M A T H L I N E
JURNAL MATEMATIKA DAN PENDIDIKAN MATEMATIKA
ISSN 2502-5872 (Print)
ISSN 2622-3627 (Elektronik)

Volume 10 Nomor 4, November 2025, 811-826

PROJECT-BASED LEARNING ASSISTED BY MULTIMEDIA INTERACTIVE LEARNING BASED ON ETHNOMATHEMATICS WITH ANDROID APPLICATION TO IMPROVE CREATIVE THINKING ABILITIES

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ABSTRACT

This study aims to investigate the effectiveness of mathematics learning with interactive multimedia based on ethnomathematics through an android application in improving students' creative thinking skills. The research method used was a quasi-experimental with a non-equivalent pretest-posttest control group design on grade IX students of SMP Negeri 1 Karangampel. The selection of experimental and control classes was carried out using purposive sampling techniques. Data collection was carried out using documentation, test and interview methods. The findings of this study indicate that who used interactive multimedia based on ethnomathematics through an android application achieved classical completeness and had higher creative thinking skills and based on the average N-gain score of the experimental class and the control class, the average N-gain score for the experimental class was higher than the average N-gain score for the control class, namely 0.8022 > 0.6994 so that more significant improvements compared to students who did not use the multimedia. Thus, interactive multimedia-based PjBL can be used as a relevant and effective pedagogical approach in learning transformation geometry material.

Keywords: Creative Thinking Ability, Interactive Learning Multimedia, Project Based Learning.

How to Cite: Nurfaidah, N., Pujiastuti. E, & Cahyono. A. N. (2025). Project-Based Learning Assisted By Multimedia Interactive Learning Based On Ethnomathematics With Android Application To Improve Creative Thinking Abilities. *Mathline: Jurnal Matematika dan Pendidikan Matematika, 10*(4), 811-826. http://doi.org/10.31943/mathline.v10i4.957

PRELIMINARY

Creative thinking skills are crucial for enhancing students' intellectual abilities and creativity in the 21st century (Medyasari *et al*., 2022). In the context of mathematics learning, these skills are essential for students to achieve learning objectives as stipulated in the national curriculum and address the challenges of the times (Gunawan et al., 2022). Creative thinking skills enable students to generate new ideas that facilitate understanding of abstract and complex mathematical concepts (Putri *et al*., 2019).

The 2013 Curriculum and recent regulations, such as Ministerial Regulation No. 16 of 2022, emphasize the importance of student activity and creativity in the learning process

to develop higher-order thinking skills. However, based on the results of a creative thinking ability test for ninth-grade students in mathematics, only 23% of students were classified as highly creative, and the majority (58%) were classified as moderately creative. This indicates that students' creative thinking skills are still relatively low (Widiyanto and Yunianta, 2021). This finding aligns with Agoestanto and Masitoh's (2021). Therefore, mathematics learning must be directed towards developing reasoning, problem-solving, and critical and creative thinking skills (Pajrin *et al.,* 2024).

To support the development of these skills, collaboration between teachers, students, and learning media is crucial (Handayani and Rahayu, 2020). Unfortunately, interactive technology-based learning media is still underutilized by teachers (Rohaeti *et al*., 2023). Yet, interactive learning media has great potential for presenting material in an engaging and easy-to-understand manner, thereby increasing student interest and achievement (Fauyan, 2019). One form of such media is interactive learning multimedia, which combines elements of text, images, animation, sound, and video in an interactive system (Arif *et al*., 2019). Moreover, Android application-based multimedia can be an appropriate choice of media because it is easy for students to access and use.

Furthermore, combining interactive media with local culture through an ethnomathematics approach is also an effective learning strategy. Ethnomathematics is an approach that links mathematical concepts with cultural elements to help students understand that mathematics is inseparable from everyday life (Nurmaya *et al*., 2021). One form of local culture rich in mathematical values is regional batik, such as Indramayu batik. Indramayu batik motifs are not only rich in cultural values but also incorporate mathematical concepts, particularly transformation geometry.

