PUBLIKASI ARTIKEL

DEVELOPMENT STUDIES: E-MODULE BASED ON ETHNOMATHEMATICS TO IMPROVE PROBLEM-SOLVING ABILITY AT JUNIOR HIGH SCHOOL 10 METRO

OLEH:

NAMA: RAHMA NUR LITA
NPM: 2101061010

Program Studi Tadris Matematika

Fakultas Tarbiyah Dan Ilmu Keguruan

INSTITUT AGAMA ISLAM NEGERI

(IAIN) METRO LAMPUNG

1445 H/2024 M

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Diajukan Untuk Memenuhi Tugas dan Memenuhi Sebagian Syarat Memperoleh
Gelar Sarjana Pendidikan (S.Pd)

Oleh:

NAMA: RAHMA NUR LITA
NPM: 2101061010

Pembimbing : Juitaning Mustika,M.Pd

Program Studi Tadris Matematika
Fakultas Tarbiyah dan Ilmu Keguruan

INSTITUT AGAMA ISLAM NEGERI
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INSTITUT AGAMA ISLAM NEGERI METRO
FAKULTAS TARBIYAH DAN ILMU KEGURUAN
Jalan Ki. Hajar Dewantara Kampus 15 A Iringmulyo Metro Timur Kota Metro Lampung 34111
Telepon (0725) 41507; Faksimili (0725) 47296; *Website*: www.tarbiyah.metrouniv.ac.id; *e-mail*: tarbiyah.iain@metrouniv.ac.id

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Prodi : Tadris Matematika
Yang berjudul : Kajian Pengembangan; E-Modul Berbasis Etnomatematika Untuk Meningkatkan Kemampuan Pemecahan Masalah Di SMPN 10 Metro (Development Studies: E-Module Based on Ethnomathematics to Improve Problem-Solving Ability at Junior High School 10 Metro)

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Metro, 28 Oktober 2024
Pembimbing

Juitaning Mustika, M.Pd.
NIP. 19910720201903 2 017

Mengetahui,
Ketua ProdiTadrisMatematika

Endah Wulantina, M.Pd.
NIP. 19911222 201903 2 010

PERSETUJUAN

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Nama	: Rahma Nur Lita
NPM	: 2101061010
Prodi	: Tadris Matematika
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Juitaning Mustika, M.Pd.
NIP. 19910720201903 2 017

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Telepon (0725) 41507, Faksimili (0725) 47296, Website: www.tarbiyah.metrouniv.ac.id, e-mail: tarbiyah.iain@metrouniv.ac.id

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TIM PENGUJI

Ketua/Moderator	: Juitaning Mustika, M.Pd	(.....)
Penguji I	: Selvi Loviana, M.Pd	(.....)
Penguji II	: Pika Merliza, M.Pd	(.....)
Sekretaris	: Sri Wahyuni, M.Pd	(.....)

Mengetahui
Dekan Fakultas Tarbiyah dan Ilmu Keguruan

Dr. Zuhairi, M.Pd.
NIP. 19620612 198903 1 006

ORISINALITAS PENELITIAN

Yang bertanda tangan di bawah ini :

Nama : Rahma Nur Lita

NPM : 2101061010

Program Studi : Tadris Matematika

Fakultas : Tarbiyah dan Ilmu Keguruan

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Development Studies: E-Module Based on Ethnomathematics to Improve Problem-Solving Ability at Junior High School 10 Metro

Rahma Nur Lita
Mathematics Education Department, Institut Agama Islam Negeri Metro, rnurlita@gmail.com

Juitaning Mustika
Mathematics Education Department, Institut Agama Islam Negeri Metro, juita.tika@gmail.com

ABSTRACT

There are still many students who need help solving mathematical- problems. The need for attractive, easy-to-understand, and culture-based learning is essential for students. The objectives of this research are as follows: 1) to determine the stages of development of ethnomathematics-based e-modules, and 2) to find out whether ethnomathematics-based e-modules can improve problem-solving abilities at state junior high school 10 Metro. The research method uses a design research and development study type, including preliminary and prototyping stages (formative evaluation). According to the subject matter, media, and cultural experts, it is "highly feasible". Suggestions and comments from revised validators display feasibility. Meanwhile, the attractiveness of the e-module is evident in how students effectively use it. The results of the N-gain value analysis with an average of 0.8 indicates that ethnomathematics-based e-modules can significantly improve students' problem-solving abilities with high criteria. The e-module has met the criteria as a suitable medium for learning.

