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Development of Ethnomathematics-Based E-Module Using the Inquiry Learning Model to Improve Mathematical Problem Solving Ability

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Abstract

The purpose of this research was to produce an ethnomathematics-based e-module development on an inquiry learning model that were valid, practical, and effective in improving students' mathematical problem solving ability. This study used the Research and Development (R&D) method with the ADDIE development model which includes Analysis, Design, Development, Implementation, and Evaluation. Data collection techniques using questionnaires and tests. The data analysis technique used a Likert scale, the one-sided average test, and the two-sided average difference test. The results of this study indicate that e-module have very valid criteria for use in the learning process with an average validity percentage of 88.54%, e-module have very practical criteria for use in the learning process with an average practicality percentage of 87.33%, and e-module are categorized as effective or can improve students' mathematical problem solving ability, which is indicated by (a) students' mathematical problem solving ability with ethnomathematics-based e-modules using the inquiry learning model to achieve mastery criteria; (b) students' mathematical problem solving ability with ethnomathematics-based e-modules using inquiry learning models are better than students' mathematical problem solving ability in conventional learning.

1. Introduction

In a country, education is an important component where education is one of the determinants of the quality of existing human resources. In accordance with the Law of the Republic of Indonesia Number 11 of 2019 concerning the National System of Science and Technology, education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by himself, society, nation and state. In Indonesian education, it is stated that mathematics is one of the subjects that must be included in the primary and secondary education curriculum.

However, the facts show that students' view of mathematics becomes a difficult subject to understand, seems uninteresting and boring. The presence of learning innovations is needed so that mathematics learning becomes more fun (Marsigit, 2016). Teaching materials are one of the media that can be used during the learning process. One of the teaching materials that can help students in the learning process is a module. The module is a teaching material that is systematically arranged with a series of learning activities according to student conditions that can create an independent learning process so as to assist students in achieving learning goals (Mardiah et al., 2018).

Various kinds of strategies are carried out by the teacher to increase student interest in learning. One of them is technology-based learning such as e-module. E-module can be used as one of the more practical learning solutions. Based on initial observations at Junior High School 1 Subah, the teacher stated that

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learning mathematics in class more often uses textbooks from the government which contain material with more complicated explanations. Students are also encouraged to memorize formulas that are already in the book. In addition, the textbook is also not equipped with problems related to culture. In accordance with the motto applied by Junior High School 1 Subah, namely "a culture-based school". This is a problem for mathematics teachers at Junior High School 1 Subah to play a role in realizing school goals because there are no learning resources available for students who are able to teach culture-based mathematics.

Based on this, it is necessary to develop an ethnomathematics-based e-module. Ethnomathematics is a form of mathematics that is influenced by certain cultures. Learning through an ethnomathematical approach can make students actively involved in finding local culture related to geometry and teachers using teaching aids related to culture so that students' motivation is increasing (Supriyanti et al., 2015). Thus, students can find out more about the culture of Central Java which is less well known by the millennial generation and is expected to be able to improve students' mathematical problem solving ability.

Problem solving ability is one of the abilities that must be possessed by students in the mathematics learning process (NCTM, 2000). Problem solving ability is one of the goals of learning mathematics (Kemendikbud, 2016). The inquiry learning strategy is a series of learning activities that emphasize critical and analytical thinking processes to seek and find answers to the problems in question (Sanjaya, 2006). Therefore, the inquiry learning model can help students to improve their mathematical problem solving ability. Wena (2011) states that based on the results of research, the inquiry learning model that has been applied in Indonesia shows that it can significantly improve student learning outcomes and improve mathematical problem solving ability.

Based on the description of the background above, it is necessary to conduct research on "Development of Ethnomathematics-Based E-Module Using the Inquiry Learning Model to Improve Mathematical Problem Solving Ability". Based on the background of the problem described, the research problems formulated were: (1) How is the development of ethnomathematics-based e-module using the inquiry learning model to improve mathematical problem solving ability?; (2) How is the level of validity of ethnomathematics-based e-module using the inquiry learning model to improve mathematical problem solving ability?; (3) How is the practicality level of ethnomathematics-based e-module using the inquiry learning model to improve mathematical problem solving ability?; (4) How is the effective of ethnomathematics-based e-module using the inquiry learning model to improve mathematical problem solving ability?

