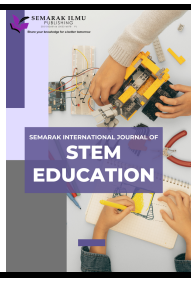
SEMARAK ILMU PUBLISHING

Semarak International Journal of STEM Education

Journal homepage:
https://semarakilmu.com.my/journals/index.php/sijste/index
ISSN: 3030-5152



Exploring the Impact of TikTok Blended Learning on Mathematics Performance: A Hypothesis Approach

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ARTICLE INFO

Article history:
Received 19 June 2024
Received in revised form 25 August 2024
Accepted 1 September 2024
Available online 17 September 2024

Keywords:
TikTok blended learning; mathematics performance; hypothesis testing; R code

ABSTRACT

Studying engineering at the university level necessitates a strong foundation in mathematics. However, the diverse mathematical backgrounds of enrolled students pose challenges to educators in higher education. To address this issue, utilizing technology and visual representations alongside various examples can enhance understanding for students with different learning preferences. Therefore, this study aimed to examine the difference in mathematics final examination scores between students engaged in TikTok blended learning and those in traditional non-blended learning environments. Hypothesis testing and z-test were employed to analyze the mathematics performance. The R software code was included to prove the hypothesis testing. The result showed that students who practised TikTok blended learning performed better than students who were in the non-blended learning environments in mathematics subject of engineering technology in final examinations.

1. Introduction

Studying engineering at university requires basic strong fundamental mathematics. Passing mathematics is a prerequisite among the core faculty courses for students to advance to the following academic year. However, the enrolled students come from diverse mathematical backgrounds, creating challenges for educators to teach in higher education. One of the strategies to tackle this issue is using technology by utilizing visual representations and various examples that may enhance understanding for students with different learning preferences. Nowadays, blended learning which combines traditional face-to-face classes with online resources and activities has gained significant attention in the field of education. The integration of social media tools such as Facebook [1,2], Instagram [3,4], YouTube [5,6] and Twitter [7,8] enhance the effectiveness of teaching and learning. One of the most popular social media platforms among young people is TikTok. As of June of 2023, Gen Z or those between the ages of 19 to 25 years old made up the majority of

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https://doi.org/10.37934/sijste.2.1.16

the TikTok users who were based in Malaysia with 35.61% [9]. Incorporating entertainment into education in delivering information and engaging students is the modern world of teaching and learning style. Since today's generation favors short videos and innovative preferences, educators tend to use TikTok to deliver knowledge to students [10,11].

Hypothesis testing is also called significance testing. Hypothesis testing allows us to draw conclusions or make decisions regarding population from sample data. The independent t-test was used to identify the differences between local and international University students' performance in statistics and mathematics courses [12]. Ali *et al*., [13] studies the difference between gender and mathematics anxiety of university students using independent t-test. Meanwhile, a paired t-test was conducted to evaluate the significant difference in secondary school students' performance in mathematics before and during movement control order (MCO) [14]. As the number of samples is large and normally distributed, Zakaria *et al*., [15] investigate whether there is a significant difference between the genders and mathematics performance of undergraduate engineering students in Mathematics courses at a public university in Malaysia. There are only few studies done about the significant difference between university students' mathematics performance in Malaysia with and without TikTok blended learning. Therefore, the purpose of this study is to examine the difference in mathematics final exam scores between students engaged in TikTok blended learning and those in traditional non-blended learning environments.

In this study, students of the Faculty of Engineering Technology (FTK) from Universiti Tun Hussein Onn Malaysia (UTHM) in Pagoh district were the population. 30 students from the mathematics class of engineering technology of Semester 1, Session 20222023 (without TikTok blended learning) and 56 students of Semester 2, Session 20232024 (with TikTok blended learning) were the samples of the population. The students' average ages were between 19 and 22 years old. They were from different educational backgrounds such as Diploma of Polytechnic, Diploma of Institute of Higher Learning, Matriculation, and 'Sijil Tinggi Pelajaran Malaysia' (STPM). The blended learning in this study was supported by the TikTok learning video (https://www.tiktok.com/@dr.nsmnoh?_t=8mCeJLzYX6u&_r=1) uploaded by the lecturer whereas the non-blended learning was solely conducted face-to-face. The video covers topic in mathematics for engineering technology 1 : limits and continuity, differentiation, and integration. These are essential degree-level mathematics concepts, suitable for engineering students from the first to final year. Each video is under 10 minutes, explaining step-by-step solutions and the video will be shared with the students at the beginning of semester. TikTok's shorter length and lack of ads make it advantegous over Youtube. Additionally, we utilized R software to run the hypothesis testing.

2. Methodology

The first step in solving hypothesis testing is to write the original claim and then identify the null hypothesis H_0 and alternative hypothesis H_1.

$$\text{Null Hypothesis: } H_0 : \mu_1 = \mu_2 \tag{1}$$

$$\text{Alternative Hypothesis: } H_1 : \mu_1 > \mu_2 \tag{2}$$

where μ_1 refer to population 1 means and μ_2 refer to population 2 means. In this study, the mean score of the final examination for the students with TikTok blended learning, μ_1 is equal to the mean scores of the final examination with non-blended TikTok learning, μ_2, as highlighted in the null hypothesis in eq (1). Meanwhile, the mean scores of the final examination for students with TikTok

learning, μ_1 is higher than the mean scores of the final examination with non-blended learning, μ_2 as highlighted in the alternative hypothesis in eq (2).