Keywords: E-module, ethnomathematics, and problem-solving abilities.

ABSTRAK

Masih banyak peserta didik yang mengalami kesulitan dalam menyelesaikan masalah matematika. Perlunya pembelajaran yang menarik, mudah dipahami, dan berbasis budaya sangat penting bagi peserta didik. Tujuan dari penelitian ini adalah sebagai berikut: 1) untuk mengetahui tahap pengembangan e-modul berbasis etnomatematika; dan 2) untuk mengetahui apakah e-modul berbasis etnomatematika dapat meningkatkan kemampuan pemecahan masalah matematika di SMPN 10 Metro. Metode penelitian menggunakan desain riset type pengembangan studi, yang mencakup tahap preliminary dan tahap prototyping (evaluasi formatif). Menurut ahli materi, ahli media, dan ahli budaya, yang memenuhi kriteria “sangat layak”. Kelayakan ditampilkan oleh saran dan komentar dari validator yang telah direvisi. Sementara kemenarikan e-modul terlihat dari bagaimana peserta didik menggunakannya dengan baik. Hasil analisis N-gain dengan nilai rata-rata 0,8 yaitu e-modul berbasis etnomatematika dapat meningkatkan kemampuan pemecahan masalah peserta didik dengan kriteria tinggi. E-modul telah memenuhi kriteria sebagai media yang layak untuk pembelajaran.

Kata Kunci: e-modul, etnomatematika, kemampuan pemecahan masalah.

INTRODUCTION

Mathematics is a basic knowledge that everyone, especially students, must have. In teaching mathematics, the educational goal is to ensure that students understand mathematics as a natural or cognitive science and a general knowledge of mathematics (Sariningsih, 2014). Problem-solving is a goal of mathematics education listed in the Content Standards (SI). Problem-solving includes understanding a problem, creating a plan for a mathematical model, solving the

model, and creating a solution to the problem (Wardani, 2008). Problem-solving is when someone thinks purposefully to solve a problem (Mawaddah & Anisah, 2015). Solving problems is essential in learning mathematics (Sofiyani & Zaenuri, 2023). According to NCTM in 2000, "Problem-solving is a necessary part of all mathematics learning, " meaning problem-solving is crucial to mathematics learning.

Polya demonstrated in previous research that students with good mathematical skills can complete all stages of problem-solving (Arilaksmi et al., 2021). The problem-solving indicators are (1) problem understanding, which is the ability to identify problems; know and ask about problems with symbols or words; (2) planning solutions, which is the student's ability to use problem-solving strategies; and (3) solving problems, which is the student's ability to use strategies to solve the problems in the questions, and (4) checking again; This ability makes it possible to correct answers and draw conclusions about the results of work (Ratuanik & Lamers, 2021). Someone also said the problem can be solved if students meet the specified indicators (Cahya & Siregar, 2023).

Based on the explanation above, problem-solving skills are critical. If students master all indicators of mathematical problem-solving abilities, it will be easy to solve them. However, from interviews with teachers at state junior high school 10 Metro, information was obtained that students experience difficulties when encountering mathematics-related problems. Students can only solve questions that are precisely the same as those that have been solved previously. If the questions are changed, students will experience difficulty in solving them. Apart from that, many students still only master one indicator of problem-solving ability. They are proven by the pre-survey results regarding students' problem-solving skills at state junior high school 10 Metro. Researchers provide test questions related to mathematical problem-solving skills on systems of equations and linear inequalities in one Variable. The following is one of the results of a test of students' problem-solving abilities on single-variable linear equations and inequalities, which is presented in Figure 1.

