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Mobile Learning Improves Students Learning Outcomes in Mathematics Subject

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ABSTRAK

Permasalahan yang terjadi saat ini yaitu dialog interaktif antara pendidik dan peserta didik tidak semudah secara tatap muka langsung. Hal ini berdampak pada hasil belajar yang rendah. Tujuan penelitian ini yaitu menganalisis pengaruh dari penerapan Mobile Learning (ML) terhadap hasil belajar mahasiswa, yang akan dilihat berdasarkan kelompok kemampuan mahasiswa (Kategori Tinggi, Kategori Sedang, Kategori Rendah), kemudian berdasarkan kelas masing-masing (Kelas A, Kelas B, Kelas C), dan secara keseluruhan mahasiswa. Jenis penelitian ini yaitu penelitian kualitatif dengan Desain One Sampel Grup Posttest. Sampel penelitian ini yaitu sebanyak 96 mahasiswa dari tiga kelas yang merupakan populasi dan sekaligus sampel dalam penelitian ini secara keseluruhan. Metode yang digunakan untuk mengumpulkan data yaitu tes. Instrument yang digunakan untuk mengumpulkan data yaitu soal lembar tes matematika. Teknik analisis data yang digunakan dalam penelitian ini yaitu analisis deskriptif kualitatif, kuantitatif dan statistic inferensial. Hasil penelitian yaitu pengaruh Mobile Learning (ML) pada kelompok hasil belajar mahasiswa untuk kategori tinggi tidak memberikan adanya pengaruh, namun kelompok hasil belajar mahasiswa untuk kategori sedang dan kategori rendah memberikan adanya pengaruh. Pengaruh Mobile Learning di masing-masing kelas A, B, C memperlihatkan adanya pengaruh yang siginifikan. Pengaruh Mobile Learning pada hasil belajar mahasiswa secara keseluruhan memperlihatkan adanya pengaruh yang siginifikan. Disimpulkan bahwa penerapan mobile learning dapat memberikan pengaruh terhadap hasil belajar mahasiswa.

ABSTRACT

The current problem is that interactive dialogue between educators and students is more challenging than face-to-face. It has an impact on low learning outcomes. The purpose of this study is to analyze the effect of the application of Mobile Learning (ML) on student learning outcomes, which will be seen based on student ability groups (High Category, Medium Category, Low Category), then based on each class (Class A, Class B, Class C), and overall students. This type of research is qualitative research with the One Sample Posttest Group Design. The sample for this study was 96 students from three classes which constituted the population and, at the same time, the sample in this study as a whole. The method used to collect data is a test. The instrument used to collect data is a math test sheet. The data analysis technique used in this research is descriptive qualitative analysis, quantitative and inferential statistics. The research results are that the influence of Mobile Learning (ML) on the student learning outcomes group for the high category does not give any influence. However, the student learning outcomes groups for the medium category and low categories do give an effect. The influence of Mobile Learning in each class, A, B, and C, shows a significant influence. The effect of Mobile Learning on student learning outcomes as a whole shows a significant influence. It was concluded that the application of mobile learning can have an impact on student learning outcomes.

1. INTRODUCTION

The world of education is a sector that has been greatly affected during the pandemic. The face-to-face process is not yet allowed to break the covid19 virus outbreak (Andarwulan et al., 2021; Dike et al.,

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2020; Kadafi et al., 2021; Zhou et al., 2021). Many challenges must be faced in education during this pandemic. The demands of educators during a pandemic require creative and innovative thinking in providing online learning (Hapsari & Fitria, 2020; Herdiana et al., 2021; Rahma & Pujiastuti, 2021). Creative learning makes students interested in receiving the learning provided and the level of students' understanding of the material (Fitriyani et al., 2020; Kristiawan et al., 2021). Appropriate learning also raises students' understanding of the material to be more optimal. Therefore, an educator must increasingly adapt to technology so that the learning that is carried out is also effective with the expected results.

Students are always required to take part in online learning and complete the assignments given in learning completely. Students must learn virtually so that learning can run optimally (Agustina et al., 2021; Habiba et al., 2020; Oktavian & Aldya, 2020). However, the current problem is that interactive dialogue between educators and students is more challenging than face-to-face. Previous research findings also reveal that many teachers must still be ready to implement online learning activities (Latifa et al., 2021; Mansur et al., 2021; Ulinsa et al., 2021). The level of students' understanding of the material provided is, of course, different; many have a lack of understanding due to their lack of seriousness in participating in the learning process (Fikri et al., 2021; Hutauruk & Sidabutar, 2020; Primasari & , Zulela, 2019). In addition, children's facilities are different, such as the type of cell phone, type of laptop, and internet provider used (Albab, 2020; Arizona et al., 2020). In learning mathematics, there are also many problems when learning is done online. It certainly has an impact on low mathematics learning outcomes.