Transformation geometry is a branch of geometry that studies changes in the position of an object on a coordinate plane, including reflection, translation, rotation, and dilation. This material is studied by ninth-grade junior high school students and is highly suitable for developing creative thinking skills because it requires students to visualize and manipulate shapes innovatively (Sahliawati & Nurlaelah, 2020). Therefore, integrating local culture, such as Indramayu batik, into transformation geometry learning through Android-based interactive learning media can be an appropriate alternative for improving students' creative mathematical thinking skills while preserving regional culture.

This study focuses on finding out whether the students' mathematical creative thinking ability in the experimental class has reached the specified classical completeness standard. In addition, this study also aims to compare whether the average score of the

students' mathematical creative thinking ability test in the experimental class is higher than that of the control class. This study also applies whether the implementation of the Project Based Learning (PjBL) model supported by interactive multimedia learning based on ethnomathematics through an android application can improve students' creative thinking ability.

METHODS

This study used a quasi-experimental method with a non-equivalent control group design, where the experimental group and the control group were both given a pre-test, then the treatment was only applied to the experimental group, and the whole thing ended with a post-test. The subjects in this study were grade IX students at SMPN 1 Karangampel. Sample selection in this study was based on certain criteria and considerations that were relevant to the research objectives, alsoo known as the purposive sample technique (Senjaya, 2017). Class IX E, with 31 students, was the experimental subject using the PjBL model and multimedia technology. Conversely, 31 students in class IX F were the control class, taught using the PjBL model without the aid of interactive ethnomathematics-based learning multimedia using an Android application. The design plan used in this study is shown in Table 1 as follows.

Table 1. ***Non-Equivalent Control Group Design***

E : O_1	X	O_2
K : O_3		O_4

Keterangan:

O_1 : Experimental class in initial condition before treatment

O_3 : Control class before being given learning treatment

O_2 : Experimental class in post-treatment conditions with the PjBL model using interactive learning multimedia based on ethnomathematics with an Android application

O_4 : The control class only uses the PjBL model without integrating interactive learning multimedia based on ethnomathematics through an Android application

X : Implementation of the PjBL model integrated with interactive learning multimedia based on ethnomathematics using an Android application in the

experimental class

(Source: Sugiyono, 2018)

The steps to be taken in this research are as follows: (1) observation and planning stage, including initial creative thinking ability tests. The descriptive questions on the mathematical creative thinking ability test were first piloted and then analyzed for validity, reliability, discrimination, and difficulty level. Only items that met the criteria were used as test instruments.

The results of the validity test show that questions number 1 (0.8691), number 2 (0.7494), number 3 (0.6329), and number 4 (0.8428) are included in the valid category. Reliability test results, It is known that the total variance is 68.6264 with the variance of question 1 being 8.8096, question 2 being 6.7721, question 3 being 2.7575, and question 4 being 10.2893. The reliability coefficient obtained is 0.6023 with a high reliability category. Furthermore, the discrimination index shows that questions number 1 (0.43333) and number 4 (0.41667) have good criteria, while questions number 2 (0.31667) and number 3 (0.21667) have moderate criteria. And, The level of difficulty shows that questions number 1 (0.490), number 2 (0.417), and number 4 (0.469) have moderate criteria, while question number 3 (0.209) has difficult criteria. From the results of validity, reliability, discriminatory power, and level of difficulty, the four creative thinking ability test questions can be used for the posttest.

In this study, the assessment of creative thinking ability tests was based on the criteria and levels of creative thinking ability. The following criteria for creative thinking ability can be seen in Table 2.

Table 2. Criteria for Mathematical Creative Thinking Ability

Assessment Score	Criteria
≥ 80	Very Creative
$60 \leq n < 79$	Creative
$40 \leq n < 59$	Quite Creative
$20 \leq n < 39$	Less Creative
$0 \leq n < 19$	Not Creative

Source: (Widiansah, 2019)

The levels of creative thinking skills used are shown in Table 3.