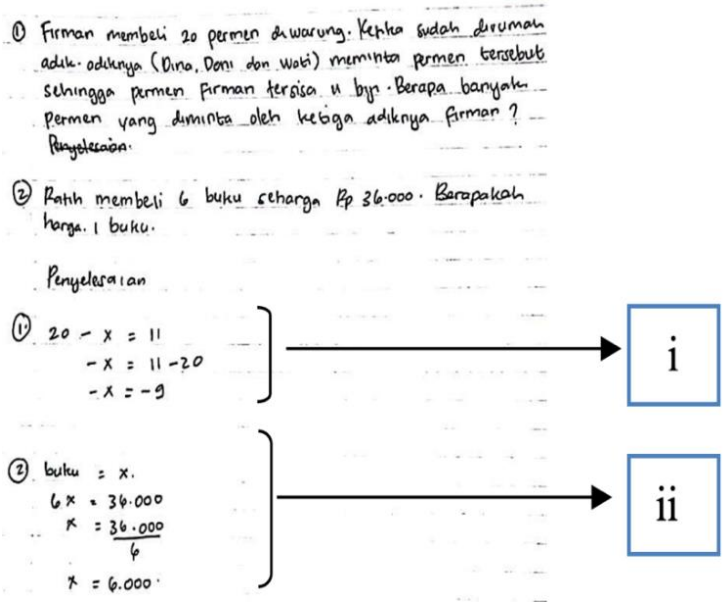


Figure 1. Results of student answers

Based on Figure 1. In (i), students only use one indicator of problem-solving ability, namely planning-solving, but refer to the right results. However, this solution step needs to be revised. Meanwhile, (ii) students write down the information in the question and refer to the correct results but need to write conclusions from the results.

The preliminary survey results showed that of the 32 students, only six could correctly answer the first question regarding indicators of plan implementation, and only three could correctly answer the hand "understanding the question." The test results show that students' problem-solving abilities still need to improve.

Based on the interviews conducted by researchers on October 18, 2023, with mathematics teachers at state junior high school 10 Metro, the learning system uses non-digital books. Students need to be more active in mathematics learning activities during the learning process. Due to the effects of COVID-19 and increasingly developing digital media, they are bored with the many heavy non-digital textbooks. Apart from that, students still need help connecting actual events with mathematics. Students experience difficulty expressing everyday events through story problems that differ from examples in language, symbols, or mathematical models. So, finding the right solution is challenging. Students need help modelling mathematics and determining solution steps in the material Linear Equations and Inequalities in One Variable. Students still need to understand and determine the steps to solve the problem presented as a story task. From this, students' problem-solving abilities could be more robust.

Mathematics learning allows students to improve their problem-solving skills and independence. However, lessons at school are very different from everyday problems (Astriyani, 2016). Problem-solving abilities are critical for students to solve problems in daily life (Sari et al., 2022). Consequently, mathematics in culture is crucial. Because both are essential parts of society, education and culture are necessary in everyday life, and every member needs education (Utami et al., 2018).

The ethnomathematics field investigates how mathematics interacts with culture (Wulantina et al., 2022). Ethnomathematics is a bridge that can connect cultures with mathematics so that mathematics becomes easy to understand. According to (Husna et al., 2023), Mathematics learning will be meaningful if students are paired with learning media in everyday life with mathematical elements, namely typical Aceh cakes. Understanding mathematics as a cultural product is known as ethnomathematics. Language, places, traditions, and ways of organizing, interpreting, conceptualizing, and providing meaning in the physical and social world are all part of the culture (Fitriyah & Syafi, 2022). How mathematical ideas are embedded in culture (Merliza et al., 2022). They are optimizing the use of mathematics in community culture and students' lives so that mathematics education can be utilized as fully as possible (Wulantina & Maskar, 2019). Studying ethnomathematics is very important; ethnomathematics is integrated into the curriculum and has a role comparable to mathematics (Pertiwi & Budiarto, 2020)

One option for cultural introduction learning for students is ethnomathematics-based mathematics learning. This method connects mathematics learning with culture, allowing students

to make connections between mathematics learning and culture (Suranti & Wulantina, 2023). This culture-based method helps students solve mathematical problems. Previous studies by Utami et al. (2018) show that culture's role in education is crucial for mathematics learning.

Apart from interviewing teachers, interviewing students also stated that the learning process was done using printed books from the school. As the world of education develops, learning media must also develop following technological developments. A preliminary study of students' preferences for learning media showed that 30% chose videos, 50% chose e-modules, and 20% chose printed books. E-modules are the most popular due to increasingly advanced technological advances. In this sophisticated era, learning media should be electronic-based. Field data also shows that 98% of students have smartphones. E-module learning media is arranged systematically and can be studied independently. In addition, the electronic format allows learning to be more interactive and enriches the learning experience ((Laili et al., 2019). E-modules based on ethnomathematics can attract students' interest and improve problem-solving abilities, resulting in better learning achievements (Utami et al., 2018).

