the course met the same days (Tuesdays and Thursdays) for the same time period (75 minutes) and were offered in the early morning and mid-day time slots. There was no difference in scheduling for the two sections and both were allowed the same (long) effective teaching time to complete complex concepts in the same time period (Henebry, 1997). The course had no prerequisites.

The data used in the study includes data from a student survey questionnaire administered on the first day of class in both sections. The information gathered includes various 'personal variables' or factors that are considered to be important determinants of students' learning in Principles of Economics courses (Skoro and Payne, 1993). Participation by students in the survey was completely voluntary and they were all assured anonymity and confidentiality.

The rest of the data used in the study is from the instructor's records of students' performance on exams and homework assignments, as well as attendance records. Additional data was obtained from University student records.

Model and Statistical Analysis

This study focuses on the effects of class size on student academic performance in a Principles of Microeconomics course and utilizes various variables which are important predictors of student achievement based on results of similar prior studies (Hill, 1998; Skoro and Payne, 1993). According to Hill (1998), it is important to replicate studies on variables that affect student performance at different institutions due to the "school-specific" nature of the data collected.

This study estimates a regression model based on an 'educational production function', with a measure of student academic performance as the dependent variable (output), and selected important independent variables which could affect student learning at UW-River Falls (inputs), and a measure of class size (number of students completing the course in each section). As stated by Okpala et al (2000), an educational function has become a dominant paradigm in the analysis of the effects of educational variables on student performance. The estimated model follows a similar general specification. The selected variables are used to control for possible differences in students' background, academic abilities, academic effort, motivation and students' study habits, and to control for possible students' 'self-selection' at the time of registration. Thus, the academic performance of students is a function of their academic abilities, academic efforts, study habits, prior knowledge and achievement, and personal characteristics.

The estimated model is specified in a general form as follows:

$$TEP = f\,[AGE, MALE, GPA, ACT, HWORK, HSTUDY, ATTEND, PSETNUM, SECTION]$$

where:

TEP = Total points earned on all exams, the dependent variable (maximum of 150 points on 3 exams)

AGE	= Students' age
MALE	= Gender of student (1=Male; 0=Female)
GPA	= UW-RF cumulative GPA at time of enrollment in the course
HWORK	= Number of works worked per week by employed students
HSTUDY	= Hours spent studying microeconomics per week
ATTEND	= Number of times student missed class during the semester (attendance was taken at randomly selected times)
PSETNUM	= Percentage score on problem sets (1=80 percent or higher; 0=otherwise)
ACT	= ACT score of each student when admitted to the university
SECTION	= Class section in which a student was enrolled (1 = large; 0 = normal)

The above model was estimated using the Ordinary Least-Squares method (OLS) to determine the sign and significance of the coefficient for each selected independent variable. The following variables, GPA, ACT, HSTUDY, PSETNUM were expected to have a positive correlation with student academic performance (TEP). The variables HWORK, ATTEND were expected to be negatively correlated with TEP. There were no a priori expectations with regard to the signs on the variables MALE and AGE.

A two-population t-test was also used to check for a significant difference in the mean values of the dependent variable based on class size (SECTION). The null hypothesis assumed that average student academic performance (TEP) would be higher in the 'normal size' section of the Principles course.

EMPIRICAL RESULTS

Controlling for the various independent variables-factors which are expected to impact student academic performance-will enable us to determine whether class size (SECTION) has any effect on student academic performance in the Principles of Microeconomics course. The regression results for the combined sections (with all the independent variables and three variations of this model) are reported in Table 1. These results show no significant effect of "class size" (SECTION) on student academic performance (TEP). This is consistent with the result of the two-population t-test analysis that showed no significant difference in the mean scores (TEP) of the 'normal' and 'large' sections (see Table 4). Student surveys also indicated that class size was not an important factor in determining which section (normal or large) a student registered for.

The regression results, however, show positive and significant correlations between students' cumulative GPA and ACT scores (the measures of students' general intellectual ability) and academic performance (TEP). This result is consistent with the results in earlier studies, such as Borg, et al. (1989), Henbry (1997), Okpala, et al. (2000), that indicate that students' GPA and ACT scores are important predictors of academic success.

The PSETNUM variable (a measure of student effort and study strategy by completing bi-weekly assignments) has a positive and significant effect on student academic performance (TEP). This result confirms the conclusion of Skoro and Payne (1993) that regular assignments increase student learning.

