23 (4), 2022, 1692-1700

Jurnal Pendidikan MIPA

e-ISSN: 2550-1313 | p-ISSN: 2087-9849

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Ethnomatematics-Based Mobile Learning Design to Improve Self-Regulated Learning

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Abstract: This study aims to produce ethnomatematic-based mobile learning that can be implemented so that it can improve student self-regulated learning. The research design used was the pre and posttest group design. The experimental and control groups will be given a pretest before treatment and a posttest after treatment. The population used was elementary school students and the sample used was 439 consisting of 215 students from the experimental class and 224 students from the control class. Data analysis in this study used statistical data processing software IBM SPSS version 27. Based on the summary of the results of the independent t test, the value of Sig. (2-tailed) on the posttest data of <0.001. This value is smaller than the specified significance level of 0.05. This means that the averages of the experimental and control groups at the time of the posttest were significantly different. The results of the analysis of self-regulated learning show that the analysis carried out on self-regulated learning only obtained complete data on 134 students from the experimental class and 134 from the control class. The research results in the experimental class show that the learning planning variable is in the high category. The conclusion from this research is that the results of learning with mobile learning with ethnomathematics content on self-regulated learning can improve student learning outcomes so that they can be implemented in schools.

Keywords: mobile learning, ethnomathematics, self-regulated learning, learning outcomes.

Abstrak: *Penelitian ini bertujuan untuk menghasilkan mobile learning berbasis ethnomatematic yang dapat diimplementasikan sehingga dapat meningkatkan self-regulated learning siswa. Desain penelitian yang digunakan adalah pre and posttest group design. Kelompok eksperimen dan kontrol akan diberikan pretest sebelum dilakukan treatment dan diberikan posttest setelah dilakukan treatment. Populasi yang digunakan adalah siswa sekolah dasar dan sampel yang digunakan sebanyak 439 yang terdiri dari 215 siswa kelas eksperimen dan 224 siswa kelas kontrol. Analisis data dalam penelitian ini menggunakan software pengolah data statistik IBM SPSS versi 27. Berdasarkan ringkasan hasil independent t test, nilai Sig. (2-tailed) pada data posttest sebesar <0.001. Nilai tersebut lebih kecil dari taraf signifikansi yang ditetapkan yaitu 0.05. Artinya rata-rata kelompok eksperimen dan kontrol pada saat posttest berbeda secara signifikan. Hasil analisis self-regulated learning diperoleh bahwa Analisis yang dilakukan pada self-regulated learning hanya memperoleh data lengkap siswa yang mengerjakan sebanyak 134 dari kelas eksperimen dan 134 dari kelas kontrol. Hasil penelitian pada kelas eksperimen menunjukkan bahwa pada variable perencanaan pembelajaran berada pada kategori tinggi. Simpulan dari penelitian ini adalah hasil belajar dengan mobile learning bermuatan etnomatematika terhadap self-regulated learning dapat meningkatkan hasil belajar siswa sehingga dapat diimplementasikan di sekolah.*

Kata kunci: *pembelajaran mobile, ethnomatematika, self-regulated learning, hasil belajar.*

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DOI: http://dx.doi.org/10.23960/jpmipa/v23i4.pp1692-1700
Received: 29 October 2022
Accepted: 16 December 2022
Published: 21 December 2022

▪ INTRODUCTION

Learning in the 21st century has experienced very rapid development, one of which is in the field of technological development. The use of smartphones among students from elementary to high school is not only used as a communication tool but is used in the learning process. This smartphone is a mobile device. Learning using mobile devices or called mobile learning is considered as one of the fastest growing learning platforms. Students' interest in using mobile learning is very large because students can have learning experiences anywhere, anytime, and according to the abilities of each student (Khachan & Özmen, 2019; Sha et al., 2012). Mobile learning has a positive impact, namely it can broaden and increase student involvement in learning (Crompton et al., 2019; Fu et al., 2021; Lai, 2020). The ideas and principles applied to mobile learning are related to culture which is the center of attention in the interdisciplinary field of ethnomathematics (Bender & Beller, 2018).