Table 3. Level of Mathematical Creative Thinking Ability

Level	Category	Characteristics
4	Very Creative	Students are able to demonstrate fluency, flexibility, originality, and elaboration in solving problems.
3	Creative	Students are able to demonstrate fluency, flexibility, and originality in solving problems.

2	Quite Creative	Students are able to demonstrate fluency in solving problems
1	Less Creative	Students are able to demonstrate flexibility in solving problems.
0	Not Creative	Students are unable to demonstrate all indicators of mathematical creative thinking skills in solving problems.

Source: (Putri *et al*., 2019)

Next, analysis of lesson plans used by teachers, initial data analysis, determining samples, and preparing learning devices; (2) implementation, including device validation, instrument trials, implementation of learning and tests; (3) data analysis; (4) report preparation; and (5) evaluation. The following shows the research flow diagram in Figure 1.

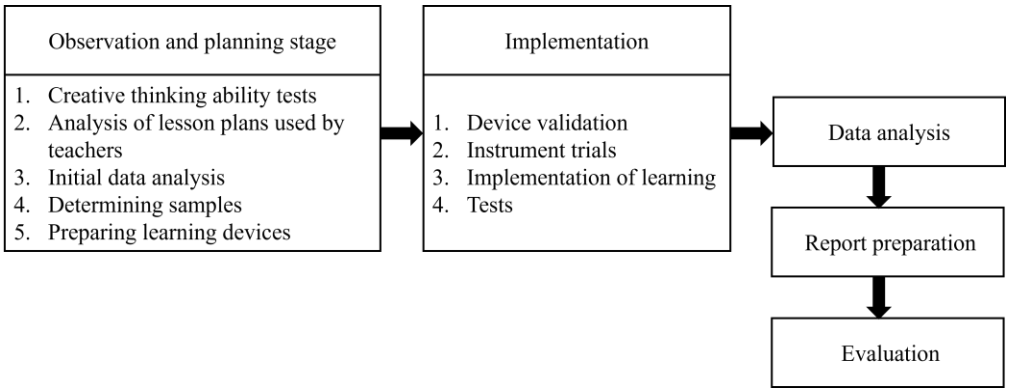

Figure 1. Research Scheme

Documentation, testing, and interview methods are used to obtain data. The documentation method is used to obtain the PAS and RPP values used by mathematics teachers at SMPN 1 Karangampel before the study. The PAS value is used to determine the initial state of the population, while the RPP is used to determine the learning model used at SMP Negeri 1 Karangampel. The documentation method was carried out before the study began. Testing methods are used to obtain pretest and posttest data on creative thinking skills. On the material of transformation geometry. The interview method in this study is used to obtain data on the deepening of creative thinking skills of students in the experimental class by taking samples.

RESULT AND DISCUSSION

The study began by calculating the actual passing limit value (BTA) the required BTA score based on the prerequisite test is 65. Then, an initial test or pretest was conducted on grade IX students at SMPN 1 Karangampel to determine their creative thinking abilities. From the initial test conducted, information was obtained that creative thinking abilities were still below expectations. The study continued by analyzing the RPP

used by mathematics teachers at SMPN 1 Karangampel to determine the learning used at the research location. The results showed that the learning used at the school used expository learning and had not implemented project-based learning.

Furthermore, it analyses the PAS values of grade IX students with normality, homogeneity, and ANOVA tests. Based on the initial analysis results, data showed that the population in this study was normally distributed, had homogeneous variance, and had the same average. This means that the population comes from the same conditions or circumstances.

The research was continued by designing the learning devices used in the research. Before the learning devices were used, the learning devices were validated by experts. The validated learning devices included lesson plans, multimedia, and creative thinking ability test questions. Several expert validation results obtained an average score for lesson plans of 95%, multimedia from material expert validation of 94%, multimedia from media expert validation of 95%, multimedia from education expert validation of 88%, and validation results from creative thinking ability test questions of 94%. Based on expert evaluation and validation, it can be concluded that learning devices that were prepared are very valid devices with several revisions according to the suggestions of expert validators. The results of the revised multimedia can be seen in Figure 2. After the learning devices were revised, the instrument was tested.

