Effectiveness of Using Mobile Based Microlearning on Calculus to Improve Students' Mathematical Understanding

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Abstract

Online learning in Indonesia is still being carried out, even though the covid 19 outbreak has ended. Learning is carried out in the form of a mix. The results of the study regarding the implementation of online learning experienced several problems including the presentation of a lot of material and broad, difficult to understand material. Many textbooks and textbooks on print-based calculus are owned by students but have not maximally helped students understand the material in online learning. Technological innovations and methods that can make it easier for students to understand calculus material are needed. The purpose of the study was to determine the effectiveness of using multimedia mobile based microlearning in calculus lectures. This type of research is a research and development research on the aspect of testing the effectiveness of the products developed. The research subjects were students who took calculus courses. The research instrument was a student mathematical understanding test. The data obtained were analyzed with quantitative descriptive statistics using the n-gain test. The results showed that there was an increase in students' mathematical understanding with the use of multimedia mobile based microlearning. It can be concluded that the use of multimedia mobile based microlearning is effective enough to improve students' mathematical understanding ability.

Keywords: Multimedia, mobile based microlearning, mathematical understanding, calculus.

INTRODUCTION

At the end of 2019 there was a health problem, namely the outbreak of pandemic coronavirus diseases (covid 19) which spread in almost every country in the world, including Indonesia. In Indonesia, this outbreak occurred in March 2020. As a result of this outbreak, all learning systems and lectures are carried out at home because the Indonesian government enforces study from home through the policies of the Ministry of Education and Culture. The lecture system switches from face-to-face to online. Online lectures are conducted using a variety of learning platforms both synchronous and asynchronous. However, the implementation of online learning has a variety of problems experienced by teachers, students and parents (Song *et al*., 2020). After the end of the outbreak, online learning is still implemented in the form of blended learning. Blended learning aims to improve the ability to use information technology needed in 21st century learning.

Some of the problems of online learning based on the research results are first; the content of the material delivered online is not necessarily understood by all students. Second; teachers' limited ability to use technology in online learning, third; teachers' limitations in controlling online learning (Song *et al*., 2020). Looking at the learner factor, the problems of online learning are first; students are less active and interested in participating in online learning, second; limitations of mobile devices/gadgets, third; some students live in areas that do not have internet access (Song *et al*., 2020). From some of the problems above, one of the most basic aspects is the content of the material that cannot be understood by students. This is because the

presentation of the material has not been perceived as interesting by students, the material provided is quite large and broad so that students have difficulty in understanding the material. Textbooks and textbooks are owned by each student but some students still have difficulty understanding the material. Textbooks and textbooks owned by students have not fully facilitated students to learn. The material presented is too broad and dense so that it needs to be studied repeatedly. The current psychological condition of students requires simple learning materials that are easy to understand, and can be used when and where they are.

Based on several online learning problems, both the process, as well as the presentation and understanding of the material by students, the right solution is needed, namely the utilization of technology and information that is growing rapidly. The development of technology and information currently requires lecturers to be able to design innovative learning. The development of technology and information can be synergized with the delivery of learning materials and assessment. In calculus lectures, it has not been developed so much. The utilization of technology and information so far is still limited to the use of powerpoint and learning videos. In meeting the needs of students and the utilization of technology in lectures, it is necessary to develop learning materials that are packaged in an attractive, simple way and utilize android smartphones owned by each student. This learning is known as mobile based microlearning.

Some previous studies state that the trend of microlearning research is carried out in higher education in the form of the use of e-learning or mobile learning, especially in the field of language focus (Leong *et al*., 2021). Research on microlearning is growing quite rapidly, especially on content analysis and utilization of mobile devices (Sankaranarayanan *et al*., 2022). The use of microlearning has an impact on improving student understanding (McNeill & Fitch, 2022). The design of microlearning can be in the form of content created in the form of videos with a short duration (Shabadurai *et al*., 2022). Using microlearning can improve learners' academic skills (Taylor & Hung, 2022). In addition, mobile-based assessment has a positive impact on increasing students' motivation to learn (Bacca-Acosta & Avila-Garzon, 2021).

METHOD

This type of research is research and development with a 4D design, namely the defining stage (define), the design stage (design), the development stage (development), and the dissemination stage (dissemination) (Sari, 2016). The defining stage involves front-end analysis, concept analysis, task analysis, and specifying instructional objectives. The design stage involves platform selection, format selection, and initial design. The develop stage involved validation by two experts to measure the validity of the product, a readability test (limited trial), and a field test to obtain data on the practicality and effectiveness of the developed product. The dissemination stage is carried out by distributing the product to the nearest campus that has the same study program and criteria. In this article, the effectiveness of the use of products developed from mobile-based microlearning multimedia was tested, which had previously been tested for validity and practicality.