Based on the results of observations made on fourth grade elementary school students, it turned out that there were difficulties in participating in learning. The reason was the occurrence of post-pandemic loss learning and the lack of skills of teachers in producing adaptive learning applications. Local tradition or culture can be used as a medium in delivering mathematics learning material (ethnomatematics) because students need things that are contextual in learning (Utami et al., 2022). Interacting directly with traditions or culture related to the material being studied can improve learning outcomes (Budi Utami et al., 2019). There are many mobile learning offered, but researchers are trying to develop mobile learning that contains ethnomathematics by introducing moor culture. This is intended so that students start from an early age to love moor culture which is increasingly being eroded by foreign cultures such as K-POP.

Not only does it contain ethno-mathematics, but the developed mobile learning also adapts to the independent curriculum and invites students to actively develop themselves with the material presented in the form of projects. The materials used are Least Common Multiple and Greatest Common Factor. The material is considered suitable for the purpose because the traditional games that are carried out require solving the problem of how to make groups, how many groups can be formed, and what are the rules of the game.

Mobile learning can encourage students to do self-regulated learning (Sha et al., 2012). Students who have self-regulated learning can manage their own emotional, motivational, and metacognition abilities so that students can monitor and manage their own learning (Khiat, 2022; Merayo et al., 2018; Russell et al., 2022). In other words, Self-regulated Learning is proven to have a positive impact on academic development, employability, and student career progress (Gabriel et al., 2020). The developed ethnomathematics aims to convey Least Common Multiple and Greatest Common Factor materials which are linked to moor games so that students can independently manage their learning. So that learning using ethnomathematics can increase student self-regulated learning (Nisa et al., 2021).

The mobile learning used in this study was created by utilizing Design Thinking. Design Thinking was originally coined by Tim Brown as a Design Thinking terminology at the Harvard Business Review (Brown, 2008) and over time Design Thinking has developed what is known as the five steps design thinking model

approach, this is done to identify problems, align stakeholders, and changing and configuring existing resources so that they can solve problems (Brenner & Uebernickel, 2016; Liedtka, 2020; Overmyer & Carlson, 2019; Pope-Ruark, 2019; Schumacher & Mayer, 2018).

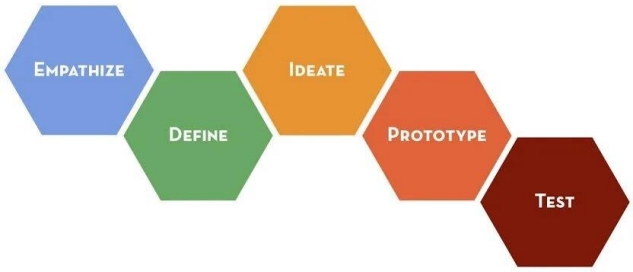

Figure 1. Patterns of design thinking in the development of mobile learning designs based on ethnomatematics

These stages include empathize: conducting interviews with teachers, students, and parents about how learning is done and what are the problems, define: identifying from the information that has been collected on the previous stage, ideate: this stage the designer tries to determine what features are needed by the user (students, students, parents), reflection, prototype, and test.

This research was designed with the help of a tunnelable application whose output can be downloaded by students through the playstore because it is in the form of an apk so that students can learn freely without being bound by space and time so that it is expected to increase achievement and self-regulated learning. The application made contains learning objectives, pre-test, material in pdf form and material in video form, post-test, and reinforcement with ethnomathematics. This is very necessary to find out how ethnomatematic-based mobile learning can improve student self-regulated learning and increase learning achievement.

▪ METHOD

The population of this study were fourth grade elementary school students in Tegal District. Sampling was done by using random sampling technique to get 439 students. The research design used was the pre and posttest group design. This study used two groups, namely the experimental group with 215 students and the experimental group with 224 students. The experimental group used mobile learning and the control group used conventional learning. The research was conducted during November 2022.

