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Development of an e-module containing ethnomathematics in the Problem Based Learning (PBL) model to improve elementary school students' problem solving abilities

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***Abstract*---**The research aims to determine the character, validity, practicality and effectiveness of e-module products containing ethnomathematics in the problem based learning (PBL) model. RnD research uses a 4D model (define, design, develop and disseminate). The research subjects consisted of a small group of 24 students from SDN 1 Plantaran and a large group testing the effectiveness of the media with a total of 53 students, namely from SDN 1 Sukomulyo a total of 27 students and SDN 3 Protomulyo a total of 26 students in mathematics subjects with material Building Spaces, Cubes, Blocks and the combination. The effectiveness test uses the n-gain value and independent t test with a significance level of 5%. The results of the research show that 1) E-module learning media products containing ethnomathematics with the Problem Based Learning learning model, 2) E-module products containing ethnomathematics were assessed as appropriate by material experts with a percentage of 99% in the very feasible category, media experts with a percentage of 96% in the very category. Worthy, the teacher's assessment of the learning process shows 87% in the very good category. 32 students responded very

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practically. 3) The use of e-modules containing ethnomathematics in the problem based learning model in mathematics learning increases students' problem solving abilities higher than students who do not use e-modules. The average n-gain score of experimental class students was 69.46 and control class students was 47.93 with the problem solving ability of 17 students in the high category in the experimental class.

***Keywords*---**E-module, Ethnomathematics, Problem Based Learning, Mathematics.

Introduction

Learning mathematics is one of the subjects studied by students and plays a role in forming students' thinking patterns, especially in everyday life (Purnamasari & Setiawan, 2019). This is because mathematics plays a role in preparing students to be able to face changing circumstances or challenges that are always developing so that learning mathematics does not only understand concepts and theories, but students must be able to use mathematical concepts and theories in solving problems (Imswatama & Lukman, 2018).

Problem solving in mathematics learning prioritizes procedures, strategic steps in solving problems and ultimately finding answers that students encounter (Riwayati, Risnanosanti, Ariani, & Ristontowi, 2021). Mathematical problem solving abilities overcome mathematical difficulties by combining concepts and rules to achieve the desired goals. Good problem solving is problem solving that does not only look at the final result, but prioritizes the process or steps used to solve a problem (Simatupang, Napitupulu, & Asmin, 2020). Indicators of problem solving ability according to (Yarmayani, 2017) are identifying the elements that are known, what is being asked and the adequacy of the elements needed; formulate mathematical problems; apply strategies to solve various problems both in mathematics and outside mathematics; explain the results according to the original problem.

The problem that arises in problem solving abilities in fifth grade elementary school mathematics subjects is the lack of effective use of interesting media, methods and learning models, resulting in low problem solving abilities (Pratiwi & Alyani, 2022). The low mathematical abilities of students can be seen from the results of the TIMSS survey regarding the mathematical abilities of Indonesian students, which are not much different from the survey results of other institutions such as PISA (International Program For Student Assessment). Based on the results of the 2015 PISA survey, Indonesian students' mathematics abilities were ranked 63rd out of 70 countries. Meanwhile, the IEA stated that the results of the 2015 Trends in International Mathematics and Science Study (TIMSS) showed that Indonesian students' mathematics achievement was ranked 44th out of 49 countries with a score of 397 (Nurliastuti, et al, 2018), while based on the OECD (Organization For Economic Cooperation and Development) in 2016, Indonesia was only ranked 62nd out of 70 countries with an average score of 386 which is still relatively low compared to the international average score of

490. The results of the survey and study show the low mathematics ability of students in Indonesia, even though mathematics is a universal science that underlies the development of modern technology and has an important role in advancing human thinking. Apart from that, mathematics is also a basic science that has an influence on the development of other sciences such as medical science, physical science, social science and natural science (BSNP, 2006).

Learning outcomes in mathematics learning include understanding the concepts that are achieved and understanding problem solving. Previous research states that problem solving abilities are an important aspect and include cognitive, behavioral and attitude components that are situational and complex depending on the student's knowledge and experience (Amalina & Vidakovich, 2023; Josep & Lopez, Rittle-Johnson, Star, & Durkin, 2009). Other research explains that problem solving abilities are acquired by students over time as a frequently used cognitive tool (Greiff et al., 2013). Problem solving abilities are very important in learning mathematics (Moln´ ar, Greiff, & Csapo, 2013; Greiff, 2013 et al., 2013) therefore the development of problem solving skills is very important in achieving mathematics learning in schools.

The development of solving skills in mathematics learning can be applied through the problem based learning (PBL) learning model (Masliah & Nirmala, 2023). Problem based learning (PBL) encourages authentic problems in learning with the aim of students being able to solve problems related to mathematics (Juniarso, 2019; Ambarwati & Kurniasih, 2021). Previous research explains that problem based learning (PBL) in mathematics learning can improve students' problem solving abilities in mathematics learning (Gunantara, Suarjana & Riastini, 2014). Furthermore, research conducted by Widyastuti & Airlanda (2023) shows that problem based learning (PBL) is effective in improving mathematical problem solving abilities in elementary school students.

The problem solving abilities of each student can be different, influenced by factors such as age, gender, school location, ability to provide training and enrichment in their learning (Williams, 2005; Ayebale, Habaasa, & Tweheyo, 2020; Adey, et., al, 2007) p. This is the teacher's focus in creating models and media that are appropriate to mathematics learning in the learning environment and school.

Previous research explains that ethnomathematics in mathematics learning makes students involved and close to learning so that it can improve students' problem solving abilities in learning (Cahyadi, Faradisa, Cayani, and Syafri, 2020). Furthermore, research by Masruroh, Zaenuri, Walid & Waluyo (2022) explains that ethnomathematics in mathematics learning provides opportunities for students to discuss the material studied and relate it to students' experiences and habits, so that students understand how to process mathematical ideas and concepts in solving problems in accordance with daily activities. This is in accordance with the learning principles in the independent curriculum, namely that learning must be relevant, that is, learning is designed to adapt to the student's environment and culture so that learning can be innovative and flexible according to student needs (Kemdikbud, 2022).

