EXAMINATION OF THE RELATIONSHIP BETWEEN CLASS ATTENDANCE AND STUDENT ACADEMIC PERFORMANCE

Xue Bai, Virginia State University, xbai@vsu.edu
Ade Ola, Virginia State University, aola@vsu.edu
Soma Akkaladevi, Virginia State University, saakaladevi@vsu.edu

ABSTRACT

The aim of this study was to evaluate the impact of class attendance on the academic performance in two programming courses. Student involvement plays an important role in the success of a learning process. And attendance in a class has been used for a long time to measure students' involvement in most high schools and universities. Research suggests a strong relevance between students' class attendance and academic performance. Good attendance usually leads to good performance and vice versa. In this study, student's involvement was directly measured with our LMS system. In this two programming courses, students used our online IDE, which is integrated with the LMS system, so we were able use the number of logins and coding time to measure how much effort a student put in a course. Based on the findings, we not only confirmed previous study that Class attendance on academic performance has strong positive impact on academic performance, but also found that students who missed classes would check the website for scheduled class work less often than those who attended classes. The results obtained from this study can be very useful to colleges and universities for drafting attendance policies.

Keywords: Class Attendance, Academic Performance

INTRODUCTION

There has been a long-standing debate about the effect of Class attendance on academic performance. On one hand, there are those who advocate that students' class attendance and engagement plays an important role in higher education. It is argued that attending classes adds value to the student as this leads to better understanding of the course material. It is generally accepted that attending class has a positive correlation with student success and a better understanding of course material. Research suggests a strong relevance between students' class attendance and academic performance (Cortright, Lujan, Cox, & DiCarlo, 2011; Eisen, Schupp, Isserof, Ibrahimi, Ledo, & Armstrong, 2015; Norhidayah, Jusof, Ali, Mokhtar, Syafena, & Salamat, 2010; Lukkarinen, Koivukangas, & Seppäl, 2016; and Purcell 2007, Kassarnig, Mones, Bjerre-Nielsen, Sapiezynski, Dreyer Lassen, and Lehmann, 2018).

Technology has profoundly changed education in many ways. However, the traditional lecture has persisted as a principal means of delivering course material, especially at the lower undergraduate levels. Lectures are probably the best teaching method in many circumstances and for many students; this is probably the case especially for communicating conceptual knowledge, and where there is a significant knowledge gap between lecturer and audience. However, the lack of a convincing rationale has been a factor in under-estimating the importance of lectures and there are many who advocate their replacement with written communications or electronic media. But Charlton (2006) and Rogers and Duncan (2017) suggested that lectures are effective because they exploit the spontaneous human aptitude for spoken (rather than written) communications and because they are real-time, human-presence social events (rather than electronic media).

This paper reports on our own experiences of using lecture as a teaching method for two programming courses. As many other universities do, in our college, taking attendance is the primary method of tracking students' academic behaviors. Students are required to maintain a high attendance rate of attendance. Unfortunately, declining student attendance has long been a problem. Classroom attendance is expected of all students. In an attempt to control the issue and to boost academic performance, the university has prescribed an 85% attendance policy which permits an instructor to drop a student's grade for every absence per credit hour. For example, a grade may be drop from a "B"

to a "C" if the student is absent 4 times in 4-credit hour course or 2 times in a 2-credit hour course. The question is: Does this policy really have an effect on student performance?

In this paper, we attempt to assess the impact of class attendance on the academic performance. To do so, we developed a cloud based attendance-taking system, which is integrated into the LMS system. The system allows us to track the students' effort that in each course and to study the relationship between and academic performance. The rest of paper is organized as follows. Section 2 deals with the literature review. Section 3 explains the methodology, data analysis and evaluation of the results. We end the paper by making recommendations based on the results obtained.

LITERATURE REVIEW

In a widely cited study, Romer (1993) reported evidence on absenteeism in undergraduate economics courses at three major US universities. The study revealed that the average attendance rate was about 67 percent. The paper also presented regression results, based on a sample of 195 Intermediate Macroeconomics students, which indicates that a positive and significant relationship between student attendance and exam performance. On the basis of these findings, Romer suggested that measures aimed at increasing attendance, including making attendance mandatory, could be considered. Park and Kerr (1990) had found an inverse relationship between students' attendance and their course grades in a Money and Banking course over a four-year period, even after controlling for the effect of unobservable motivation by means of students' self-reported hours of study and their perceived value of the course. Following the controversial conclusions of Romer (1993), in the past decade a number of empirical studies in Economic education literature had examined the relationship between student attendance and academic performance. Durden and Ellis (1995) investigated the link between overall course grade and self-reported attendance levels in a sample of 346 Principles of Economics students over three semesters. Their results indicate that attendance matters for academic performance. In particular, whereas low levels of absenteeism have little effect on the eventual outcome, excessive absenteeism has a large and significant effect.