Indonesia has a variety of cultures, one of which is Acehnese culture. Based on previous research, no research has utilized ethnomathematics-based electronic learning media in Aceh culture to improve mathematical problem-solving skills on linear equations and inequalities material where one Variable is studied simultaneously using a research design type of development research. The culture used for research is the Acehnese culture. The culture focused on traditional Acehnese cakes. So, the objectives of this research are as follows: 1) to determine the stages of development of ethnomathematics-based e-modules at state junior high school 10 Metro; 2) to determine whether ethnomathematics-based e-modules can improve problem-solving abilities at state junior high school 10 Metro.

METHOD

The research method used is the design research and development study type according to procedures by Tressmer (Putrawangsa, 2019). The research was conducted on class VII students at state junior high school 10 Metro with 32 students for one month in the odd semester of the 2023/2024 academic year. The final product is web-based e-module material that focuses on equations and inequalities of a variable. The development procedure used is the Tessmer development procedure, which has two stages in the research model, namely preliminary and formative evaluation (see Figure 2). This type of research consists of several steps, namely as follows: 1) self-evaluation, 2) expert review, 3) one-on-one, 4) small group, and 5) field test. The subjects of this research were class VII students at State Junior High School 10 Metro.

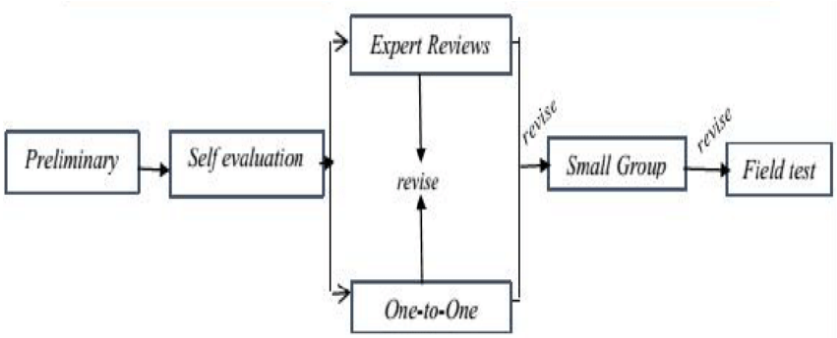


Figure 2. Formative evaluation design flow

The data collection and analysis consist of walkthroughs, observations, interviews, and tests. The walkthrough stage provides information about how feedback and opinions from review experts were collected and incorporated into the e-module design. Discuss specific changes or improvements made based on feedback. In this research, validation was carried out by experts, namely material experts (one mathematics education lecturer and one mathematics subject teacher), media experts (one mathematics education lecturer and design teacher), and cultural experts (one cultural observer lecturer). The material expert assessment sheet consists of 17 points to test content aspects, the media expert assessment sheet consists of 23 points to test aspects of application, user control, and multimedia design, and the cultural expert assessment sheet consists of 4 points to examine the cultural elements used. Observations were carried out at the small group stage, and field tests were performed to ensure the correct use of teaching materials by responding. Responses in a questionnaire consist of material presentation, language, usefulness, and attractiveness. A small group of 6 students will be used as subjects for testing the e-module by responding with a questionnaire. For additional information about student responses, open face-to-face interviews were conducted in small groups with discussion to clarify student responses in the form of criticism and suggestions regarding the e-module material. The small group results are revised according to student responses. Next, the field stage consisted of 32 students as research subjects who provided responses and worked on mathematical problem-solving ability test questions. Meanwhile, the validation results and student responses can be categorized in Table 1.