In the second step, the alternative hypothesis H_1 is used to identify the type of test. The alternative hypothesis is the mean scores of the final examination for students with TikTok blended learning, which are higher than the mean scores of the final examination without TikTok blended learning, where one right-tailed test with α=0.05 is used. In this study, the population variances σ^2 are unknown, and the number of samples is more than 30. Therefore, standard normal distribution and substitute population standard deviation σ are used with sample standard deviation s . The test statistic in this study is:

$$z_{Test} = \frac{\left(\overline{x_1} - \overline{x_2}\right) - \left(\mu_1 - \mu_2\right)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \tag{3}$$

where $\bar{x}$ refer to the sample mean. In this case, we would use the z percentage point z_α as the boundary of the critical region to reject H_0 if:

$$z_{test} > z_\alpha \tag{4}$$

And we should fail to reject H_0 if:

$$z_{test} < z_\alpha \tag{5}$$

The eq (4) and (5) define the critical or rejection region of the test.

3. Results and Discussion

Table 1 refers to the sample size for students with TikTok blended learning, n_1, the sample size for students with TikTok non-blended learning, n_2, the sample mean for students with blended learning, $\bar{x}_1$, the sample mean for students with non-blended learning, $\bar{x}_2$, sample standard deviation for students with blended learning, s_1, and sample standard deviation for students with non-blended learning, s_2.

Table 1
Sample mean and sample standard deviation

	TikTok blended learning (Final examination score, %)	Non TikTok blended learning (Final examination score, %)
Sample size, n	56	30
Sample mean, $\bar{x}$	24.35	10.24
Sample standard deviation s	20.17	10.33

The one right-tailed test with α=0.05 is used and the rejection region is Z_α>1.6449 as shown in Fig. 1 below.

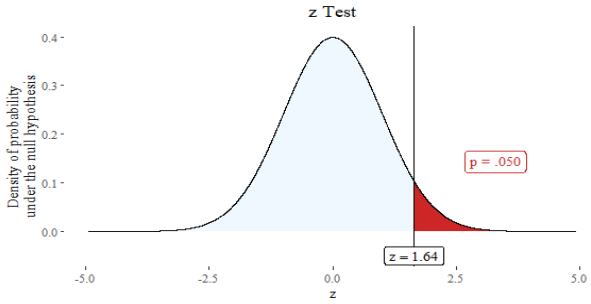

Fig 1. Rejection region

Using Eq (3), the z-test value is 4.2672 which is greater than the critical value of 1.6449. The decision is to reject the null hypothesis. Thus, there is enough evidence to support the claim that students' final exam scores with TikTok blended learning are better than non-blended learning environments in mathematics subjects for UTHM students. This study also provides the R code (as shown in Fig 2) for hypothesis testing for the difference between the two-sample means, and the results are shown in Fig 3.

```
Blended_scores <- read.csv(blended data)

df <- data.frame(Blended_scores.csv)

colMeans(df[column])

var(df$column)

sd(df$column)

Non-blended_scores <- read.csv(non-blended data)

df1 <- data.frame(Non-blended_scores)

colMeans(df1[column])

var(df$column)

sd(df$column)

library(BSDA)

z.test(df[column],df1[column],alternative='greater',mu=0,sigma.x=standard
deviation of blended learning sample, sigma.y=standard deviation for non-
blended learning sample, conf.level=.95)

library(nhstplot)

plotztest( z_c = 1.6449, tails = "one")
```

Fig 2. R code for hypothesis testing

```
Two-sample z-Test
data:  df[c(14)] and df1[c(4)]
z = 4.2672, p-value = 9.899e-06
alternative hypothesis: true difference in means i
s greater than 0
95 percent confidence interval:
8.674586       NA
sample estimates:
mean of x mean of y
24.35714  10.24138
```

Fig 3. Result of hypothesis testing using R Software

The p-value in Fig 3 is very small (less than 0.05). We would reject the null hypothesis based on the significance level of 0.05. This means we have sufficient evidence to say that the final examination marks for blended learning students are better and they outperformed the non-blended learning students' performance. These students belong to a generation that underwent 'Sijil Pelajaran Malaysia' (SPM) examination between 2019 and 2021 amidst the COVID-19 era. Many students face challenges adapting from conventional teaching and learning to an online learning environment, especially when studying mathematics that requires one-to-one assistance. Limited access to resources like reliable internet connection and online learning devices, and online materials such as e-modules and e-books may have impeded certain students' capacity to study and practise mathematics effectively. By gaining insight into the background of students entering the post-COVID-19 era, educators can develop teaching approaches that can cater to their needs. Proficient students grasp concepts in class, but those with lower proficiency require extra time. Hence, this TikTok video was made. The limitation of this study is the small sample size and the specific population.

4. Conclusion

The objective of this study was to investigate the difference in final examination scores between students who were engaged in blended learning and those who learned in traditional, non-blended learning environments. Blended learning in this study refers to the TikTok learning video used in every chapter taught on the subject of mathematics. This was achieved by finding the significant difference between the two sample means of final scores of UTHM students who took mathematics class for engineering technology 1. A total of 56 students for sample 1 (TikTok blended learning) and 30 students for sample 2 (non-TikTok blending learning) were analyzed using hypothesis testing with a one-tailed test (right-tailed test). The result of the z-test was 4.2672 where the test value was larger than the critical value of 1.6449. Therefore, the decision was to reject the null hypothesis. Hence, there was statistically significant evidence to support the claim that the final scores for students engaged in TikTok blended learning were better than students with a non-blended learning environment based on the final examination scores. Future work for this study could involve increase sample size by recruiting participants from additional sections and subjects, such as mathematics for engineering technology 2 and statistics for engineering technology to enhance the generalizability of the findings.

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