Comparing student scores between blended and face-to-face learning: case study of engineering mathematics II

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ABSTRACT – In recent years, the usage of electronic materials among mathematics lecturers has been steadily increasing. E-materials are part of a new trend, then so-called blended learning, i. e. a new teaching method combining physical and virtual sources. Although the effectiveness of blended learning has been widely accepted in most higher learning institutions, nonetheless, the students' performance, especially in the mathematics-based course is not commonly discussed statistically. Therefore, this paper aimed to statistically compare the students' scores in an Engineering Mathematics II course offered in 2 different learning environments (blended and face-to-face) in the Faculty of Manufacturing Engineering (FKP), Universiti Teknikal Malaysia Melaka (UTeM). Final examina from 110 students were collected and have been analyzed by using SPSS. Analysis of the results revealed that there is no significant difference between student scores for these two learning environments.

1. INTRODUCTION

Mathematics has an important role in various fields such as employment, science and technology, the environment and in public decision making. Hence, the process of learning mathematic should facilitate students in understanding relevant mathematical concepts. In this era, the use of technology could not be disregarded in the teaching and learning process. These requires teachers to improve their technological skills for better mathematics learning [4].

In fulfilling the latest high technological needs and expectations, higher learning institutions have been incorporating web-based learning into their conventional class education. Masrom et al. [8] mentioned in his study that the implementation of web-based learning in Malaysia's higher education is seen as an effective option of education advancement. Haron et al. [3] further stated that the first generation of web-based education which is also known as e-learning program are literally presenting the traditional classroom learning materials onto the web settings. These studies further emphasized that the second wave of e-learning has been enhanced with an integration of diverse delivery techniques into the web-based learning known as the blended learning.

Blended learning leads lecturers to use technology in learning process [6]. This technology is usually in a form of a website that contains learning materials, live instruction, or learning supplements for students. In blended learning, technology is combined with socialization opportunities in conventional classroom session. In other words, blended learning is a blend of face-to-face learning in the classroom with online learning [7].

Although the effectiveness of blended learning has been widely accepted in the most higher learning institutions, nonetheless, the students' performance, especially in the mathematics-based course is not commonly discussed statistically. Therefore, this paper aimed to statistically compare the students' scores between blended learning and face-to-face learning.

2. METHODOLOGY

This study used quantitative research methodologies to compare student success in two different learning environments. The following research question was used to guide this study: does the type of learning environment relate to successful course performance as measured by the final exam and course grade?

2.1 Participants

This research study used a convenience sample. A total of 110 students from Engineering Mathematics II (second semester) were involved in this study. They attended 3 hours' lecture per week for 14 weeks. Besides that, they also need to attend a tutorial class an hour per week for 14 weeks. 57 students experienced blended learning while 53 students experienced face-to-face learning.

2.2 Software

The software Statistical Package for the Social Science (SPSS) was used to analyse the data collected.

2.3 Data Analysis

The Independent Sample *t*-Test was applied for this study to compare two sample means to determine whether the population means are significantly different. The significance level ($\boldsymbol{\alpha}$) for all statistical tests was 0.05.

2.4 Hypothesis

The purpose of this study was to see if there were a significant difference in students score between two different learning environments. Therefore, the null hypothesis ($\boldsymbol{H_0}$) and the alternative hypothesis ($\boldsymbol{H_1}$) of the Independent Sample *t*-test for this study are as follows:

$\boldsymbol{H_0}$: $\boldsymbol{\mu_b = \mu_f}$ (the two population means are equal).

$\boldsymbol{H_1}$: $\boldsymbol{\mu_b \neq \mu_f}$ (the two population means are not equal).

3. RESULTS AND DISCUSSION

Table 1 presents basic information about the group comparisons, including the sample size, mean, standard deviation and the standard error for a score by type of learning. There are 57 students experienced blended learning and 53 students experienced face-to-face learning. The mean score for blended learning is 61.3, while the mean score for face-to-face learning is 65.5. The results shown that the mean score for face-to-face learning is better than the mean score for blended learning. However, there is no statistical proof to make such a conclusion based on Table 1.

Table 1 Group Statistics.

	Type of Learning	*N*	Mean	Std. Deviation	Std. Error Mean
Score	Blended Learning	57	61.3	11.1083	1.47
	Face-to-face	53	65.5	12.2656	1.68

Note: The *N* column lists the number of students in the group.

Table 2 displays the results most relevant to Independent Sample *t*-test. There are two results from two different *t*-tests, one assumed equal variance and the other unequal variance. If the Lavene's test produces a significant result, then we use the lower line that is labeled equal variances are not assumed. From Table 2 above, the p-value of Levene's Test is 0.397 which is more than 0.05, we can assume that the variance of the two groups is the same. Then, we have to use the "equal variances" result. Since the p-value is 0.058 which is more than 0.05, we accept the null hypothesis and conclude that there is no significant difference between the mean score of blended learning and face-to-face learning students at a 5% significance level.

Table 2 Independent Sample Test.

		Levene's Test for Equality of Variances		*t*-test for equality of Means	
		F	Sig.	*t*	Sig.
Score	Equal variances assumed	0.725	.397	-1.913	.058
	Equal variances not assumed			-1.906	.059

4. CONCLUSION

This study investigated the comparison of the student score in an Engineering Mathematics II course offered in blended learning and face-to-face learning. Analysis of the results revealed that there is no significant difference between the student scores of these two learning environments. The result was supported by many research findings of no significant difference in success based on the learning environment [1, 2, 5, 9, 10].

Even there is no significant difference in success based on the learning environment, the combination of traditional and online learning, if properly set and uses a natural digital environment for the students, could benefit from both forms of education in the teaching of mathematics.

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