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Statistical Analysis on Students' Evaluation and Students' Final Exam Marks in Undergraduate Mathematical Courses at Universiti Teknologi Malaysia

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ABSTRACT

The COVID-19 pandemic has become a global health issue and has had a major impact on education. Distance learning was implemented during COVID-19 pandemic. Concerns towards the negative impact of online learning such as lack of physical interaction between lecturers and students give rise on the need to study the impact of such a method towards student's performance and student's perception in the quality of teaching. This paper aims to determine whether the subject's mean marks and lecturer's evaluation (e-PPP) marks differs significantly between the online and face to face teaching method. From the case study of subjects offered by Mathematical Sciences Department in UTM, the results show that there is no correlation between the subject's mean marks and lecturer's evaluation marks. Findings from ANOVA show that both marks are not significantly different between the online and face to face of teaching methods. This may indicate the adaptability and readiness from students to experience and embrace the distance learning via online teaching.

Keywords:
Online teaching, teaching evaluation, R-square, ANOVA.

1. Introduction

Since 2020, the COVID-19 pandemic has swept the globe, and Malaysia is one of the countries that has not been spared from the current COVID-19's impact. To curb the spread of COVID-19, the Malaysian government has taken precautionary measures by enforcing movement control order since March 18, 2020. As a result of the movement control order, a few service sectors were not allowed to operate and remained closed temporarily. The education sector was no exception to government enforcement, where the schools and the universities need to change their education delivery setting from physical to online learning. Educators have begun to integrate online learning even before COVID-19; yet there were still several concerns about it, including educators' readiness to support digital learning, lower income students with a B40 income classification background who could not afford to buy a laptop, students from rural areas who have poor internet connections for online

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classes, unsupportive environments that made it difficult for both teachers and students to focus on teaching and learning, and limited communication and interaction between teachers and students. However, due to the serious outbreak of COVID-19, online teaching-learning was no longer an option, but rather a need. Therefore, to help students cope with the changing educational landscape, educators have implemented diverse online pedagogical tools to provide the best quality of teaching and learning throughout the pandemic. At Universiti Teknologi Malaysia (UTM), one of the ways to measure the quality of the teaching and learning approaches that we have implemented is by looking at the students' grades which is called as mean marks of courses extracted from Course Assessment Report (CAR) and students' evaluations which is called as mean value of Online Teaching and Evaluation (e-PPP). Lecturers often received high mean marks in CAR and e-PPP scores during physical classes. However, since COVID-19 required UTM's lecturers to switch from offline to online mode, the situation has changed.

Online and face-to-face (F2F) education had been compared in a number of studies. Some studies claim online education leads to less effective teaching [1],[2] & [3], which may negatively impact students' perception on the teaching quality of their lecturers. In online teaching, students report spending longer studying due to a lack of physical interaction with teaching [4]. Other problems such as limited access to internet facilities, and a lack of available devices (such as a mobile phone and laptop) also contribute to the difficulty of the online learning process. This may also lead to a reduction of quality teacher-student interaction time, as well as frustration and lack of motivation for students [4]. Nevertheless, other studies have cited strengths, such as its flexibility and ability to accommodate diverse learning styles [5],[6] & [7]. This strategy also claimed to contribute to student-centered learning [7] and enhance learning outcomes [8]. Some researchers discovered that online learning in fact had positive impact on student's performance [9],[10] & [11] such as in terms of the availability of the recorded lectures and extended office hours and having more access to faculties through email [12]. A study reveals that students are comfortable with online classes and getting enough support from teachers [13]. Various responses towards online teaching were discovered from several studies. In some instances, online teaching had affected negatively towards student perception on the online teaching quality and their active interactions during the online classes [14] However, some findings suggest there's no significant difference on student's perception of the online course quality in terms of teaching and learning across academic discipline [15]. In this study, based on the students' performance and their perception of a lecturer's teaching evaluation, two forms of teaching are compared in this study: online and face-to-face. We aim to determine whether the mean marks in CAR and e-PPP scores are significantly different for courses taught by the Department of Mathematical Sciences' academic staff with online teaching and physical classes.

1.2 Research Question

Our research aims to study the effects of online learning towards student's performance and student's perception of lecturers' teaching quality during the coronavirus pandemic. Hence, our main research question is:

"Has online learning during COVID-19 affected students' performance and students' perception of lecturers' teaching quality?"

1.3 Research Objectives

The goal of this research is to identify the factors affecting online learning during COVID-19. Hence, our study objective is as follows:

To determine whether there is an association between students' performance and students' perception of lecturer's teaching evaluations for courses taught by the Department of Mathematical Sciences' academic staff with online teaching and physical classes.

