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Ethnomathematics:
Electronic Math Module Based on Madura Batik in Improving Creative Thinking Skills

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ABSTRACT
Creative thinking skill is one of the important competencies in mathematics that must be possessed by students as a provision for life in the future. But in reality, it is not easy for a teacher to explain for students in primary schools. Through linking the existing cultures around students, Madura batik, it is hoped that it can help students to more easily present abstract mathematical concepts to be more concrete and improve their creative thinking skills. The research method used to adapt the Borg and Gall Development Model includes 10 stages: problem identification, information gathering/preliminary studies, prototype design, expert validation, prototype revision, prototype testing, prototype revision, product use trial, product revision, and dissemination of products. A preliminary study was carried out to explore batik motives in Madurese batik centers. The results of the initial study were appointed as an ethnomathematic study which would be presented in the form of an electronic mathematics module and tested on primary school aged students in Madura Island. The research subjects chosen for the trial were students in grades IV, V, and VI. The results showed that the electronic mathematics module based on the ethnomatematics of Madura batik was feasible to be used to improve the creative thinking skills of primary school students.

Keywords: *Electronic Math Module, Ethnomathematics, Madura Batik.*

1. INTRODUCTION

One of the subjects that must be mastered by students in primary schools is Mathematics. The abstract characteristics of mathematics make this subject difficult for students to understand. According to Piaget's theory of cognitive development, primary school students are mostly at the stage of concrete operational cognitive development. The characteristics of the concrete operational stage of cognitive development as opposed to the characteristics of abstract mathematics make most students find mathematics difficult and less enjoyable. This has an impact on the achievement of student learning outcomes including influencing the achievement of 21st century skills that should be achieved by students optimally, one of which is creative thinking skills. Even though creative thinking skills are important because they can become provisions for students to face the times in the future. This is confirmed by the results of the initial test to measure the creative thinking ability of primary school students, especially in Mathematics. A person who has creativity must be accomplished from an primary age [1,2].

Based on the results of the test which was attended by 43 primary school students in Madura in the high class as the initial sample, it was found that the average creative thinking ability of students was in the non-creative category with an average score of 0. So far, there are not many elem.ents of local wisdom in an area that have been linked as material for student learning resources, especially in mathematics. The involvement of cultural values in the content of learning resources in Mathematics learning should be able to attract students' interest in learning mathematics because it helps students get to know mathematical concepts from concrete things in their immediate environment. Mathematical concepts that are abstract in nature can be illustrated through the culture around them so that they not only get an understanding of a mathematical concept but also a deeper introduction to the cultures that exist around them and can foster a love of their own culture compared to foreign culture.

Currently, many children like to use gadgets, for example to play. They are happy when operating gadgets. However, gadgets will have a negative impact on children if they use them incorrectly. Learning by using gadgets can attract primary school students. Some of the advantages of learning using gadgets, among others, can increase creativity, self-confidence, and pleasure. Starting from the joy of children playing gadgets, linking Mathematics learning with local culture around students through the use of gadgets is expected to increase student's creativity in learning mathematics and their love for local culture [3]. Therefore, it is necessary to develop teaching materials in accordance with current technological developments that can attract primary school students in learning mathematics. Through teaching materials that can attract students' interest in learning mathematics, it is hoped that they will be able to present mathematics material in a concrete manner in everyday life. One of the efforts that can be done is to link the existing culture in the environment around students with mathematical concepts. This will make abstract mathematics easier to understand because it is represented by tangible forms in the student environment and fosters a sense of love for local culture. This association between culture and mathematical concepts is called ethnomatematics.

2. FRAMEWORK THEORY

Ethnomatematics is an alternative linking culture with Mathematical concepts. This is consistent with what D 'Ambrosio states that making a link or link between culture and mathematics is an important step in recognizing the various ways of thinking that lead to various forms of mathematics [4]. According to Hardiarti explains briefly the notion of ethnomatematics, namely mathematics in culture [5]. Meanwhile, Fajriyah states that ethno-mathematics can bring out cultural wisdom so that it can motivate students in learning Mathematics [6]. One of the cultural products that is quite famous in Madura is Madura batik. There are various types of Madurese batik motives and patterns. Some of the Madurese batik motives actually symbolize geometric motives which are the concepts taught in Mathematics learning. This can be a teaching material for students in primary schools to learn mathematics through a culture that is close to them, so that it is hoped that mastery of mathematics material will be easier. The exploration of geometric motives contained in Madurese batik motives that are tied to concepts in Mathematics and packaged in the form of an electronic module that can be accessed by android freely in the play store is expected to be an alternative to modern teaching materials that can help students. Students in Madura, especially in learning Mathematics without leaving the values of local / traditional culture, are expected to have a love for their own country culture compared to cultures from other countries.