The objectives of the research were: (1) to describe the development of ethnomathematics-based e-module using the inquiry learning model to improve mathematical problem solving ability; (2) knowing the level of validity of ethnomathematics-based e-module using the inquiry learning model to improve mathematical problem solving ability; (3) knowing the level of practicality of ethnomathematics-based e-module using the inquiry learning model to improve mathematical problem solving ability; and (4) knowing the level of effective of ethnomathematics-based e-module using the inquiry learning model to improve mathematical problem solving ability.

2. Methods

This study used the Research and Development method. The Research and Development method is a research method used to produce a certain product and test the effectiveness of the product (Sugiyono, 2017). The research development procedure used in this research was the ADDIE model. According to Branch (2009) revealed that the stages of ADDIE development are Analysis, Design, Development, Implementation, and Evaluation. The subjects of this study were students of class VIII at Junior High School 1 Subah. Quantitative research used a quasi-experimental design. Sampling for the experimental class and control class was done randomly, consisting of 25 students of class VIII B and 25 students of class VIII F. Class VIII B used an ethnomathematics-based e-module as the experimental class. Class VIII F using the conventional method.

Data collection techniques in this study used questionnaires and tests. Questionnaires were used to obtain data on the level of validity and practicality of ethnomathematics-based e-module. This test technique was used to obtain data about the mathematical problem solving ability of the experimental class and control class students. The test was carried out twice, namely pretest and posttest with description

questions. The data obtained in this study were the results of the e-module validity test, the e-module practicality test results, and the results of the mathematical problem solving ability test.

3. Results & Discussions

This study produced a product in the form of an ethnomathematics-based e-module for class VIII Junior High School students on number pattern material. The development is carried out using the ADDIE model as follows:

3.1. Analysis

At this stage, information is collected by observing which is used as the basis for making e-module and making the e-module function optimally. Initial observations were made to mathematics teachers at Junior High School 1 Subah on April 9, 2021. There are several aspects to be considered in making the e-module as follows.

3.1.1 Needs Analysis

The media used in the mathematics learning process at Junior High School 1 Subah is teaching materials. Teaching materials provided by teachers to students are in the form of textbooks recommended by the government. The display in the textbook is currently considered by students to be difficult to understand and also not equipped with problems that are able to link students' abilities with ethnomathematical aspects. This is a problem for mathematics teachers at SMP Negeri 1 Subah to play a role in realizing "a culture-based school" in accordance with the motto of Junior High School 1 Subah.

3.1.2 Curriculum Analysis

The curriculum used at Junior High School 1 Subah is the 2013 curriculum. The material chosen in the development of the e-module in accordance with the 2013 curriculum is number pattern material. Number pattern material is one of the materials taught in SMP/equivalent class VIII odd semester. The basic competencies used are 3.1 Making generalizations from patterns in number sequences and object configuration rows and 4.1 Solving problems related to patterns in number rows and object configuration rows.

3.1.3 Analysis of Facilities

Analysis of facilities in this study covers smartphone ownership for both teachers and students. Based on observations, it was found that all teachers and students at Junior High School 1 Subah have a personal android smartphone. This is according to the number of WhatsApp groups in each class with teachers and students joining according to the provisions.

3.2. Design

At this stage the researcher begins to design the e-module that will be developed. The steps in the design stage are the preparation of the e-module framework, the collection and selection of references, the preparation of the e-module design and features, and the preparation of the e-module assessment instrument.

3.2.1 E-Module Framework

Ethnomathematics-based e-module consists of three main parts, namely the beginning, content, and end. The initial part of ethnomathematics-based e-module consists of a cover page, foreword, table of contents, e-module description, objectives, instructions for using e-modules, core competencies, basic competencies, competency achievement indicators, inquiry learning models, concept maps, and motivation. The content section of ethnomathematics-based e-module consists of an overview of the material, learning activities, sample questions, and summaries. The final part of ethnomathematics-based e-module consists of a competency test, glossary, answer key, and bibliography.

3.2.2 Reference Selection

The references used as a reference in the selection of materials and the development of ethnomathematics-based e-module on number pattern material are books from the government and journals.

3.2.3 E-module Design and Features

Ethnomathematics-based e-module were created using Microsoft Office 2016 software for writing, and Canva for designing images. In the initial design of the ethnomathematics-based e-module, it was dominated by white as the background, and partly blue as a complement. This is so that the ethnomathematics-based e- module can make students interested in reading it. E-module are made in A4 size (21 cm × 29.7 cm). The examples of the display of teaching materials are shown on Figure 1. below.