2. Methodology

2.1 Sample data and resources

The study was conducted using data for lecturer's teaching score (ePPP) and student's final examination average marks for subjects offered by Mathematical Sciences Department of Faculty of Science, University Teknologi Malaysia. The subjects considered in this study were offered in Semester 1 Session 2019/2020, Semester 2 Session 2019/2020, Semester 1 2020/2021 and Semester 2 2020/2021. Semester 1 resumed in February while semester 2 started in September. Teaching deliveries were done face to face in the first two semesters and a month of the third semester before the surge of Covid19 pandemic became serious in Malaysia with movement control order (MCO) was implemented in March 2020. While two third of the third semester and all of the fourth semester teaching and learning were conducted through online classes via platforms such as webex, googlemeet and other mediums. Therefore, data for each ePPP and final examination average marks will be compared between the first two semesters and the last two semesters for face to face and online teaching.

2.2 Instrumentations

The ePPP score is obtained from a questionnaire filled in by students from each course at the end of every semester. The student's evaluation forms were designed by UTM Academic Leadership Unit (UTMLead). It consists of several items such as teaching component (five items), delivery (seven items), assessment (five items), student and lecturer's relationship (five items) and application of generic skills (seven items). All of the 33 items are presented on a five-point Likert scale ranging from '1-strongly disagree', '2-disagree', '3-neither agree nor disagree', '4-agree' and '5-strongly agree'. The average ePPP score for the lectures is ranked according to these categories: P1: Rank 20%, P2: 20% Rank 40%, P3: 40% Rank 60%, P4: 60% Rank 80%, P5: Rank 80%. The ePPP score is important and is used as part of the contributing marks in end of the year evaluations with lecturer's scores averaging more than 4.6 for five consecutive years. The final examinations average marks for each subject were captured at every end of the semester. The lecturers filled in the Course Assessment Report (CAR) manually or through online Outcome Based Education system (iOBE) and uploaded the form to the repository website for each respective faculty of the university.

2.3 Data collection procedure

The data collected for this study are secondary data where the average marks from each distinct subject for each lecturers were obtained from the CAR and the ePPP of physical class totaling of 55 data. Meanwhile 62 data for average marks and Eppp from respective lecturers teaching online are collected throughout the duration from September 2019 until March of 2021.

2.3 Analysis procedure

In the first part of the analysis, descriptive statistics of the data such as the summary, the boxplot and regression statistics are presented. For the second part, in order to compare the student's score

and the lecturer's score between the the two groups (teaching face to face and online) a statistical method known as One-way Analysis of Variance (ANOVA) is carried out. ANOVA is a statistical technique which is used to determine if there is any statistically significant difference between the means of two or more groups with certain assumptions that are assumed to be true such as each sample is taken from independent normally distributed populations with equal variance.

3. Results and Discussion

The data contained the mean marks of the lecturers from the teaching evaluation and the mean marks of the students' scores for the subjects taught by the lecturers. A simple linear regression model is used to see if there is any correlation between these two variables. Two groups of samples from physical and online classes of the students' scores are used to see if there are any significant findings during physical and online classes. The descriptive analysis of the data is as shown in Table 1 below.

Table 1
Descriptive statistics of the data

	Total count	**Mean**	**Standard deviation**	**Variance**
Lecturers' teaching score (physical)	55	4.5935	0.1853	0.0343
Lecturers' teaching score (online)	62	4.6902	0.1423	0.0202
Students' score (physical)	55	3.2544	0.4269	0.1822
Students' score (online)	62	3.1782	0.4584	0.2101

Based on Table 1, the mean lecturers' teaching scores during physical classes is lower than those. In this study, we also used the box plot as one of the descriptive statistics methods. In descriptive statistics, a box plot is a graphical representation of the localization, spread, and skewness groups of numerical data through their quartiles. A box plot's whiskers extend beyond the upper and lower quartiles, suggesting variability beyond the upper and lower quartiles. Consequently, the plot is also known as the box-and-whisker plot or the box-and-whisker diagram. Meanwhile, outliers are observations that are numerically distant from the rest of the data, and these outliers are shown as data points located outside the whiskers of a box plot.

