Study of Student Performance in a Construction Science Course using Multiple Regression Technique

Ifte Choudhury
Department of Construction Science
Texas A&M University

Abstract

Student performance is an important issue for educators at colleges and universities. The purpose of the study was to determine correlation between student performance in weekly evaluative quizzes and homework on student performance in major tests during a semester in a construction science course taught by the author at a university in Bangladesh. Data was collected from a classroom situation. Total number of students was 34. Multiple regression technique was utilized to examine the relationship. The findings generated from the analysis of the data indicated that performance in weekly quizzes and gender of a student have a statistically significant relationship with student performance in tests for this particular course.

Key words: Bangladesh, Construction Science, Gender, Homework, Quiz, Student Performance

Topic category: Undergraduate Education

Introduction

The author offered a course on materials and methods of construction, in the spring semester of 2005 in a Bangladesh university. Students of construction science are required to take one or more courses dealing with building materials and methods of construction in their freshmen or sophomore year. Students completing these courses are expected to be familiar with the inherent physical and structural properties of these materials and methods employed for construction.

Lecture and class room discussion represented the primary means of teaching the course. Since the course was related specifically to the construction industry in Bangladesh, it was difficult to use a particular textbook. Written notes on different topics were given to the students. Contents of the notes were explained in details during class meetings, both by means of lectures and visual aids. Students were encouraged to ask questions and participate in discussions on the course topics. Even though people in Bangladesh speak Bangla, the medium of instruction in this particular university was English.

Quizzes were given on topics discussed in the class on a weekly basis. No particular dates were indicated in the syllabus for the quizzes; they were unannounced. Three home works were assigned during the course of the semester. Submission dates were indicated in the syllabus. Students were required to submit them in the class in person. Both the quizzes and home works

were graded. Quizzes and home works were worth 20 and 10 percent respectively of the total course grade.

Three written tests were given during the semester---one at the end of the fourth week of the semester, one mid-term, and a comprehensive at the end of the semester. The comprehensive test was worth 30 percent and the two tests 20 percent each of the total course grade.

The purpose of this study was to determine whether student performance in quizzes and home works had an effect on cumulative test grades of a student for this particular course offered in Bangladesh. A secondary purpose was to find out whether gender had an effect on student performance in the course.

Review of the Literature

Many courses in construction science comprise of concepts or ideas that students need to comprehend in order to succeed in follow-on courses. An in-depth understanding of the fundamentals of a course helps them transfer knowledge to from one course to another. Bransford et al.[1] argue that it is necessary for students to continuously evaluate their learning at current level of understanding. In order to do that, they require constant feedback from instructors. Different methods are used by faculty at college level to enhance and improve such awareness[2]. Frequent feedbacks are considered as hallmarks high-quality education. Such actions on the part of the instructors allow students to identify their problems and take corrective measures. Most widely adopted method of such feedback is giving frequent short tests or quizzes, often unannounced, and assigning problem-solving home works.

Home works and quizzes may also have a significant role to play in predicting performance. Literature indicates that absenteeism is one of the major factors of overall student performance[3,4,5]. But Douglas & Sulock[6] report that the independent effect of attendance may not remain statistically significant, when quiz performance is introduced in the model. Apart from considered as tools for enhancing student learning, the use quizzes and home works for credit have been found to have an inverse relationship with absenteeism[7]. Students tend to be more particular in attending classes when quizzes given are unannounced. This increase in attendance may have an indirect positive effect on student performance.

The effect of one other variable on performance that has been tested by many researchers is gender. Some studies indicate that men have more positive attitude toward education in engineering and science than women[8, 9]. It is reflected by their performance in relevant courses. However, there are other studies that do not report any correlation between gender and student performance[10,11].

Methodology

Study Population

The study population consists of students who registered for the materials and methods of construction course offered by the author at the particular university in Bangladesh and attended

the course in the spring semester of 2005. The sample size includes the total population of 34 students, 20 female and 14 male. The unit of analysis is the student.

