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The effects of students' online learning anxiety on their performance in Calculus 1 using multiple linear regression analysis

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ABSTRACT

The emergence of the Covid-19 pandemic has changed the learning approaches such that online learning becomes the most suitable platform in the learning process. This situation influences students' anxiety towards their sudden shift in learning behaviour from face-to-face (f2f) to online learning non-face-to-face (non-f2f), which affects their performance in Calculus1. They are likely to feel anxious about their self-learning ability and this makes their self-confidence level low. Hence, this study was conducted to investigate the effects of students' anxiety on online learning towards their Calculus1 performance. An online questionnaire through Google Forms was distributed to 200 students of Diploma Sains (AS120), UiTM Cawangan Pahang Kampus Jengka. The collected data were analysed using multiple linear regression analysis. Based on the obtained results, out of the four factors of anxiety, the factor of assessment was found to affect students' anxiety towards online learning that further affects their performance, especially in Calculus1. Thus, the implication of this study caters both sides of lecturer and students in the online distance teaching and learning processes which by knowing the students' anxiety factors might help educators boost students' confidence in online learning, especially in the Calculus1 subject.

Keywords: Students' anxiety, Calculus 1 performance, Online learning, Multiple linear regression analysis

INTRODUCTION

The emergence of the Covid-19 pandemic has changed the learning approaches. Most governments worldwide had enforced a lockdown to restrain the Covid-19 virus, including Malaysia. The outbreak has challenged the global educational systems' readiness to handle disasters that demand electronic and remote operation. Hence, to sustain the knowledge transfer among students, educators in schools, colleges, and universities need to change their learning approaches during the Movement Control Order (MCO) and online learning has become the most suitable platform to ensure continuity of education.

Online learning is part of the distance learning process involving a web-based medium or the internet as mentioned by Mukhtar et al.(2020) and (Chung et al.(2020) and it is also known as e-learning. According to Chung et al. (2020), online learning can exceed the limits of distance, time, space, medium, and location so that it becomes the best method for teaching and learning in this crucial time. David (2014) and Block et al. (2008) found that online learning will cause anxiety to students, especially those who taking online courses the first time. Online learning requires students' self-learning, including controlling the surrounding environment, learning time, and self-motivation. This situation influences students' anxiety due to the sudden shift in learning behaviour from face-to-face (f2f) to online learning non-face-to-face (non-f2f). Saadé et al. (2017) viewed anxiety towards online learning as a "feeling of fear from misuse of information technology compromising course performance." The symptoms can include psychological, physical, or environmental challenges. There are also various forms of anxiety such as excessive worrying, a sense of fear, restlessness, overly emotional responses, and negative thinking. Some

people who feel anxious appear to be calm; however, the brain never stops thinking as reported by Vitasari et al. (2010).

This sudden leap in the instruction method has impeded student learning and caused stressful workloads, which begins to increase anxiety and depressive symptomatology among undergraduate students (Fawaz and Samaha (2021)). Hence, students feel more anxious about the distance learning approach because they could not discuss or share their problems with the instructors daily. David (2014), Merrell (2008) and Ajmal and Ahmad (2019) concluded that the anxiety towards online learning emerges due to some reasons, for instance, lack of communication with the tutors, poor feedback from the tutors, offices, lack of understanding of assignments, assessments, and tutor remarks, performing a job side by side with education, including several issues regarding assignment schedules. Chung et al. (2020) found that challenges faced by students are related to the understanding of the subject matter. They also lack self-learning control, either in terms of timing or online communication efficacy.