Figure 2. Multimedia Display

The instrument was tested in class IX C. The creative thinking ability test trial questions consisted of 4 questions. After analysis with validity test, reliability test, discriminatory power, and difficulty level, after getting 4 valid creative thinking ability test questions, the learning aid can be used.

Implementation of learning in class IX E (experimental) and class IX F (control) was carried out six times each with details of one meeting as an initial evaluation of creative thinking skills, four meetings for learning using models, and one meeting for the

posttest of creative thinking skills. In the experimental class, PjBL model-based learning with interactive ethnomathematics multimedia integration through Android applications. By presenting multimedia and projects, students' curiosity is great. This makes students more enthusiastic in solving problems, which ultimately improves their creative thinking skills.

Based on the proportion test with the z test, it was found that mathematical creative thinking ability (KBKM) of class IX E students (experiment) had achieved classical completeness with a proportion of 75% and by the established BTA. The findings on students' answers that showed creative thinking abilities are shown in Figure 3.

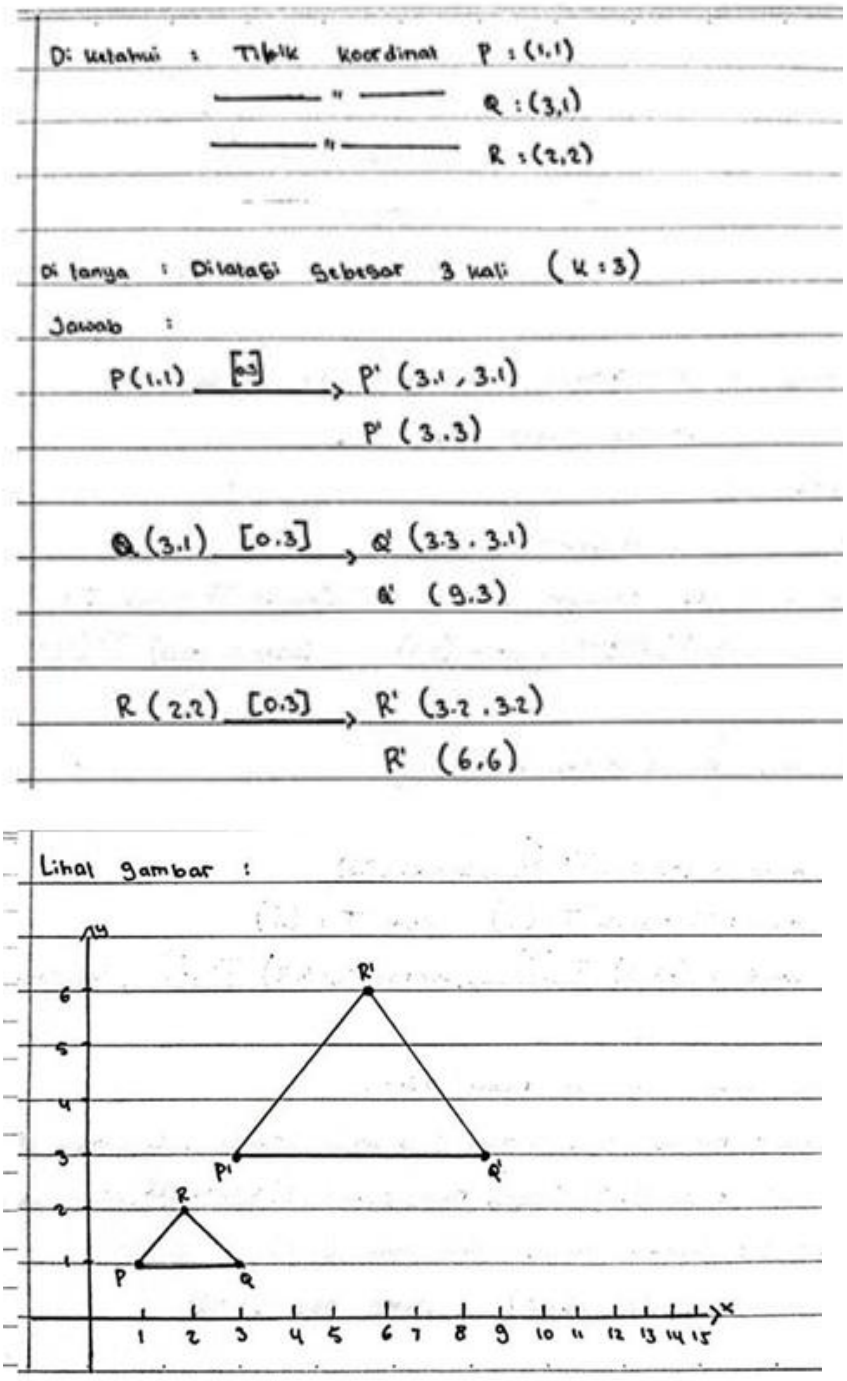

Figure 3. Creative Thinking Results Fluency Indicator

As seen in Figure 3, students work on the questions correctly and properly. This shows that students produce creative thinking skills by working on questions by providing answers correctly and properly. Furthermore, other findings are in the flexibility indicator as seen in Figure 4.