In learning, especially learning mathematics, to get good mathematics learning results, students must construct their concepts learned through concrete objects (Y. F. Chen et al., 2018; Mahendra, 2017; Szabo et al., 2020). It makes students understand and tend to understand related concepts given. In addition, learning mathematics can develop concentration, increase the ability to express opinions briefly and precisely, and think rationally and make decisions appropriately (Purwitaningrum & Prahmana, 2021; Rachmavita, 2020; Santagata & Yeh, 2014). Students who understand mathematics well will certainly impact their learning outcomes which increase. Learning outcomes are a series of combined assessments of the process for various assessment domains of attitude or behaviour, cognitive/knowledge, and psychomotor/skills (Brooker et al., 2018; Sari et al., 2023; Sinnayah et al., 2019). Learning mathematics requires an appropriate online learning design to improve students' abilities.

The learning process carried out during this pandemic needs to be considered and properly designed to obtain the learning outcomes as expected. An online learning model that can be used during a pandemic is by implementing Mobile Learning (ML). *Mobile learning* is a teaching and learning activity that utilizes information and communication technology which refers to mobile handheld devices via mobile devices such as mobile phones (Hp), smartphones, ts (Tab), personal digital assistance (PDA), notebooks, and netbooks (Imelda & Astuti, 2019; Muswita et al., 2018; Nikolopoulou & Kousloglou, 2019). The use of mobile learning causes the availability of teaching materials that can be accessed at any time and the visualization of interesting and interactive materials (C.-H. Chen & Tsai, 2021; Lai & Hwang, 2014; Skiada et al., 2014). Previous research findings also state that information and communication technology through electronic devices and digital media can facilitate students' learning (David & Schwaninger, 2021; Kattayat et al., 2017).

The use of mobile learning at least helps in the Education process during the Pandemic so that learning outcomes can be more optimal. Higher education is a cultural developer and centre of civilization for building a life; during a pandemic, the application of mobile learning in higher education is an example of when the learning process is hindered by distance, time and place so that learning outcomes are optimized. The wise application of mobile learning can improve student learning outcomes in mathematics education. Previous research findings also state that mobile learning can increase students' understanding of learning (Lai & Hwang, 2014; Nikolopoulou & Kousloglou, 2019). Other research also reveals that the application of mobile learning can make learning effective and efficient (Bano et al., 2018; Darmaji et al., 2019; García-Martínez et al., 2019). There is no study on mobile learning on student learning outcomes in mathematics education. Based on this, this research aims to analyze the effect of Mobile Learning (ML) on the learning outcomes of mathematics education students.

2. METHOD

This study uses a quantitative approach. The quantitative approach is research based on the philosophy of positivism to examine certain populations or samples by collecting data using instruments and statistical data analysis (Sugiyono, 2019). Quantitative approaches use more closed-ended approaches in which the researcher identifies a set of response categories so that they will be viewed from various angles to see the accuracy of the research results (Creswell, 2012). The discussion of this article is part of

the results of research that tests Mobile Learning (ML) in the learning process in class to see how the effects it produces are based on the group, class and overall categories by taking the final grade obtained in the Linear Algebra course. The method used to collect data is a test. The instrument used to collect data is a math test sheet.

The design in this study is One Group Posttest Only. The design of this study was made to see the effect that occurs from Mobile Learning (Y) on Linear Algebra Learning Outcomes (X), as shown in Figure 1, in which it will be seen how these influences are on the Linear Algebra Learning Outcomes Group in the High Category (X_{1A}), Moderate Category (X_{1B}), Low Category (X_{1C}), then based on Class A, (X_{2A}), Class B (X_{2B}), Class C (X_{2C}) and overall (X_3). The data used in this study is the final value after learning using Mobile Learning (ML) conducted at the Mathematics Education Study Program at Singaperbangsa Karawang University with a population of 96 students from three existing classes, namely from Class A students, as many as 31 students, Class B as many as 35 Class A students as many as 31 students, so that the population is used as a whole sample or a saturated sample. The data analysis technique used in this research is descriptive qualitative analysis, quantitative and inferential statistics.