Creative thinking skills are one of the learning objectives that students must have, including in Mathematics. However, in reality, it is not easy for educators to guide students to have 21st century skills through Mathematics learning because Mathematics is abstract, involving many symbols that are difficult to understand. Even though creative thinking skills are one of the skills that can be used as provisions later so that students are able to adapt to the times. Therefore, educators need to prepare a mature scenario so that they can guide students to master these skills, one of which is through the use of modern teaching materials, which can be in the form of modules that are packaged practically using computer applications known as electronic modules without leaving the traditional cultures. This research is based on research conducted by Zayyadi related to ethnomatematic exploration in Madura batik. Zayyadi stated that several mathematical concepts contained in the Madurese batik motives include the concept of straight lines, curved lines, parallel lines, corner points, symmetry, flat shapes, and similarities [7]. In this study, the exploration will continue to several batik centers in four districts in Madura to obtain detailed data on the forms of batik motives related to mathematical concepts as materials for the preparation of material to be presented in an electronic math module based on Ethnomatematics of Madura Batik.

3. METHOD

The type of research taken by researchers is the type of research and development (Research and Development). This research was conducted to develop a product in the form of an electronic math module based on the Ethnomathematics of Madura Batik using the Borg and Gall Development Model covering 10 stages, namely: Problem Identification, Information Gathering/Preliminary Study, Prototype Design, Expert Validation, Prototype Revision, Prototype Testing, Revision Prototypes, Product use trials, Product Revisions, and Mass Production/Product Dissemination [8]. The locations used in this study include several places: a) a preliminary study by exploring batik in 4 districts in Madura as a material for making prototype electronic math modules based on Madura Batik Ethnomatics, namely at the batik centers of Tanjung Bumi (Bangkalan), the batik market (Sampang), the Mandilaras Museum and the largest batik market in the Village of Banyumas. Klampar (Pamekasan), and the Pekandangan Batik Center (Sumenep), b) One schools which are used as large-scale trial sites/use of electronic math modules based on the Ethnomatematics of Batik Madura respectively, c) the location for conducting limited scale trials of the prototype electronic math module based on Ethnomathematics of Madura Batik. Below are the detail procedure of this research.

3.1. Identification of problems

Problem identification is the initial stage to determine the ability of students in primary mathematics, especially in the aspect of creative thinking skills

3.2. Information Gathering / Preliminary Study

Information gathering is a continuation of the problem identification results. This information gathering aims to explore Madurese batik motives in batik centers in 4 districts, namely Bangkalan, Sampang, Pamekasan, and Sumenep. The results of the initial study were appointed as an ethnomatematic study which would be presented in the form of an electronic mathematics module and tested in primary school Mathematics learning in Bangkalan, Sampang, Pamekasan, and Sumenep

3.3. Prototype design

After the information gathering stage, a prototype design that will be developed is made, namely the prototype electronic math module based on the Ethnomathematics of Batik Madura

3.4. Design Validation

The next step after designing the prototype design is to validate the design. Prior to the trial, the prototype electronic math module based on Ethnomathematics of Batik Madura was validated by 4 validators / experts, namely experts in the field of ICT, Madurese Culture, Content / Material Content, and Language. to find out the validity of the prototype. The goal is for the prototype electronic math module based on Batik Madura Ethnomatematics to be developed more optimally after getting suggestions and responses from experts

3.5. Design Revision

After validation by the experts, the researcher then improved the prototype electronic math module based on Ethnomathematics of Batik Madura which was made to meet the validity criteria of the product developed by the researcher. Through suggestions and responses from experts, it is used as a guideline forcorrecting deficiencies in the prototype electronic math module based on Batik Madura Ethnomatematics

