Journal of Construction Education
Fall 2001, Vol. 6, No. 3, pp. 139- 145

1522-8150/01/$3.00/Educational Research Manuscript

Correlates of Student Performance in Environmental Control Systems Courses at an Undergraduate Level

Ifte Choudhury
Texas A&M University
College Station, Texas

The purpose of this study was to examine the correlates of student performance in Environmental Control Systems courses offered by the Department of Construction Science at a large South Central University. It is indicated by a number of studies that student performance is affected the class size. Some other studies suggest that student characteristics, teaching effectiveness, student satisfaction with a course, and overall academic ability of a student are also correlated with student performance in a course. The study population consisted of the students who attended Environmental Control Systems courses in Summer Semesters of 1997 and 1998, Fall Semester of 1997, and Spring Semester of 1998. Relevant data related to these factors were collected using a survey instrument. Sample size of the study was 223 students. The data was analyzed using correlation and multiple regression analyses. The findings generated from the analyses of the data indicated that student performance in Environmental Control Systems courses, offered by the Department of Construction Science at a large South Central University, are not correlated with class size. Personal characteristic variables such as gender and academic classification are inversely related to student performance. Overall academic ability of a student is positively correlated with student performance.

Key Words: Undergraduate Education, Construction Science, Environmental Control Systems, Class Size, Gender Difference

Statement of the Problem

The question of class size is probably one of the first problems of education approached by research. Studies conducted at both school and college levels indicate that students learn more where there are fewer of them in the class (Pate-Bain, et al., 1992; Toby, 1993). Glass et al. (1982) report that the relationship between class and student performance is very strong. However, there are some other studies that contradict these findings (Hanushek, 1998; Siegfried and Kennedy, 1995).

Student population in the Department of Construction Science (COSC) at a large South Central University is over 600 and is expected to be higher in the coming years. The Strategic Plan of the Department does not envisage any market reason to put a cap on student enrollment (COSC, 1996). The construction industry requires about 7,000 Construction Science graduates every year, whereas the total output of such graduates from all university programs in the United States is about 2,000 per year (COSC, 1996). As a result of this increasing number of students, class sizes are gradually becoming bigger.

The primary mission of the Department as stated in the Strategic Plan (COSC, 1996) is to "prepare students for successful careers in construction and construction-related industries" (p.4). The Plan also emphasizes that "in order to accomplish this mission, the Department must create an environment conducive to academic excellence" (p.4). Effective classroom teaching is one of the factors to achieve this goal. This effectiveness is likely to be affected, among other factors, by the size of classes.

Effective classroom teaching leads to better student performance (McKeachie, 1980). Apart from classroom sizes, factors such as personal characteristics, student attitude, interest, motivation, and satisfaction are also assumed to have an effect on student performance. In view of the evidence provided by the results of the studies conducted in other disciplines, it is hypothesized that student performance in Construction Science students is affected, apart from classroom size, by the following factors related to the students:

1. Personal characteristics (academic classification and sex),
2. Interest and enthusiasm for class work,
3. Participation in discussions,
4. General feelings towards the course,
5. Perceived understanding of the materials taught,
6. Overall course satisfaction, and
7. Academic ability.

Methodology

Study Population

The study population consists of the students who registered for and actually attended Environmental Control Systems I and II courses offered by the Department of Construction Science, Texas A& M University, in the following semesters:

1. Summer I and II, 1997
2. Fall, 1997
3. Spring, 1998
4. Summer I and II, 1998.

Number of students in the classes ranged from a minimum of 25 to maximum of 80. The sample size was 223. The entities under study are the students who attended these classes. The unit of analysis is the student.

Data Collection Procedure

A survey instrument was prepared to collect the data related to personal characteristics of the student, feelings of the student toward the course, teaching effectiveness, and the student's current grade point average (*GPA*). The instrument was administered in the classrooms at the end of the semesters. The sample size of the study was 223.

Variables and their Operationalization

Student Performance (GRADE)

Student performance is the actual academic performance of the student in the class. It was measured by the percentage of total numerical grade obtained by the student in the course.

Class Size (CLSIZE)

It is the size of the class in terms of the number of students. It was measured by the number of students who actually attended the class.

Semester (SEMESTER)

Semester is an academic term during which the student attended the course. It was categorized into two groups: 1) regular semesters consisting of fall and spring semesters and 2) summer semesters or terms. The regular semesters have duration of 15 weeks each, while the summer terms have a shorter duration of 5 weeks each. This variable was included to measure the effect of semesters on student performance. It is a dummy variable, which took on a value of 1 for a regular semester and 0 for a summer semester.