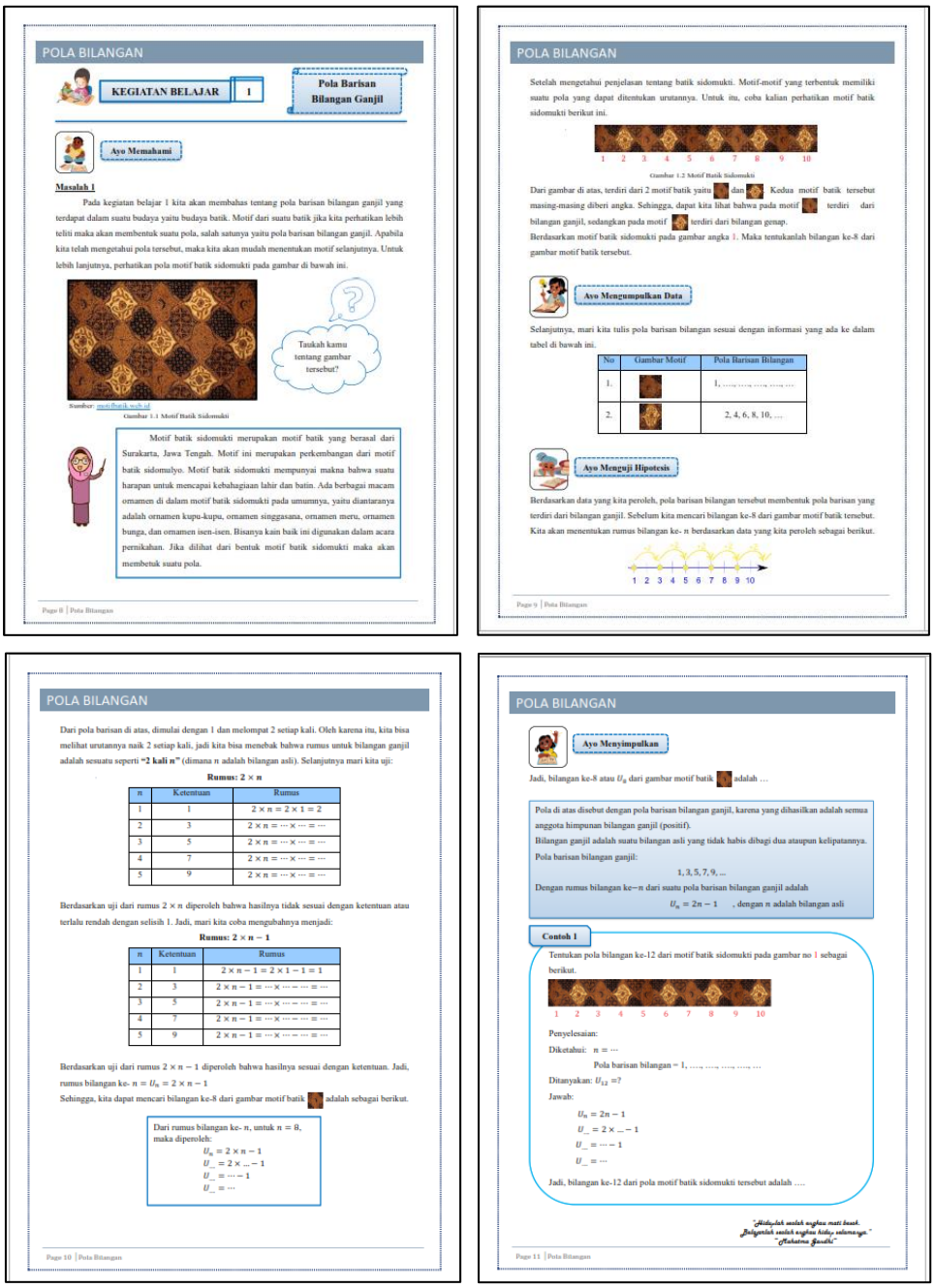

Figure 1. Example of Content from Teaching Materials

3.3. Development

At this stage the product was realized based on the framework that had been prepared in the previous stage and tested validity. In this study, the assessment instrument was adjusted based on the aspects and criteria of the BSNP assessment that had been modified by the researcher. The evaluation of the validity of the e-module is assessed from three aspects, namely content validity, presentation validity, and linguistic validity. According to Riduwan (2013), the ethnomathematics-based e-module developed must meet the

requirements to be said to be valid if the assessment score is >60%. If an assessment score of 60% is obtained, the e-module must be revised again. Validation was carried out by a Lecturer in the Mathematics Department of the State University of Semarang and 4 mathematics teachers at Junior High School 1 Subah. E-modules based on ethnomathematics on the material Patterns of numbers in the very valid category based on the criteria of validity with a percentage of 88.40%. The results of the analysis of the validity test by the five validators are shown in Table 1. below.