The results of observations in mathematics subjects for class V (five) at SDN 1 Sukomulyo, SDN 1 Plantaran and SDN 3 Protomulyo show that the use of learning media is still conventional. Reflected in the learning process using learning resources in the form of printed modules. The printed modules used still do not look attractive and focus on the teacher, so that students are not independent in thinking and are not active when learning. The printed modules used are limited to displays to visualize mathematical concepts, so students find it difficult to connect mathematical concepts (Yuriah et al., 2024). Abstract concepts in printed modules have not been able to direct students to actively find solutions, and it is difficult to find ideas for solving problems. This influences the low level of mathematics learning in solving problems which shows that 50% of students are still below learning achievement. On the other hand, mathematics learning does not yet link culture to the modules studied by students. Learning with culture and everyday life problems makes it easier to develop concepts in learning, because of the proximity of students' culture and environment. This is because students are familiar with the environment and understand the culture around them so that students can be aware of and develop more optimal mathematical problem solving. One of the cultures that exists and is close to the student environment at SDN 1 Sukomulyo, SDN 1 Plantaran and SDN 3 Protomulyo, Kendal Regency is the weh-wehan tradition and culture. Apart from having religious value, weh-wehan is also related to basic mathematical activities, but in practice the weh-wehan tradition is still not linked to mathematics learning in elementary schools.

Based on the problems that exist at SDN 1 Sukomulyo, SDN 1 Plantaran and SDN 3 Protomulyo in mathematics learning, researchers provide solutions by analyzing student needs to develop e-modules by integrating the culture found in Kendal Regency, namely weh-wehan. Researchers intend to develop an e-module containing ethnomathematics in the Problem Based Learning (PBL) model to improve problem solving abilities in mathematics learning

Method

This research uses research and development (R&D) methods. The development model in this research refers to the steps of the 4D development model (Define, Design, Develop, Disseminate). The research and development carried out is to produce a product in the form of an ethnomathematics learning E-module using the Problem Based Learning model to improve elementary school students' problem solving abilities.

Development Procedure

The stages of the 4D development model (Define, Design, Develop, Disseminate) will be used in this research procedure. The charts and data on the results of each stage of the 4D research and development procedures carried out are as follows (Salafudin, 2017).

Data Sources and Research Subjects

The data sources in this research are researchers, validators, teachers and fifth grade studentsas part of the Kyai Guru Cluster, South Kaliwungu DistrictKendal Regency. The subjects in this research were fifth grade studentsSDN 1 Sukomulyo, SDN 1 Plantaran and SDN 3 ProtomulyoKendal Regency. Small product testing was carried out at SDN 1 Plantaran by taking class V students from SDN 1 Plantaran who were selected using a cluster random sampling technique. Meanwhile, usage trials were carried out in classSDN 1 Sukomulyo and SDN 3 Protomulyo.Kendal Regency.

Table 1
School Data

School name	The number of students
SDN 1 Plantaran	24
SDN 1 Sukomulyo	27
SDN 3 Protomulyo	26

Data Collection Techniques and Instruments

Data collection can be done in various settings, various sources, and various ways (Sugiyono 2016:308). Data collection techniques in this research were carried out using test and non-test techniques. There are two types of technical tests carried out in research and development, namely pretest and posttest. Pretest and posttest were carried out to determine the effectiveness of the e-module in improving problem solving abilities.The non-test technique is an interview to obtain data about the mathematics learning process that occurs in class VSDN 1 Sukomulyo, SDN 1 Plantaran and SDN 3 Protomulyo, related to the learning model,e-module, and students regarding the learning that occurs in class. Wawa resultsnhow can be used as qualitative data to determine the effectiveness of e-modules containing ethnomathematics in the probelem based learning model.Observationto obtain initial data to identify problems that occur in class VSDN 1 Sukomulyo, SDN 1 Plantaran and SDN 3 Protomulyo.Document data daThe data used is mathematics learning documentation used in learning in the form of lesson plans in class V at SDN 1 Sukomulyo, SDN 1 Plantaran and SDN 3 Protomulyo.A questionnaire is a data collection technique that is carried out by giving a set of questions or written questions to respondents to answeranswer.

Data analysis technique

Analysis of Teacher and Student Responsesregarding e-modules containing ethnomathematics in Class V Mathematics. The criteria for teacher and student responses regarding e-modules containing ethnomathematics in Class V Mathematics are said to be "Practical" if the teacher and student responses exceed 80%.

Analysis of E-module Product Effectivenessethnomathematical content using: Descriptive Statistics, Normality Test, N-gain test, andIndependent Samples T Test
Decision making in this test is:
Ho = There was no difference in problem solving for students who applied the e-module containing ethnomathematics to the model*problem based learning*
Ha = There are differences in students' problem solving who apply e-modules containing ethnomathematics to the model*problem based learning*compared to students who do not use e-modules.
Ho is accepted when the significance value is more than 0.05 (sig > 0.05) while Ho is rejected when the significance value is less than 0.05 (sig < 0.05).

Results and Discussion

Characteristics of E-Module Products Containing Ethnomathematicson the Problem Based Learning (PBL) Model in Improving Elementary School Students' Problem Solving Abilities

a. Development style
The research method used in this research is research and development.

b. Development Procedure
Development procedures are used by researchers in designing, manufacturing and testing products. The research and development used in this research is the 4D model (Thiagarajan, 1974), with development procedures:

1) Define
This stage has several steps:

a) Initial analysis (front-end analysis)
The initial analysis was carried out by observing learning carried out at SDN 1 Sukomulyo with observation checklist activities and interviews with grade 5 teachers in mathematics learning. Based on the results of observations carried out on September 5 2023, it shows that 50% of teachers are still not optimally using learning media in using the PBL learning model in mathematics learning and learning is still not effective because students have not demonstrated problem solving abilities in mathematics learning.

Based on the results of interviews conducted at SDN 1 Sukomulyo in the fifth grade elementary school mathematics subject, it shows that there are only 10 printed teaching materials that teachers use in learning, this number is quite limited. On the other hand, in learning, teachers have not linked mathematics learning with ethnomathematics or cultural content in the students' environment. Students' abilities in learning mathematics, especially problem solving abilities, are still low, only 40% of students have these abilities. This limitation is the driving factor for researchers in providing access to designing ethnomathematics-based e-modules to improve students' problem-solving abilities in learning mathematics.

b) Concept analysis (concept analysis)
The concept analysis carried out by researchers in this study was to determine the content of the material in the e-module containing ethnomathematics for 5th grade elementary school students. The concept analysis that has been carried out by researchers based on the Phase stages according to class 5 SD is the learning outcomes:

Table 2
Analysis of Mathematics Learning Achievements

Phase	Phase C (Grade 5 Elementary School)
Material	Build Spaces, Cubes, Blocks and their combinations.