The ATTEND variable (measured by the number of times a student was absent during 16 randomly selected class periods) is found to be negative and significantly correlated with student academic performance (TEP). Specifically, students' total exam points (TEP) are reduced by one point (-1.028) for every absence recorded. This 'class attendance' variable is also significant with a slightly greater estimated coefficient (-1.176) in the individual 'large' section regression (shown in Table 2). The authors believe that a student is more likely to be absent in the 'large' section than the 'normal size' section, and thus this absence has a greater impact on the student's grade if that person is registered for the 'large' section. The results support an earlier study by Skoro and Payne (1993) who found a strong positive learning effect for class attendance. Earlier, Schmidt (1983) found that time spent attending lectures contributed positively to students' performance in a Macroeconomic Principles course. Durden and Ellis (1995) also found that attendance does matter for academic achievement in a Principles of Economics course, becoming important only after a student has missed four classes during a semester.

The regression results also indicate a positive and significant effect of the MALE and AGE variables on student academic performance (TEP). These results suggest that males are more likely to out perform females, especially on multiple-choice exams. Tay and Kennedy (1994) found that gender and age (or maturity) of a student also positively influence academic performance. However, a 'test' of the difference of means (Table 4) does not reveal any significant difference in TEP between the students enrolled in the 'normal' section compared with those in the 'large' section. In this regard, there does not seem to be any 'self-selection' by students at the time of enrollment.

Contrary to expectations, but consistent with earlier studies, Borg, et al. (1989), Schmidt (1983), and Okpala, et al. (2000), this analysis found that study time (HSTUDY) outside the classroom and hours spent working (HWORK) have no significant effect on student academic performance (TEP). These results may be largely due to the fact that students determine the hours they expect to work at the time of registration and subsequently determine study time. Also, what may be important is not how many hours students study, but the quality of what they study in relation to the examination questions. For example, there may be no marginal benefit from an extra hour of study spent memorizing "bad" class notes or reading material in the textbook that was not emphasized by the instructor.

CONCLUSION

The regression results from this estimated model do not show any negative and significant effect of class size ("SECTION") on student academic performance (TEP). Thus, there is no evidence to support the hypothesis that academic performance is higher for students enrolled in the 'normal' section rather than the 'large' section. This conclusion is consistent with earlier studies where the effects of class size on student academic achievement were mixed. However, there is evidence that certain variables used as "inputs" in the estimated 'educational production function' have effects on student academic performance that are consistent with results from earlier studies.

Nevertheless, there is need for more "school-specific" evidence in analyzing the effects of class size on student academic performance. The authors are in the process of collecting and analyzing additional data obtained from sections of Microeconomics Principles taught during Fall Semester 2001 by a different instructor. Data from different introductory courses also needs to be collected to further explore this important but unresolved issue. It may be important, for example, to determine whether instructors change pedagogy to suit class size. In addition, it may be necessary to determine whether or not students enrolled in the course at different times may have academic abilities, study habits, and personal characteristics that affect their performance differently when enrolled in the 'large' rather than the 'normal' size sections. In addition, students may adjust their academic effort, study habits, or work hours based on whether or not they were previously enrolled in a 'large' section of a course.

Table 1: Estimated Regression Coefficients for All Models (Combined Sections)
(Standard Errors in parentheses)

Variables	Full Model (Adj. R^2 = .489) N = 94	Without ACT (Adj. R^2 = .413) N = 105	Without GPA (Adj. R^2 = .396) N = 94	Without MALE (Adj. R^2 = .430) N = 94
Constant	3.186 (24.324)	66.770*** (9.688)	9.456 (26.382)	1.326 (25.671)
AGE	1.916* (1.085)	-0.066 (0.367)	2.478** (1.169)	2.235* (1.140)
MALE	7.979*** (2.437)	8.477*** (2.463)	5.869** (2.587)	
GPA	11.029*** (2.724)	13.024*** (2.510)		9.122*** (2.809)
ACT	1.340*** (0.417)		2.066*** (0.409)	1.522*** (0.436)
HWORK	0.083 (0.145)	0.056 (0.151)	-0.080 (0.152)	0.199 (0.149)
HSTUDY	0.570 (0.627)	0.025 (0.627)	0.783 (0.679)	0.467 (0.661)
ATTEND	-1.028** (0.475)	-0.811* (0.455)	-1.539*** (0.497)	-1.108** (0.500)
PSETNUM	8.247*** (2.417)	9.165*** (2.512)	11.729*** (2.455)	9.014*** (2.539)
SECTION	0.347 (2.480)	0.036 (2.583)	-0.153 (2.692)	-0.302 (2.609)