3. RESULTS AND DISCUSSION

Results

Mobile Learning is a learning that offers a new concept, especially during a pandemic that does not allow everyone to interact directly. This article discusses how the influence of Mobile Learning is more in-depth as measured statistically in groups of student learning outcomes in the high category, medium category, and low category, then based on class A, class B, class C and overall student learning outcomes. The results of data analysis show that the average value of student learning outcomes from three classes in the Mathematics Education Study Program at Singaperbangsa Karawang University in 96 students in Semester III Linear Algebra courses after learning by implementing Mobile Learning (ML) which is divided by group Average Category (High, Medium, Low) and Class (A, B, C) Learning Outcomes and as a whole, the data shows how the distribution of average scores for student learning outcomes.

Based on the average score obtained, as a whole of the three classes, the overall average score of learning outcomes is 70.39, with a standard deviation of 9.09. The difference in the average score in each class is similar. The average score for learning outcomes by class, the lowest, is class C at 66.38, with a standard deviation of 7.90. In contrast, the highest average score for mathematics learning is class B at 73.00, with a standard deviation of 9.31. Then the difference in the average value of each group based on the category, the average value of learning outcomes in the high category is 82.83 with a standard deviation of 2.95, the medium group is 70.74 with a standard deviation of 5.35, and the low group is 50.19 with a standard deviation of 1.56.

The average score for each class students gets after learning by implementing Mobile Learning in the Linear Algebra Course in the Odd Semester of the 2020/2021 Academic year is spread over three classes of 96 students. The student scores obtained will be processed for statistical tests to show the effect that occurs from Mobile Learning (Y) on Linear Algebra Learning Outcomes (X) in which it will be seen how these effects are on Linear Algebra Learning Outcomes in the High Category (X1A), Moderate Category (X1B), Low Category (X1C) and based on Class A, (X2A), Class B (X2B), Class C (X2C) and Overall (X3). Grouping based on the high category, medium category and low category is done by using the formula for calculating the overall Average Learning Outcome Value (μ) and calculating the Standard Deviation (SD).

The high category grouping (X1A) is a value greater than or equal to the average plus one standard deviation value (μ + 1 SD), for the low category (X1C) is a value less than the average minus one standard deviation value (μ - 1 SD). The Medium Category (X1B) is the value between high and low category values. Based on this calculation, the number of students for the high category is 19, the medium category is 56, and the low category is 21. Student ability category groups are presented in Table 1.

Table 1. Student Ability Category Groups

X	Group		n
X_{1A}	High Category	$X \geq (\mu + 1\ SD)$	19
X_{1B}	Moderate Category	$(\mu - 1\ SD) \geq X < (\mu + 1\ SD)$	56
X_{1C}	Low Category	$X \leq (\mu - 1\ SD)$	21
Amount (N)			96

Based on the calculations presented in Table 1, the number of student learning outcomes grouped based on the Learning Outcomes Category (High, Medium, Low) is obtained. Furthermore, the data on the

value of student learning outcomes will be tested statistically based on grouping categories based on the class of each learning achievement value. As a whole, the data is tested to find out some of the influences that occur. To find out the effect that occurs from Mobile Learning (Y) on Linear Algebra Learning Outcomes (X) in which, it will be seen how these influences on Linear Algebra Learning Outcomes based on High Category (X1A), Medium Category (X1B), Low Category (X1C) then a statistical test was carried out. The results of the normality prerequisite test for the category data to be tested are presented in Table 2.

Table 2. Normality Test by Category

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
High Category	0.206	19	0.033	0.901	19	0.051
Moderate Category	0.172	19	0.140	0.928	19	0.159
Low Category	0.282	19	0.000	0.818	19	0.002

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The average value of student learning outcomes based on the High Category (X1A) with a small sample size concluded that student learning outcomes based on the high category were normally distributed with a value of 0.051 because the value was greater than or equal to a significance value of 0.05, then for medium category (X1B) with a large sample size. It was concluded that the value of student learning outcomes based on the medium category was normally distributed with a value of 0.159 because the value was greater than or equal to the significance value of 0.05, while for the low category (X1C) with a small sample size. It is concluded that the value of student learning outcomes based on the low category is not normally distributed with a value of 0.000 because it is not greater or less than the significance value of 0.05. Then, for the next step, parametric statistical tests were carried out for the high category and medium category because the data were normally distributed. At the same time, non-parametric statistical tests were carried out for the low category because the data were not normally distributed.