The choice of analysis of learning outcomes has been adjusted through material analysis, characteristics of grade 5 elementary school students and the use of appropriate technology used in mathematics learning at school.

c) Task analysis (task analysis)
The researcher's task analysis activity carried out identification through a study of learning outcomes in the material Building Spaces, Cubes, Blocks and their combinations. The results of the analysis of learning outcomes in concept analysis produce a task analysis which is arranged in the following learning objective flow:

Table 3
Flow analysis of learning objectives

Flow of Learning Objectives	Student Main Duties
Building materials for cubes, blocks and their combinations.	1. Students are able to analyze cube and block shapes 2. Students are able to present a report on the results of calculating the volume of cubes and blocks 3. Students are able to determine the volume of cubes and blocks

d) Formulating Learning Objectives (specifying instructional objectives)
To formulate learning objectives based on the results of analysis of the flow of learning objectives to determine the behavior of the research object, namely 5th grade elementary school students. Based on the analysis of learning outcomes, the flow of learning objectives, the learning objectives that can be achieved by students are formulated as follows:

Table 4
Analysis of Learning Objectives

Learning objectives	Student Achievement
Building materials for cubes, blocks and their combinations.	1. By carrying out cultural literacy in the e-module, students are able to analyze the volume of cubes and blocks correctly 2. By discussing, students are able to solve problems related to the volume of cubes and blocks with real problems correctly.

2) *Design* (Planning)

In the design phase of this research, the researcher began to design an e-module containing ethnomathematics. Before the researcher compiled the e-module, the researcher designed an instrument that would be used to create an e-module containing ethnomathematics for 5th grade elementary school students to improve problem solving abilities. The design or design stages that the researchers have carried out are as follows:

a) Composing Tests
   The process carried out by researchers in compiling e-modules begins with creating a reference test consisting of an instrument in the form of a questionnaire adopted from previous research to determine the suitability of the media proposed to media experts, material experts and learning practitioners as well as students who use learning e-modules. Researchers also prepared a description test to determine students' problem solving abilities in learning mathematics using an e-module containing ethnomathematics.
b) Media Selection
   The choice of e-module media in the mathematics learning process is because e-modules can be monitored digitally based on various student abilities (Tsai et al., 2017). The e-module was chosen because the presentation was interactive, independent and systematic (Feriyanti & Asmawati, 2019).
c) Format Selection
   The choice of learning e-module format is used to provide effective learninginteractive in accordance with learning objectives (Gufron & Mataya, 2020). In choosing the format in developing this e-module, the researcher used the Canva application in its creation and for the final result used the Flipbuilder application.
d) Planningbeginning
   The researcher carried out an analysis to produce an initial design for developing an e-module containing ethnomathematics. The initial design or draft that the researcher carried out was:
   (1) E-module concept design
       In the initial design stage, researchers determine the concept of the e-module application used. The e-module application that will be used in this research uses Canva as the creation medium, and Flipbuilder for displaying e-modules in learning. E-module contains ethnomathematics.
   (2) Designing the interface design for the E-module display
       Researchers in the interface design stage use steps

(a) *Canva*in this research it is used to design e-modules and the flipbuilder application for the final appearance of the e-module.

Figure 1. Initial appearance of the ethnomathematics e-module on Flipbuilder

The initial display in the ethnomathematics e-module is designed in a user friendly way to make it easier for students to learn.

(b) Interface or display design on devices and laptops or computers

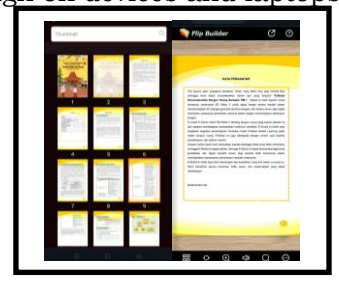

Figure 2. Ethnomathematics E-module display on student devices

(c) Collection and Preparation of Materials

Before compiling the material in the e-module, researchers collected the materialaboutvolume of cube and cuboid. The researchers collected material using a mathematics book for elementary school class V in the Merdeka curriculum in 2022, a geometry book in 2014 and a mathematics book about volume in 2021.

(d) Creation of the Ethnomathematics E-module

The stages in creating an ethnomathematics e-module are carried out by researchers after having an initial design and materials that have been collected.

The ethnomathematics e-module application can be studied via the following linkhttps://online.flipbuilder.com/ldgzr/ougk/and can be scanned via the following barcode scan:

Figure 3. Ethnomathematics E-module QR Code

(3) Ethnomathematics E-Module Design

(a) The display of the guide to using the ethnomathematics e-module created is displayed via flipbuilder. The guide used by students as a means of using e-modules in learning is as follows.

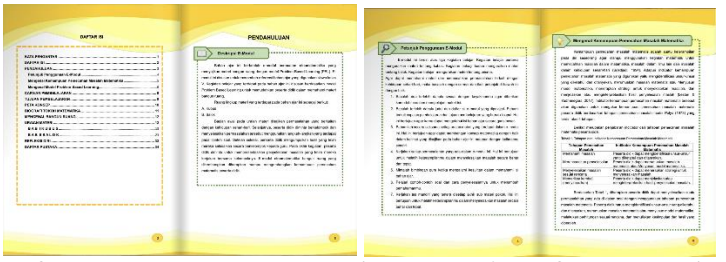

Table 4.Table of Contents Page Foreword, Instructions for Use and PBL Explanation Page

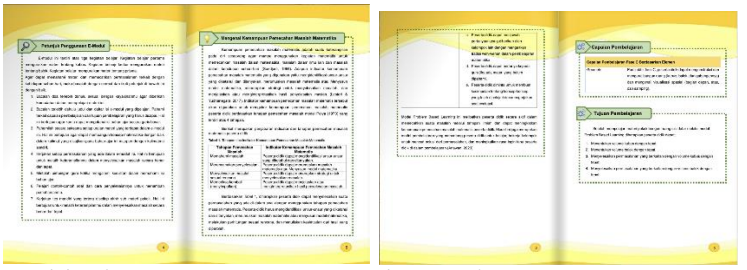

Table 5.PBL Stages Page and Learning Outcomes Page

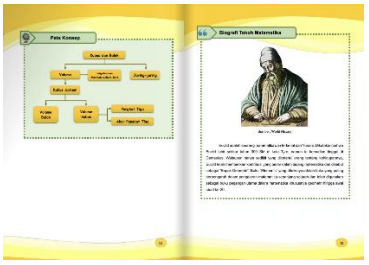

Table 6. Learning Outcomes Page

(b) Content Display of E-module Ethnomathematics Problem Based Learning Model

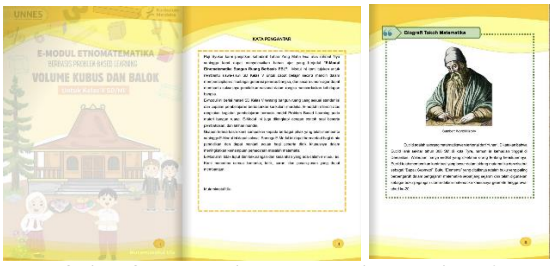

Figure 7. Contents of the foreword page andIntroduction to Mathematical Figures

The display in the content section before discussing the material is an introduction to Mathematics figures. The introduction of mathematical

