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Design and Development of Ethnomathematics E-Modules through Lombok's Traditional Culinary Heritage

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ABSTRACT

This study aims to develop and evaluate an ethnomathematics-based e-module that integrates Lombok's traditional culinary heritage to enhance elementary students' understanding of three-dimensional geometry within the context of the Merdeka Curriculum. Employing a research and development (R&D) design using the ADDIE model, the study involved needs analysis through interviews with teachers, the principal, and students; design and development of an interactive digital e-module enriched with cultural elements and augmented reality; implementation through limited trials involving six students and field testing with twenty-one students; and evaluation through expert validation and N-gain analysis. The validation results demonstrate that the e-module meets feasibility criteria, with expert assessments yielding scores of 83% for material validity, 88% for media validity, and 80% for language validity. Limited trials produced N-gain scores ranging from 0.34 to 0.92 (mean = 0.69), while field testing yielded N-gain values between 0.00 and 0.84 (mean = 0.47), categorized as moderate improvement. These findings indicate that the e-module is effective in strengthening students' conceptual understanding, although learning gains vary according to learners' initial abilities and digital literacy. The study implies that integrating ethnomathematics with digital learning media can create meaningful, culturally relevant mathematics instruction.

Keywords: E-module, Ethnomathematics, Culinary heritage, Digital learning

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1. INTRODUCTION

Education is very important for every individual because it is a lifelong necessity (Rawas, 2024). Humans continue to undergo changes influenced by the development of the times. Therefore, an education system is needed that is designed to be able to adapt to these dynamics. Entering the 21st century, education faces various challenges, one of which is the demand for teachers to innovate in the learning process. As time goes by, science and technology are like two inseparable components (Buzzoni, 2024). Technological advances have further reinforced this demand, requiring teachers to be able to utilize technology as a means of improving the quality of learning. Digital teaching materials such as e-modules have become strategic instruments for bridging the gap between curriculum requirements and the needs of students in the modern era (Chatzidaki et al., 2025).

Students in the modern era need learning media that are in line with the times, namely, technology-based learning. Parents and teachers can strengthen students' attitudes and character by equipping them with digital literacy (Yulia et al., 2022). One type of learning media that keeps up with the times is the E-module learning media (Prabasari et al., 2023). E-modules are learning media that provide visualizations and can be accessed through electronic devices (Pratamadita & Dwiningsih, 2022). E-modules are digital modules consisting of text, images, or both, containing digital electronic material accompanied by simulations that can be used effectively in learning (Zhitfi, 2025). The integration of e-modules with ethnomathematics through Lombok's traditional culinary heritage is one relevant solution to address this issue.

Ethnomathematics is a concept that combines mathematics with culture and the surrounding environment, making mathematics learning more effective and enjoyable for students (Yanti, 2025).

Ethnomathematics is a science derived from the mathematical thinking of a community group (Simbolon, 2024). One form of ethnomathematics application can be seen in traditional cuisine, which not only serves as a source of sustenance but also as a cultural expression rich in values, reflecting the history and identity of a community (Syifa & Maharbid, 2025). Traditional food is an important element of cultural tourism because it presents authenticity and local stories (Jasmani et al., 2024). *Cerorot* is one of Lombok's traditional foods that represents a geometric shape, specifically a cone, through its physical structure (Subarinah et al., 2022).

Based on previous research, the development of e-modules in ethnomathematics has been widely undertaken by a number of researchers. (Aini et al. (2023) investigated e-modules to improve understanding of mathematical concepts, Fitrianawati & Setiyawati (2021) studied the development of electronic modules on geometry material, and (Hastuti et al., 2024; Nizaar et al., 2021) studied the development of thematic modules based on the Direct Instruction model, Suryawan et al. (2023) investigated the development of multimodal digital modules based on ethnomathematics problems, while Sutarto et al. (2022) focused on improving metacognitive abilities through electronic modules). Pratama et al. (2024) developed an e-module based on traditional Indonesian food, with results showing a validity rate of 88%, a practicality rate of 84%, and effectiveness in improving students' mathematical literacy. However, these studies have limitations, namely that they have not fully optimized the integration of interactive technology, the visualizations tend to be static, and they have not explored more specific local cultural contexts such as traditional Lombok cuisine.