Devadoss and Foltz (1996) examined attendance in a sample of about 400 agricultural economics students at four large U.S. universities. They find that, even after controlling for both prior grade point average and the degree of motivation, on average students who attended all classes achieved a full letter grade higher than students who attended no more than 50 percent. Marburger (2006) investigated the relationship between absenteeism and exam performance in a sample of 60 students in a Principles of Microeconomics course. In the study, information on student attendance in each class during the semester is matched with records of class meetings during which the material corresponding to each question was covered. The results indicate that students who miss class on a given date are significantly more likely to respond incorrectly to questions relating to material covered that day than students who were present. Rodgers (2002) found that attendance had a small but statistically significant effect on performance in a sample of 167 introductory statistics course. Kirby and McElroy (2003) studied the determinants of levels of attendance at lectures and classes and the relationship with exam performance in a sample of 368 first year economics students. The result illustrated that hours worked and travel time were the main determinants of class attendance, and that the latter, in turn, had a positive and diminishing marginal effect on grade.

Among studies that reach less robust conclusions about the positive effect of attendance on performance, Bratti and Staffolani (2002) argued that estimates of student performance regressions that omit study hours might be biased, given that hours of study are a significant determinant of lecture attendance. Using a sample of 371 first-year Economics students they find that the positive and significant effect of lecture attendance on performance is not robust to the inclusion of the number of hours of study. Cretchley (2005) found that mathematics students who attended a sufficient number of classes got an average score of 63.6% while others got 54.3%. Marburger (2001) showed that a mandatory class attendance policy can reduce absenteeism significantly. Allen and Webber (2006) argued that the link between student performance and class attendance was not linear. Other factors such as revision strategies and peer-group effects might have significant impact on performance. They noted that class attendance has only a very small marginal benefit on test scores. This idea was supported by Martins and Walker (2006). Purcell (2007) found that for each 10% increase in class attendance, there was about a 3% increase in examination performance. The study was conducted on 2nd and 3rd year Civil Engineering students. Dolton et al. (2003), applying stochastic frontier techniques to a large sample of Spanish students, find that both formal study and self study are

significant determinants of exam scores but that the former may be up to four times more important than the latter. However, they also find that self study time may be insignificant if ability bias is corrected for. All of these studies, with the exception of Marburger (2001) and Rodgers (2001), were based on cross-sectional data sets. As a consequence, as observed by Romer (1993), the possibility that the estimated relationship between attendance and exam performance reflects the impact of omitted factors rather than a true effect cannot be ruled out. In this paper, we report results obtained using data on three classes to examine the relationship between class attendance and academic performance, as well as other factors that may affect their academic performance.

METHODOLOGY

Data Collection

The data set includes 39 students from two different courses in the Spring 2018. Only those students who took final exam have been included in the data set. In both courses, students are required to attend class lectures and in-class exercise sessions. Academic performance was measured as the overall grade by the end of semester using the grade distribution as specified in the syllabus for each course. For example, Table 1 shows how the overall grade was calculated:

Table 1. Grade Distribution

Activity	% of Final Grade
Project	10%
Excellent Attendance*	5%
Lab Assignments	10%
Homework Assignments	10%
Tests(2)	20%
Midterm Exam	20%
Comprehensive Final Exam	25%