figures is linked to the field of material that students will study, namely geometry in cubes and blocks for grade 5 elementary school students.
Displaying the content of the material, the researcher first introduces the students' environment, namely Kendal Regency, this is the main point in introducing ethnomathematics to students.

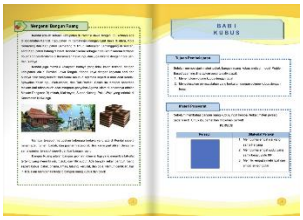

Figure 8. Introduction to Culture through Learning Materials

The cultural introduction to this material is in accordance with the explanationSupriyanti (2015) that learningrelatedwith cultural concepts and practices is a form of ethnomathematics.
After introducing culture in learning mathematics with ethnomathematics, the researcher showed the material in chapter 1 (one), namely about cube material, by explaining the learning objectives after students had studied the material.

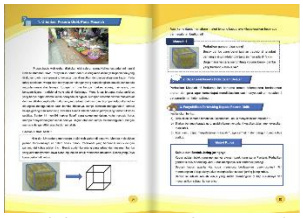

Figure 9. Stages of the Problem Based Learning Model on Cube Material

In sectionexplanationcube material, researchers used stages in the Problem Based Learning model in an e-module containing ethnomathematics, namely: Student Orientation to Problems, Student Organization in Learning, and Guided Investigation of Students.

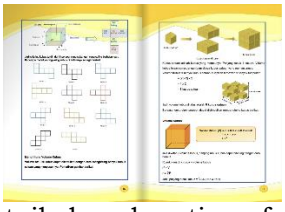

Figure 10. Detailed explanation of cube material

The investigation stage requires full concentration from students, because students must focus on the material to find solutions to the problems to be solved.

After students understand the material in the e-module containing ethnomathematics, the next step is the stage regarding example questions. Students are invited to think systematically and gradually in solving problems, this is the basis for students to determine the main problem, find what needs to be solved in the problem, and the final stage is the process of students finding answers to the problems they face.

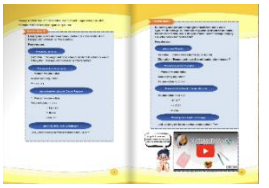

Figure 11. Examples of questions and learning videos on cube material

The problem solving example stage is accompanied by a learning video that is directly connected to the YouTube application. Combining detailed example questions via video is one of the advantages of using the ethnomathematics e-module.
Students in the investigation stage together with their groups are expected to have found the answer to problem 1, after studying the material, example questions and learning videos.

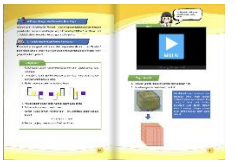

Figure 12. Summary. Quizzes and Independent Questions on Cube Material

The final stage of the cube material is a summary of the material, this is to provide a brief explanation for students to repeat the material points that have been studied.

Figure 13. Continued Independent Questions on Cube Material

The next material after the cube is the block. In chapter 2 (two) material about blocks, the researcher explains the learning objectives and prerequisite material, the same as with cube material. In the next discussion before going to the main material, the researcher emphasizes the problem based learning model, with stages: Student Orientation to Problems and Student Organization in Learning.

Students are invited to group after finding the focus of the problem in the block material.

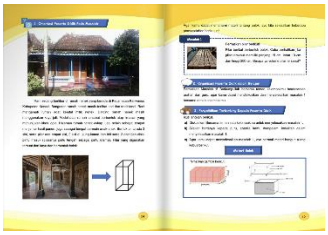

Figure 14. Problem Based Learning Model for Block Material

Guided Investigation for Students. The guided investigation stage in block material has a slight difference, in block material students are invited to find several questions related to blocks. This encourages students to think critically on block material before finding a solution to problem 1.

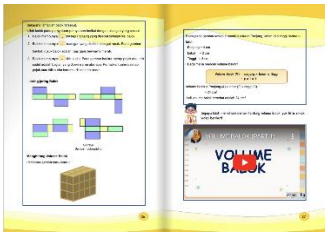

Figure 15. Learning Video on Block Material

Examples of questions and discussions on block material are given at the end after the learning video. This is designed differently like blocks to make students more enthusiastic in studying practice questions and discussions.

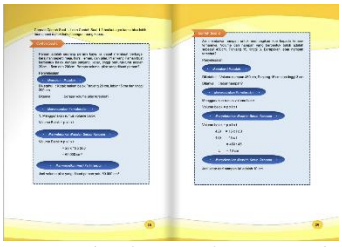

Figure 16. Questions and Discussion on Block Material

Development and Presentation of Work Results. After exploring the investigation process, students in groups prepare a report regarding the results of the answer to problem 1. Analysis and Evaluation of the Problem Solving Process is used for discussions regarding the solution to the problem that has been reported, whether it is appropriate or still needs improvement.

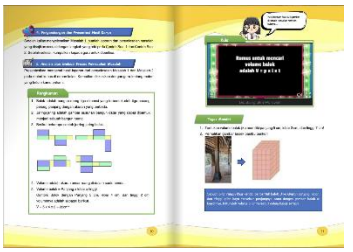

Figure 17. Summary of Material, Quizzes and Independent Assignments

After each stage in the problem based learning model is carried out, students receive a guided summary to recall the block material points that have been studied in the ethnomathematics e-module. The independent assignment stages can measure whether students as a whole have understood learning by using e-modules containing ethnomathematics in block material.

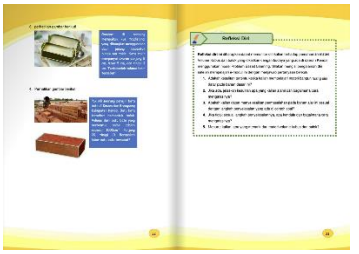

Figure 18. Independent Tasks and Self-Reflection

The final stage in the ethnomathematics e-module is self-reflection. Self-reflection is very much needed in every learning material.