Fitrianawati & Setiyawati (2021) explained that his research results showed that the electronic module developed met the appropriate criteria based on the assessment of six validators on aspects including material content, presentation, suitability of the electronic module with the concept of ethnomathematics, effectiveness of media in learning strategies, physical appearance, and language. Suryawan et al. (2023) emphasizes that based on the material validity test, a validity of 4.45 was obtained, and the media validity test obtained a validity of 4.87, which is included in the very high category. Hamid (2024) shows that the results of research on ethnomathematics-based electronic modules on number patterns meet the criteria for use in learning based on expert reviews and are able to attract the interest of students.

Kurniawati & Mahmudi (2025) presenting research results: (1) The RME e-module features contextual problem solving, the development of mathematical models from real-world problems, students building their own models, interactive activities, and connections between topics or subjects (2) The products and instruments meet the validity criteria; (3) The practicality of the E-Module achieved a score of 90% based on teacher assessment and 81.01% based on student assessment, and the implementation of learning reached 94.44%, thus meeting the practicality criteria; (4) The t-value in the hypothesis test is less than 0.05, so the E-Module meets the effectiveness criteria. Madu et al. (2025) emphasize that the developed e-module has been validated and proven practical by expert validators and practitioners, and has received positive feedback from students. Effectiveness tests show a significant improvement in student learning outcomes after using the e-module. Gesty (2025) explains that ethnomathematics-based modules can be an innovative solution in improving the quality of mathematics learning in the digital age.

Based on the results of several previous studies, more focus has been placed on the technical aspects of validating and testing the effectiveness of e-modules. However, these studies have not highlighted their integration with more specific local wisdom, such as the traditional culinary heritage of Lombok. Therefore, this study aims to present a comprehensive description of the effectiveness of integrating local culture into digital e-modules, so that mathematics learning is not only understood from a cognitive perspective, but also more contextual and meaningful to the daily lives of students. This study is expected to strengthen understanding of how ethnomathematics-based e-module innovations can improve the quality of learning, while also serving as a relevant, collaborative, and digitally literate 21st-century learning strategy.

2. RESEARCH METHOD

This study applies the research and development (R&D) method to develop an interactive multimedia learning media product based on Android by adapting the ADDIE model (Analysis, Design, Development, Implementation, Evaluation (Nasution 2023). Research and development (R&D)

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methods are structured and systematic approaches aimed at producing practical solutions and creating new products or improving existing products through a validated process (Setyosari et al. 2023). The following is the R&D research procedure using the ADDIE approach method in Figure 1.