The instruments used were 20 multiple-choice test questions and 5 essay tests (pre-test and post-test) and self-regulated learning questionnaires with a Likert scale of 4 which were validated by material experts, namely PGSD teachers and lecturers. The sub-variables and indicators used are (1) learning planning with indicators determining learning strategies to be used, feeling obligated to complete school assignments, and self-regulating in preparing for learning, (2) implementation of learning with indicators of establishing cognitive and metacognitive strategies, monitoring and controlling emotions and motivation, and carrying out activities, and (3) evaluation of learning with

indicators of choosing strategies in overcoming learning failures, feeling able to evaluate learning outcomes, and reviewing the results of one's own work. Data analysis in this study used statistical data processing software IBM SPSS version 27. The process of data analysis in this study in outline was the process of cleaning the data (cleaning outliers), testing the classical assumptions, and testing the hypotheses.

▪ RESULT AND DISSCUSSION

The development of mobile learning is based on the needs of stakeholders by paying attention to the stages of design thinking. Empathize is obtained at five stages: to obtain information, the designer conducts interviews and obtains information from 1) learners: in learning experience difficulties in delivering material, difficulties in applying appropriate learning methods/models, learning is less interactive, difficulties in changing student mindsets about mathematics, as well as difficulties in conducting learning evaluations, 2) students: weak mathematical abilities at their level, this is caused by not having mastered mathematical abilities at the previous level, 3) schools: lack of IT personnel which results in limited development of digital learning, 4) parents: feeling uneasy about the child's habit of using a smartphone so that it causes learning difficulties for children, the second stage is define: from the information collected at the empathize stage, the designer concludes that what is needed includes mobile-based learning media, designed media interactively and according to students' abilities, materials are made per element by incorporating local wisdom components, there are projects for each material, there are exercises that students can do and immediately give results, and there is feedback that students, students, and parents can get to know. The third stage is ideate: at this stage the designer tries to determine the features needed by the user, namely instructions, pre-test, exploration activities, materials, post-test, project. The fourth stage is to make the resulting prototype, and the fifth stage is to conduct a test.

After all the design thinking series have been carried out, the next step is for the product to be validated by learning technology experts, in this case learning technology lecturers, and learning experts, namely teachers. From the validation results of learning technology experts, it was found that mobile eligibility was 85% and learning experts were 87.5% so that an average of 86.25% was obtained. Based on these results, the resulting mobile learning products are suitable for use in learning in the experimental class. Self-regulated learning is an important predictor of student motivation and achievement (Zumbrunn, 2011). Self-regulated learning requires students to be able to plan, implement, and assess their own independent learning. Some students can do this process independently. Independent learning can help students manage their thoughts, behaviors, and emotions so that students can direct their learning experiences. This process can occur when there is an action and process of student goals directed at obtaining information or skills.

Data analysis in this study used statistical data processing software IBM SPSS version 27. The process of data analysis in this study in outline was the process of cleaning the data (cleaning outliers), testing the classical assumptions, testing the hypotheses. In the data cleaning process. The data needs to be cleaned first to ensure that the data is free from outliers that can affect the results of the analysis. Outliers in the data can be detected by using a boxplot. The data in this study were cleaned of

outliers in two stages. The outliers were removed to avoid bias in the analysis results by 8. After removing the outliers, the results were obtained in the pre-test of the experimental class, namely the lowest value was 54, the highest value was 68 and the average obtained was 60.97, for the post-test results, the lowest value was 82, the highest value 97, and the average is 88.58. In the control class, for the pre-test the lowest score was 53, the highest score was 69 and the mean was 61.51, for the post-test results the lowest score was 76, the highest was 92, and the average was 83.93. The average pre-test and post-test for the experimental and control classes can be observed in table 1.