Table 1. Results of the Validity Test Analysis E-module by the Validator

No	Validator	P(%)	Criteria
1.	Validator D1	80%	Valid
2.	Validator G1	97.56%	Very Valid
3.	Validator G2	84.46%	Very Valid
4.	Validator G3	87.07%	Very Valid
5.	Validator G4	92.91%	Very Valid
	Average	88.40%	Very Valid

Based on the results of the validity test of the ethnomathematics-based e-module on the Number Pattern material, it is also known that the percentage of validity of each aspect in the e-module is shown in Table 2. below.

Table 2. Validity Test Results E-module on Each Aspect

Aspect	P(%)	Criteria
Content	88.35%	Very Valid
Presentation	91.00%	Very Valid
Language	85.85%	Very Valid

Results indicate that the ethnomathematics-based e-module on the Number Pattern material with very valid criteria. Thus, the e-module has met the requirements of the validity aspect set by the BSNP as well as from the ethnomathematics-based e-module. Ethnomathematics is the study of mathematics that involves a culture where mathematics emerges by understanding the reasoning and mathematical systems used (D'Ambrosio, 1985). Based on Sirate's research (2012) which revealed that the application of ethnomathematics in learning is used as a means to motivate and stimulate students so that they can overcome boredom and difficulties in learning mathematics which in turn can improve student learning outcomes. Wena (2011) states that based on the results of research, the inquiry learning model that has been applied in Indonesia shows that it can significantly improve student learning outcomes and improve mathematical problem solving ability.

3.4 Implementation

E-modules based on ethnomathematics were tested for use in the learning process to determine the level of effective and practicality. This study involved 3 sample classes, namely as an experimental class, a control class, and a test class. The class sampling technique in this study was a random sampling technique. Randomly selected class VIII-B as the experimental class, class VIII-F as the control class, and class VIII-E as the experimental class. The control class is only used as a comparison. In this study, learning was carried out online through the WhatsApp and Google Classroom applications in class VIII-B and VIII-F of Junior High School 1 Subah.

3.4.1 E-Modul Effective Test

This stage is divided into four stages, namely the preparation stage, the pretest stage, the material giving stage, and the posttest stage.

- Preparation Stage

The purpose of this stage is to find out which questions will be used in the pretest and posttest stages. The test of mathematical problem solving ability was carried out in class VIII-E of Junior High School 1 Subah on 27 July 2021. The results of the test of mathematical problem solving ability were analyzed for validity, reliability, differentiating power, and difficulty level. Recapitulation of the test results of mathematical problem solving ability question in Table 3.4 below.

Table 3. Test Results of Mathematical Problem Solving Ability Question

Question Items	Validity	Reliability	Differentiating Power	Difficulty Level
1.	Valid		Easy	Enough
2.	Valid		Medium	Enough
3.	Valid	High	Easy	Enough
4.	Valid		Medium	Enough
5.	Valid		Medium	Enough

Based on the results of the analysis of validity, reliability, differentiating power, and difficulty level above, it can be concluded that each of these questions can be used or used. The pretest and posttest questions used are the same, namely 5 questions. These questions are questions that contain indicators of competency achievement and indicators of mathematical problem solving ability.

- Pretest Stage

The pretest will be held online on July 29, 2021 for class VIII-B and on August 2, 2021 for class VIII-F. The pretest was attended by 25 students from class VIII-B and 25 students from class VIII-F. The results obtained will be used to test the effective.

- Material Giving Stage

At the stage of giving the material, the learning was carried out in 2 meetings with VIII-B as the experimental class and class VIII-F as the control class. Giving material to class VIII-B using an ethnomathematics-based e- module using an inquiry learning model. For class VIII-F no treatment was given or just as usual the teacher taught using conventional learning. Learning is carried out online through the WhatsApp application for each class group due to the Covid-19 pandemic so it is not possible to carry out face-to-face learning in schools.