Online courses continue to increase dramatically. Mukhtar et al. (2020) and Chung et al. (2020) stressed that one of the main challenges include the internet connection. Other than that, computer-related anxiety remains an important issue, and, in this context, it has evolved to online learning anxiety with deeper psychological states involved. Consequently, performance is compromised (Saadé et al. (2017)). However, a significant effect of anxiety on the academic performance of distance learners was found. Merrell (2008) conducted a study to identify the relationship between anxiety and task performance. It was explored in the study that, as anxiety towards school performance becomes more serious; students' ability to fully perform these tasks is diminishing, even as anxiety becomes a severe issue for them. Thus, student performance drops gradually as described by Ajmal and Ahmad (2019) in their work. Saadé et al. (2017) reviewed that anxiety is not only about fear of using information technology, but also more about interaction and communication with the subject matter. The process of knowledge transfer may incur misunderstanding and result in poor performance; hence, students are likely to feel anxious about their self-learning ability and this makes their self-confidence level low. Students with anxiety also show a passive attitude in their studies. For instance, they show a lack of interest in learning, frequent absence in online classes, poor performance in exams, give more excuses than actions, and perform their assignments poorly (Vitasari et al. (2010)).

Many studies have been conducted on students' online learning anxiety and their result performance by using various instruments. Vitasari et al. (2010) used the State-Trait Anxiety Inventory (STAI) to measured anxiety level and Grade Point Average (GPA) to measured student academic performance. In contrast, Chung et al. (2020) used Online Readiness Scale (OLRS) adapted with permission from Hung et al. (2010) in their study. The OLRS scale has five dimensions: self-directed learning, learner control, motivation for learning, computer/internet self-efficacy and online communication self-efficacy. Apart from that, four items were applied to gauge the respondents' overall learning satisfaction, overall learning experience, and intention to continue using online learning in the following semester Chung et al. (2020). Meanwhile, David (2014) introduced a Check-in Quiz as an alternative method to reduce students' online learning anxiety, especially for first-time students.

In higher-level institutions, Mathematics is a compulsory subject in science and technology courses; thus, failing the subject may cause the students to either not be able to complete their studies on time or being dismissed from the university. Therefore, students with a low level of mathematics anxiety will perform better in mathematics subjects. We also believe that student performance in mathematics courses can be improved if mathematics anxiety is reduced, as mentioned in Wahid et al. (2014).

METHODOLOGY

This study was conducted in UiTM Cawangan Pahang Kampus Jengka where the population includes all Diploma Sains (AS120) students on this campus. The sample size was calculated using Krejcie and Morgan's table and a sample of 217 students was identified using a simple random sampling technique.

The methods used in this study are quantitative descriptive and survey, while the primary data from the first source of individuals were obtained via an online questionnaire using Google Forms, which was distributed to 217 students of Diploma Sains (AS120), UiTM Cawangan Pahang Kampus Jengka. The questionnaire involves two different parts, which are demographic characteristics and students' anxiety factors. Overall, the questionnaire contains 47 items and was designed using a 5-point Likert Scale that ranges from 1 = *Never to* 5 = *Always*. Questions for the students' anxiety factors were divided into four elements, namely emotions, assessment, environment, and technology. The first factor, emotions, include 13 items, while the factors of assessment and environment include 11 items, respectively. This is followed by the factor of technology that includes 12 items. Meanwhile, academic performance was measured using the students' final assessment marks.

The collected data were analysed using multiple linear regression analysis via IBM SPSS version 23. The four elements, namely emotions, assessment, environment, and technology were chosen as the independent variables to be analysed in this survey. Firstly, the reliability of the elements must be checked to assess the internal consistency of the items; each item must have good and acceptable reliability. Subsequently, the analysis continued with Pearson's correlation between the dependent and each independent variable. The regression assumptions must also be checked using normal probability and residual scatter plots to detect and eliminate any outliers. This is followed by collinearity diagnostic to check the existence of multicollinearity in the data. Lastly, a regression analysis was performed to model the estimated regression from the main factors affecting student performance.

RESULTS AND DISCUSSION

The reliability analysis was computed for the constructed questionnaire to assess the internal consistency of the items. According to Sekaran (2003), Cronbach's alpha value of 0.70 is acceptable, while values over 0.80 are considered good. The reliability analysis results are shown in table 1 in which the four constructs were found to have good and acceptable reliability. The overall Cronbach's alpha value for all items is 0.948, which indicates excellent consistency of items.