* Regression coefficient is significant at 10% level
** Regression coefficient is significant at 5% level
*** Regression coefficient is significant at 1% level

Table 2: Estimated Regression Coefficients for All Models (Large Section)
(Standard Errors in Parentheses)

Variables	**Full Model (Adj. R^2 = .587) N = 65**	**Without ACT (Adj. R^2 = .498) N = 73**	**Without GPA (Adj. R^2 = .467) N = 65**	**Without MALE (Adj. R^2 = .472) N = 65**
Constant	-4.432 (25.016)	53.227*** (11.707)	3.128 (28.343)	-3.063 (28.269)
AGE	2.250* (1.150)	0.410 (0.433)	2.894** (1.295)	2.650** (1.140)
MALE	11.972*** (2.921)	11.281*** (3.055)	9.628*** (3.256)	
GPA	12.234*** (2.920)	14.180*** (2.869)		9.941*** (3.239)
ACT	1.268*** (0.451)		1.992*** (0.473)	1.243** (0.509)
HWORK	0.120 (0.159)	0.123 (0.170)	-0.015 (0.177)	0.383** (0.164)
HSTUDY	-0.055 (0.729)	-0.513 (0.738)	0.151 (0.827)	-0.453 (0.817)
ATTEND	-1.176** (0.478)	-0.861* (0.477)	-1.708*** (0.523)	-1.040* (0.538)
PSETNUM	9.437*** (2.630)	11.301*** (2.876)	12.604*** (2.862)	11.343*** (2.926)

* Regression coefficient is significant at 10% level
** Regression coefficient is significant at 5% level
*** Regression coefficient is significant at 1% level

Table 3: Estimated Regression Coefficients for All Models (Normal Section)
(Standard Errors in Parentheses)

Variables	Full Model (Adj. R^2 = .448) N = 29	Without ACT (Adj. R^2 = .289) N = 32	Without GPA (Adj. R^2 = .465) N = 29	Without MALE (Adj. R^2 = .430) N = 29
Constant	-37.446 (56.043)	81.410*** (15.832)	-40.341 (54.987)	-19.913 (55.306)
AGE	4.480* (2.485)	-0.016 (0.782)	4.848* (2.372)	3.398 (2.381)
MALE	-6.405 (4.912)	-0.348 (4.715)	-7.510 (4.489)	
GPA	3.484 (5.767)	12.317** (5.085)		6.285 (5.441)
ACT	2.654*** (0.921)		2.967*** (0.751)	2.157** (0.852)
HWORK	-0.636* (0.335)	-0.344 (0.342)	-0.729** (0.293)	-0.521 (0.328)
HSTUDY	1.243 (1.176)	0.130 (1.189)	1.338 (1.148)	1.285 (1.195)
ATTEND	-1.599 (1.351)	-1.015 (1.394)	-1.820 (1.281)	-0.976 (1.285)
PSETNUM	3.964 (5.131)	0.664 (5.232)	5.335 (4.532)	4.313 (5.209)

* Regression coefficient is significant at 10% level
** Regression coefficient is significant at 5% level
*** Regression coefficient is significant at 1% level

Table 4: Summary of Mean Values for All Variables and t-test for Equal Means (Standard Deviations in Parentheses)

Variables	Combined Sections	Large Section	Normal Section	Computed t-value for Equal Means
TEP	107.84 (15.572)	107.04 (16.232)	109.65 (13.998)	0.848*
AGE	20.380 (3.631)	20.22 (3.273)	20.75 (4.354)	0.764*
MALE	0.48 (0.501)	0.47 (0.502)	0.50 (0.506)	0.349*
GPA	2.73 (0.554)	2.70 (0.558)	2.81 (0.544)	1.034*
ACT	21.59 (3.169)	21.68 (3.129)	21.37 (3.291)	-0.481*
HWORK	14.28 (9.881)	14.57 (10.143)	13.62 (9.349)	-0.503*
HSTUDY	4.51 (2.011)	4.47 (2.065)	4.58 (1.914)	0.268*
ATTEND	3.44 (3.063)	3.72 (3.194)	2.80 (2.672)	-1.594*
PSETNUM	0.423 (0.496)	0.444 (0.500)	0.375 (0.490)	-0.736*

* None of the computed t-values show a significant difference between the mean values for the two separate sections (Large and Normal)

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