Data Collection

Data related to the study was collected by the author from his own records. All home works, quizzes, and tests covered materials presented in the class and the written handouts. Students could make a perfect score for all these measures of performance if they read and understood the materials.

Variables and Their Operationalization

Test Grade (TEST). It is the sum of all the scores made by a student in three tests given during the semester. It was measured by the numerical grade obtained by the student in the test.

Gender (GENDER). It indicates the gender of a student. It was a dummy variable, operationalized by assigning a value of 1 when the gender was female and 0 when the gender was male.

Home Work (HW). It is the performance by the student for a particular assignment related to a topic covered by the course and done at home. It was measured by the cumulative numerical grade obtained by the student in all home works.

Quiz (QUIZ). It is the performance by a student in a short, previously unannounced, test held in the class related a particular course topic. It was measured by the cumulative numerical grade obtained by the student in all quizzes.

Analysis and Results

Analysis

Multiple regression technique was used for the analysis of the data. Following model was used for the purpose:

$$TEST = \beta_0 + \beta_1 GENDER + \beta_2 HW + \beta_3 QUIZ \quad (1)$$

where GRADE = sum of all the scores made by a student in three tests given during the semester terms of numerical grade, GENDER = gender of the student with an assigned value of 1 for female and 0 for male, HW = cumulative numerical grade obtained by the student in all home works, QUIZ = cumulative numerical grade obtained by the student in all quizzes, β_0 = intercept, β_1 = the coefficient of GENDER, β_2 = the coefficient of HW, and β_3 = the coefficient of QUIZ.

Results
The results of the analysis are shown in Table 1.

Table 1 Multiple Regression Analysis for TEST using GENDER, HW, and QUIZ as independent variables

Variable	Intercept	Regression Coefficient	T	p<|T|
Intercept	-11.086		-0.685	0.498
GENDER		9.992	3.334	0.002
HW		0.324	0.383	0.705
QUIZ		3.036	3.940	0.001
F-value of the Model: 22.330	p>Model F = 0.0001	Model R2 = 0.69	Adjusted model R^2 = 0.66	

The results indicated that overall test grade of a student in a materials and methods of construction course offered at a Bangladesh university is positively related to quiz performances and gender at the levels of significance of 0.001 and 0.002 respectively. The results implied that the final grade of a student would increase by 3.036 points for every quiz point earned. They also implied a female student would earn about nine points more than a male student for this course. Home work performances did not have a statistically significant effect on the cumulative test score of student.

A multicollinearity test was performed to find out whether home work grades (HW) were related to quiz scores (QUIZ). It is a statistical phenomenon that indicates correlation between /among two or more predictor variables in a multiple regression model. A widely recognized index used to assess the severity of this phenomenon is Variance Inflation Factor (VIF). The values of VIF for home work and quiz were found to be 1.712 and 1.394 respectively. A VIF of 10 or higher indicates severe multicollinearity. The low VIF values of the predictor variables confirmed that multicollinearity was not a problem for this model.

Figure 1 shows the relationships between quiz and test performances of students in this course.

