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Development of an Ethnomathematics Module Based on the Pancasila Student Profile in Learning Flat and Solid Geometry

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Abstract

This research aims to develop module with context ethnomathematics wisdom local Bojonegoro on geometry, flat and solid geometric shapes that are valid and practical and have potential effects. This study is a development research using the ADDIE model. The subjects of this study include validators (media experts, material experts), mathematics teachers, and 8th grade students. Data collection techniques were carried out by interviews, filling out questionnaires, and tests. Based on research results, developed modules own validity of 0.82 so that categorized as very valid. The practicality of the module based on teacher responses of 84% is in the very practical category and student responses (small groups) of 97.2% are in the very practical category. Meanwhile , the use of module show positive impact to student learning outcomes of 75.9% are in the good category. Based on these data, the module ethnomathematics based on Pancasila student profile on flat and solid geometry material proven to be very valid, practical, and shows impact positive on student learning outcomes so that worthy used in learning.

Keywords: Ethnomathematics; Context; E-Module; Flat Side Geometry; Pancasila Student Profile

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INTRODUCTION

Utilization of learning media and resources Study is part from components that influence the learning process (Satriawati, 2015). Learning media includes all forms of media used to assist teachers in carrying out learning activities. Learning media in essence is means delivery information from communicator (teacher) to communicant (student) as recipient (Saleh, et al., 2023). Instructional Media should customized with condition students and teaching strategies used by teachers (Gerard, et al., 2022). Good learning media should easy operated, delivered easy instructions understandable, and easy understood by students (Satriawati, 2015).

The achievement of learning objectives is very dependent on the learning process experienced by students. Learning process will more effective and successful if educator capable create appropriate learning media with material and level age participant educate (Hasan, et al., 2021). In addition to being required For careful in carry out method learning, teachers must also capable choose learning media that makes it easier delivery material (Wahid, 2018). Especially for mathematics material which is often considered abstract by students. The difficulties that exist in learning mathematics demand teacher creativity for develop learning Good from aspect method and the media used (Hasiru, et al., 2021). Learning media can in the form of teaching materials, including all material or tools used in the learning process (Febriana, et al., 2020). The availability of teaching materials is one of the factors that

influences the quality of learning. Teaching materials can be categorized into printed and non-printed teaching materials. Printed teaching materials include learning modules.

The module contains information that covers the achievement and assessment of certain knowledge and skills needed by students. The module functions as a learning tool or media that includes content, methods, limitations, and evaluation approaches that are designed systematically and attractively. The module emphasizes role active students, allowing they For Study in a way independent without teacher assistance (Suprihatiningsih & Annurwanda, 2019).

Mathematics learning modules often do not include local cultural elements and values. In fact, mathematics and culture is two mutual things related (Safitri & Sulistyorini, 2023). Each culture has its own way of developing mathematics, so that mathematics is the result of human thought in everyday activities. With thus, mathematics can understood as product culture which is results abstraction thought man and tool help breakdown problems (Soebagyo, et al., 2021). By including cultural elements and values, students not only gain insight into mathematical concepts, but also learn folklore, traditions, and other forms of local wisdom. Ethnomathematics-based learning is an approach that emphasizes student activities while still integrating the diversity of their cultural heritage into mathematics learning. Learning mathematics through approach ethnomathematics give impact positive to ability mathematics participant Educate (Pratiwi & Pujiastuti, 2020). Learning based on culture divided become three aspect that is Study about culture, learning with culture, and learning through culture (Sintiya, et al., 2021).

Ethnomathematics is one of form mathematics rooted in culture, which is capable of connect education with elements culture (Utami, et al., 2018). According to D'Ambrosio, one of the goals of ethnomathematics is to show that there are various ways to practice mathematics by considering mathematical knowledge in academic fields, which have been developed by various sectors of society using various methods or approaches. Various culture formulate practice mathematics they with various way, such as grouping, counting, measuring, designing building or tools, games, and others (Sintiya, et al., 2021). In the sense others, ethnomathematics is activities involving numbers, patterns geometry, calculations and so on which are considered as implementation knowledge in field mathematics involving culture local (Pusvita, et al., 2019). Learning mathematics based on culture required For transform values culture in build character nation through approach ethnomathematics (Romadoni, 2017).