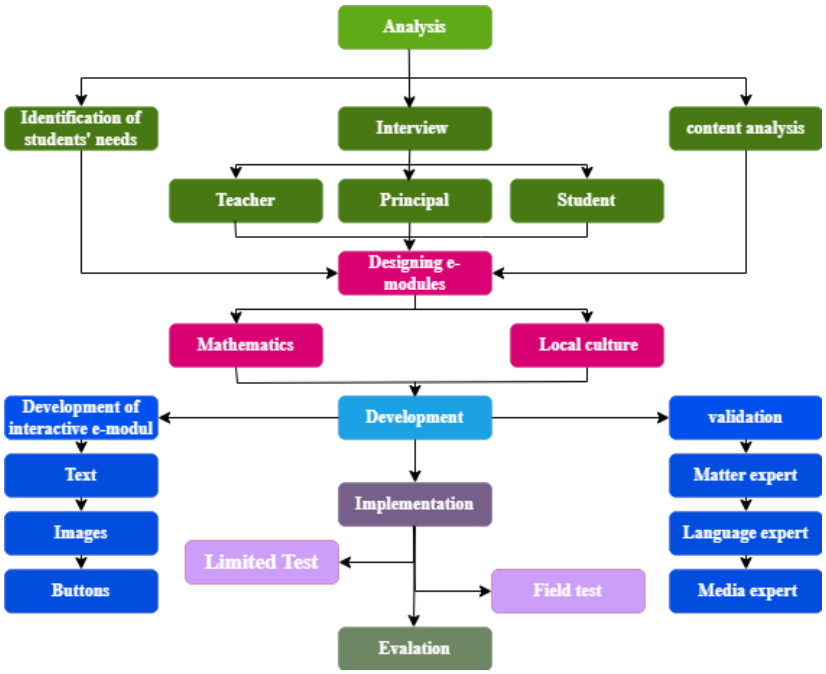

Fig. 1. Stages of ADDIE Model Development

Figure 1 shows that ADDIE consists of five stages. The first stage is analysis, which involves identifying learner needs and analyzing the material (Adeoye et al. 2024). The needs analysis was conducted at SD Negeri 15 Mataram through semi-structured interviews with teacher (T), principal (P) and student (S) to determine the needs for mathematics teaching materials to be developed. The material analysis was conducted by examining the main material to be taught, the opportunities for applying ethnomathematics, and the relevance of Lombok's traditional culinary heritage as a learning context. During the design stage, an e-module was developed that combines mathematical concepts with local culture. Next, during the development stage, interactive digital e-modules were created, complete with text, images featuring illustrations of traditional Lombok cuisine, along with navigation buttons.

During the implementation stage, researchers tested the e-module on students during one session. The tests consisted of a limited class test with six students and a class test with 21 students to obtain data on the product's effectiveness using pre-tests and post-tests in the form of 15 multiple-choice questions to assess changes in mathematical understanding of mathematical concepts. Meanwhile, the evaluation stage is carried out through revisions to the e-module based on the results of expert validation and user feedback. The research instruments consisted of a validation questionnaire given to subject matter, media, and language experts, and learning outcome tests in the form of pre-tests and post-tests. Validity analysis was conducted using a Likert scale to determine the suitability category of the e-module. Product effectiveness was measured by comparing the pre-test and post-test results using the N-gain statistical test.

3. RESULTS AND DISCUSSION

A. Analysis

During the analysis stage, researchers conducted three main types of analysis on October 18, 2025, at SD 15 Mataram, including e-module needs analysis, student needs analysis, and curriculum analysis, with respondents consisting of a teacher, a student, and a principal to obtain information on e-module needs.

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1. The e-module needs analysis aimed at determining the types and characteristics of e-modules feasible for mathematics learning in elementary schools. Based on the results of interviews with the teacher (T), it was conveyed that:

   > *"The difficulty faced by children in elementary school, especially those in class 5B, is short-term memory or forgetfulness, so they have to be taught several times before they truly understand. Teaching materials on spatial construction must include content, three-dimensional images, examples, and formulas".*

   This statement shows that teachers want e-modules that not only present theory, but also include three-dimensional visualizations and real-world examples so that students can more easily understand spatial concepts and reinforce these concepts repeatedly.

2. An analysis of student needs was conducted to identify student preferences for learning media that are interesting and in line with technological developments by interviewing a student in class 5 B. Based on the interview results, (S) stated that:

   > *"I like learning that incorporates animation and has original content".*

   This indicates that students prefer interactive teaching materials that feature animations and real objects, making learning more lively and enjoyable.

3. Curriculum analysis was conducted by interviewing the school principal to ensure the suitability of the e-module development with the implementation of the Merdeka Curriculum. Based on the interview results, (P) stated that:

   > *"Class 5 has been using the Merdeka Curriculum in accordance with its learning outcomes (CP), but it has not been maximized, so it would be better to increase the use of interactive learning media".*

   This statement shows that the principal wants to improve the quality of learning through the use of more varied and innovative media.