Attendance was recorded with a cloud based automated attendance management system. With the automated attendance tracking system, students can use computers or portable devices, including smartphones to submit attendance. In addition, the system provides automated data mining service to help instructors identify students who have both poor attendance records and poor academic performance in a class. The automated attendance-taking system provides a highly efficient and accurate mechanism for tracking attendance. Most importantly, the system provides a live dashboard that shows students' attendance and academic performance. This capability allows the instructor to identify students who may be falling behind due to absenteeism. The system uses color-coded schema (for privacy reason, color-coded student list is omitted in the following figure) to highlight those students who performed poorly and missed classes more than 4 times.
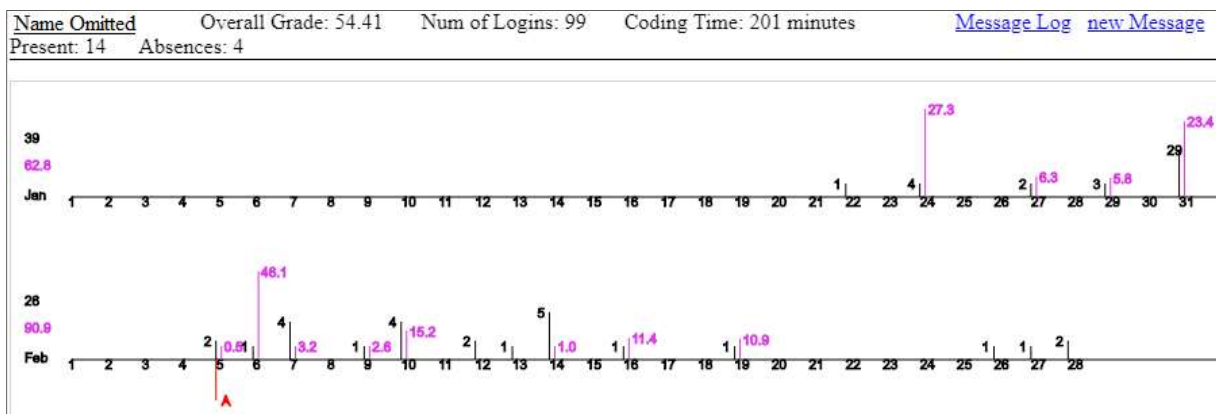

Figure 1. Activity Log, Attendance and Overall Grade Record

In the following sections, we discuss the variables and how the data was collected in the cloud based attendance taking system.

Explained Variable

Overall grade: this is used to measure student academic performance. It was calculated based on grade distribution described in each course syllabus. Grading is on a scale of 0 to 100. All tests were scheduled to be taken in class. In some cases tests were scheduled at least three days before due date. In theory, a student could receive full points for those assessment types (except tests which were scheduled in class) without attending classes. However, in order to incentivize students to attend classes, students with perfect attendance records receive additional 5% in their overall grade. To further explore the effect of class attendance on the test (which are all scheduled in class) and other assessment types, we calculated the overall grade based on only the tests only and the overall grade on the other assessment types.

Explanatory Variables

Total attendance. This is the number of classes attended by a student. The maximum possible number of recorded attendances varied among the three classes because attendance were not recorded for some special activities, including school wide event or working on projects with team members.

Total logins and coding time. Both courses are hosted in a Learning Management Systems (LMS) which is accessible from wholelearning.com. Both are programming courses and the wholeleaning platform provides cloud based Integrated Development Environment (IDE). For most students, the wholelearning IDE is the only tool needed to complete course assignments. The LMS records the number of logins and coding times throughout the semester for each of the two programming courses. Both logins and coding time can be considered as indicators on the time and effort spent on the courses.

Control variables

Bonus motivation. In order to incentivize students to attend classes, students can earn up to 5% towards overall grade. A student with no more than 1 absence was awarded 5 points towards overall grade, and 4 points, 3 points, 2 points, or 1 point if the student's absences were 2, 3, 4 or 5, respectively.

Result and Discussion

Attendance data were collected over a 16-week semester. Because the grade distribution and the number of attendance taken were different for each course, we present the data separately. Then the degree of correlation among variables was determined. Graphs were plotted to illustrate the correlation. The correlation among them was determined by identifying the degree to which there is a 'linear relationship' among them. The value of correlation coefficient (r) gives us an idea of the strength and significance of the correlation. We apply the following general classification (Hinkle, Wiersma, and Jurs, 2003):

Table 2. Rule of Thumb for Interpreting the Size of a Correlation Coefficient

Correlation Coefficient	Interpretation
.90 to 1.00 (−.90 to −1.00)	Very high positive (negative) correlation
.70 to .90 (−.70 to −.90)	High positive (negative) correlation
.50 to .70 (−.50 to −.70)	Moderate positive (negative) correlation
.30 to .50 (−.30 to −.50)	Low positive (negative) correlation
.00 to .30 (.00 to −.30)	negligible correlation

Another important measure is the coefficient of determination (R^2). This number tells us how well the best-fit line actually represents the data. R^2 specifically tells us the percentage of variation in one variable that can be explained by the variation in the other variable.