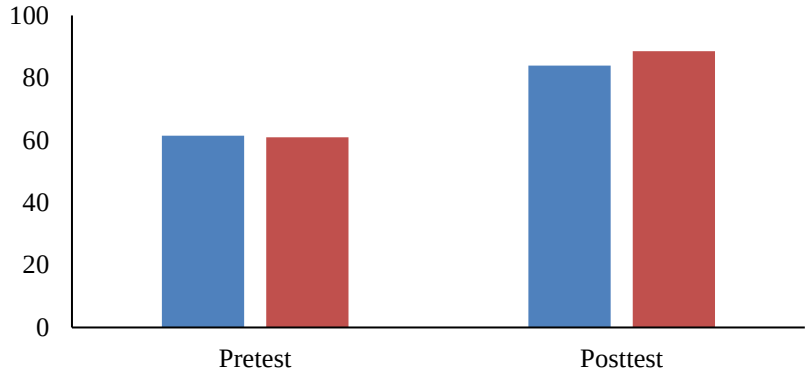

Table 1. Comparison of pretest and posttest for experiment (red) and control (blue) group.

To find out how the initial abilities and final abilities of the experimental and control class students are presented in table 1, it is necessary to test the next stage, namely the classical assumption test, namely the normality test and homogeneity test to meet the assumptions of the independent t test. Based on the Kolmogorov-Smirnov statistical test, the pre-test and post-test data for the experimental class and control class had $p < 0.05$ which indicated that the data for the two groups were normally distributed. Based on Levene's statistical test, the pretest and posttest groups were higher than the established significance level of 0.05. So it can be concluded that the experimental and control groups on the pretest and posttest data have the same (homogeneous) variance.

The final stage is hypothesis testing, in this study using the independent t test. The independent t test is one of the inferential statistical tests used to see the average difference in two independent. In the independent t test, the value of Sig. (2-tailed) on the pretest data of 0.055. This value is greater than or equal to the specified significance level of 0.05. This means that the average of the experimental and control groups at the pretest was not significantly different. So it can be concluded that the experimental and control groups had comparable initial abilities prior to treatment. Based on the summary results independent t test, the value of Sig. (2-tailed) on the posttest data of <0.001. This value is smaller than the specified significance level of 0.05. This means that the averages of the experimental and control groups at the time of the posttest were significantly different.

The analysis carried out on self-regulated learning only obtained complete data from students who worked on as many as 134 from the experimental class and 134 from the control class. The results of the research in the experimental class showed that the

learning planning variable was in the high category with the following details on indicators determining learning strategies high 86 students (64%), medium 33 students (25%), and low 15 students (11%). On the indicator of having the obligation to complete the task high 75 students (56%), medium 42 students (31%), and low 17 students (13%). On the indicators of self-regulation for high learning preparation 78 students (58%), moderate 41 students (31%), and low 15 students (11%). In the implementation of learning variables are in the high category with the following details on indicators of cognitive and metacognitive strategies high 58 students (43%), medium 56 students (42%), and low 20 students (15%). On the indicator of monitoring and controlling high emotions 60 students (45%), medium 50 students (37%), and low 24 students (18%). On the indicators of carrying out high activities 69 students (51%), medium 53 students (40%), and low 12 (9%) students. In the learning evaluation variable, the medium category is obtained with detailed indicators of choosing a strategy in overcoming high failures of 57 students (43%), medium 42 students (31%), and low 35 students (26%). On the indicator of feeling able to evaluate learning outcomes high 50 students (37%), medium 48 students (33%), and low 36 students (27%). On the indicator of reviewing their own work high 40 students (30%), moderate 59 students (44%), and low 35 students (26%).