Discussion

The e-module contains ethnomathematics problem based learning models to improve students' problem solving abilities which have been developed by researchers based on the define or preliminary analysis stage and the design stage. Researchers in the preliminary stage have carried out a needs analysis at SD N1 Sukomulyo, SDN 1 Plantaran and SDN 3 Protomulyo, from these three schools it was found that the problem of using learning models carried out by teachers was still not optimal. There are still many teachers in the three schools who do not use learning models when teaching. One learning model, namely problem based learning, has not been fully used by teachers. The impact of less than optimal use of learning models is low achievement of learning objectives in the learning process. On the other hand, the needs analysis at SD N1 Sukomulyo, SDN 1 Plantaran and SDN 3 Protomulyo shows that students' problem solving abilities are still low because the teacher is still the center of learning, so independent learning has not yet been realized. The use of learning media in the three schools is still conventional and has not been integrated into technology as a whole.

Based on this needs analysis, researchers conducted a needs analysis study to provide solutions in learning through the development of e-module products containing ethnomathematics with a problem based learning model to improve problem solving abilities (Muthoharoh et al., 2022). This development is based on research studies by Riawan et al (2020) that e-modules containing ethnomathematics are able to support the implementation of student learning activities so that students can learn independently. Researchers in designing e-modules containing ethnomathematics provide an element of students' closeness to culture so that students are able to think critically and find it easier to solve problems because they relate to everyday life in the students' environment (Ismawanto, 2014; Orey, 2004). The material in the e-module contains ethnomathematics, researchers relate it to culture and provide easy-to-understand illustrations based on student characteristics. This encourages active participation between teachers and students (Fujiati & Mastur, 2014). This is in line with Samo (2017) that measuring mathematical problem solving abilities can be done by solving contextual problem solving questions. Problem solving questions can be general contextual questions or contextual problems that highlight local or cultural wisdom.Rizky et al, (2018), have conducted development research to produce ethnomathematics-based E-Module products to improve problem solving abilities. In the e-module containing ethnomathematics, the problem based learning model, researchers provide elements of problems that must be solved by students, this encourages students' problem solving abilities in finding solutions to the problems they face (Sepriani et al., 2024). The main point in this e-module is being able to link culture with mathematics through existing problems and then students finding solutions to problems as a form of increasing problem solving abilities. The Problem Based Learning model provides students with the opportunity to better understand problems, plan problems, solve problems according to plan, and double-check or interpret solutions (Andi, 2018)

E-modules containing ethnomathematics are designed by preparing tests, selecting media, selecting formats and initial design. The researcher prepared a test consisting of a questionnaire that the researcher adopted from previous research and designed a descriptive test to determine students' problem solving abilities (Yuriah et al., 2022). After that, the researcher chose e-module media because he saw the elements of convenience, interactivity and interest in learning, on the other hand, e-modules can be monitored digitally. An important stage is choosing the format. From the preliminary study and design, the researchers conducted a study on using the Canva application and viewer application via Flipbuilder. The main reason researchers use these two applications is because they are easy to obtain, easy to create visual content such as modules, you can design them yourself or use design templates (Rahmasari & Yogananti, 2021; (Rosmalinda, Risdalina & Pamela, 2023). On the other hand, viewers use flipbuilder because it is more interesting, practical, user friendly and interactive (Anggraini, 2022; Wangi Fakhrudin & Lubis, 2024). Researchers designed an e-module containing ethnomathematics consisting of 37 pages including the cover page.

The design of the ethnomathematics e-module on the researcher's cover displays an easy-to-understand title "Problem Based Learning Ethnomathematics E-module", the material to be studied is "Volume of Cubes and Blocks" and the

users of the e-module are "Class V SD/MI" students. The emphasis in the cover sheet by choosing a house design indicates that students will study mathematics with cultural content in the students' environment. The use of this e-module can be accessed via students' devices, laptops and computers. The researcher prepared an e-module containing ethnomathematics by providing a display design that is easy to understand according to the characteristics of grade 5 elementary school students which does not require a lot of buttons, thereby reducing student concentration. The arrangement of buttons is adjusted to student needs. To make the sharing process easier because the e-module is accessed online, researchers created a QR Code. This is in line with Winkel (2009) thate-modules are self-instructional, meaning students can independently use e-modules to learn. Jaenudin et al (2017) further supported that e-modules which combine technology development and learning provide new learning experiences and build student knowledge. The display of the e-module contains ethnomathematics to make it easier for students to have a guide before using it consisting of a table of contents, instructions for using the e-module, an explanation of abilities inProblem Based Learning learning model, stages of implementing the Problem Based Learning model, learning outcomes and concept maps.

The design of the e-module containing ethnomathematics is attractive, easy and systematic while still focusing on improving problem solving (Yuriah & Kartini, 2022). This e-module has advantages in its preparation, according to the needs of teachers who have not yet optimally developed problem based learning models. On the other hand, this e-module links culture with mathematics or ethnomathematics as a means of improving students' problem solving abilities. This e-module learning gives students the opportunity to learn independently because it is equipped with interesting learning videos and quizzes.

Product Validity and PracticalityE-ModuleContaining Ethnomathematics in the Problem Based Learning (PBL) Model to Improve Elementary School Students' Problem Solving Ability

1) Develop (Development)

At the development stage, researchers began to validate the e-module media containing ethnomathematics, assisted by experts.

a) E-Module Media Validation

Media validation is carried out by media experts and material experts.