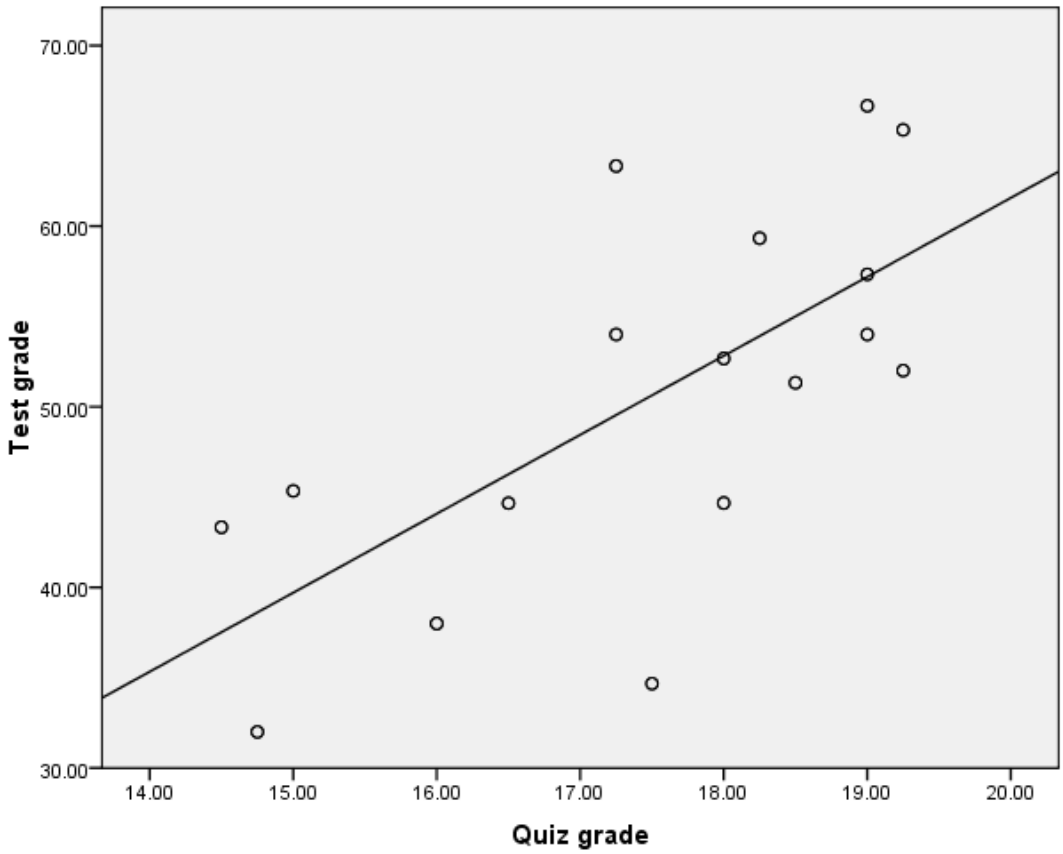

Figure 1. Relationship between grades on quizzes and test performances

The F statistic of a model basically tests how well the model, as a whole, accounts for the dependent variable's behavior. The F-value of this particular model was found to be statistically significant at less than the 0.001 level.

An important aspect of a statistical procedure that derives model from empirical data is to indicate how well the model predicts results. A widely used measure of the predictive efficacy of a model is its coefficient of determination or R^2-value. If there is a perfect relationship between dependent and predictor variables, R^2 is 1. In case of no relationship between dependent and predictor variables, R^2 is 0. Predictive efficacy of this particular model was found to be moderately high. Gender of a student and quiz performances explained 66 per cent of the variance.

Discussions

The results of the statistical analysis indicated that there is a positive relationship between in performances by a student in quizzes and major tests in material and methods of construction course offered at a university level in Bangladesh. Students scoring high in quizzes also obtained high grades in major tests. Studies on education done by other researchers provide strong support to this empirical finding[12, 13]. Woit & Mason[14] report an increase in student learning and retention with administering quizzes on a course in computer science. A poor performance in the

quizzes indicates an inadequate understanding of the materials discussed in the class. It eventually affects a student's overall performance in the course.

Gender effect on test performance was interesting, but not surprising. The female students were found to be more attentive in the class than the male students. They missed fewer classes than their male counterparts. Even though class attendance was not included as a variable in this study, there is a wide body of literature that indicates negative correlation between absenteeism and student performance[3, 4, 5, 15]. This particular factor effect might have an effect on enhanced quiz performance by the females in tests.