Expanding the use of ethnomathematics that is adapted to the diverse cultural backgrounds of students and the practical application of mathematics in everyday life can bring mathematics closer to its environment. This Because in a way no direct ethnomathematics functioning as activities that convey values culture and education mathematics (Wijayanto, 2017). Teachers need to be more creative so that students can understand mathematics as an interesting and enjoyable subject. Through ethnomathematics, learning will more impressive Because at a time introduce tradition and culture local which is still recognized and practiced by the group public certain (Putri, 2017).

Ethnomathematics is the approach that has been Lots developed For connect mathematics with culture local (Soebagyo, et al., 2021). Various study has explore implementation ethnomathematics in learning mathematics, such as utilization game traditional (Pratiwi & Pujiastuti, 2020) and artifacts culture (Safitri & Sulistyorini, 2023). However, research previously more lots focus on relationships between culture and concept mathematics, but not yet in a way explicit link it with development character student based on Profile Pancasila Students . In addition, research the nature explorative, for example identify draft geometry in game traditional or artifact culture, but not yet develop product concrete like module learning that can direct used in class.

Based on results observation through interview with math teacher Class VIII of SMP Negeri 2 Bojonegoro, learning media used in schools the Still in the form of book print and

students worksheet (LKS), while module Not yet utilized in the learning process. The teacher also mentioned that student tend more active participate and be enthusiastic in Study when material served with use tool props or media in the environment around. However, the limitations use of media based wisdom local in learning mathematics cause student not enough capable connect concepts learned with experience real them. Besides that, not yet existence module based on integrating ethnomathematics culture local Bojonegoro make learning not enough contextual and not yet fully support development Profile Pancasila Students. Therefore that, is needed development module learning mathematics based on ethnomathematics that is not only help student understand draft mathematics in a way more meaningful but also grow appreciation to culture local as well as skills 21st century.

This study do approach new with develop module ethnomathematics based on profile Pancasila students on the material geometry flat and solid. This is because of learning Geometry is an important part of the educational curriculum taught from elementary school to college, so it needs to be studied in more depth (Huda, 2018). This module designed No only For help student understand draft mathematics through culture local Bojonegoro, but also for to plant character in accordance with Profile Pancasila students, such as think critical, creative, and work-oriented same. Approach This different from study previously Because in a way explicit merge aspect ethnomathematics with learning character, which has not been Lots applied in curriculum Mathematics. Profile Pancasila students emphasize six dimensions main, namely faithful and pious to God Almighty, global diversity, mutual cooperation, independence, reasoning critical, and creative. Values This in line with draft ethnomathematics Because both of them put forward wisdom local, work The same in understand draft mathematics from various perspective culture, as well as build better understanding deep through experience real (Utami, et al., 2018). With integrate Profile Pancasila Students in module this, learning mathematics No only become more relevant in a way culture, but also helps to form character student in accordance with vision education national. Research This done as an effort to formulate better learning content and approaches. Thus, this study aimed for develop and evaluate module based on combining ethnomathematics wisdom local Bojonegoro and Profile Pancasila Students. Research This evaluate validity, practicality, and impact to results Study students. This module is designed to be easily accessible and understood by students, making it easier for students to study independently at home.

METHOD

The research flow must be presented in this section complete with image captions. Research Images This is development research that utilizes the ADDIE development model. The ADDIE model was chosen Because its systematic and effective structure in development module education, ensuring improvement repeating on every stages (Hidayah, et al., 2019). The subjects of the study included mathematics teachers and 9 students of class VIII-B in a small group test to assess the practicality of the e-module, and 29 students of class VIII-C in a field test to evaluate the potential impact of the e-module on learning outcomes. The stages of the ADDIE development model applied in this study are presented in Table 1.