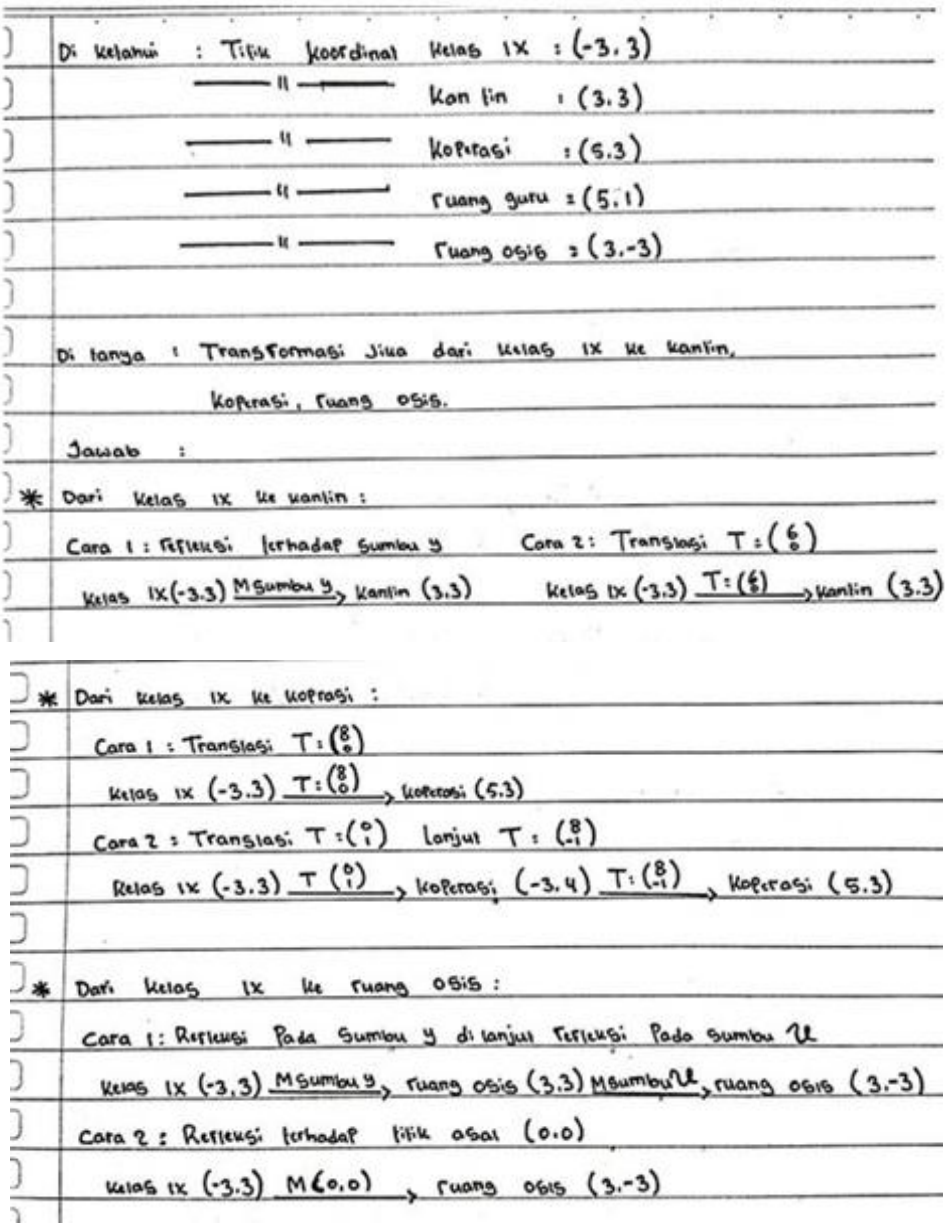

Figure 4. Creative Thinking Results Fexibility Indicator

As seen in Figure 4, students work on the problem in two different ways. This shows that students produce creative thinking skills by solving problems in two different ways. Furthermore, other findings are in the Originality indicator shown in Figure 5.