Table 1. Validation Category Results and Student Responses

Score	Validation criteria	Student response criteria
3.25 ≤ score < 4	Very worthy	Very interesting
2.5 ≤ score < 3.25	Worthy	Interesting
1.75 ≤ score < 2.5	Decent enough	Quite interesting
1 ≤ score < 1.75	Not feasible	Not attractive

Criteria determined from the pretest and posttest results are used to measure the achievement of the research objective of increasing students' problem-solving abilities. The data analysis used in the research is the N gain score (Meltzer, 2002; Widodo & Purnami, 2018) using the following equation.

$$g = \frac{S_{pos} - S_{pre}}{S_{\max} - S_{pre}}$$

Note: S_{pos} = posttest value
S_{pre} = pretest score
S_{max} = maximum value

High or low N-Gain values are determined based on the following criteria in Table 2 (Widodo & Purnami, 2018).

Table 2. N-Gain Value Criteria

N-Gain Value	Criteria
N- gain ≥ 0.70	Tall
0.30 < N – gain < 0.70	Currently
N – gain ≤ 0.30	Low

N-gain is used to determine the magnitude of the increase in students' problem-solving abilities after being treated with ethnomathematics-based e-modules, categorized as high, medium, and low.

RESULT AND DISCUSSION

This research aims to develop digital learning media in ethnomathematics-based e-modules to improve valid and practical mathematical problem-solving abilities and help students understand material about linear equations and inequalities in one variable. The steps for developing learning media are as follows:

Preliminary Design

This research is based on interviews with teachers and students at state junior high school 10 Metro and investigates the curriculum, learning models, media, and materials used. The interview results revealed that the teacher's use of learning media remained the same, only in the form of printed books.

Self Evaluation

At this stage, the researcher is designing an ethnomathematics-based e-module with problem-solving capabilities regarding language, constructs, and content. This e-module has problems related to linear equations and inequalities in one variable. The Independent Learning curriculum at the Middle School Level causes this problem. Meanwhile, the ethnomathematics element is an addiction to typical Acehnese cake with mathematical problem-solving abilities. After creating the e-module, the researcher evaluates it with a supervisor’s help.

Figure 3. Material in the E-Module Based on Ethnomathematics.

At the one-to-one stage, students and expert reviewers will validate prototype 1, developed by the researcher. The problem-solving ability material in the e-module is presented in Figure 3, and examples of problem-solving ability questions are shown in Figure 4. The material contained in the e-module is one-variable linear equations and inequalities based on ethnomathematics, where the ethnomathematics elements used are traditional Acehnese cakes.

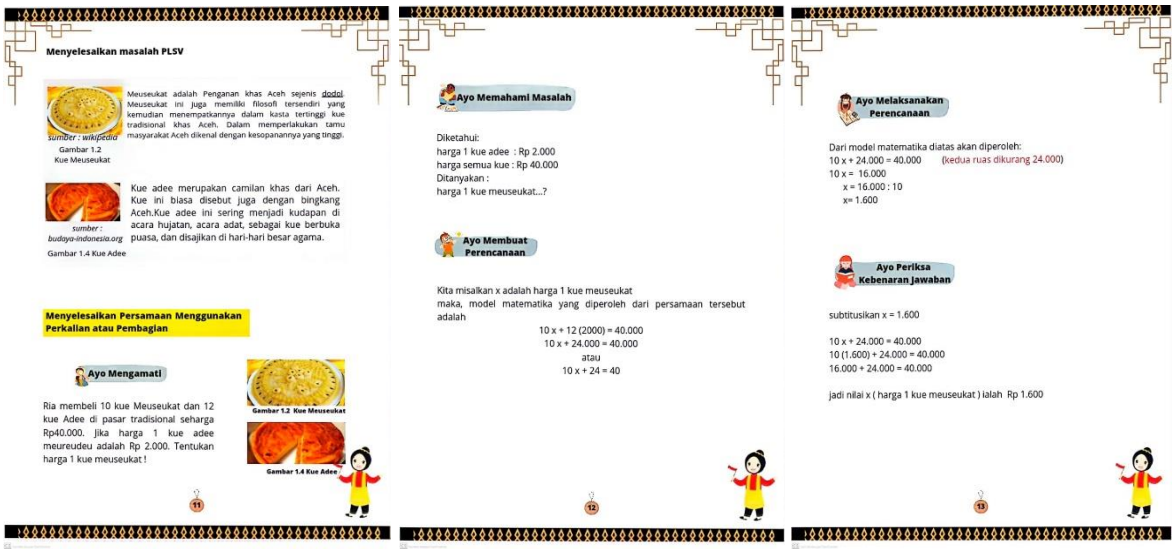


Figure 4. Problem-Solving Ability Questions

Expert Review and One-to-One

At this stage, provide e-module media to the subject matter, media, and culture validators to validate and obtain suggestions and comments regarding the e-module. The confirmation results from experts become the basis for revising the e-module. Then, a trial was conducted on students by giving them response questionnaires. After the e-module has been tested, a valid and effective