Table 1. Stages of the ADDIE Development Model

Stages	Description
Analysis	This stage includes Competency or Curriculum Analysis, Student Character Analysis, and Media Analysis.
Design	This stage includes the creation of module framework, module map, draft material, draft layout and research instruments. The collection of images related to the context of local wisdom of Bojonegoro is also carried out at this stage.
Development	This Stage Includes Product Creation and Validation Testing.

Stages	Description
Implementation	This stage includes practical tests and exams to determine the potential impact of the module on learning outcomes.
Evaluation	This stage is carried out to analyze the practicality and effectiveness of the modules that have been developed.

Data collection techniques in this study include interviews, validation questionnaires, response questionnaires, and learning outcome tests. Interviews were conducted to fulfill the needs analysis at the analysis stage. Interviews are a data collection technique used when researchers intend to conduct preliminary research to identify problems that need to be studied (Sugiyono, 2016). This interview is intended to obtain initial information, suggestions, and input that researchers can use as considerations for developing products.

The validation questionnaire was given to the validator during the development stage to assess the validity of the e-module. This questionnaire uses a Likert scale instrument, presented in the form of a checklist (✓) for answers that are in accordance with the opinions of experts on the questions given. The alternatives include: a score of 5 indicating "very good" (VG), 4 indicating "good" (G), 3 indicating "fair" (FG), 2 indicating "bad" (P), and 1 indicating "very bad" (VP) (Riduwan, 2015). Response questionnaires were given to teachers and students (small groups) during the implementation phase to measure opinions regarding enjoyment, interest, relevance, and ease of understanding the material. The questionnaire for teachers used a Likert scale instrument, requiring them to tick the appropriate response. Scores of 5, 4, 3, 2, and 1 correspond to "very good" (VG), "good" (G), "fair" (FG), "bad" (P), and "very bad" (VP) respectively (Riduwan, 2015). The questionnaire for students used the Guttman scale, which asks students to evaluate statements by marking their responses. The scoring is binary, with "Yes" being scored 1 and "No" being scored 0.

Tests are given to students (field tests) during the implementation phase to determine the potential impact of the module on learning outcomes. A test is an evaluation tool commonly used in education to measure student achievement during the learning process (Arruarte, et al., 2021)

The data analysis technique used in this study is qualitative descriptive analysis. The validity of the module is determined from the questionnaire score filled out by the validator, then the level of validity is determined. The practicality of the e-module is obtained from the response questionnaire score filled out by the user (teachers and students), then the level of practicality is determined. Data obtained from the trial results are used to determine the potential effects of the developed module. This is done by calculating the number of students who achieve completeness, calculating the percentage of classical completeness, and categorizing it according to predetermined criteria.

RESULTS AND DISCUSSION

This study uses the ADDIE development model which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation.

Analysis Stage

This stage covering analysis curriculum, analysis characteristics participant education, and media analysis (Tege, et al., 2014). The curriculum analysis is based on the curriculum used at SMP Negeri 2 Bojonegoro, namely Independent Curriculum. Planar and spatial geometry materials for Grade VIII even semester are adjusted to the Learning Outcomes (CP) and Learning Programs (ATP) set out in the Independent Curriculum content standards.

Analysis of student characteristics was conducted through interviews with grade VIII mathematics teachers to determine students' learning styles and attitudes towards mathematics. This ensures that the teaching materials developed are in accordance with student

characteristics. In line with what was stated by (Aulia, et al., 2024) the results of this study showed that students were more involved and enthusiastic in learning when the material was presented using media or aids related to their daily environment. In addition, the learning process that was not fully carried out in class and irregular class schedules caused students' motivation to complete homework to decrease.