3.6. Prototype Testing

The improved prototype on the basis of suggestions and responses from experts was then tested on primary school students. Product trials were carried out on a small scale, three students in every Islamic boarding school

3.7. Prototype Testing

After conducting field trials in small groups, researchers made improvements back to the prototype. This improvement was carried out to determine the shortcomings of the developed prototype so that at the time of application to large groups, the results obtained were in accordance with the eligibility criteria for an electronic mathematics module. If the product being developed is near perfect, then the electronic math module does not need to be repaired anymore

3.8. Trial Use

After going through the product revision stages based on the results of small group trials, then a large-scale use trial was carried out to improve any deficiencies that might still exist from the product of the Madura Batik Ethnomatematics-based electronic math module being developed in 240 students

3.9. Final Stage Revision

At this stage improvements are made in accordance with the input at the trial use stage

3.10. Mass Production

The product that has been developed in the form of an electronic math module based on Batik Madura Ethnomathematics is distributed to teachers online. Researchers conduct scientific publications through proceedings at international seminars

Research instruments used by researchers include: questionnaire, observation sheet, Interview guidelines. Questionnaire is a data collection technique which is done by giving a set of questions or written statements to respondents to be answered. The validation questionnaire is addressed to Madurese cultural experts, information and communication technology (ICT) experts, content / content experts for electronic math modules, linguists and is aimed at students to find out students' responses to the electronic math module based on Madura Batik Ethnomatematics. The observation technique was carried out to determine the activities carried out by students during learning by using an electronic math module based on the Ethnomathematics of Batik Madura. Interviews were conducted in a preliminary study to explore the mathematical concepts contained in the Madurese batik motives as well as to obtain information regarding the philosophical meaning of each of the Madurese batik motives. When conducting interviews, researchers prepare a list of questions to make it easier for researchers to obtain the data they want to research.

4. RESULT AND DISCUSSION

4.1 The exploration results obtained several examples of Madurese batik motives as follows:

4.1.1. Tel-Cantil motive

Headings may be numbered or unnumbered ("1 Introduction" and "1.2 Numbered level 2 head"), with no ending punctuation. As demonstrated in this document, the initial paragraph after a heading is not indented

The Tel-Cantil motive depicting a bent index finger, symbolizes a commitment to a promise made. The meaning of the Tel-Cantil motive illustrates a commitment between husband and wife, that during a trip to another land to earn a living, the husband will always be loyal, as well as the wife who is left behind will always be faithful waiting for her husband to come home. Batik Tel-Cantil is used as a guide for local residents to remain loyal and not cheat on their partners. Therefore, it is rare or even never have cases of adultery in Tanjung Bumi. Batik with a Tel-Cantil motive is usually in the form of a sling. For the people of Tanjung Bumi, carrying is a form of love for a grandmother for her grandchild.

In general, a mother will be busy making batik slings when she finds out that her child is pregnant. This is used as a hope for the grandchildren who will be born. For people in other areas, preparing equipment in the form of clothes, slings, and other things for an unborn baby is a pamali. However, this does not apply to the people of Tanjung Bumi to simply prepare a sling. In fact, there is a myth among the people of Tanjung Bumi that "If a grandmother does not give a sling to her grandchild, then later when the grandmother dies she will get wrapped up in her own intestines like a baby wrapped in her arms". This myth has led to the emergence of the tradition of giving sling gifts to grandchildren who will be born. From *Tel-Cantil* motive (Figure 1) below, the students can learn about mathematics such as: the concept of reflection (a part of the geometry transformation)

Figure 1 *Tel-Cantil's* motive.

4.1.2. Lentrek motive or commonly known as card game

Lentrek is a game commonly played by crew members to fill their free time while crossing the vast ocean. Playing cards is also one of the ways to shift the feeling of longing, loneliness, and fear that often haunts the crew when traveling across the ocean. This is in line with the slogan of the Madurese sailors, namely *'asapok angen abental ombak'* which means to be covered wind with pillows. From this motive, the student can learn about many two-dimentional figure such as: triangle, rectangle, rhombus, etc.