Table 1. Reliability Analysis.

Construct	Cronbach's Alpha
Emotions	0.929
Assessment	0.895
Environment	0.858
Technology	0.710
Overall	0.948

Table 2 shows the correlations between the final examination scores in Calculus1 with emotions, assessment, environment, and technology. Based on the results, the factors of emotions and technology showed no significant relationship with the students' final examination scores in Calculus1. The result also showed that the p-value is greater than 0.05 ($r = -0.116$, P-value = 0.089), whereas Pearson's correlation between final examination scores and technology is equivalent to

0.027 with a *P*-value of 0.692. This indicates that the factor of technology also does not have a significant relationship with the students' final examination scores. Meanwhile, a significant relationship can be concluded between the factors of assessment and environment with the students' final examination scores by which both factors have a *P*-value of less than 0.05 with correlation values of r with -0.312 and -0.282, respectively. However, the correlation values for both factors indicate a weak negative relationship with the students' final examination scores. In other words, it can be deduced that the higher the mean value of the students' anxiety factors, the lower the final examination scores.

Table 2. Correlations between exam scores with emotions, assessment, environment, and technology.

Variables	**Pearson's Correlation**	***P*-value**
Exam Scores & Emotions	-0.116	0.089
Exam Scores & Assessment	-0.312	0.000
Exam Scores & Environment	-0.282	0.000
Exam Scores & Technology	0.027	0.692

In general, the regression model is written in equation (1) as follows:

$$Y_i = \beta_0 + \beta_i X_{i1} + \beta_i X_{i2} + \cdots + \beta_{p-1} X_{i,p-1} + \varepsilon_i \quad (1)$$

where $\beta_0, \beta_i, \ldots, \beta_{p-1}$ are parameters, $X_{i1}, \ldots, X_{i,p-1}$ are known constants, and ε_i is the random error. In this study, student performance was selected as the dependent variable, (Y) to be predicted by the four independent variables. The regression model obtained can be written as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon_1 \quad (2)$$

where X_1= emotions, X_2= assessment, X_3= environment, X_4= technology, and the model error that is assumed to be normally distributed with constant variance. However, based on the correlation analysis results, the two significant variables of assessment and environment as the anxiety factors required regression analysis to be carried out. Before conducting the regression analysis, the assumption of the regression must first be checked. Figure 1 shows the normal probability plot and the scatter plot of residual. All points on the normal probability plot fall along the straight line, indicating that the residuals were normality distributed. A random pattern was also shown on the scatter plot, which indicates that the residual has a constant variance, independent of each other, and is linearly related. Besides, no outliers were detected in the scatter plot (exceeds 3.3 or less than -3.3). Table 3 shows the collinearity diagnostic value to check for multicollinearity. All of the tolerance values are more than 0.1, indicating that the multicollinearity assumption was not violated. This is further supported by the VIF values of less than 10. Overall, based on these results, all regression assumptions have been satisfied and, as such, the regression analysis was subsequently conducted.