Research expert validation test stage through media experts and learning material experts. The results of the media expert validation test are as follows:

Table 5
Media Expert Validation Results

No	Assessment Aspects	Expert 1	Expert 2	Total Score	Ideal Score	Percentage	Category
1	Media Display	5	5	47	50	94%	Very Worth It
		5	5				
		5	4				
		5	4				
		5	5				

No	Assessment Aspects	Expert 1	Expert 2	Total Score	Ideal Score	Percentage	Category
2	Media effectiveness and efficiency	5	5	29	30	96%	Very Worth It
		4	5				
		5	5				
3	Ease of Media Use	5	5	20	20	100%	Very Worth It
		5	5				
Amount		49	47	96	100	96%	Very Worth It

As shown in table 5, media expert validation for the display aspect shows a score of 94% in the "Very Eligible" category, media liveliness and efficiency aspect 96% in the "Very Eligible" category, media ease of use aspect 100% in the "Very Eligible" category, so it can be it was concluded that the e-module media containing ethnomathematics with a problem based learning model to improve students' problem solving abilities was "Valid". The results of the material expert validation test are as follows:

Table 6
Material Expert Validation Results

No	Assessment Aspects	Expert 1	Expert 2	Total Score	Ideal Score	Percentage	Category
1	Media Display	5	5	30	30	100%	Very Worth It
		5	5				
		5	5				
2	Material Contents	5	5	50	50	100%	Very Worth It
		5	5				
		5	5				
		5	5				
		5	5				
3	Language	5	5	39	40	97%	Very Worth It
		5	5				
		4	5				
		5	5				
4	Characteristics of e-modules with learning models	5	5	60	60	100%	Very Worth It
		5	5				
		5	5				
		5	5				
		5	5				
		5	5				
Amount		89	90	179	180	99%	Very Worth It

From Figure 6 it can be concluded that the material expert validation results show a score of 99% in the "Very worthy" category and the media expert validation results show a score of 94% in the "Very Eligible" category. Validation of learning practitioners in validation of e-modules containing ethnomathematics is used to validate the Learning Implementation Plan (RPP).

Table 7
Learning Practitioner Validation Results

No	Assessment Aspects	Expert 1	Expert 2	Total Score	Ideal Score	Percentage	Category
1	Identity of Learning Implementation Plan	5	5	20	20	100%	Very Worth It
		5	5				
2	Formulation of Learning Achievements and Objectives	5	4	19	20	95%	Very Worth It
		5	5				
3	Learning materials	5	5	29	30	96%	Very Worth It
		5	4				
		5	5				
4	Learning model	5	5	78	80	97%	Very Worth It
		5	5				
		5	4				
		5	5				
		5	5				
		5	5				
		5	5				
		5	4				
5	Evaluation	4	5	28	30	93%	Very Worth It
		4	5				
		5	5				
Amount		88	86	174	180	96%	Very Worth It

From table 7 it can be concluded that the validation results of learning practitioners regarding the learning implementation plan show a score of 96% with the category "Very feasible", so it can be concluded that the learning implementation plan is "Valid".

b) Results of Student Responses or Responses to E-modules

The results of student responses begin with trials of operating e-module products containing ethnomathematics. In testing student responses, researchers conducted small group trials and for research using large groups. Small group student response trials were carried out at SDN 1 Plantaran with a total of 24 students, while large group trials were carried out at SDN 1 Sukomulyo with a total of 26 students.

From the results of response trials for small groups at SDN 1 Plantaran, it was shown that 14 students responded that the e-module media contained ethnomathematics "Very Practical", and 10 students responded that the e-module contained ethnomathematics content "Practical". From the results, the average student response was 81, it was stated that the response was that the e-module media was "Practical".

From the results of response trials for large groups at SDN 1 Sukomulyo, it was shown that 18 students responded that the e-module media contained ethnomathematics "Very Practical", and 9 students responded that the e-module contained ethnomathematics content "Practical". From the results of

the average student response is 84, it is stated that the response is that the e-module media is "Practical"

c) Response Results or Responses to Teacher Ability in Learning
The results of the teacher's response or response to the researcher's ability to implement learning using ethnomathematics-laden e-modules in the experimental class at the meeting.

Table 8
Results of Responses to the Experimental Class Teacher's Ability

No	Assessment Aspects	Pert 1	Pert 2	Score Acquisition	Total Score	Percentage	Category
1	Ability to open lessons	4	4	24	30	80%	Good
		4	4				
		4	4				
		4	5				
2	Teacher Attitudes in the Learning Process	4	5	34	40	85%	Very good
		4	4				
		4	4				
		5	5				
3	Mastery of Learning Materials	4	5	36	40	90%	Very good
		4	4				
		5	4				
		4	5				
4	Learning process	4	5	72	80	90%	Very good
		4	5				
		4	5				
		5	5				
		5	5				
		4	4				
		4	4				
		4	4				
5	Learning Evaluation	5	4	27	30	90%	Very good
		5	5				
		4	4				
6	Closing Learning Activities	4	4	25	30	83%	Very good
		4	5				
		5	5				
7	Follow-up	4	5	28	30	93%	Very good
		4	5				
		4	4				
Amount		119	127	246	280	87%	Very good

The results of the teacher's response or response when the researcher was in the experimental class using an e-module containing ethnomathematics with a problem based learning model in the aspect of ability to open a lesson was 80% in the "Good" category, the teacher's attitude aspect in the learning process was 85% in the "Very Good" category, aspect mastery of learning materials 90% in the "Very Good" category, aspects of the learning process 90% in the "Very Good" category, learning evaluation aspects 90% in the "Very Good" category, aspects of learning closing activities 83% in the "Very Good" category and aspects 93%

follow-up with the “Good” category. For the control class, the results of the teacher's response or response to the researcher's abilities when using an e-module containing ethnomathematics, problem based learning model:

Table 9
Results of Responses to Control Class Teacher Ability

No	Assessment Aspects	Pert 1	Pert 2	Score Acquisition	Total Score	Percentage	Category
1	Ability to open lessons	5	5	27	30	90%	Very Good
		4	5				
		4	4				
		4	5				
2	Teacher Attitudes in the Learning Process	4	5	34	40	85%	Very good
		4	4				
		4	4				
		5	5				
3	Mastery of Learning Materials	4	5	35	40	88%	Very good
		4	4				
		4	4				
		4	4				
4	Learning process	5	4	71	80	89%	Very good
		4	5				
		4	5				
		4	5				
		5	5				
		4	5				
		4	4				
		4	4				
5	Learning Evaluation	4	4	26	30	87%	Very good
		5	5				
		4	4				
6	Closing Learning Activities	4	4	25	30	83%	Very good
		4	5				
		4	5				
7	Follow-up	5	5	28	30	93%	Very good
		4	5				
		5	5				
Amount		118	128	246	280	87%	Very good

The results of the teacher's response or response when the researcher was in the control class without using an e-module containing ethnomathematics with a problem based learning model in the aspect of ability to open a lesson was 90% in the "Very Good" category, the teacher's attitude aspect in the learning process was 85% in the "Very Good" category. , aspects of mastery of learning materials 88% in the "Very Good" category, aspects of the learning process 89% in the "Very Good" category, aspects of learning evaluation 87% in the "Very Good" category, aspects of learning closing activities 83% in the "Very Good" category and the follow-up aspect is 93% in the "Very Good" category.