The results of the study in the control class showed that the learning planning variable was in the medium category with the following details on indicators determining learning strategies high 46 students (44%), medium 56 students (42%), and low 32 students (24%). On the indicator of having the obligation to complete the task high 55 students (41%), medium 51 students (38%), and low 28 students (21%). On the indicators of self-regulation for high learning preparation 47 students (35%), moderate 61 students (46%), and low 26 students (19%). The learning implementation variable is in the medium category with the following details on cognitive and metacognitive strategy indicators high 38 students (28%), medium 66 students (49%), and low 30 students (23%). In the indicators of monitoring and controlling emotions, 56 students (42%) were high, moderate were 48 students (36%), and low were 30 students (22%). On the indicators of carrying out high activities 44 students (33%), medium 63 students (47%), and low 27 (20%) students. In the learning evaluation variable, the low category is obtained with detailed indicators of choosing a strategy in overcoming high failures of 37 students (28%), medium 34 students (25%), and low 63 students (47%). On the indicator of feeling able to evaluate learning outcomes high 38 students (28%), medium 45 students (34%), and low 51 students (38%). On the indicator of reviewing own work high 38 students (28%), moderate 40 students (30%), and low 56 students (42%).

This research was conducted by introducing the mobile learning used, namely the thunkable. This application can be downloaded with the apk model, the application used is as shown in Figure 1 below

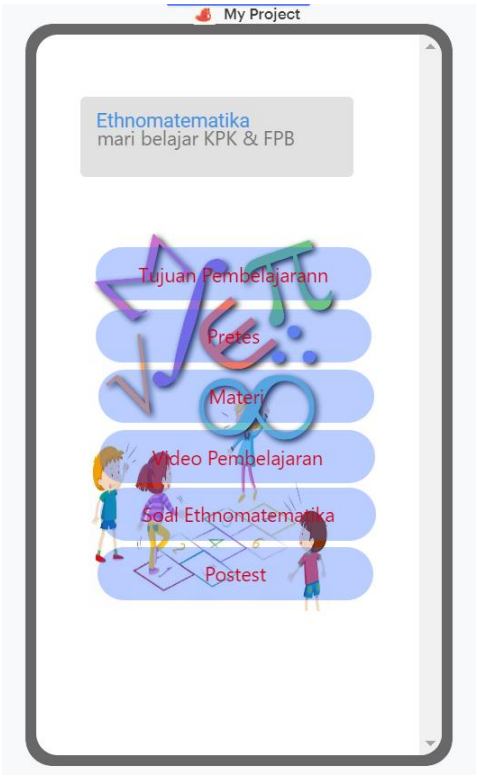

Figure 2. Mobile learning application

The material presented is Least Common Multiple and Greatest Common Factor for grade IV elementary school students. Figure 1 explains that the main menu used to help students includes learning objectives, pre-test and post-test consisting of 20 multiple choice questions and 5 essay questions, materials, learning videos, and ethnomathematics questions. This study uses two classes, namely the experimental class using mobile learning and the control class without using mobile learning.

In general, the advantages of using mobile learning from the student aspect raises self-regulated learning, this can be seen from learning independence, being able to organize learning, knowing one's own abilities, being able to explore material, prioritizing collaboration in solving problems, being able to regulate emotions (Gabriel et al., 2020; Jones, 2019; Khiat, 2022; Rivers et al., 2022; Russell et al., 2022), and for students they can become facilitators, know students' abilities, and can evaluate activities carried out by students (Merayo et al., 2018). The results of the study showed an increase in student learning outcomes, but it was better in the experimental class, namely mobile learning because in addition to containing ethno-mathematics, a level menu was also provided so that self-regulated learning.

▪ CONCLUSION

Based on the research results, it can be concluded that learning outcomes with ethnomathematics-based mobile learning for self-regulated learning so that it can be implemented in schools. The advantages of mobile learning with ethnomathematics content can bring up self-regulated learning in students, including students can learn independently, can organize learning, know their own abilities, can explore material,

prioritize collaboration in solving problems, can regulate emotions, and for students, among others, students can become facilitator and evaluate the activities carried out by students. The disadvantages include that not all students have support devices (smartphones), students need to plan carefully because it requires repeated trials in using programs designed for mobile learning.

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