Sex (SEX)

Sex is the gender identification of a student. It is a dummy variable, which took on a value of 1 for a female and 0 for a male.

Level (LEVEL)

Level indicates the academic classification of a student. As per University regulations, only students classified as juniors and seniors are eligible for enrollment in Environmental Control Systems courses. A student classified as a senior was coded 1 and a student classified as a junior was coded 0.

Teaching Effectiveness

The following variables were used to measure teaching effectiveness:

1. *Interest and Enthusiasm for Class Work (INSPIRE)*: It is the reported level of interest and enthusiasm of the student for doing the assigned class work. It was operationalized using a single-item measure on a five-point Leikert-scale.
2. *Feelings toward the Course (FEELING)*: It is the reported level of perceived self-directiveness achieved by the student as a result of taking the course. It was operationalized using a single-item measure on a five-point Leikert-scale.
3. *Perceived Level of Understanding of the Materials Taught (UNDSTAND)*: It is the reported level of understanding of the course materials by the student. It was operationalized using a single-item measure on a five-point Leikert-scale.

4. *Overall Course Satisfaction (SATISFY)*: It is the reported level of satisfaction of the student with the course. It was operationalized using a single-item measure on a five-point Leikert-scale.

Grade Point Average (GPA): It is the reported overall grade point average of the student. It ranges from 0 to 4.

Analysis and Interpretation

Results

A correlation analysis was used to measure the strength of relationship between class size (*CLSIZE*) and student performance (*GRADE*). A correlation of 0 between two variables indicates that each variable has no linear predictive ability for each other. A correlation coefficient of close to |1| means that the two variables have a perfectly linear connection. The product-moment correlation obtained from the test was not found to be statistically significant at the 0.10 level (*Rho* = 0.06, $p>|Rho|$ = 0.35). The results indicated that class size did not have any statistically significant effect on student performance in Environmental Control Systems courses under study.

A multiple regression analysis was performed in order to ascertain whether the student's personal characteristics, overall course satisfaction, overall academic ability, and teaching effectiveness had an effect on student performance (*GRADE*). The following model was used for the analysis:

$$GRADE = ?_0 + ?_1 CLSIZE + ?_2 SEMESTER + ?_3 SEX + ?_4 LEVEL + ?_5 INSPIRE + ?_6 FEELING + ?_7 CONTRIB + ?_8 UNDSTAND + ?_9 SATISFY + ?_{10} GPA + e \quad (1)$$

where $?_0$ = intercept,
$?_1$, $?_2$, etc = regression coefficients, and
e = error term.

Results of the analysis are shown in Table 1.

Based on the results of the analysis, the regression equation can be written as follows:

$$GRADE = 62.48 + 0.05*CLSIZE + 0.95*SEMESTER - 2.04*SEX - 2.3*LEVEL + 0.64*INSPIRE + 0.24*FEELING - 0.93*CONTRIB + 0.21*UNDSTAND + 0.5*SATISFY + 5.36*GPA \quad (2)$$

The *F*-value of the model used for multiple regression analysis was found to be statistically significant at the 0.0001 level. However, the predictive efficacy of the model was not found to be very high with an R^2 of 0.37 and an adjusted R^2 of 0.34. But such values are considered to be satisfactory related to empirical studies in social sciences (Freund and Wilson, 1991).

Table 1

Multiple Regression Analysis of GRADE Using Class Size, Personal Characteristics, Overall Course Satisfaction, Overall Academic Ability, and Teaching Effectiveness.

Variable	**Intercept**	**Regression Coefficient**	***T***	***p*>|*T*|**	**Critical Value of |*T*|**
Intercept	62.48	---	12.89	0.0001	1.65
CLSIZE	---	0.05	1.52	0.13	
SEMESTER	---	0.95	0.72	0.43	
SEX	---	-2.04	-1.71	0.09	
LEVEL	---	-2.30	-1.79	0.07	
INSPIRE	---	0.64	0.71	0.48	
FEELING	---	0.24	0.57	0.57	
CONTRIB	---	-0.93	-1.51	0.13	
UNDSTAND	---	0.21	0.27	0.79	
SATISFY	---	0.50	0.52	0.60	
GPA	---	5.36	9.34	0.0001	
Model F (1,222) = 12.62	$p>F$ = 0.0001	Critical Value of F = 2.73	Model R^2 = 0.37	Adjusted Model R^2 = 0.34	

Class size (*CLSIZE*) was not found to have any statistically significant effect on student performance in Environmental Control Systems courses offered by the Department of Construction Science at a large South Central University. It confirmed the results obtained earlier using correlation analysis.

