World Academy of Science, Engineering and Technology
International Journal of Educational and Pedagogical Sciences
Vol:14, No:11, 2020

The Relationship between Class Attendance and Performance of Industrial Engineering Students Enrolled for a Statistics Subject at the University of Technology

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***Abstract*—**Class attendance is key at all levels of education. At tertiary level many students develop a tendency of not attending all classes without being aware of the repercussions of not attending all classes. It is important for all students to attend all classes as they can receive first-hand information and they can benefit more. The student who attends classes is likely to perform better academically than the student who does not. The aim of this paper is to assess the relationship between class attendance and academic performance of industrial engineering students. The data for this study were collected through the attendance register of students and the other data were accessed from the Integrated Tertiary Software and the Higher Education Data Analyzer Portal. Data analysis was conducted on a sample of 93 students. The results revealed that students with medium predicate scores (OR = 3.8; p = 0.027) and students with low predicate scores (OR = 21.4, p < 0.001) were significantly likely to attend less than 80% of the classes as compared to students with high predicate scores. Students with examination performance of less than 50% were likely to attend less than 80% of classes than students with examination performance of 50% and above, but the differences were not statistically significant (OR = 1.3; p = 0.750).

***Keywords*—**Class attendance, examination performance, final outcome, logistic regression.

I. Introduction

CLASS attendance is of paramount importance and it contributes excessively to enhanced learning [1]. It is expected that students with high class attendance should perform better academically [1] than students with low class attendance. Attendance of classes is crucial, not only in higher education but in education at large [2]. Class attendance creates a space for sufficient teaching and learning to take place as the lecturer and the students can engage with the topics related to the subject and the lecturer can be able to detect if the student does not understand and then the lecturer can explain better to the student [2], [3]. It is common that at universities many students do not attend classes [4] as often as they should. Lack of class attendance has negative consequences for lecturers and for students [4] as it may negatively impact on students' academic performance.

Modern technologies and availability of online study materials may be one of the causes for low attendance of classes as students can use technology to access information [4], [5]. For example, students are able to access and download Microsoft PowerPoint presentations and videos to learn at their own pace and convenience [5]. Consequently, this raises the concern of whether missing classes still has an impact on the students' academic performance as it was the case prior to the advancement of technology [5]. Some of the reasons of absenteeism reported in literature include illness, tiredness, prioritisation of other academic work, lack of interest and finding the class boring [5].

Previous studies across different disciplines such as pharmacy, health sciences, physical sciences, psychology and economics reported a positive association between class attendance and academic performance that the more students missed the classes the poorer they performed in assessments and examinations [4], [5]. Oghuvbu used Pearson's correlation coefficient and found positive relationships between class attendance and academic performance [3]. Alexander and Hicks used the Pearson product-movement correlation coefficient to investigate the relationship between class attendance and academic performance and found a significant positive relationship between class attendance and performance on formative assessments [5]. Landin and Pérez used the Pearson's correlation coefficient to assess the correlation between class attendance and the examination grade and between class attendance and final course grade [4]. Results revealed a weak negative correlation between class attendance and students' grade [4]. Lukkarinen et al. used cluster analysis and regression analysis to investigate the relationship between university students' class attendance and learning performance and found that class attendance was positively associated with learning performance in the group that attended classes [2].

Although technology has improved and is used for teaching and learning, classes are still essential for teaching instructions in many undergraduate courses for full time designed programs [6]. University students gain maximum benefits from attending classes [7]. As compared to the academic performance of previous academic periods for industrial engineering students who registered for the Statistics subject, the academic performance of the class of 2017 was low and the attendance of classes was poor [8]. Little research has been done to investigate the impact of class attendance at tertiary level of education in South Africa. This has led to the decision making of conducting this study. The primary aim of this

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study is to determine whether class attendance is an important factor in relation to academic performance of industrial engineering students at a university of technology in South Africa. The findings of this study will indicate the importance of class attendance and can be used as a motivation for students to attend classes. The objectives of this paper are:

- to determine the relationship between class attendance and predicate;
- to determine the relationship between class attendance and examination performance;
- to determine the relationship between class attendance and final outcome.