Next, observations were made on traditional Lombok cuisine with the aim of identifying relevant and feasible types of food to be used as examples in the e-module. Based on the results of observations at the *Kebon Roek Lombok* traditional market, data was obtained on the variety of traditional Lombok cuisine as shown in Figure 2.

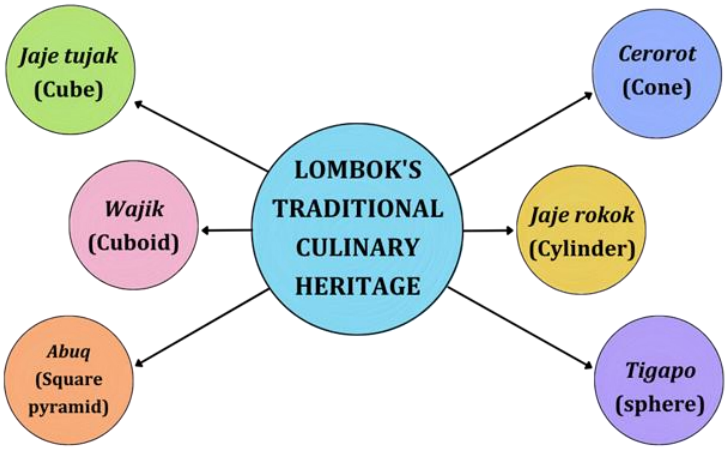

Fig. 2. Lombok's Traditional Culinary Heritage in Geometric Form

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Figure 2 shows six types of Lombok's traditional culinary heritage that represent different shapes, namely *Jajek Tujak*, which is cube-shaped; *Wajik*, which is cuboid; *Abuq*, which is square pyramid; *Cerorot*, which resembles a cone; *Jaje Rokok*, which is a sylinder without a base or top; and *Tigapo*, which is a sphere.

B. Design

The second stage was design. Researchers designed e-modules using the Canva platform through several structured steps, as listed in Table 1.

Table 1. Ethnomathematics E-module Design Flow

No.	Design Flow
1	Setting learning objectives based on the results of needs analysis and the learning outcomes of the Merdeka Curriculum
2	Developing an e-module framework (outline of chapters and subchapters, cover, content structure, and exercises)
3	Designing storyboards (display flow, page navigation, image placement, and visual elements)
4	Developing evaluation instruments
5	Choosing a visual style (colors, fonts, icons, and illustrations)

Table 1 explains that the design process for the ethnomathematics e-module began with setting learning objectives based on an analysis of student needs and the achievements of the Merdeka Curriculum. Next, an e-module framework was developed, which included an outline of chapters, subchapters, cover, material presentation, and exercises. In the content section, the researcher integrated elements of traditional Lombok cuisine and added examples of 3D-based spatial structures using *Assemblr EDU* (https://edu.assemblrworld.com/home) . The next stage involves designing a storyboard that organizes the display flow, navigation, and placement of visual elements, and compiling evaluations. The final stage is selecting visual styles such as colors, icons, and illustrations to make the e-module attractive and support effective learning. The following is the outline design for the cover of Ethnomathematics e-module in Figure 3.

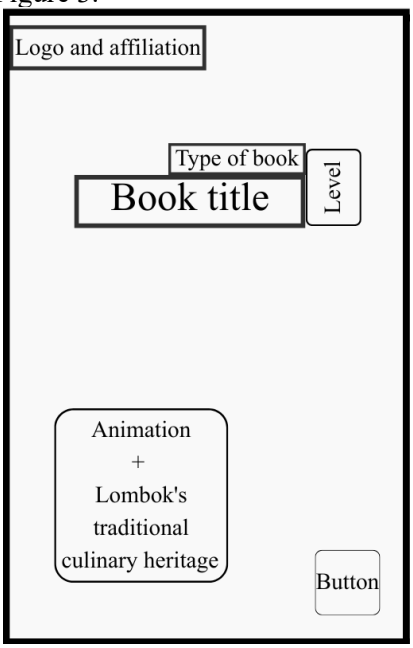

Fig. 3. Ethnomathematical Outline Design for The Cover of The Ethnomathematics E-module