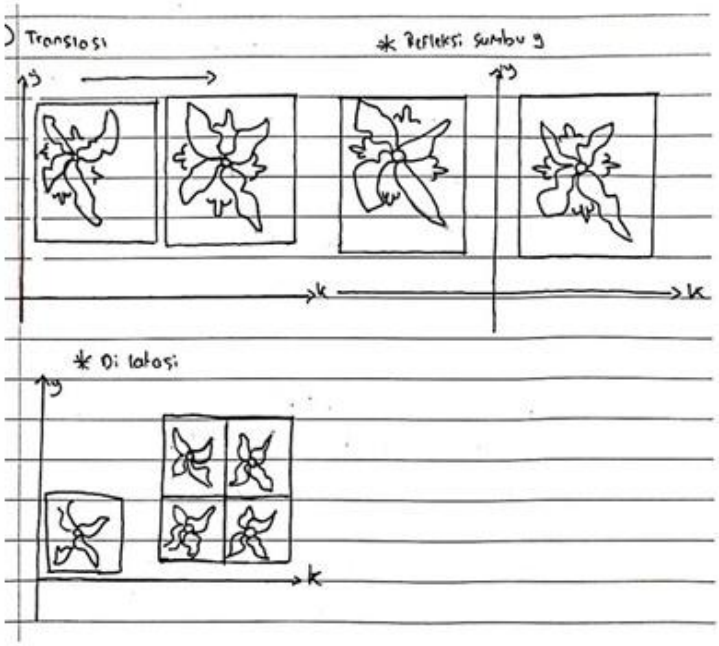

Figure 5. Results of Creative Thinking Originality Indicator

In Figure 5, it can be seen that students work on the questions in their way. This shows that students produce creative thinking skills by working on questions in their way. Furthermore, other findings are in the Elaboration indicator shown in Figure 6.