Table 3. Correlation Coefficient (r) for Introduction to Java Programming

	No. of Logins	Coding Time(Min)	Attendance	Absence	Missed Assessments	Test Grade	Asmt. Grade	Overall Grade
No. of Logins	1							
Coding Time(Min)	0.52	1						
Attendance	0.34	0.46	1					
Absence	-0.34	-0.46	-1	1				
Missed Assessments	-0.69	-0.61	-0.83	0.83	1			
Test Grade Only	0.50	0.73	0.49	-0.49	-0.61	1		
Asmt. Grade	0.43	0.79	0.67	-0.67	-0.80	0.73	1	
Overall Grade	0.51	0.80	0.58	-0.58	-0.71	0.97	0.87	1

Table 4. Correlation Coefficient (r) for Web Page Design (HTML and JavaScript)

	No. of Logins	Coding Time(Min)	Attendance	Absence	Missed Assessments	Test Grade	Asmt. Grade	Overall Grade
No. of Logins	1							
Coding Time(Min)	0.45	1						
Attendance	0.54	0.39	1					
Absence	-0.54	-0.39	-1	1				
Missed Assessments	-0.66	-0.54	-0.65	0.65	1			
Test Grade Only	0.53	0.40	0.39	-0.39	-0.38	1		
Asmt. Grade	0.60	0.47	0.74	-0.74	-0.74	0.39	1	
Overall Grade	0.66	0.50	0.62	-0.62	-0.61	0.90	0.75	1

As shown in table 3, the correlation coefficient between absence and number of logins is 0.34, while that of the correlation between attendance and coding time is 0.46 for the Introduction to Java programming course. For the Web Page Design course, the respective coefficients are 0.54 and 0.39, respectively. That means students attending classes more often were more likely to login in to the system and spend more time on course work. We use graph to present and discuss some correlations in more detail.
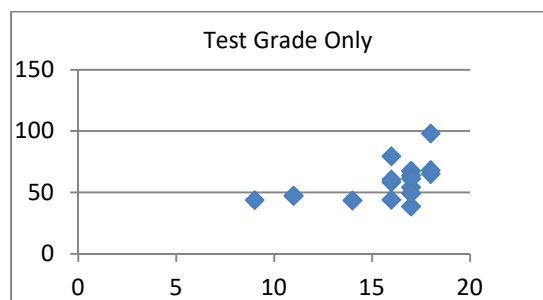

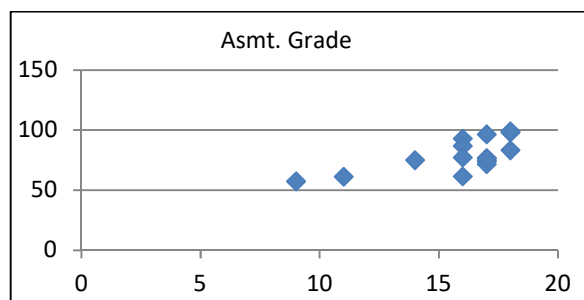**Figure 2.** Attendance v/s Test Grade Only

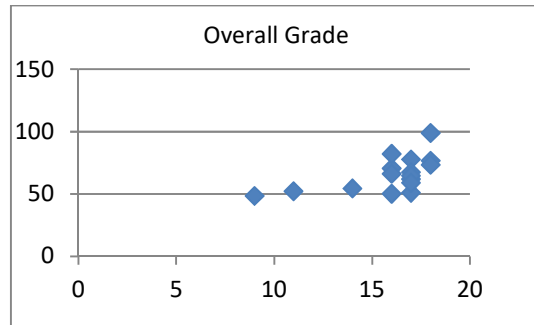**Figure 3.** Attendance v/s Assignment Grade Only

Figure 4. Attendance v/s Overall Grade

Figures 2 through 4 show the correlations between attendance and other three explained variables (test grade, assignment grade, and overall grade) for the Introduction to Java Programming course. Their correlations and the coefficient of determination are summerized in table 3.

Table 3. Coefficient of Correlation and Determination for Introduction to Java Prorgramming

	r	R^2
Attendance v/s Test Grade	0.49	0.24
Attendance v/s Assignment Grade	0.67	0.45
Attendance v/s Overall Grade	0.58	0.35

The correlation between attendance and other explained variables are high. It is well known that students who are organized and motivated perform better, and performance correlates strongly with attendance in practical classes. Since the courses in the study involves programming, concepts and coding examples are demonstrated during class meeting times. Students who attend class regularly gain additional knowledge from materials and other in-class support and resources. Results of the present study clearly support this concept. All assignments and in-class tests were announced at least three days in advance. We expected that students who missed classes would check the website more often for scheduled class work (including test and assignment schedule), but the opposite was the case. Table 4 summarizes the correlation of absence v/s number of logins and coding time.