2) Disseminate (Dissemination)
Dissemination is carried out by distributing e-modules containing ethnomathematics online to schools that have become research subjects, namelySDN 1 Sukomulyo, SDN 1 Plantaran and SDN 3 Protomulyo.

Discussion

To determine the validity and practicality of e-module media containing ethnomathematics with a problem based learning model, the develop or development and disseminate stages were carried out. In the develop stage, researchers validate the products and instruments that will be used. Validation of e-modules containing ethnomathematics was carried out by media experts and learning material experts. Media expert validation includes aspects of media appearance, media effectiveness and efficiency and ease of use of media (Prayitno, 2022; Arsyad, 2013; Daryanto, 2016; Ramdhani, 2015). The overall results from media expert validation show a percentage of 96% with a very feasible category. These results indicate that the e-module media contains ethnomathematics with a problem based learning model. It can be concluded that the e-module media can be used for research and student learning in improving problem solving abilities because it is supported by a media display that is able to attract students' attention, the effectiveness and efficiency of the e-media -modules that are appropriate to the material, questions, quizzes and culture or ethnomathematics that are developed and are easy to use or user friendly. Material expert validation includes aspects of media display, content aspects, language aspects and aspects of student characteristics (Prayitno, 2022; Wardana, 2022; Rahman, 2022;Lauren, 2016; Koenig & Holbrook, 1995).The e-module containing mathematics has an e-module appearance that is appropriate to the material being developed, the language used makes it easy for students to learn the e-module, the characteristics of the e-module containing ethnomathematics are in accordance with the problem based learning model as evidenced by each phase or stage in The e-module pays attention to 5 main stages, namely focusing on the problem, organizing students, investigation, developing and presenting work, as well as analysis and evaluation (Trianto, 2007).

The validation results of media experts and material experts are a benchmark that the ethnomathematics e-module developed by researchers has been adapted to students' learning needs, and shows that the e-module media is ready to be used as material for research and learning. This is the basis for researchers to use ethnomathematics e-modules in research and development.

Apart from expert and media validation, researchers validated the learning tools that will be used, namely the Learning Implementation Plan (RPP) carried out by learning practitioners. This validation is an effort to provide integrated learning with e-module media containing ethnomathematics.

The researcher accompanies the students and provides a guided explanation regarding the use of e-modules containing ethnomathematics. Students who still do not understand the use can ask the researcher directly. After all students have studied the material in the e-module, the researcher, assisted by the teacher,

divides into groups to give students the opportunity to discuss this as a form of problem based learning model activity. Researchers give students the opportunity to understand the material in groups through guided investigations, based on the material, example questions and learning videos contained in the e-module. Researchers accompany and observe students in the process of finding answers to problems or questions that researchers provide. Students try to develop and present their work through making individual reports. After completion, students collect the results of the report. The results of the report are then analyzed and evaluated by researchers as a form of confirmation of whether they understand the material and whether students are able to solve problems.

In addition to analyzing student responses, researchers analyzed teacher responses to researchers' abilities in the learning process using e-modules containing ethnomathematics. In the experimental class and control class, the researcher's ability in the learning process both showed 87% with a very good category in terms of ability to open learning, researcher's attitude in the learning process, researcher's mastery of teaching materials, ability in the learning process, learning evaluation, closing activities and follow up plan.

Based on the validation results of experts, material experts, learning practitioners, student responses and teacher responses, it shows that the e-module media containing ethnomathematics with a problem based learning model is very feasible and very practical to use for research and learning, the questions used to improve students' problem solving abilities are valid and reliable for measuring the problem solving abilities of 5th grade elementary school students. The researcher's ability to learn using e-module media containing ethnomathematics and without media is very good in the learning process.

Effectiveness of E-Module Products Containing Ethnomathematicson the Problem Based Learning (PBL) Model to Improve Elementary School Students' Problem Solving Abilities

Descriptive analysis results
From the results of the descriptive analysis carried out in the experimental class and control class, it shows:

Table 10
Descriptive Statistical Analysis

Information	Experimental Class		Control Class	
	Pre-test	Post-test	Pre-test	Post-test
The number of students	27	27	26	26
Minimum score	25	70	21	59
Maximum score	76	100	91	97
Average	50.03	83.55	44.23	71.92
Standard Deviation	14.69	10.23	17.89	10.57

The results of the descriptive test showed that the number of students in the experimental class was 27 students, and the number of students in the control class was 26 students. The minimum score for the experimental class in the pre-test was 25 for the post-test, 70 while the control class' minimum score in the

pre-test was 21 and the post-test was 59, the maximum score in the experimental class in the pre-test was 76 and the post-test was 100, while the control class' minimum score in the pre-test was 91 and post-test was 97. The average score of the pre-experimental class students test 50.03 for posttest 83.55 while the control class had a minimum pretest score of 44.23 and posttest 71.92. The standard deviation of experimental class students for the pre-test was 14.69 and the post-test was 10.23, while the minimum score for the control class was 17.89 for the pre-test and 10.57 for the post-test.

Normality Test Results are carried out to determine whether the data that has been collected is normally distributed. The results of research using e-module media containing ethnomathematics show that the data is normally distributed, as can be seen from the following SPSS results:

Table 11
Kolmogrov-Sminorv Normality Test*
Student Problem Solving Ability

Class	Treatment	Sig.	Information
Before Treatment	Experimental Pre-test	0.080	Normal
	Control Pre-test	0.200	
After Treatment	Experiment Post-test	0.099	Normal
	Control Post-test	0.121	

*significance level 5%

The results of the normality test show that all data is normally distributed, this is because the significance value is more than 0.05.

Table 12
N-Gain Table

Information	Class	
	Experiment	Control
The number of students	27	26
Minimum Value	62.78	40.42
Maximum Value	76.14	55.45
Average N-gain	69.46	47.93

Based on the results of the N gain test, it shows that the number of students in the experimental class is 27 children and the control class is 26 children. The minimum score for experimental class students was 62.78 and control class 40.42. The maximum score for students in the control class was 76.14 and the control class was 55.45. The average n-gain value of experimental class students was 69.46 and control class students was 47.93.