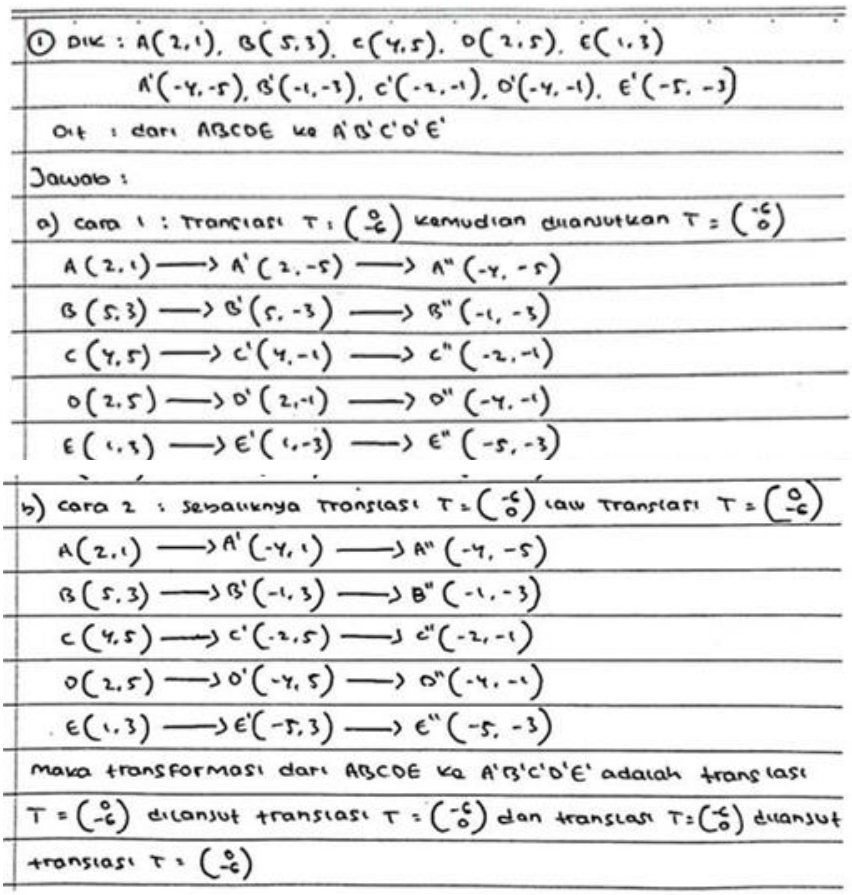

Figure 6. Results of Creative Thinking Elaboration Indicator

In Figure 6, it can be seen that students work on questions by developing ideas or concepts to solve problems in detail. Data on creative thinking skills were obtained in both classes. Descriptively, the analysis data using SPSS 20 software is shown in Table 4.

Table 4. Descriptive Statistics of Posttest Scores

	Class	N	Mean	Std. Deviation	Std. Error Mean
Posttest Value	Class IX E (Experiment)	31	81.48	7.728	1.388
	Class IX F (Control)	31	77.23	9.746	1.750

Based on the results of the SPSS output in Table 4, it can be seen that the average mathematical creative thinking ability of students taught with the help of multimedia is 81.48, and the standard deviation is 7.728. Meanwhile, the average mathematical creative thinking ability of students taught without the help of multimedia is 77.23, and the standard deviation is 9.746. This means that descriptively, the mathematical creative thinking ability of students taught with multimedia is higher and more consistent than students taught without the help of multimedia.

Next, the SPSS output results for the Independent Samples Test on the average difference test are shown in Table 5.

Table 5. Independent Samples Test on the Mean Difference Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Posttest Value	Equal variances assumed	1.276	.263	1.906	60	.061
	Equal variances are not assumed.			1.906	57.038	.062

Based on the results of the Levene test, the significance value is 0.263 > 0.05, so it can be concluded that the variance of the two groups is homogeneous or there is no significant difference in variance. Because the variance is homogeneous, the analysis uses a column with the assumption of equality of variance in testing the average through the t-test obtained the price of t = 1.906, df = 60, and sig. (2-tailed) = 0.061 / 2 = 0.0305 < 0.05 which means H0 is rejected. Thus, it can be concluded that the average post-test score of students' mathematical creative thinking abilities who learn using interactive learning multimedia based on ethnomathematics through an Android application is higher than that of students who take part in learning without using the multimedia. Wulandari, *et al* (2023) stated that the use of learning media can support the effectiveness of the learning process

and clarify the delivery of messages and the content of the material being taught. In line with this, according to Rafiah dan Ekawati (2017), effective learning can have a positive impact on students.