Conclusions

Based on the empirical data, a mathematical model has been developed to predict student performance in a course on materials and methods of construction offered at a university level in Bangladesh. The model as a whole accounts quite well for the behavior of the dependent variable of overall student performance. This is evident from the high F-value of the model that is statistically significant at the 0.0001 level. The predictive efficacy of the model is quite high with an adjusted R^2-value of 0.66. It could be useful as a tool for identifying predicted poor performers in such a course.

It is crucial for the students to have a clear understanding of the materials of a course. The instructors can have a measure of this understanding through administering quizzes on a regular basis. A grasp of the basic concepts is more important than the simple equation solving skills. The process would enable the instructors to take remedial measures at an earlier stage to provide additional help to the groups at risk by find ways to help them evaluate their understanding of course materials. The study will hopefully generate enough interest to do further research for deriving models for predicting student performance in other courses.

References

1. Bransford, J. D., Brown, A. L., & Cocking, R. R., (eds.), 1999, "How people learn: Brain, mind, experience, and school", National Academy Press, Washington, D. C.
2. Freeman, M. & McKenzie, J., 2001, "Aligning peer assessment with peer learning for large classes: the case for an online self and peer assessment system," in Peer Learning in Higher Education, Boud, D., Cohen, R., & Sampson, J. (eds.), Kogan Page Ltd., London, pp. 156-169, 200.
3. Cohn, E. & Johnson, E., 2006, "Class attendance and performance in principles of economics," Education Economics, Vol. 14, No. 2, pp. 211-233.
4. Murburger, D., 2001, "Absenteeism and undergraduate exam performance," The Journal of Economic Education, Vol. 32, No. 2, pp. 99-109.
5. Devadoss, S. & Foltz, J., 1996, "Evaluation of factors affecting student class attendance and performance," America Journal of Agricultural Economics, Vol. 78, No. 3, pp. 499-507.
6. Douglas, S. & Sulock, 1995. "Estimating educational production functions with correction for drops," Journal of Economic Education, Vol. 26, No. 2, pp. 101-112.
7. David, A. W., Flood, W. A., & Stromsnes, W., 2001, "The use of random extra credit quizzes to increase student attendance,", Journal of Instructional Psychology, Vol. 28, No. 2, pp. 117-120.
8. Kahle, J. B. & Lakes, M. K., 1983, "The myth of equality in science classrooms," Journal of Research in Science Teaching, Vol. 20, pp. 131-140.
9. Potter, C. et al., 2006, "A longitudinal evaluative study of student difficulties with engineering graphics," European Journal of Engineering Education, Vol. 31, No. 2, pp. 201-214.

10. Buchanan, W., 2006, "Correlation between academic and skills-based tests in computer networks," British Journal of Educational Technology, Vol. 37, No. 1, pp. 69-78.
11. Harb, N. & El-Shaarawi, A., 2007, "Factors affecting business students' performance: The case of United Arab Emirates," Journal of Education for Business, May/June 2007, pp. 282-290.
12. Devadoss, S. & Foltz, J. 1996, "Evaluation of factors affecting student class attendance and performance," American Journal of Agricultural Economics, Vol. 78, No. 3, pp. 499-507.
13. Landrum, R. E., 2007, "Introductory psychology student performance: Weekly quizzes followed by Cumulative final exam," Teaching of Psychology, Vol. 34, No. 3, pp. 177-180.
14. Woit, D. & Mason, D. (2000), "Enhancing student learning through on-line quizzes," ACM SIGCE Bulletin, Vol. 32, No. 1, pp. 367-371.
15. Senior, B. A., 2008, "Correlation between absences and final grades in a college course," Proceedings of the 44th Annual Conference of the Associated Schools of Construction, Auburn, Alabama, April 2-6, 2008, on CD-ROM.

IFTE CHOUDHURY
Ifte Choudhury is an Associate Professor in the Department of Construction Science at Texas A&M University. Dr. Choudhury has extensive experience as a consulting architect working on projects funded by the World Bank. His areas of emphasis include housing, alternative technology, issues related to international construction, and construction education. He is also a Fulbright scholar.