II. Methods

A. Data

The data used for analysis were accessed from Integrated Tertiary Software (ITS), Higher Education Data Analyzer Portal (HEDA) and class attendance register [8]-[10]. Students' information including background information is recorded and saved into the ITS [8] and the HEDA databases [9]. A register was created using a class list that was downloaded from ITS [8], [10]. Students had to sign the register during each class time [10]. The class attendance of each student was counted at the end of each semester [8], [10]. Data for both semester 1 and semester 2 were joined to form a single dataset [8], [10]. Information of the students repeating the subject during semester 2 was included for semester 1 only and not for semester 2 [8], [10] as that would have been a duplication and the repeating student may have an advantage of performing better academically in semester 2.

B. Measures and Variables

For the sake of this paper, predicate is the calculation of the combination of all formative assessments that took place during the semester of teaching the Statistics subject [8], [11]. Examination marks refer to the marks that the student obtained in the examination while the final outcome is the average mark of both the predicate and the examination mark [8], [11]. Predicate marks are used to determine whether the student qualifies to write the examination or not [8], [11]. A predicate mark of 40% or above is required for the student to qualify to write the examination [8], [11]. The final mark is the mark that determines whether the student passed the subject or not [8], [11]. A final mark of 50% or above implies that the student has passed the subject [8], [11].

The outcome variable is class attendance and it was regarded as high if the student had attended 80% or higher of the classes and it was regarded as low if the student attended less than 80% of the classes. Gender was categorised as male and female. Residence was categorised as university residence if the student was residing at the university residence and as private residence if the student was residing at a non-university residence. Predicate was categorised as high if the predicate was 60% or higher, as medium if it was 40% to 59% and as low if it was below 40%. Examination mark was regarded as passed if it was 50% or higher and as failed if it was below 50%. Similarly, the final outcome was regarded as passed if it was 50% or above and as failed if it was below 50%.

C. Statistical Model

The outcome variable is class attendance and is dichotomous (high = 0 and low = 1). Amongst other appropriate statistical techniques, logistic regression technique can be used to analyse data when the outcome variable is binary [12]. Logistic regression is a mathematical modeling approach that can be used to describe the relationship between the outcome variable and one or more explanatory variables [12]-[14]. The logistic regression can be expressed as:

$$\pi_{ik}\left(\mathbf{x}\right)=\frac{e^{\beta_0+\beta_k\mathbf{X}_{ik}}}{1+e^{\beta_0+\beta_k\mathbf{X}_{ik}}} \quad (1)$$

where π_{ik} is the probability of the ith student in the kth class with a low class attendance, β_0 is the intercept, β_{k_s} are the regression coefficients of the explanatory variables and $\mathbf{X}_{ik}$ is the vector of explanatory variables [13], [14].

Four models were fitted. In Model I separate univariate models between class attendance and each explanatory variable (sex, residence and predicate) were fitted. In Model II a multivariate model was fitted between class attendance and all three explanatory variables (sex, residence and predicate). Model III was based on univariate models between class attendance and examination performance and between class attendance and final outcome while Model IV was a multivariate model between class attendance and examination performance and final outcome. Data were analysed using STATA 14.

D. Ethics

Approval to use the data and to conduct this study was obtained from the Research Ethics Committee of the university where the data were obtained and the reference number is REC/2018/05/001 [15].

III. Results

The summary statistics of the variables considered for analysis is illustrated in Table I whilst Tables II-V contain the results of the logistic regression models.

A. Descriptive Statistics

A total of 93 Industrial Engineering students were enrolled for the Statistics subject in 2017. Of these 93 students, 66 (71.0%) were male and 27 (29.0%) were female. 42 students (45.2%) attended 80% and above of the classes and 51 (54.8%) attended below 80% of the classes. 27 seven students (29.0%) resided at university residences and 66 (71.0%) resided at private residences. A total of 26 students (28.0%) had high predicate scores while 38 (40.9%) had medium predicate scores and 29 (31.2%) had a predicate scores below 40%. Only 64 students (68.8%) qualified to write the

examination whereas 29 (31.2%) did not. Of the 64 students who qualified to write the examination 49 (76.6%) obtained examination scores of 50% and above and 15 (23.4%) obtained examination scores lower than 50%. Of all the 93 students who were registered for the subject 58 (62.4%) passed and 35 (37.6%) failed.