Table 4. Coefficient of Correlation and Determination

	r	R^2
Absence v/s Logins (Java)	-0.39	0.15
Absence v/s Coding Time(Java)	-0.46	0.21
Absence v/s Logins (Web)	-0.54	0.29
Absence v/s Coding Time(Web)	-0.39	0.15

CONCLUSION

The aim of this study was to assess the relationship between attendance and academic performance by exploring some other factors that are related to attendance and performance in our experimental settings. Our study is innovative in the sense that this is the first study which tracks the effort that a student puts in for a course and analyzes the relationship between the absence/attendance and the effort which is measured by the number of logins and coding time. The results are relevant for instructors and students alike. The results can be used at the start of a new course in two ways. First, they can be used as a means of motivating students to attend class, because attending class is demonstrably related to academic performance. Second, the result can used to provide direction to those students who cannot or do not want to attend class: Students can be encouraged to utilize online resources that are available through the LMS system.

IMPLICATION OF THE STUDY

Student involvement plays an important role in the learning process. And class attendance has been used for a long time to measure students' involvement in most high schools and universities. It is generally accepted that attending class has a positive correlation with student success and a better understanding of course material. Good attendance usually leads to good performance and vice versa. Therefore, any problems related to attendance should be identified as early as possible so that appropriate measures can be taken to address them. As other universities do, taking attendance has been widely used in our college as a method to track students' academic behaviors. To motivate student to come to class, we give students bonus points for attending classes. Even though we are required to take attendance for each class, the attendance records have seldom been used to track student's academic performance. On the other hand, tracking students' attendance, especially if done manually, can be tedious and time consuming, especially for classes will large number of students. Moreover, there are other issues such as signatures forgery where other students are signing on behalf of their absence friends when attendance is recorded manually. To address this issue, we developed a cloud based attendance tracking system. The system automates most of the steps involved in tracking students' attendance. And the system provides tools to perform data mining to identify issues that are related to students' performance and attendance record. For example, the regression model can be used to track the student's attendance and overall performance in a class. Figure 5 shows the regression result between the number of attendances and overall grades for an introductory computer programming course in our college.
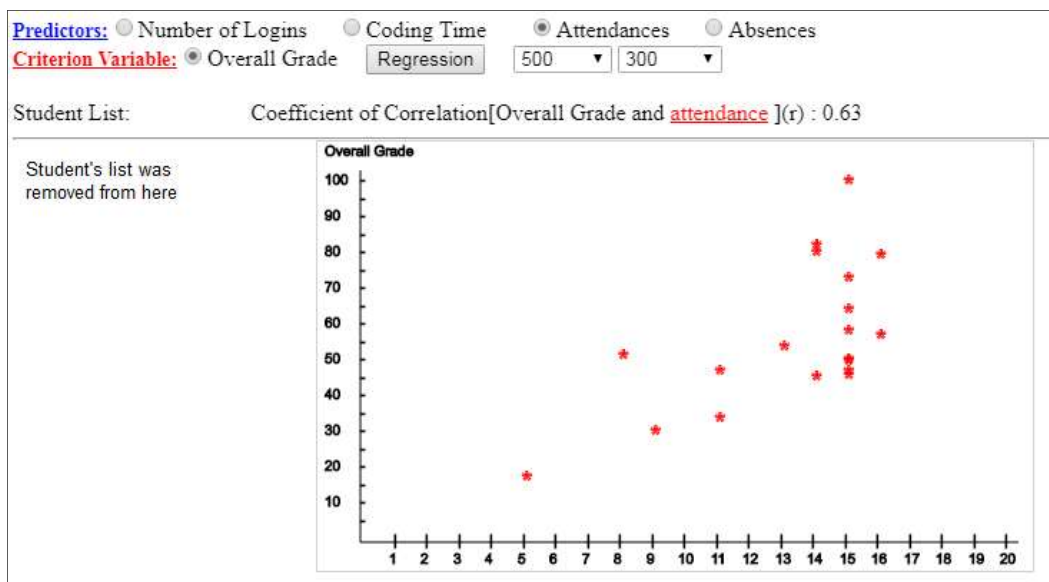

Figure 5. Regression Model

The students list uses different colors to highlight those with certain number of absences. So instructors can easily use this tool to identify students require further investigation.

RECOMMENDATION FOR FUTURE RESEARCH

The aim of this study was to assess the relationship between attendance and academic performance by exploring some other factors that are related to attendance and performance in our experimental settings. However, the only controlled variable included in this study was bonus motivation. Several notable factors that influence attendance and academic performance are motivation, prior grade point average (GPA), self-financing by students, hours worked on jobs, quality of teaching, and nature of class lectures. So, we recommend including these controlled variable in future study.

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