For the first assessment, to see whether the students' scores were affected by the lecturers' teaching scores, linear regression analysis was performed. From the analysis output, the value of the R-square and F-test will be used to determine whether there is a correlation between these two variables. If R-square is near to 1, it gives meaning that the variables have a strong relationship, depending on each other. As for the F-test, it will help to determine whether the independent variable has a relationship with the dependent variable. The null hypothesis of the F-test in this study is that there is a strong relationship between the independent and dependent variables. In this study, the value of the F-test will be determined from the significance F value generated by Excel. If the significance F is smaller than 0.05, we will accept the null hypothesis. The regression statistics from Excel that obtained is shown in Table 2.

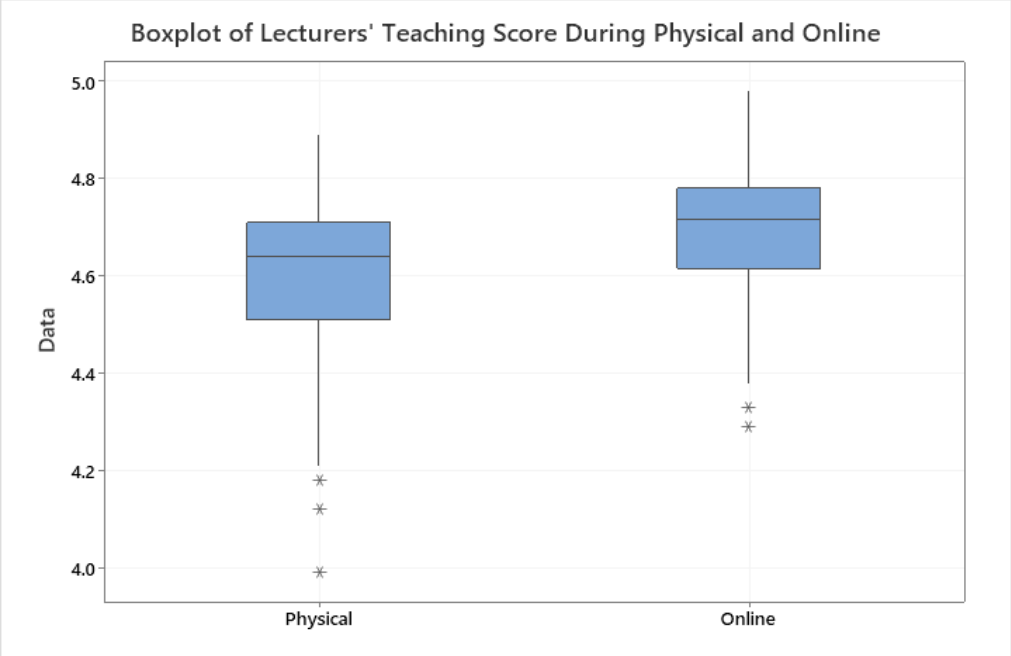

Fig. 1. Boxplot for teaching scores during physical and online classes

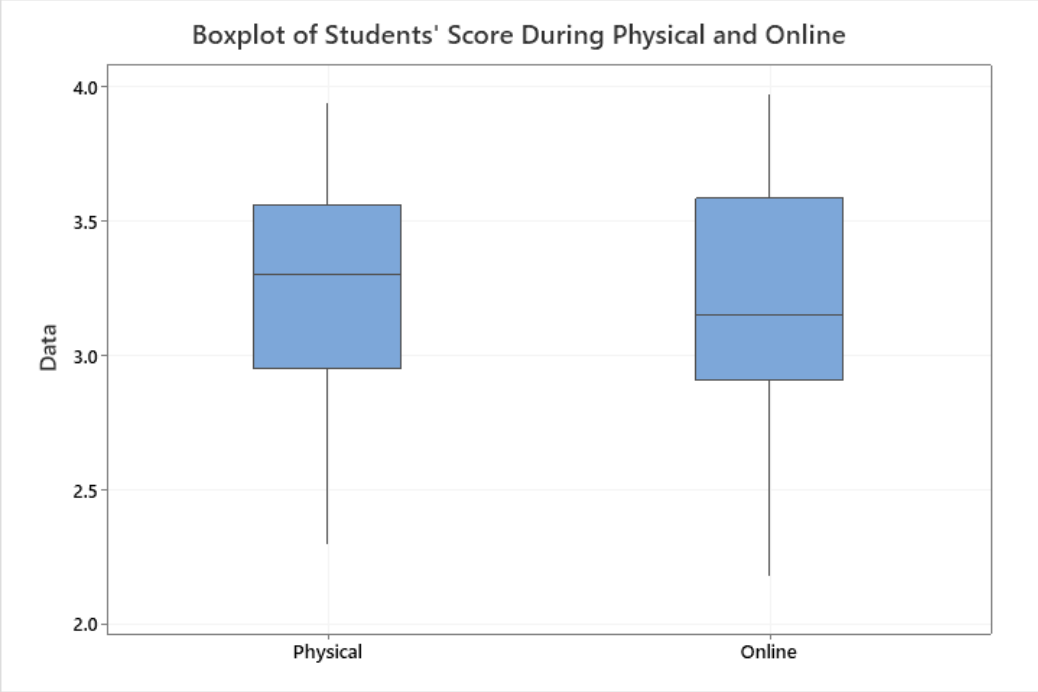

Fig. 2. Boxplot for students' score during physical and online classes

Table 2
Regression statistics to see interaction between lecturers' teaching score and students' score during physical and online classes