TABLE I
SUMMARY STATISTICS

Variables	Categories	N (%)
Class Attendance	High	42 (45.2)
	Low	51 (54.8)
Gender	Male	66 (71.0)
	Female	27 (29.0)
Residence	University Residence	27 (29.0)
	Private Residence	66 (71.0)
Predicate	High	26 (28.0)
	Medium	38 (40.9)
	Low	29 (31.2)
Examination	Passed	49 (76.6)
	Failed	15 (23.4)
Final Outcome	Passed	58 (62.4)
	Failed	35 (37.6)

B. Results from Model I

The results of Model I are presented in Table II. The results showed that class attendance was significantly associated with sex, residential status and predicate score. Male students were significantly more likely to attend less than 80% of classes than female students (OR = 3.5; p = 0.009). Students who resided at private residences were significantly likely to attend less than 80% of classes as compared to students who resided at university residences (OR = 2.8; p = 0.030). Furthermore, students with medium predicate scores (OR = 3.7; p = 0.021) and students with low predicate scores (OR = 20.8, p < 0.001) were significantly more likely to attend less than 80% of the classes as compared to students with high predicate scores.

TABLE II
RESULTS FROM MODEL I

Explanatory variables		Model I OR (S.E)	P-value
Sex	Female	0 (-)	
	Male	3.5 (1.69)	0.009
Residence	University	0 (-)	
	Private	2.8 (1.32)	0.030
Predicate	High	0 (-)	
	Medium	3.7 (2.10)	0.021
	Low	20.8 (14.83)	< 0.001

C. Results from Model II

The results of Model II are presented in Table III. Male students were more likely to attend less than 80% of classes than female students, but the differences were not statistically significant (OR = 1.2; p = 0.774). Also, students who resided at private residences were more likely to attend less than 80% of classes as compared to students who resided at university residences, but the differences were not statistically significant (OR = 3.1; p = 0.061). Students with medium predicate scores (OR = 3.8; p = 0.027) and students with low predicate scores (OR = 21.4, p < 0.001) were significantly more likely to attend less than 80% of the classes as compared to students with high predicate scores.

TABLE III
RESULTS FROM MODEL II

Explanatory variables		Model II OR (S.E)	P-value
Sex	Female	0 (-)	
	Male	1.2 (0.72)	0.774
Residence	University	0 (-)	
	Private	3.1 (1.82)	0.061
Predicate	High	0 (-)	
	Medium	3.8 (2.34)	0.027
	Low	21.4 (16.62)	< 0.001

D. Results from Model III

The results of Model III are presented in Table IV. The results revealed no significant associations between class attendance and examination performance and between class attendance and final outcome of the 64 students who qualified to write the examination and wrote the examination. Students with examination performance of less than 50% (those who failed the examination) were more likely to attend less than 80% of classes than students with examination performance of 50% or above (those who passed the examination), but the differences were not statistically significant (OR = 1.4; p = 0.587). Students with the final outcome of less than 50% (those who failed the subject) were more likely to attend less than 80% of classes than students with the final outcome of 50% and above (those who passed the subject), but the differences were not statistically significant (OR = 1.5; p = 0.625).

TABLE IV
RESULTS FROM MODEL III

Explanatory variables		Model III OR (S.E)	P-value
Examination Performance	Passed	(-)	
	Failed	1.4 (0.822)	0.587
Final Outcome	Pass	(-)	
	Fail	1.5 (1.308)	0.625

E. Results from Model IV

The results of Model IV are presented in Table V. The results showed that class attendance was not significantly associated with examination performance and final outcome of the 64 students who qualified to write the examination and wrote the examination. Students with examination performance of less than 50% (those who failed the examination) were more likely to attend less than 80% of classes than students with examination performance of 50% or above (those who passed the examination), but the differences were not statistically significant (OR = 1.3; p = 0.750). Students with the final outcome of less than 50% (those who failed the subject) were more likely to attend less than 80% of classes than students with the final outcome of 50% or above (those who passed the subject), but the differences were not

statistically significant (OR = 1.3; p = 0.833).