To test the effect of mobile learning on learning outcomes based on categories, parametric and non-parametric tests were carried out through the One Sample t-test with a test value of the average value of each category. Based on the high category with a total sample of 19 students, the student learning outcomes for the high category show a 2-tailed significance test value of 0.806 greater than a significance value of 0.05. It can be concluded that the null hypothesis is accepted for the high category. The meanings obtained from these statistical results show various assumptions that students in the high category with mobile learning applications do not affect their learning outcomes. The parametric test results are presented in Table 3.

Table 3. Parametric Test by Category

	One-Sample Test					
	t	df	Sig. qa(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
High Category	-0.249	18	0.806	-0.168	-1.59	1.25
Moderate Category	9.441	55	0.000	6.745	5.31	8.18

The next parametric statistical test results are to see the effect based on the categories shown in the table 3, based on the medium category with a sample of 56 students, it shows that the student learning outcomes for the medium category show that the 2-tailed significance test value of 0.000 is not greater than the significance value of 0.05, so it can be concluded that the null hypothesis is rejected for the medium category. The meaning obtained from the statistical test results shows that there is an assumption that students in the medium category with the implementation of mobile learning affect learning outcomes that are different from the high category.

Based on the low category with a total sample of 21 students, it shows that the student learning outcomes for the low category show a significance test value of 0.000, not greater than a significance value of 0.05, so it can be concluded that the null hypothesis is rejected for the low category. The meaning obtained from the results of the statistical test shows that there is an assumption that students in the high category with the application of mobile learning influence their learning outcomes. Based on the statistical test results, it was concluded that the application of mobile learning affected only the medium category

and the low category, which means that mobile learning assisted in student learning outcomes. In contrast, for the high category, there was no effect with the possibility that the ability of high-ability students would remain better by implementing any learning.

The next discussion is to find out the influence that occurs from Mobile Learning (Y) on Linear Algebra Learning Outcomes (X) in which it will be seen how these influences on Linear Algebra Learning Outcomes each Class A (X2A), Class B (X2B), Class C (X2C) then a statistical test is carried out which will be used, namely parametric or non-parametric, but before carrying out the test a prerequisite test is carried out, namely to see whether the data is normally distributed or not, thus showing the test to be carried out next, as for the results of the Normality Test the data obtained are as follows with significant values taken based on the number of samples either the Kolmogorov-Smirnov method for large samples or the Shapiro-Wilk for small samples. The prerequisite normality test for data based on the class to be tested is presented in Table 4.

Table 4. Normality Test by Class

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Class_A	0.126	19	0.200	0.948	19	0.360
Class__B	0.154	19	0.200	0.901	19	0.051
Class__C	0.240	19	0.005	0.861	19	0.010

The average value of student learning outcomes is based on each class. For class A (X2A) with a large sample size, it can be concluded that the student learning outcomes in class A are normally distributed with a value of 0.200 because the value is greater or equal to the significance of 0.05. For class B (X2B) with a large sample size, the learning outcomes in class B are normally distributed with a value of 0.200 because the value is greater than or equal to the significance value of 0.05. In contrast, for class C (X2C) with a large sample size, it can be concluded that the value of student learning outcomes in class C is not normally distributed with a value of 0.005 because the value is not greater or less than the significance value of 0.05. Then, for the next step, a parametric statistical test was carried out for classes A and B because the data was normally distributed. At the same time, a non-parametric statistical test was carried out for class C because the data was not normally distributed.

To determine the effect of mobile learning on learning outcomes based on each class, parametric and non-parametric tests were carried out through the One Sample t-test with a Value test of the average value of each class. Based on class A, the high category with a total sample of 31 students shows that the student learning outcomes for class A show that the 2-tailed significance test value of 0.002 is not greater than the significance value of 0.05, so it can be concluded that the null hypothesis is rejected for class A. Meaning The results obtained from these statistics show that there is an assumption that students in class A with the application of mobile learning influence their learning outcomes. Parametric Test Based on Class is presented in Table 5.

Table 5. Parametric Test Based on Class

	One-Sample Test					
	T	df	Sig. qa(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Class_A	3.351	30	0.002	5.32581	2.0801	8.5715
Class__B	3.812	34	0.001	5.99714	2.7998	9.1944

The next parametric statistical test results are to see the effect by class. Based on class B with a total sample of 35 students, it shows that the student learning outcomes in class B show that the 2-tailed significance test value of 0.001 is not greater than the significance value of 0.05, so it can be concluded that the null hypothesis is rejected in class B. The meanings obtained from the statistical results show that there is an assumption that students in class B with the application of mobile learning influence their learning outcomes.