e-module will be obtained. At this stage, the prototype will be tested by Expert Review and One-to-one. Two lecturers, a material expert, two media experts, and one culture expert validated the e-module. At this one-to-one stage, prototype one was tested on three students not involved in the research, namely in class VII A at state junior high school 10 Metro. At this stage, students are given a questionnaire to provide feedback and suggestions about the e-module.

a. Material Validation for E-Module Based on Ethnomathematics.

At this stage, the material developed by researchers is tested for suitability by subject matter experts. The researcher chose two people to be validators. The following are the results of e-module validation by two subject matter experts, presented in Table 3.

Table 3. Material Expert Validation Results

Aspect	Average score	
	Expert 1	Expert 2
Content Eligibility	3.4	3.8
Suitability of Presentation	3.4	3.4
Language Suitability	3.2	3.6
Total	3.35	3.6
Total average	3.5	
category	Very worthy	

According to the subject matter expert validator, researchers can use the e-module with a few changes. With the "very feasible" criteria, the average validator assessment is 3.5. Based on the validation results from two material experts, it can be concluded that the e-module is suitable for use. Based on the results of expert validation, several revisions made to the e-module can be seen in Table 4.

Table 4. Revision of Material Based on Input from Validators.

No	Before Revision	After Revision
1	The writing is not neat	The researcher has fixed the writing order
2	The presentation of the material is incomplete	Completed the material
3	The ethnomathematics presented are still lacking	Has improved the production of ethnomathematics
4	When solving problems, there is less than one problem-solving indicator, "checking the correctness of the answer."	The researcher already added a split indicator
5	Too little practice questions	Researchers have added practice questions

Table 4 shows that there are several improvements to the e-module. Regarding this matter, researchers have made improvements to obtain a valid e-module. The ethnomathematics e-module contains questions based on four indicators of mathematical problem-solving ability as exercises reviewed by experts and revised. The e-module developed can improve students' mathematical problem-solving skills.

b. Media Expert Validation of Ethnomathematics-Based E-module

Several aspects are included in media validation, including e-module cover design, e-module content design, and flipbook media. On the e-module cover, the validator assesses the contrasting colour aspect of the e-module title, the best central positioning of the view, and the use of a combination of fonts. Meanwhile, in the content of the e-module, the validator assesses the attractiveness aspect of the e-module, the typography of the e-module content, as well as the suitability of the material for the learning objectives, and in the flipbook media, the validator validates the aspect of ease of navigation and ease of accessing information.

Table 5. Media expert validation results

Aspect	Average Score	
	Expert 1	Expert 2
E-Module Cover	3.3	3.5
Contents of E-Module	3.0	3,2
Flipbook	3.0	3.3
Average Amount	3.1	3.3
Total Average	3,2	
Category	Worthy	

Based on the results of expert validation, an average of 3.2 was obtained with the "feasible" criteria (see Table 5), and it was stated that the e-module could be used with slight modifications. Several revisions made to the e-module can be seen in Table 6.

Table 6. Media Revision

No	Before Revision	After Revision
1.	The guide to using the e-module is less interesting	It has been improved by adding a chart to make it easier for readers.
2.	Inconsistent use of text	The text has been adjusted.

Based on Table 6, the researcher made improvements to the e-module in the instructions for using the e-module and adjusted the text, which was not correct. To produce a valid e-module.

c. Cultural Validation for Ethnomathematics-Based E-modules

At this stage, the e-module is validated by cultural experts to check the presentation and suitability of Acehnese culture. The validator claims that the culture used in the e-module is appropriate and can be used without changes. With the "very feasible" criterion, validators gave an average score of 3.75. The results of cultural validation will be presented in the following Table 7.

The e-module developed is based on ethnomathematics. The culture that is focused is Acehnese culture on traditional Acehnese cakes. In the e-module, traditional Acehnese cakes are integrated into the material on one-variable linear equations and inequalities.