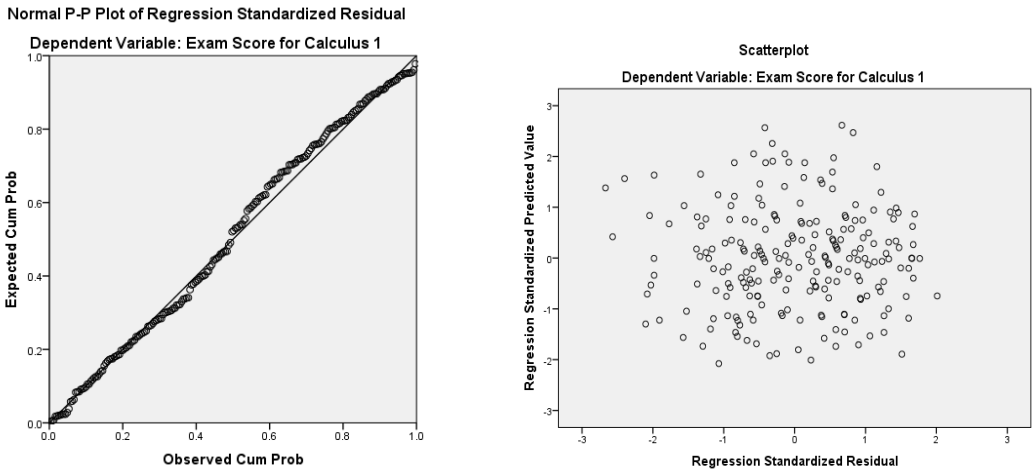

Figure 1. Normal probability plot (left) and residual scatter plot (right).

Table 3. Collinearity Diagnostic.

Model	Collinearity Statistics	
	Tolerance	VIF
(Constant)		
Assessment	0.401	2.494
Environment	0.401	2.494

Table 4 shows the analysis of variance results to test the overall significance of the model. Since the P-value is equal to 0.000 and less than 0.05 (F = 12.167), the model can significantly be used to explain the students' final examination scores in Calculus1 based on their significant anxiety factors.

Table 4. Analysis of Variance.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	2001.878	2	1000.939	12.167	0.000
Residual	17688.048	215	82.270		
Total	19689.927	217			

Based on the results in table 5, the anxiety factor of environment could not be significantly included in the model with a P-value of more than 0.05. This indicates that the environment does not affect the students' Calculus1 final examination scores; hence, it was, suggested that the variable be removed to improve the model. However, only the factor of assessment was found to be statistically significant (t = -2.301, P-value = 0.022) with a negative relationship with the students' Calculus1 final examination scores. The coefficient value ($\beta 1$ = 2.916) for the assessment factor indicates that, when the assessment value increases by one unit, the students' final examination scores are also expected to decrease. This result is in line with the study by Ajmal and Ahmad (2019), which found that students felt anxious due to some issues related to the students' assignments and assessment. The authors also reported that students face challenges that contribute to a high level of anxiety such as time constraint in preparing tasks, assignments, and projects, lack of standardised and quality books, due dates of assignments, comprehension of assignments, appraisal system, tutor remarks, and issues regarding assignment schedules. Additionally, Merrell (2008) conducted a study to identify the relationship between anxiety and task performance, and they found that students' ability to fully perform all of the assigned tasks

tends to weaken as anxiety becomes more serious and their performance gradually drops. Besides, the students also seem overwhelmed by the assessment given to them and this gradually gives a negative effect on their examination performance.

Table 5. Regression Analysis.

Model	Coefficient	Std. Error	Beta	t	p-value
(Constant)	88.653	2.635		33.645	0.000
Assessment	-2.916	1.2.67	-0.235	-2.301	0.022
Environment	-1.304	1.328	-0.10	-0.982	0.327

In this study, only one anxiety factor was found to affect the students' Calculus 1 final examination scores during online distance learning; therefore, the estimated regression model is written as follows:

$$Exam\ Score = 88.653 - 2.916 assessment \quad (3)$$

CONCLUSION

This study investigated the effects of students' anxiety that consequently influence their performance in Calculus 1 subject via online learning due to the current Covid-19 Pandemic. Four factors were considered in this study, namely emotions, assessment, environment, and technology. All factors were tested for reliability, correlations between factors, collinearity diagnostic values, and variance analysis. Among the four factors considered, only one factor was found to affect students' anxiety, namely the assessment factor. This study has also revealed that students with a higher level of anxiety tend to have lower examination scores in the subject, which coincides with the findings of other studies such as by Mukhtar et al. (2020). The estimated regression model was further derived to show the relationship between examination scores and the assessment factor. The study's implication can be used as guidance to have a productive online distance teaching and learning in this current pandemic situation. Thus, both lecturers and students must find suitable approaches to help the students cope with the assessment of the subject. At least, this may help reduce students' anxiety and consequently increase their examination scores in the Calculus 1 subject.

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