Figure 2 *Panji Lentrek's* motive

4.1.3. Fiber motive means coconut skin

In ancient times, coconut fiber was widely found along the coast of Tanjung Bumi, both from local coconut trees and from other islands. During the high wind season accompanied by big waves, there are many coconut fiber along the coast of Tanjung Bumi. It is the presence of this head fiber that inspires the Tanjung Bumi batik handicraftsman to create the hair motive. This motive also has a fairly high level of difficulty in its work. From this motive the students can learn about parallel lines, kinds of angle (riht angle, acute angle, obtuse angle).

Figure 3 *Sabut's* motive

4.1.4. Sekoh Bujel

Sekoh Bujel is one of the batik motives which in the process has a very high level of difficulty. The level of difficulty lies when making a thin line by means of a wall using a wax candle and it should not be broken. This kind of technique is called durien tebbengan (thorn temboan). Hand-written batik with the Sekoh Bujel motive is usually worn by the rich. This is because batik with this motive is priced very expensive. From this moive the students can learn about line, kind of two-dimentional figure.

Figure 4. *Sekoh Bujel's* motive

4.1.5. Ajem Kateh means chicken kate

This type of chicken is not a native chicken from Madura, but its existence has been found in Madura. Ajem Kateh has a very tame nature and only wanders on the terraces of the house, so that these chickens often accompany the batik makers to work on their batik. This is what inspired the batik makers to create the Ajem Kateh motive, which depicts kate chickens in a row, symbolizing a group life with full order. In this motive, the students can learn about the operation of integer include addition, multiplication.

Figure 5. *Ajem Kateh's* motive

4.1.6. Coconut trees that will bear fruit usually produce shoots resembling a heart

Next, the heart will bloom and stalks appear. Madurese people call it krocok. This is what illustrates the Krocok motive on the written batik of Tanjung Bumi. Through this motive, the students can learn about two-dimentional figure, angles and lines

Figure 6. *Krocok's* motive

4.1.7. Tera' Bulan motive is also an ancient or classic motive from Sumenep Regency

Batik Tera 'Bulan (bright moon) is inspired by the beauty of the full moon that shines brightly. This batik is commonly used as a samper (sarong for women), even at this time Tera 'Bulan batik is widely used as clothes, shirts and dresses. Below is Tera' Bulan's motive. From this motive the students can learn about number pattern in Mathematics

Figure 7. *Tera' Bulan's* motive

4.2 Designing Prototype

Based on the results of the exploration of Madurese batik motives, an analysis of the Basic Competencies was carried out and the material compiled on the electonic math module based on the ethnomatematics of Madura batik was specifically focused on four main topics, including: Integer, Lines and Angles, Flat Builds, and Reflections The results of the association between mathematics and Madurese batik are used to compile a story board for the electronic math module based on the ethnomatematics of Madurese batik. The following is an example of how it looks.

Figure 8. The Cover of E-Math Module

Figure 9. Map of Madura Island

Figure 10. Content of Motive '*Batik*'

Figure 11. Content of menu '*Belajar Math*'

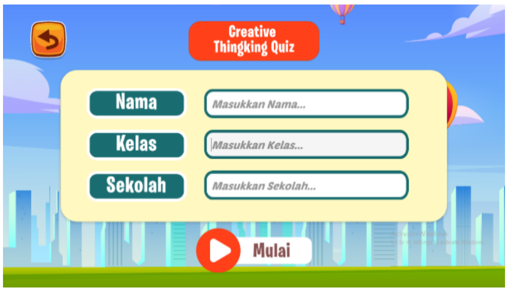

Figure 12. Identity of Student for Creative Thinking Test

Figure 13. Creative Thinking Test

4.3 Product Trials

Based on the data from the validation results, it is known the product validity value with an average percentage of the validation results from the experts and a score of 86.74% was obtained. Product trials in four districts in Madura were conducted at Islamic boarding schools involving high-grade IV, V, and VI students. This trial was carried out through small group trials and large group trials. Small group testing was carried out by selecting test subjects as many as 3 representative students from each class IV, V, and VI in each Islamic boarding school which was used as the trial sample. For this trial subject was selected based on the different ability levels in each class in order to represent the class population. This trial aims to determine the effectiveness of the learning outcomes obtained by students through the E-Module used.