The results indicated that there was a gender difference in student performance. Sex was negatively related to student performance at 0.10 level of significance. The male students obtained higher grades than the female students did.

Student classification (*LEVEL*) was also negatively related to student performance at the 0.10 level of significance. It indicated that students with junior classification performed better than did the seniors.

It was intriguing that none of the teaching effectiveness variables appeared to have any statistically significant effect on student performance. Overall satisfaction with the course was also not found to be related to student performance.

The most important correlate of student performance was found to be the student's overall Grade Point Average (*GPA*). It was statistically significant at the 0.0001 level.

Discussion

Gender difference (*SEX*) was found to be a statistically significant predictor of student performance at the 0.10 level. Coleman and Gotch (1998) report a similar finding with respect to spatial perception skills of chemistry students. However, the results should be viewed with caution. It requires further investigation.

Student classification (*LEVEL*) is another variable that was found to have a statistically significant effect on student performance at the 0.10 level. It is possibly due to the fact that some mathematical skills are required for the Environmental Control Systems courses. In case of seniors, these skills are not likely to remain fresh in mind because they would have taken the mathematics-related courses in their freshmen and sophomore years.

The most statistically significant predictor of student performance was found to be the academic ability of student, measured by the student's overall grade point average (*GPA*). Studies on education indicate that student performance in any particular course is positively correlated with overall grade point average. Findings by Seymour et al. (1994) reveal that most significant factor in predicting success in a business microcomputer course is the overall grade point average of a student. Similar findings have been reported by Rose et al. (1996) in a study of student performance in an introductory psychology course. It was, therefore, likely to find a positive relationship between student performance in Environmental Control System courses and overall grade point average.

The study indicated that student performance in Environmental Control Systems courses, offered by the Department of Construction Science at a large South Central University, is not correlated with the size of a class (*CLSIZE*). A study conducted by Siegfried and Kennedy (1995) reported similar findings related to economics courses and class size. A recent study by Hanushek (1998) states, "the enormous amount of research devoted to studying class size has failed to make a very convincing case that reducing class size is likely to improve student performance" (p.1). However, this finding should not be generalized to other Construction Science courses. A logical extension of this study would be to conduct studies on the effect of class size on student performance in other courses.

The study was based on the same teaching methods for all classes. They included lectures with the help of audio-visual aids, presentation of the course materials and relevant literature using personal web page, individual design of systems, and homework problems. Jamison (1982) indicates that a reduction of class size may not be necessary to alleviate student achievement if an effective and relevant teaching method is adopted to teach a course. For future studies, it may be worthwhile to use teaching method as a predictor of student performance in construction science courses.

References

Department of Construction Science (1996). *Strategic plan of the department of construction science*. College Station, TX: Texas A&M University.

Glass, V. G., Cahen, L. S., Smith, M. L., & Filby, N. N. (1982). *School class size: Research and policy*. Beverly Hills, CA: Sage Publications.

Freund, R. J. & Wilson, W. J. (1991). *Statistical methods*. College Station, Texas: Texas A&M University.

Hanushek, E. A. (1998). The evidence of class size. W. Allen Wallis Institute of Political Economy, NY: University of Rochester.

Jamison, D. T. (1982). Reduced class size and other alternatives for improving schools: An economist's view. In G. V. Glass, L. S. Cahen, M. L. Smith, & N. N. Filby (Eds.), *School class size* (pp. 116-129). Beverly Hills, CA: Sage Publications.

McKeachie, W. J. (1980). *Class size, large classes, and multiple sections*. Academe, 66, 24-27.

Pate-Bain, H., Achilles, C. M., Boyd-Zaharias, J., & McKenna, B. (1992). *Class size does make a difference*. Phi Delta Kappan, 74, 253-256.

Rose, R. J., Hall, C. W., & Bolen, L. M. (1996). *Locus of control and college students' approaches to learning*. Psychological Reports, 79, 163-71.

Siegfried, J. J. & Kennedy, P. E. (1995). *Does pedagogy vary with class size in introductory economics*? The American Economic Review, 85, 347-351.

Seymour, J., Goings, D., & Vincent, A. (1994). *Factors contributing to success in a microcomputer course*. Perceptual and Motor Skills, 79, 1338.

Toby, S. (1993). *Class size and teaching evaluation*. Journal of Chemical Education, 70, 465-466.