	Physical Classes	**Online Classes**
R-square	0.006879	0.01404
Significance *F*	0.5472	0.3590

From Table 2, the R-square value is near to 0 for both physical and online classes. Thus, we could conclude that there is no relationship between lecturers' teaching score and students' score. This result is supported by the significance F value from physical and online classes. The values are larger than 0.05 for both groups of classes.

Other than the correlation between lecturers' teaching score and students' score, we also perform ANOVA test to see if the online and physical classes affect the students' score. The ANOVA test is used to determine whether there are any statistically significant differences between the means of independent unrelated groups. The one-way ANOVA compares the means between the groups you are interested in and determines whether any of those means are statistically significantly different from each other. The null hypothesis is the groups are from the same group. To accept the H null, the F-value should be larger than F critical. The output of the ANOVA test from Excel is as shown in Table 3 below.

Table 3
ANOVA test to see the effects of online and physical classes to the students' score

SUMMARY						
Groups	**Count**	**Sum**	**Average**	**Variance**		
Physical	55	178.99	3.254364	0.182218		
Online	62	197.05	3.178226	0.210143		
ANOVA						
Source of Variation	**SS**	**df**	**MS**	***F***	***P*-value**	***F* crit**
Between Groups	0.168954	1	0.168954	0.857506	0.356377	3.923599
Within Groups	22.65846	115	0.19703			
Total	22.82741	116				

From Table 3 above, the F-value is smaller than the F critical value and the p-value is larger than 0.05, thus we accept H null. This ANOVA output shows that the mode of the learning does not affect the students' score. This result can be supported with the boxplot graph in Figure 4 where the boxplot during physical and online classes are at a significant level or in the same group although the means are different for these two boxplots.

Table 4
ANOVA test to see the effects of online and physical classes to the lecturers' teaching score

SUMMARY						
Groups	**Count**	**Sum**	**Average**	**Variance**		
Physical	55	252.64	4.593455	0.03433		
Online	62	290.79	4.690161	0.02024		
ANOVA						
Source of Variation	**SS**	**df**	**MS**	***F***	***P*-value**	***F* crit**
Between Groups	0.272573	1	0.272573	10.14907	0.001859	3.923599
Within Groups	3.088542	115	0.026857			
Total	3.361115	116				

The results of the ANOVA for lecturers' teaching scores are different. ANOVA for lecturers' teaching scores shows a different result. The F-value is larger than the F critical value, and the p-value is smaller than 0.05. Thus, the H null the null hypothesis is rejected, indicating that there is a significant difference in the teaching scores during physical and online classes. Referring to boxplot in Figure 1, the boxplot during online classes is slightly higher than the boxplot during the physical classes. This explains why the ANOVA test displays the results, as shown in Table 4. Although students' score test shows no significant difference, the lecturers' teaching score shows a slight increment in their score. Although there is no substantial variation in the students' scores, the lecturers' teaching scores have increased slightly. This might be a signal that the students prefer to have online classes compared to physical or traditional classes.

4. Conclusions

Online teaching and learning activities are now a necessity for all students regardless of level. Mean marks collected from the CAR report and student evaluations from the ePPP are used as measuring stones at UTM to assess teaching and learning quality. As a result, the purpose of this study was to see if the mean CAR and e-PPP scores for courses taught by the Department of Mathematical Sciences' academic staff using an online or face-to-face approach is significantly different. According to the regression correlation results, there is no association between lecturers' teaching scores and students' scores. This ANOVA result reveals that the students' score is unaffected by the learning style. This is supported by the boxplot graph, which shows that the boxplots during physical and online classes are at a significant level or in the same group, despite the fact that the means are different. Although the students' scores have not changed significantly, the lecturers' teaching scores have improved slightly. This could indicate that students prefer online classes over traditional or physical classes. As a result, it may be confirmed that the lecturers' teaching score and the students' score are unrelated, and that the grades are unaffected by one another.

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