Based on the results of the creative thinking test given after the application of e-module in small group trials, the average creative thinking test results of primary school students who took the trial had reached the minimum completeness criteria. After the small group trial was carried out, the results showed that the Madura Batik Ethnomathematics based *E-Math Module* product could be continued to the large group trial. The large group trial was conducted on 240 primary school students in Madura. The results of tests for creative thinking skills from large group trials in 4 districts in Madura are summarized in the graph below

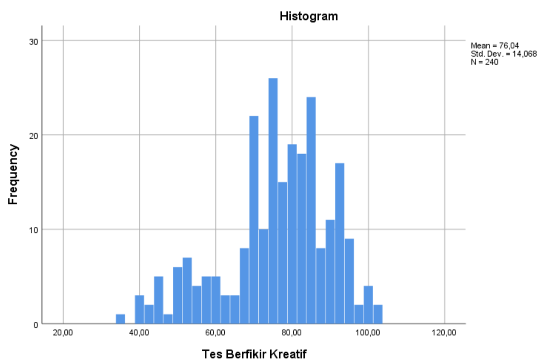

Figure 14. Histogram of Large Group Creative Thinking Skills Test Results

Based on the Figure 14 above, it can be seen that the average test results for creative thinking skills in large group trials were 76.04 and had reached the average minimum completeness criteria for primary schools in Madura. After the E-Math Module product was declared fit for use based on the results of development research, an experimental research was conducted with a quasi experiment design to see whether there was an effect of learning mathematics using the Electronic Math Module on the creative thinking skills of primary school students in Madura. The research sample consisted of 168 primary school students in 4 districts as the control class as well as the 168 experimental class with purposive sampling technique consisting of students in grades IV, V, and VI. Hypothesis testing is used to know the difference in the average learning outcomes of primary school students who are taught using the Electronic Math Module and those who do not use the Electronic Math Module. Before testing the hypothesis, the steps taken are conducting a prerequisite test, namely the normality and homogeneity test. Here is the explanation.

4.4 Normality Test

The normality test of the control and experimental group data used SPSS 25. The figure below shows the results of the normality test of the creative thinking test results of elementary school students in Madura.

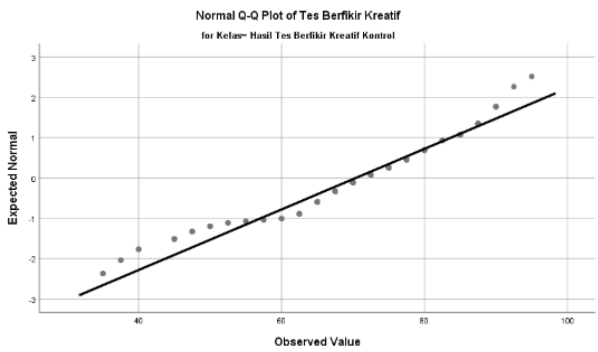

Figure 15. Graph of Control Class Data Normality

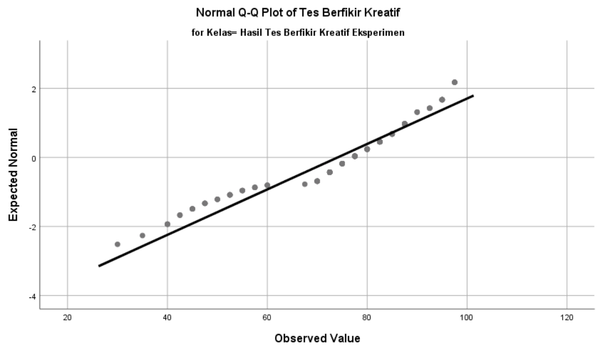

Figure 16. Graph of Experimental Class Data Normality

The results of data normality testing using Kolmogorov Smirnov in Table 1, it can be seen that the Sig value <0.05, so it can be concluded that the data from the creative thinking test results in both the control class and the experimental class are not normally distributed.

4.5 Homogeneity Test

The homogeneity test of both the control and experimental group data was carried out using SPSS 25.The image below shows the results of the homogeneity test of the data on the creative thinking test results of elementary school students in Madura.