The sample in this study were even semester students who took calculus courses at Bina Bangsa University. In the research, what was done was to test the effectiveness of the product developed in the form of mobile based microlearning. Mobile based microlearning development products in the learning process were tested on all students who took calculus courses in even semesters.

The research instrument used in this study consisted of a student mathematical understanding test consisting of 5 essay items. Analysis of student mathematical understanding test data was carried out by calculating N-gain as follows.

$$N - Gain = \frac{S_{Post} - S_{Pre}}{S_{Maxs} - S_{Pre}}$$

Description.

S_{Post} = Post test Score
S_{Pre} = Pre test Score
S_{Maxs} = Maximum Score

The N-Gain score categories used are as follows (Asbanu & Babys, 2017).

Table 1. N-gain score categories

Limitations	Category
$g > 0,7$	High
$0,3 < g \leq 0,7$	Medium
$g \leq 0,3$	Low

The interpretation of the N-gain score is interpreted with the following criteria (Asbanu & Babys, 2017) .

Table 2. N-gain criteria

Percentage (%)	Criteria
< 40	Ineffective
$40 - 55$	Less Effective
$56 - 75$	Effective Enough
> 75	Effective

RESULTS AND DISCUSSION

The development of multimedia development of mobile-based microlearning has been carried out several series of validity and practicality tests of the product, this stage is to test the effectiveness of the product by testing it in the learning process of calculus lectures. The following is presented data on the results of trials in calculus lectures. The results of the pre-test and post-test data are presented on Table 3.

Table 3. Frequency data of Pre-test and Post-test results

Pre-test result		Post-test result	
Score Interval	Frequency	Score Interval	Frequency
1– 10	7	1– 10	0
11 – 20	2	11 – 20	0
21 – 30	9	21 – 30	0
31 – 40	6	31 – 40	1
41 – 50	7	41 – 50	3
51 – 60	3	51 – 60	2
61 – 70	5	61 – 70	10
71 – 80	1	71 – 80	15

Pre-test result		Post-test result	
Score Interval	**Frequency**	**Score Interval**	**Frequency**
81 – 90	0	81 – 90	7
91 – 100	0	91 – 100	2
Total	40	Total	40

The test averages obtained in Table 4.

Table 4. N-gain score

Pre-test result		Post-test result	
Average	37,1	Average	74,36

Based on table 4 above, it can be seen that the average pre-test and average post-test obtained by students has increased significantly. The next stage is testing the N gain value in Table 5.

Table 5. N-gain score

Number of Students	Average Pre-test	Post-test Average	N-gain score
40	37,1	74,36	0,59

Based on table 5 above, it can be seen that the N-gain score obtained is 0.59 with a medium N-gain score category, with an N-gain value of 59% with fairly effective criteria. The pre-test results obtained by students are the results of students' initial mathematical understanding tests before learning using mobile multimedia based microlearning, this aims to measure the extent of students' initial abilities. This initial ability aims to see the extent of students' basic understanding of lecture material before the material is taught. This is in line with the opinion that reveals that initial ability has a positive effect on students' mathematical understanding (Aprillia & Sutiarso, 2023).

Post-test results reflect the extent of the results obtained by students with the use of multimedia mobile based microlearning. The results of the post-test of students' mathematical understanding after being treated for 5 meetings have increased quite effectively. This increase is due to the use of multimedia mobile based microlearning helps students in making it easier to learn the material, the material is packaged simply so that it makes it easier for students to learn each lecture topic (Moore *et al*., 2024).

The increase with the n-gain value significantly indicates that the use of mobile-based microlearning multimedia is quite effective in improving students' mathematical understanding, the use of multimedia helps students understand each topic given, because it is presented clearly and interestingly. This is in line with research which reveals that learning with the use of microlearning will increase interaction in learning by utilizing learning videos that support the learning atmosphere (Sung *et al*., 2023; Aulia *et al*., 2024).

The advantages of developing multimedia mobile based microlearning are that the learning is packaged more simply with a small scope of discussion so that the material is easy to understand well. Learning is more interesting because the presentation of the material is interactive and has a shorter duration of time. The use of multimedia mobile based microlearning supports distance learning and online learning, making it easier for students to learn anytime and anywhere (Al-Zahrani, 2024).

CONCLUSION

Based on the results and discussion of the research, it can be concluded that the development of mobile multimedia based microlearning is effective enough to be applied to calculus learning. The effectiveness of this development is obtained based on the increase in students' mathematical understanding obtained from the results of the pre-test and post-test given. Research suggestions for further discussion are the need for the development of interactive learning multimedia that emphasizes soft skills aspects not limited to hard skills aspects such as learning independence and self efficacy.

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