IV. Discussion

The results of the univariate analysis revealed that male students, students who resided at private residences, students with medium predicate scores and students with low predicate scores were significantly associated with low class attendance. However, in the multivariate analysis a significant association was found between class attendance and predicate implying that students with medium predicate scores and students with low predicate scores were significantly associated with low class attendance. There is no clear reason of why male students were associated with lack of class attendance than female students. However, the results are in agreement with the findings reported by Cortright et al. whereby it was found that high grades of examination performance was associated with female students than male students due to female students attending more classes than male students [1]. The possible reason to this finding could be that male students are not as disciplined as female students. Male students do not always follow instructions like female students do.

TABLE V
Results from Model IV

Explanatory variables		Model IV OR (S.E)	P-value
Examination Performance	Passed	(-)	
	Failed	1.3 (0.925)	0.750
Final Outcome	Pass	(-)	
	Fail	1.3 (1.321)	0.833

The reason students who reside at private residences were associated with lack of class attendance could be related to lack of transport and financial challenges. Some of the students who stay at private residences could be residing in areas where sometimes they are affected by the delays of public transport. Service delivery protests also affect transportation and movements of people as the protesters block the roads during protests [16]. During these protest actions the protestors close the roads, thus directly affecting vehicle and people's movements [16]. Some students could have been affected by service delivery protest actions hence they missed some of the classes. Other possible reasons for delays could be attributed to being stuck in traffic congestions that occur in the early hours of the day and in turn students arrive late at the university which results in missing the classes that took place early on those specific days.

Poor class attendance was associated with poor examination performance and poor final outcome in both the univariate logistic models and the multivariate logistic models, but the differences were not statistically significant. The reason for not finding significant differences between class attendance and examination performance and again between class attendance and final score is that the students who wrote the examination had high predicate scores and high class attendance. This is supported by the results of Model I and Model II that low and medium predicate scores were associated with class attendance of less than 80%. These results show that a class attendance of less than 80% puts the students at a high risk of failing. The results are in agreement with the findings by Landin and Pérez wherein it was found that students with the highest class attendance performed better academically than students with low class attendance [4]. Overall, the findings imply that poor class attendance is associated with poor academic performance. The more the student attends classes the higher the chances of performing well academically.

V. Conclusion and Recommendations

It has been shown that class attendance has an effect on the academic performance of the student. Students who attend less than 80% of classes were associated with poor academic performance. The lesser the student attends the classes the higher the risk of failing the subject. The improvement of class attendance by the students can increase their academic performance [3]. More than half of the students (54.8%) attended less than 80% of classes and this contributed to poor academic performance as only 58 (62.4%) of them passed the subject. If all the students had attended more than 80% of classes, the pass rate would have been significantly high. Lack of attendance could be attributed to students seeing Statistics subject as a less important subject than engineering related subjects.

Class attendance should be made compulsory [4] and the university should develop and implement class attendance policy (or rule) that will enforce students to attend a minimum of 80% of classes. Students who attend less than 80% of classes should automatically be disqualified to write the examination. As the number of students enrolling at the university has increased substantially, the university should build more residential hostels for students in order to reduce the number of students residing at private residences. Students should be made aware of the importance of doing the subject Statistics in their qualification. They will need to apply what they learn from this subject for Quality Control and for experimentation and research. Lecturers should administer attendance registers for each and every class. By so doing the pass rates and success rates of many subjects will improve substantially.

VI. Limitations

Other variables such as method of teaching, age of the student, Admission Point Score and type of school where the student matriculated were not included in the analysis due to lack of access to that information. These variables can contribute towards establishing in detail the factors associated with poor academic performance. It is not possible that class attendance is the only predicting factor towards poor academic performance [4], there could be other factors that may be related to poor class attendance and/or poor academic performance.

ACKNOWLEDGMENT

Special thanks to the university and the Faculty Ethics Committee for allowing to use the data.

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