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Figure 3 explains that the cover design applies a proportional layout, combines elements of local culture, and follows the principles of visual hierarchy, thereby effectively reinforcing the character of the e-module as educational material oriented towards local wisdom. The logo and institutional affiliation serve as the official mark of the e-module developer, while the type of book and e-module title are displayed in a more prominent size as the center of attention. The level indicates the target user group. The ethnomathematics-themed illustration reflects the relationship between mathematical concepts and the traditional culture of Lombok. The navigation buttons facilitate page transitions in digital use.

C. Development

The third stage is development. In this stage, researchers develop the content of the e-module according to the outline that has been prepared, such as the cover, e-module content, 3D images, and interactive exercises. Based on the design results, the following are the results of the development of the ethnomathematics e-module as shown in Figure 4.

a. Cover

b. cone material display

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c. Cone display in QR code *d. Practice display*

Fig. 4. Ethnomathematics E-module Display

Figure 4, explain that:

1. Section a, shows the initial stage of cover development using the Canva platform. The design was carried out by considering visual aspects such as color selection, illustrations, local cultural nuances, and layout, resulting in a design that is in harmony with the outline design.
2. Section b presents material on cone shapes through an ethnomathematics approach. The local cultural object featured is *Cerorot*. *Cerorot* is a traditional snack from Lombok, made from coconut milk and flour mixed with brown sugar. Its shape resembles a cone. This comparison is intended to make it easier for students to understand the relationship between real shapes and mathematical models. An additional feature is a QR code to load a three-dimensional model.
3. Section c integrates augmented reality technology through *Assemblr EDU* to display a three-dimensional representation of a cone. The use of augmented reality technology provides students with the opportunity to observe geometric objects interactively and view them from various angles, with the support of devices such as mobile phones, computers, or other digital technologies.
4. Section d contains exercises, where each student will complete the missions presented in the e-module. Students are given challenges in the form of contextual questions that relate spatial concepts to examples of traditional Lombok snacks. The instructions displayed in the dialog box guide students to identify one of the square pyramid snacks, so that the exercise not only emphasizes cognitive aspects, but also strengthens the connection between mathematics and local culture. The presentation of the mission in an interactive visual format is designed to increase students' motivation, engagement, and critical thinking skills when completing learning tasks.

D. Implementation

At this stage, the testing process covers two areas, namely the expert area and the student area. The expert area consists of three types of validation, namely: (1) material expert validation by a primary school teacher education lecturer who has expertise in mathematics, (2) language expert validation by a lecturer in Indonesian Language Education, and (3) media expert validation by a lecturer in Physics Education who has expertise in technology development. Data collection for validation was carried out through a questionnaire consisting of 12 statements with a score range of 1–5, and the assessment results

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were calculated to obtain a percentage of feasibility. The following are the results of the material, media, and language expert validation, as shown in Table 2.

Table 2. Expert Validation Results

1.	Subject matter expert validation	
	Aspects evaluated	Percentage
	Curriculum alignment	86%
	Presentation of material	80%
	Quality and appeal of content	90%
	Average	**83%**
2.	Media expert validation	
	visual	95%
	Readability and clarity	90%
	functionality	80%
	Average	**88%**
3.	Language expert validation	
	Language	83%
	Readability	77%
	Clarity of information	80%
	Average	**80%**

Table 2 contains the results of expert validation of the material, media, and language of the ethnomathematics e-module. The curriculum suitability aspect obtained an average percentage of 86% with a "Feasible" qualification, the material presentation aspect obtained an average percentage of 80% included in the "Feasible" qualification, and the content quality and attractiveness aspect achieved an average percentage of 90% with a "Highly Feasible" qualification. This is consistent with a study (Fawaid et al., 2025) which states that the 90%–100% range falls into the “Highly Feasible” category and the 75%–89% range into the “Feasible” category. Overall, the average of the three aspects in the subject matter expert validation was 83% and was in the "Feasible" category. These findings indicate that the ethnomathematics e-module on spatial figures is "valid" from a subject matter assessment perspective.