Table 1. Results of Normality Test for Control and Experimental Group Data

Tests of Normality							
		Kolmogorov-Smirnov			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
The Result of Creative Thinking Test	Control Group	,134	168	,000	,945	168	,000
	Experimental Group	,191	168	,000	,912	168	,000

Table 2. Homogeneity Test Results of Control and Experimental Group Data

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
The Result of Creative Thinking Test	Based on Mean	2,126	1	334	,146
	Based on Median	1,010	1	334	,316
	Based on Median and with adjusted df	1,010	1	317,553	,316
	Based on trimmed mean	1,636	1	334	,202

From the results obtained in Table 2, it is known that the Sig Value is 0.146 > 0.05, it is concluded that the two data groups are homogeneous. The results of the prerequisite test for both data groups were homogeneous but not normally distributed. Therefore, hypothesis testing can not be done using a parametric statistical test so that hypothesis testing is carried out using a non-parametric statistical test, the Mann Whitney test.

4.5 Hypothesis Test

Following are the results of hypothesis testing using the Mann Whitney Test. From Table 4, it is known that the Asymp. Sig (2-tailed) is 0.001 < 0.05 so it can be concluded that there is a significant difference in the average test results of students' creative thinking skills in the control class and the experimental class.

Table 3. The Value of Ranks using the Mann Whitney Test

Ranks				
	Group	N	Mean Rank	Sum of Ranks
The Result of Creative Thinking Test	Control Group	168	150,74	25325,00
	Experimental Group	168	186,26	31291,00
	Total	336		

Table 4. The results of hypothesis testing using the Mann Whitney Test

Test Statistics	
	The Result of Creative Thinking Test
Mann-Whitney U	11129,000
Wilcoxon W	25325,000
Z	-3,358
Asymp. Sig. (2-tailed)	,001
Mann-Whitney U	11129,000

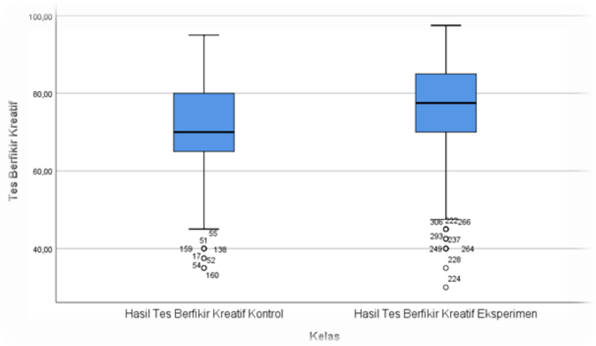

Figure 16. Graph Mann Whitney Test Results Control Group and Experimental Group

Based on the results of the analysis of the hypothesis test using the Mann Whitney test above and it is clarified by Figure 4, it can be seen that there is a significant difference in the average test results of students' creative thinking skills in the control class and the experimental class indicating that there is an effect of learning using the Electronic Math Module Based on Madura Batik on elementary school students creative thinking skills. It's happen cause in learning using the electronic math module students are trained to be able to think logically and freely. As stated by Pehkonen, Tatag stated that creative thinking in mathematics is a combination of logical and divergent thinking which is based on intuition but has a conscious aim [9,10].

As when observing Sekoh Bujel's motive on learning plane material, students were trained to find how many shapes of shapes such as rhombus in this motive. For students whose way of thinking is divergent, they are able to find a rhombus in a complex motive and this cannot be found by students whose way of thinking is convergent. In Figure 4, it can be seen that the creative thinking skills of elementary school students whose learning using the assistance of the Electronic Math Module are higher than those of the control class who do not use the assistance of the Electronic Math Module so that it can be concluded that learning using Electronic Math Module of Madura Batik has an effect on increasing skills. elementary school students creative thinking.

5. CONCLUSION

The electronic mathematics module based on the ethnomatematics of Madura batik was feasible to be used to improve the creative thinking skills of primary school students. Learning mathematics using electronic math module based on ethnomatematics of Madura batik is an effort to introduce local culture to the students. Thus, it can foster a sense of love for the nation's culture.

AUTHORS' CONTRIBUTIONS

The contributions of teams are as follows. a). Rozie Fachrur as the lead researcher led the implementation of each stage of the research, determined a series of schedules for the implementation of all stages of the research, was involved in the data collection process, and designed the e-module. b) Wulandari Rika as the designer of Mathematics related to Madura batik for learning elementary school students, carrying out administrative / correspondence tasks, being involved in the data collection process, and analyzing research data. c) Ningsih Puji Rahayu assisted in administration and completing of the electronic math module application.

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