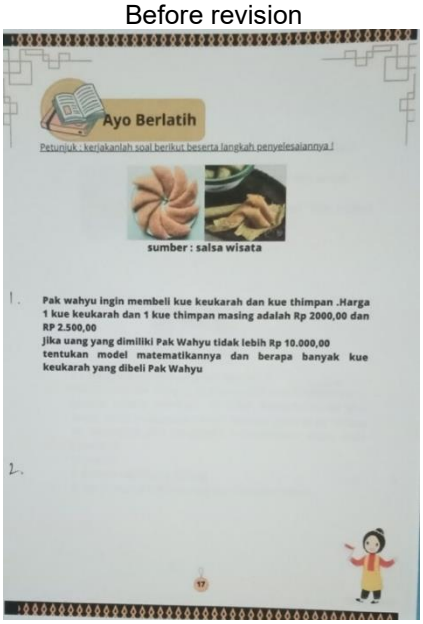
Table 7. Cultural Expert Validation Results

Aspect	Item	Score
Quality of E-Module	1	4
Content	2	4
	3	3
	4	4
Total score		15
Maximum Score		16
Average		3.75
Eligibility Category		Very worthy

A one-to-one location was also carried out along with the expert review stage. At this one-to-one stage, prototype one was tested on three students not involved in the research, namely class VII. A student at state junior high school 10 Metro then the researcher explained about the e-module that had been developed. As a facilitator, the researcher invites students to study the e-module. In the final stage, students assess the e-module and provide comments and suggestions.

The results of student responses at the one-to-one stage obtained an average score of 3.0 with the criteria "decent." Based on these results, the e-module developed can be used as a learning medium, but there are still revisions so that it continues to the Small Group stage. The following revisions made to the e-module can be seen in Figure 5.

Before revision



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After revision

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Figure 5. Revision results in one-to-one trials

Small Groups

Prototype 2, modified from the expert review and one-to-one stages, will be tested in small groups, namely in class VII. A student at state junior high school 10 Metro consists of 6 students. These six students had never studied linear equations and inequalities in one variable before. The

purpose of this stage is to evaluate the practicality of the lesson material. After the material is given to students, a response questionnaire is used to revise the lesson material. The prototype of teaching materials created after revision is known as prototype 3. The results of student responses at the small group testing stage obtained an average score of 3.5 with the criteria "very feasible." Based on these results, the e-module developed can be used.

Based on the results of the responses from the six students, two respondents understood the material contained in the e-module well; for the usefulness of the e-module, three respondents gave good responses, and for the attractiveness of the e-module, there was one student who gave a good response.

Field Tests

This stage is the final stage of formative evaluation of E-module development. Class VII.B of state junior high school 10 Metro, totalling 32 students, became the focus at this stage. The field test stage is divided into two stages; the first is the learning process using e-modules, and the second is the test. The e-module trial and test questions measure the potential effect on students' mathematical problem-solving abilities.

Data from the results of student response sheets shows that the quality of the modules developed is based on their level of attractiveness; all students gave an average score of 3.4 with the criteria "exciting." A response questionnaire sheet is provided after students use the e-module that has been developed.

The results of the analysis show that students with strong mathematical problem-solving abilities can carry out all stages of problem-solving, according to Polya (Amalina & Ekawati, 2020). The test results of students' mathematical problem-solving skills are shown in Figure 6 dan Figure 7.