The results of media validation of the ethnomathematics e-module show that the visual aspect received an average percentage of 95% with a rating of "Highly Feasible," the readability and clarity aspect received an average percentage of 90% with a rating of " Highly Feasible," and the functionality aspect received an average percentage of 80% with a rating of "Feasible.". The average of these three aspects is 88% in the "Feasible" category. This indicates that the ethnomathematics e-module on spatial figures is "valid" from a media assessment perspective.

The results of language validation of the ethnomathematics e-module show that the linguistic aspect obtained an average percentage of 83% with a "Feasible" rating. In terms of readability, an average percentage of 77% was obtained, which is classified as " Highly Feasible," while the clarity of information aspect achieved an average percentage of 80% with a "Feasible" rating. Overall, the average of these three aspects was 80% and was categorized as "Feasible". These findings indicate that the ethnomathematics e-module on spatial figures is "valid" from a language assessment perspective.

The next step is to conduct a limited trial involving 6 respondents, as well as a field trial involving 21 respondents from SD Negeri 15 Mataram elementary school who used the ethnomathematics e-module on Thursday, November 12, 2025. In the limited trial phase, researchers involved six 5A students selected based on their mathematical ability, including three male students and three female students with high, medium, and low levels of mastery of the material. Next, in the field test stage, the researcher involved 21 students from class 5B to measure the effectiveness of the ethnomathematics e-module on spatial figures in learning conditions. The researcher collected data by administering a pre-test and post-test consisting of 15 questions to all students. The results of the limited trial and field test are presented in Figure 5.

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a. limited test *b. field test*

Fig. 5. Graphs of Pre-Test and Post-Test Results for Limited Testing and Field Testing

Figure 5 shows the results of limited trials and field tests with pre-test and post-test instruments consisting of 15 multiple-choice questions. In the limited trial, the pre-test scores ranged from 20% to 60%, indicating that the initial abilities of the students were still relatively low. After participating in learning using the ethnomathematics e-module, the post-test scores increased significantly to 67%–94%. In the field test, the pre-test scores ranged from 13% to 67%, and after the learning intervention, the scores increased to a range of 67% to 87%. The increase in both test stages shows the positive effect of using the ethnomathematics e-module on students' understanding. Based on the score graph above, the N-gain values in Tables 2 and 3 can be obtained.

Table 3. Descriptive Statistics Limited Test

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_score	6	,34	,92	,69	,21
Ngain_persen	6	33,75	91,53	69,74	21,45
Valid N (listwise)	6				

Table 4. Descriptive Statistics Field Test

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_score	21	,00	,84	,47	,19
Ngain_persen	21	,00	83,85	47,33	19,25
Valid N (listwise)	21				

Table 3 shows the results of descriptive statistical analysis in a limited trial involving six respondents who obtained N-gain scores ranging from 0.34 to 0.92, with an average value of 0.69 and a standard deviation of 0.21 in the "moderate" category. The percentage of N-gain ranged from 33.75% to 91.53%, with an average value of 69.74% and a standard deviation of 21.45%. This variation illustrates that respondents experienced an increase in understanding despite differences in individual abilities.

Table 4 shows the results of descriptive statistical analysis in the field test involving 21 respondents. The N-gain value ranged from 0.00 to 0.84 with an average value of 0.47 and a standard deviation of 0.19 in the "moderate" category. N-gain in percentage form ranged from 0% to 83.85%,

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with an average of 47.33% and a standard deviation of 19.25%. The range of values varies, indicating differences in students' ability to absorb the material due to differences in initial abilities and motivation. The field test results had a positive impact on improving learning outcomes, although further strategies are needed to ensure equitable improvement among all students.