Table 13
Analysis of Student Problem Solving Ability Results

Experimental Class					
Problem Solving Ability Pre-test			Post-test Problem Solving Ability		
Score	The number of students	Category	Score	The number of students	Category
≥ 80	0	Tall	≥ 80	17	Tall
65-80	7	Currently	65-80	10	Currently
≤65	20	Low	≤65	0	Low
Control Class					
Problem Solving Ability Pre-test			Post-test Problem Solving Ability		
Score	The number of students	Category	Score	The number of students	Category
≥ 80	2	Tall	≥ 80	6	Tall
65-80	2	Currently	65-80	12	Currently
≤65	22	Low	≤65	8	Low

The results of the analysis of students' problem solving abilities for the experimental class in the pretest class were 20 students in the low category in problem solving and 7 students in the medium category, after the students used the e-module containing ethnomathematics in the posttest class, it showed that 17 students were in the high category and 10 students were in the medium category. Control class students showed that in the pretest class 22 students were in the low category, 2 students were in the medium category and 2 students were in the low category, then in the posttest it showed that 6 students were in the high category, 12 students were in the medium category and 8 students were in the low category.

Test results*Independent Samples T Test*carried out by comparing the post-test scores from the experimental class and the control class. This analysis test is called the One Way Anova or one-way test by only comparing the problem solving ability variables being analyzed. The results of this test are processed using SPPS and show:

Table 14
Descriptive Analysis Results *Independent Samples T Test*

Problem solving skill		
Group	The number of students	Mean (Average)
Experiment	27	83.55
Control	26	71.92

Table 15
Independent T Test Results

Data	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Problem Solving Ability	0.067	0.797	4,069	51	0,000
			4.67	50,745	0,000

Based on the results of the Independent T Test with the One Way Anova test or one-sided test, it shows that the t value is 4.069 with a significance of 0.000. If the sig value is <0.05, it can be concluded that Ho is rejected and Ha is accepted, namely the test decision that there is a differenceproblem solving of students who apply e-modules containing ethnomathematics in the problem based learning model compared to students who do not use e-modules. Reasons for using the test*One Way ANOVA*or one-party test in this research because it is only to measure students' problem-solving abilities in using ethnomathematics-laden e-modules, so using the one-party test is better for determining the level of significance in decision making.

Discussion

This research aims to determine the effectiveness of using an e-module containing ethnomathematics in the problem based learning model to improve students' problem solving abilities in the topic of volume, cubes and blocks, class V elementary school mathematics subjects.

Researchers in the experimental class implemented an ethnomathematics e-module with problem based learning to improve the learning process of problem solving skills so that children's thinking becomes more meaningful by planning, analyzing and working independently in groups, as well as discovering their own knowledge and skills.

Learning activities in the experimental class began with greetings and presence, the teacher opened the learning session with enthusiasm. Motivation and apperception are provided to bridge old knowledge with new material to be studied. The next step, students are invited to explore the richness of local culture through reading about weh-wehan culture. This aims to connect mathematical concepts with everyday life, especially local culture.

The classroom atmosphere is filled with a spirit of collaboration and helping each other in solving problems. Students are divided into small groups to discuss and find answers to the problems given using the ethnomathematics e-module. The students' enthusiasm was seen when some of them asked the teacher questions, such as "How do you determine the length of the known sides of a cube-shaped basket?" and "How do you calculate the volume of a bucket in the form of a cube?".

The research results show that the application of the ethnomathematics e-module has proven effective in increasing students' understanding and ability to solve mathematical problems. Students in the experimental class who used the ethnomathematics e-module showed better results compared to students in the control class who did not use the ethnomathematics e-module. This research proves that the ethnomathematics e-module can be an effective tool in learning mathematics. This approach combines mathematical concepts with local culture, so that learning becomes more meaningful, contextual and enjoyable for students.

In the experimental class, students play an active role, such as asking questions to the teacher, looking for information using ethnomathematics e-modules,

making reports on discussion results and the teacher only acts as a motivator and facilitator for students to direct teaching and learning activities only. Students actively ask about the relationship between culture and learning mathematics cubes and blocks. Students also understand more about the culture in Pekalongan Regency with the mathematics problems they study. When students learn by implementing the ethnomathematics e-module, it becomes easier for students to construct mathematics learning because they can see real examples in their immediate environment. This is in line with Umi et al, (2022) who explained that the use of e-modules can increase student activity in learning. By using entomathematics e-module media in the Problem Based Learning model, the learning process takes place in a fun and natural way in the form of students working and experiencing their own activities starting from planning, discussing, to solving problems and reporting the results of their discussions, not just the teacher 'pouring' knowledge/knowledge to students (Yuriah et al., 2023). The research results are in accordance with Gufran & Mataya (2020) that the existence of e-modules is able to provide self-assessment in learning.

After testing the n-gain, the researcher analyzed the level of each student's problem solving ability. The researchers obtained this analysis through experimental and control post-test data. From the results of the analysis of problem solving abilities, it shows that experimental class students who have used e-modules containing ethnomathematics have a higher level of problem solving compared to control class students who have not used e-modules. This can be seen from the number of students in the experimental class after carrying out the posttest, as many as 17 students had a high problem solving category, while for the control class after carrying out the posttest it showed that only 6 students had high problem solving abilities. Next, the researcher carried out an independent t test with one way ANOVA, the purpose of this test was to determine whether or not there was a difference in students' problem solving scores before and after learning using an e-module containing ethnomathematics.

Based on the explanation of the research results, it can be concluded that the e-module media containing ethnomathematics is effective in learning and is able to improve students' problem solving abilities with a high problem solving category. This research is in line with the results of Andi (2018), Aprillia et al, (2022) and Riawan et al, (2020) that e-modules containing ethnomathematics are effective in providing convenience in learning for students and teachers supported by the problem based learning model in improving students' problem solving abilities. On the other hand, this research is supported byMasruroh et al,(2022) that ethnomathematics improves students' problem solving abilities

Conclusion

Research and development of e-module media containing ethnomathematics in the problem based learning model to improve problem solving abilities has been successfully developed and applied in learning in accordance with 4D product development procedures. The results of this research and development can be concluded: 1) The resulting product is an E-module learning media containing ethnomathematics with a Problem Based Learning learning model to improve students' problem solving abilities, which was developed using Canva via the

Flippbuilder viewer with specifications of 37 pages from cover to cover. cover, equipped with materials, instructions for using the e-module, materials containing ethnomathematics, questions, interactive quizzes, and learning videos and can be used online via a device, laptop or computer. 2) The ethnomathematics-laden e-module product that has been produced is assessed for suitability by material experts, media experts, students and teachers. The questions used in learning are also valid and reliable. The assessment results show that the media is very feasible and very practical in learning to measure student problem solving. 3) The use of e-modules containing ethnomathematics in the problem based learning model in mathematics learning can improve students' problem solving abilities to a greater extent compared to students who do not use e-modules.

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