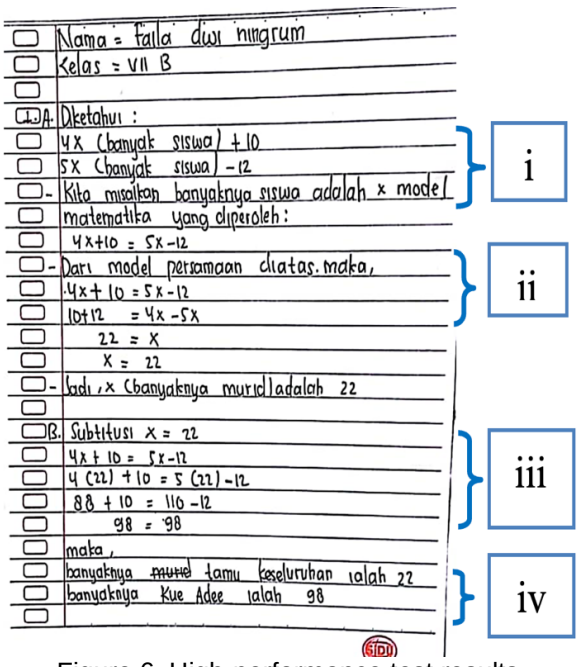

Figure 6. High-performance test results

At the time of the pre-survey, none of the students had mastered all the indicators of problem-solving ability. After implementing learning with e-modules, it was seen that there were students with high skills who could solve all problem-solving-ability questions with four indicators: (i) understanding the problem, (ii) planning a solution, (iii) resolving the problem, and (iv) checking again.

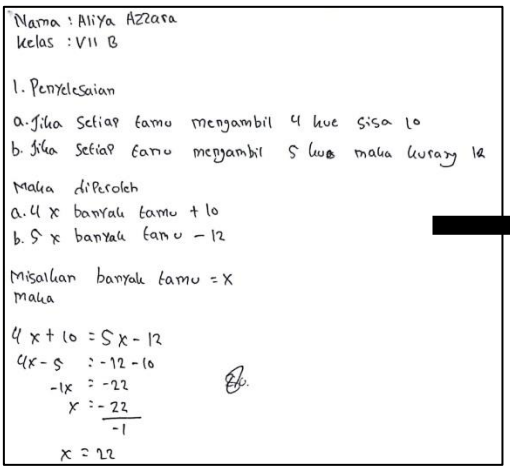

Figure 7. Test results of medium-ability students.

Based on Figure 7, students can develop correct strategies and solutions but need to write down the information on the questions and recheck them.

Test to determine the increase in students' mathematical problem-solving abilities after using e-modules in the learning process. In

Figure 6, students can solve problems with problem-solving solve problem-solving steps. Meanwhile, in Figure 7, students still need to solve the problem correctly with their problem-solving skills; they need to write down the problem information and check again. So, the results need to be more accurate. The analysis was carried out using pretest and posttest data on the results of problem-solving skills. The study results are then tested using N-gain, presented in Table 8.

Table 8. Results of mathematical problem-solving ability scores and the N-gain test

Mark	Pretest	posttest	Average N-gain	Criteria
Highest	50	100		
Lowest	0	62.5	0.8	Tall
Average	25.7	83.2		

Based on Table 8, The average value obtained for N-gain is 0.8 at high criteria, so it can be concluded that students' mathematical problem-solving abilities increase after using ethnomathematics-based e-modules.

Based on the results of problem-solving research on linear equations and linear inequalities for one variable based on ethnomathematics by valid criteria, validators gave an average of 3.2 for media validators, 3.45 for subject matter validators, and 3.75 for cultural validators. Another activity carried out during the expert review stage is a readability test, the results of which help teachers understand the language in the device so that they can understand all the words contained. The results of student responses to the e-module are in the criteria of being exciting and practical, with

an average score of 3.2. In line with previous research, it is stated that the research results show that e-modules are an effective and practical learning media (Cahya & Siregar, 2023; Suryaningsih & Putriyani, 2022). Apart from the above, the results of the pretest and posttest mathematical problem-solving abilities were also measured, stating that using ethnomathematics-based e-modules can improve students' mathematical problem-solving skills. The cultural limitations students can learn are limited to typical Acehnese cakes, so there are few math-solving problems related to the issue of regular Acehnese cakes.

CONCLUSION

The conclusions obtained from the research are as follows: An e-module based on ethnomathematics was developed using a design research model and development study type, namely, preliminary and formative evaluation. The design product has been validated by three experts: media, subject matter, and cultural experts. The "decent" category was obtained in media experts with an average value of 3.2. The results of content expert validation obtained the "very appropriate" type with an average of 3.5. The cultural expert validation result averaged 3.75 in the "very feasible" category.

Meanwhile, student responses received an average of 3.2 in the "interesting" category. So, an ethnomathematics-based e-module on single-variable linear equations and inequalities material is suitable for use as a learning medium. The average N-gain value is 0.8 with high criteria, so students' problem-solving abilities can increase after using ethnomathematics-based e-modules.

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