E. Evaluation

At this stage, researchers refined the ethnomathematics e-module based on the validity results, limited trials, and field tests. The final results of the revised e-module are presented in Figure 6.

a. Cover

b. cone material display

c. Cone display in QR code

d. Practice display

Fig. 6. Display of The Revised E-module Ethnomathematics

Figure 6 shows a number of improvements to the e-module display. On the cover, the navigation buttons that were previously located in the lower right corner have been moved to the center to improve accessibility and visual clarity for users. The class level, which was originally located next to the title,

has also been repositioned at the bottom to make the layout structure neater and more proportional. In the exercise section, the question format has been changed from fill-in-the-blank to multiple choice. Each answer clicked will display automatic feedback. If the answer is incorrect, the system will direct the student to try again, while if the answer is correct, the student will be directed to the next page. This revision aims to increase interactivity, provide immediate feedback, and strengthen students' understanding of concepts in the learning process.

Based on the validity results, the ethnomathematics e-module on spatial figures was declared to meet the eligibility criteria. This validity was reflected in the experts' assessment results. In terms of material, it obtained an average percentage of 83% with a "feasible" qualification. This finding is consistent with the research (Bidiyah et al., 2024) which reported that similar products in flat building materials also achieved an average validation score of 83% from validators. In terms of media, the e-module scored 88% in the "highly valid" category, in line with the research. Khair et al. (2023) which obtained an average validity score of 80% in the development of ethnomathematics modules based on Lombok culture. Meanwhile, the language aspect scored an average of 80%, higher than the study (Triwahyuningtyas et al., 2020) which only reached 75% in the content expert validation in the development of two-dimensional modules based on ethnomathematics for elementary school students.

Limited trials involving six respondents showed that N-gain values ranged from 0.34 to 0.92, with an average of 0.69 and a standard deviation of 0.21, indicating an improvement in student ability. The N-gain values in percentage ranged from 33.75% to 91.53%, with an average of 69.74% and a standard deviation of 21.45%. In a field test involving 21 respondents, N-gain values ranging from 0.00 to 0.84 were obtained, with an average of 0.47 and a standard deviation of 0.19. These values fall into the "moderate" category and indicate an increase in understanding after using the e-module. The N-gain data in percentage supports these findings with a range of 0% to 83.85% and an average of 47.33% and a standard deviation of 19.25%. These results are in line with the findings (Ekadayanti et al., 2024), which show that the Buton traditional house-based ethnomathematics module is valid, practical, and effective in improving students' numeracy. These findings are also reinforced by research (Tanjung et al., 2025), which shows that the Panai tribe's ethnomathematics module has a significant effect on improving critical thinking skills and learning outcomes in arithmetic sequences and series. Thus, the developed ethnomathematics e-module is considered valid, practical, and effective in strengthening students' mathematical competence.

4. CONCLUSION

Based on the results of the evaluation conducted, the ethnomathematics e-module on three-dimensional shapes can be deemed to meet the criteria of validity, practicality, and effectiveness, as evidenced by high levels of suitability in terms of content, media, and language, as well as a moderate improvement in student learning outcomes in both the pilot test and the field test. The development of this e-module integrates Lombok's traditional culinary heritage with the use of augmented reality technology, which significantly enriches the visualization of geometric concepts, enhances interactivity, and provides a more contextual and meaningful learning experience. Compared to previous studies that generally focused on the validation and effectiveness of ethnomathematics-based e-modules, this study offers improvements in the design of digital learning that is more adaptive, interactive, and oriented toward meaningful learning experiences. Thus, the main contribution of this study lies in the refinement of a locally-based digital learning design that is adaptive to the demands of 21st-century learning, while also providing a critical understanding that the successful implementation of e-modules is influenced by students' prior knowledge, learning motivation, and digital literacy..

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