- Posttest Stage

The posttest was carried out online in class VIII-B after using an ethnomathematics-based e- module using an inquiry learning model on August 19, 2021. For class VIII-F it was held online on August 14, 2021. The posttest was attended by 25 students from class VIII- B and 25 students of class VIII-F. The results obtained will be used to test the effective of the hypothesis which includes (a) students' mathematical problem solving ability with ethnomathematics-based e-module using an inquiry learning model to achieve mastery criteria; and (b) students' mathematical problem solving ability with ethnomathematics-based e-module using the inquiry learning model are better than students' mathematical problem solving ability in conventional learning. Problem solving ability is used as an effort to find an answer to a difficulty so as to achieve a goal that is not immediately achievable (Polya, 2004).

The analysis of the effective hypothesis test consists of a normality test, a homogeneity test, a hypothesis test a (minimum completeness limit in the experimental class average), and a hypothesis test b (the difference in the average mathematical problem solving ability). The results obtained in the trial use are as follows.

1) Normality Test Result

The normality test was used to see whether the values of the results pretest and posttest in the experimental class and control class were normally distributed or not. The hypothesis used is as follows.

H_0: data pretest and posttest from the experimental class and the control class were normally distributed.

H_1: data pretest and posttest from the experimental class and the control class were not normally distributed.

In this study, the normality test using the Kolmogorov-Smirnov test with the help of the SPSS 24 program, the result is shown in Table 4.

Based on Table 4. obtained sig on the pretest VIII-B amounted to 0.118, posttest VIII-B, pretest VIII-F, and posttest grade VIII-F of 0.200. It is clear that the value of sig pretest, VIII-B posttest VIII-B, pretest VIII-F and posttest VIII-F > $\alpha = 0.05$. So, based on the test criteria, H_0 is accepted. This shows

that the pretest and posttest data of class VIII-B and class VIII-F of Junior High School 1 Subah students are normally distributed.

Table 4. Normality Test Results Pretest and Posttest Class VIII-B and Class VIII-F

	Sig.
Pretest VIII-B	0.118
Posttest VIII-B	0.200
Pretest VIII-F	0.200
Posttest VIII-F	0.200

2) Homogeneity Test Result

Data homogeneity test was used to determine whether the data posttest of mathematical problem solving abilities from the two classes had the same variance (homogeneous) or not. The hypothesis used is as follows.

$H_0: {\sigma_1}^2 = {\sigma_2}^2$ (data Posttest for class VIII-B and VIII-F have the same variance)

$H_1: {\sigma_1}^2 \neq {\sigma_2}^2$ (data Posttest for class VIII-B and VIII-F do not have the same variance)

The homogeneity test in this study using the SPSS 24 program, the result is shown in Table 5. below.

Table 5. Posttest Test Results for Homogeneity Class VIII-B and Class VIII-F

	Sig.
Posttest Class VIII-B and VIII-F	0.067

Based on Table 5. the value sig for Posttest Class VIII-B and VIII-F was 0.067. It is clear that thevalue sig in the Posttest Class VIII-B and VIII-F > α = 0.05. So, based on the test criteria, H_0 is accepted. This shows that the posttest data of class VIII-B and class of Junior High School 1 Subah students have the same variance.

3) Hypothesis 1 Test Result

The learning mastery test is used to determine whether students' mathematical problem solving ability after learning with an ethnomathematics-based e-module using an inquiry learning model on number pattern material can reach the minimum completeness limit on average. Learning is said to be complete if the results of the posttest reach the minimum completeness limit on average that the researcher has set, which is 70.

Hypothesis 1 test uses the one-sided average test. The hypothesis used is as follows.

$H_0: \mu \leq 70$ (The average mathematical problem solving ability of students after using the ethnomathematics-based e-modul has not reached the minimum completeness limit on average)

$H_1: \mu > 70$ (The average mathematical problem solving ability of students after using the ethnomathematics-based e-modul reaches the minimum completeness limit on average)

The test criteria are H_0 is rejected if $t_{count} \geq t_{table}$ with probability (1-α) and dk = (n-1). Based on the results of the calculation of the average completeness the one-sided average test, the result is shown in Table 6. below.

Table 6. The One-Sided Average Test

n	**s**	$\bar{x}$	μ_0	t_{count} **(Result)**
25	10.34	87.92	70	8.67

Based on table 6. obtained $t_{count} = 8.67$ and $t_{table} = 1.711$. It is clear that based on the test criteria, $t_{count} \geq t_{table}$ and H_0 are rejected. From these calculations, it can be concluded that the average mathematical problem solving ability of students after learning with an ethnomathematics-based e-module using an inquiry learning model on number pattern material reaches the minimum completeness limit on average, which is 70.