Based on the class, a one-sample t-test was carried out using a non-parametric statistical test. Based on class C with a total sample of 30 students, it shows that the student learning outcomes for class C show a significance test value of 0.039 which is not greater than the significance value of 0.05, so it can be concluded that the null hypothesis is rejected for class C. The meaning obtained from the results These

statistics show that there is an assumption that students in class C with the application of mobile learning influence their learning outcomes. Based on the results of statistical tests in the three classes conducted, namely class A, class B, and class C, it can be concluded that the application of mobile learning affects only each class which means that the application of mobile learning assists in student learning outcomes obtained.

The next discussion is to look at the influence of Mobile Learning (Y) on the overall Linear Algebra Learning Outcomes (X). The average result of the overall student learning outcomes (X3) with a large sample of 96 students is not normally distributed with a value of 0.000 because the value is not greater or not equal to a significance value of 0.05. Then for the next non-parametric statistical test because the data is not normally distributed. To test the effect of mobile learning on learning outcomes based on all students, a non-parametric test was carried out through the One Sample t-test with a test value of 70.39. Based on the total number of students with a sample of 96 students, it shows that the value of student learning outcomes shows that the 2-tailed significance test value of 0.009 is not greater than the significance value of 0.05, so it can be concluded that the null hypothesis is rejected for all students. The meaning obtained from these statistical results shows the assumption that overall, students implementing mobile learning influence their learning outcomes.

Discussion

Mobile Learning is a learning that gives its colour to the stages or processes carried out in developing learning, especially during a pandemic which is very beneficial. The results of the analysis show that the effect of mobile learning on student learning outcomes in each class shows a significant influence, so it is good to be given to any class. It is due to several factors. First, mobile learning can facilitate student learning and improve student learning outcomes. In maximizing mobile learning, several capabilities must be provided by mobile learning devices, such as the ability to connect with other devices, especially computers, the ability to present learning information and the ability to realize bilateral communication between instructors and students (Imelda & Astuti, 2019; Muswita et al., 2018). Mobile learning helps the education process during the Pandemic so that learning outcomes can be more optimal. Higher education is a cultural developer and centre of civilization to build a life; Mobile learning is unique learning because students can access learning materials, directions and applications related to learning anytime and anywhere (Lai & Hwang, 2014; Nikolopoulou & Kousloglou, 2019).

Second, mobile learning can increase student enthusiasm for learning, impacting a pleasant learning atmosphere. Mobile learning content has various types (Imelda & Astuti, 2019; Muswita et al., 2018; Nikolopoulou & Kousloglou, 2019). Content is closely related to the device's ability to display or run it. It makes learning activities more enjoyable. Mobile learning is part of e-learning, so the learning method is divided into 2 types: Synchronous Training and Asynchronous Training (Kattayat et al., 2017; Suprianto et al., 2019). Synchronous learning occurs simultaneously when the teacher is teaching and students are learning (Muswita et al., 2018; Nikolopoulou & Kousloglou, 2019). Training is a type of learning, and students can take lessons at different times with the instructor providing training. The benefits of using mobile learning in learning mathematics are facilitating the teaching and learning process in or outside the classroom. In addition, learning activities also attract students' attention to foster student enthusiasm and motivation in learning so that the material being delivered can be conveyed properly and understood by students. Other research findings also reveal that mobile learning can support students toward independent learning (Bano et al., 2018; Darmaji et al., 2019; García-Martínez et al., 2019).

Third, mobile learning can make it easier for students to learn, so it impacts increasing student understanding. Mobile learning can make users adjust the time and place of learning (García-Martínez et al., 2019; Kattayat et al., 2017). Students can insert learning during their free time and in different places. In addition, mobile learning can also help students with different abilities. Each learner has a different ability to absorb lessons, some are fast, and some are slow. Mobile learning can overcome it because the learning speed depends on each student. Mobile learning as a supplement means freedom for students to choose and use mobile to access learning materials or as a learning medium (C.-H. Chen & Tsai, 2021; Churchill et al., 2016). It makes it easier for students to learn. This research implies that applying mobile learning to students can improve students' abilities and understanding of learning mathematics.

4. CONCLUSION

The results of the data analysis show that the effect of mobile learning on student learning outcomes for the high category does not give any effect. However, for the medium and low categories, it does. In other words, it is possible to assume that groups of students with high learning outcomes are given any learning model, the results will still be the same but different from groups of students who are

in the medium and low categories, with the implementation of mobile learning, the learning outcomes show a significant influence. The effect of mobile learning on student learning outcomes in each class shows a significant influence, so it is good to be given to any class. Mobile learning could have a significant effect.

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