To see whether creative thinking skills have increased, the N-Gain value is used. The value is calculated from the difference between the posttest and pretest scores in the experimental class, then divided by the difference between the maximum score and the pretest score. The average N-Gain score for the experimental class can be seen in Table 6.

Table 6. N-Gain Experimental Class

Average N-Gain of Experimental Class	0,8022
Experimental Class N-Gain Percentage	80%
Min N-Gain Experimental Class	0,6735
Max N-Gain Experimental Class	0,9556

Referring to Table 6, the average N-gain value in the experimental class utilizing multimedia is 0.8022. This value is categorized as high because it is in the range of N-gain ≥ 0.7. The lowest N-gain value in the experimental class is 0.6735, which is categorized as medium because it is in the range of 0.3 ≤ N-gain < 0.7. Meanwhile, the highest value obtained reaches 0.9556 and is categorized as high. Information regarding the N-gain value in the control class is presented in Table 7.

Table 7. N-Gain Control Class

Average N-Gain of Control Class	0,6994
Control Class N-Gain Percentage	70%
Min N-Gain Control Class	0,5325
Max N-Gain Control Class	0,8750

Referring to Table 7, the calculation of the N-gain score shows that the average N-gain in the control class (without multimedia use) is 0.6994. This value is in the range of 0.3 to less than 0.7, so it is categorized as moderate. The lowest N-gain score in the control class was recorded at 0.5325 and is also included in the moderate category. Meanwhile, the highest score reached 0.8750, which is included in the high category.

The average N-gain value in the experimental class showed higher results compared to the control class, so it can be concluded that the increase in student learning outcomes in the experimental class was more prominent. This indicates that the use of multimedia is more effective in developing students' creative thinking skills than learning

methods without multimedia. The ability to think mathematically creatively in students after treatment increased, namely in the very creative category, where there were 16 students, and in the creative category, there were 15 students. Furthermore, findings of characteristics were found in each creative indicator; namely, in the fluency indicator, students understand the problems in the questions and can solve problems by providing many suggestions; in the flexibility indicator, students can find many alternative solutions from various other points of view, in the originality indicator students can create new and unique expressions, in the elaboration indicator students can provide detailed details of an object so that they can present more interesting results. This finding is in line with the opinion of Kozlowski and Si (2019) that creativity can produce new ideas. According to Hasnawati dan Sutarni, 2024 students with high creative thinking skills are usually good at some things, but there are still parts that need to be improved. Students with average abilities are also quite good at some parts, but still need to learn more. While students with low abilities need a lot of practice to improve their creative thinking.

CONCLUSION

Based on the results of research on the application of the Project-Based Learning (PjBL) learning model supported by interactive multimedia based on ethnomathematics through Android applications, several findings were obtained as follows: (1) The creative thinking skills of students who follow learning with the PjBL model assisted by interactive multimedia based on ethnomathematics through Android applications have met the classical completion criteria. (2) The level of creative thinking skills of students who use the PjBL model with the support of interactive multimedia based on ethnomathematics through Android applications is superior to students who follow the PjBL model without multimedia support. (3) There is an increase in creative thinking skills in students in classes that apply the PjBL model with the help of interactive learning multimedia based on ethnomathematics through Android applications.

Teachers are advised to implement the Project Based Learning (PjBL) learning model supported by ethnomathematics-based interactive multimedia through an Android application in the learning process. The application of this model has proven effective in improving students' creative thinking skills, as indicated by the achievement of classical mastery. In addition, the creative thinking skills of students who participate in learning supported by ethnomathematics-based interactive multimedia through an Android application are also superior compared to students who learn using the PjBL model without

multimedia support. Therefore, the use of local culture-based technology in learning not only makes the learning process more contextual and interesting, but can also significantly improve students' creative thinking competencies.

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