4) Hypothesis 2 Test Result

Test the difference between two the average in this study aims to determine whether the average mathematical problem solving ability of students after being given learning with ethnomathematics-based e-modul using an inquiry learning model is better than the average mathematical problem solving ability of students in conventional learning. Hypothesis 2 test uses the two-sided average difference test. The hypothesis used is as follows.

$H_0: \mu_1 \leq \mu_2$ (The average mathematical problem solving ability of students with ethnomathematics-based e-modul is less than or equal to the average mathematical problem solving ability of students in conventional learning)

$H_1: \mu_1 > \mu_2$ (Average solving ability students' mathematical problems with ethnomathematics-based e-modul are more than the average mathematical problem solving ability of students in conventional learning)

The test criteria are H_0 is rejected if $t_{count} \geq t_{table}$ with probability (1-α) and dk = $(n_1 + n_2 - 2)$. Based on the results of the calculation of the average completeness the two-sided average difference test, the result is shown in Table 7. below.

Table 7. The Two-Sided Average Difference Test

n_1	n_2	s_1	s_2	$\overline{x_1}$	$\overline{x_2}$	s	t_{count} $(Result)$
25	25	10.34	13.74	87.92	74.64	12.16	3.91

Based on Table 7. obtained $t_{count} = 3.91$ and $t_{table} = 1.677$. It is clear that based on the test criteria, $t_{count} \geq t_{table}$ and H_0 are rejected. From these calculations, it can be concluded that the average mathematical problem solving ability of students after being given learning with ethnomathematics-based e-modul an inquiry learning model, is better than the average mathematical problem solving ability of students in conventional learning.

3.4.2 E-Modul Practicality Test

The practicality test was carried out to students after learning using an ethnomathematics-based e-module to find out whether the e-module was practical or easy to understand by students. The practicality test used in this study used a questionnaire consisting of four aspects, namely student interest and e-module display, process of use, time, and evaluation. It will be held on August 19, 2021 and will be carried out online via google form. The ethnomathematics-based e-module practicality test was attended by 25 students of class VIII-B of Junior High School 1 Subah. According to Riduwan (2013) the ethnomathematics-based e-module developed is considered easy to understand by students if the assessment score is >60%.

Based on the results of the practicality test of ethnomathematics-based e-module on the number pattern material in the very practical category based on practicality criteria with a percentage of 87.33%. Therefore, the e-module is very practical or easy to understand by students. Based on the results of the practicality test of ethnomathematics-based e-module on the Number Pattern material, it is also known that the percentage of practicality of each aspect in the e-module, as presented in Table 8. below.

Table 8. Practicality Test Results E-module on Each Aspect

Aspect	P(%)	Criteria
Student Interest and E-module Display	87.77%	Very Practical
Use Process	85.49%	Very Practical
Time	90.80%	Very Practical
Evaluation	88.80%	Very Practical

These results indicate that the ethnomathematics-based e-modul on the Number Pattern material contains aspects of student interest and the appearance of the e-module, aspects of the process of use, aspects of time, and aspects of evaluation with very practical criteria. Based on research by Rahayu & Sudarmin (2015) which states that the module aims to make students able to learn independently, can be studied anytime, and anywhere without the need for supporting tools.

3.5 Evaluation

Ethnomathematics-based e-modul were evaluated through the data that had been obtained at the implementation stage, then reviewed the results of the validity test, the results of the practicality test, and the results of the effective test on improving students' mathematical problem solving ability. So that the creation of the final product in this study, namely an ethnomathematics-based e-module on the Number Pattern material in the form of an e-module that has met the validity test, practicality test results, and effectiveness test results.

4. Conclusion

Based on the results of research and discussions that have been carried out by researchers, the following conclusions are obtained. The process of developing an ethnomathematics-based e-module using an inquiry learning model on number pattern material using the ADDIE development model. Ethnomathematics-based e-module using an inquiry learning model on number pattern material have very valid criteria for use in the learning process with an average validity percentage of 88.40%. Ethnomathematics-based e-module using an inquiry learning model on number pattern material have very practical criteria for use in the learning process with an average practicality percentage of 87.33%. Ethnomathematics-based e-module using an inquiry learning model on number pattern material are categorized as effective or can improve students' mathematical problem solving ability, which is indicated by (a) students' mathematical problem solving ability with ethnomathematics-based e-modules using the inquiry learning model to achieve mastery criteria; (b) students' mathematical problem solving ability with ethnomathematics-based e-modules using inquiry learning models are better than students' mathematical problem solving ability in conventional learning.

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