Design Phase

Activities at this stage include preparing teaching materials, media, and instruments research (Hidayah, et al., 2019). In this study, the design stage includes the creation of a module framework consisting of two learning activities, namely a module map for flat geometry and spatial geometry, a draft of material derived from the module map, a layout draft, and a research instrument to evaluate the module in terms of validity, practicality, and its potential influence on learning outcomes. The purpose of product validation is to ensure that the developed teaching materials meet a high level of validity, making them suitable for trial implementation in learning" (Putri, et al., 2024).

Development Stage

At the stage development , designs made at the development stage previously realized in form concrete (Purnasari, 2020). This involves translating design specifications into physical module prototypes. The module is developed based on a previously created module framework and consists of the following components.

Cover, includes the module title, subject, topic/learning material, grade level, author, and school logo. Module Identification and Foreword, contains details about the author, designer, and year of creation, along with an introduction from the author who developed the module. Table of Contents, provides an outline of the module structure. The layout of the cover, foreword, and table of contents can be seen in Figure 1.

Figure 1. Cover, Foreword, and Table of Contents

The introduction section provides a brief overview of the module. The instructions section use module containing guide general For learn module at a time merge a number of component profile Pancasila students. The ethnomathematics section explains the concept of ethnomathematics, combining cultural elements with mathematical material. The layout of this module was adapted from development research (Putri, et al., 2024), namely an ethnomathematics module based on Pancasila student profiles. The layout part introduction, instructions use modules, and ethnomathematics sections can be seen in Figure 2.

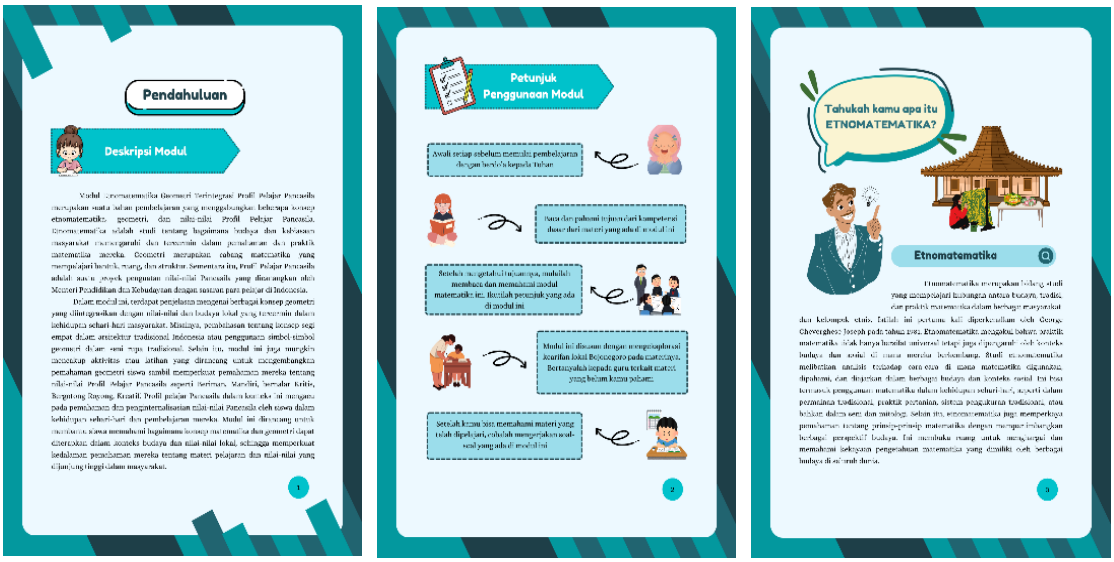

Figure 2. Introduction, Instructions for Using the Module, and Ethnomathematics

Pancasila students profile section load symbols and explanations for every element profile Pancasila students. The CP (Learning Achievements) and ATP (Learning Objective Flow) sections describe the achievements and objectives to be achieved after studying the module material. Learning Objective Flow is a series of learning objectives that have been arranged systematically and logically in the complete learning achievement phase from the beginning to the end (Manalu, et al., 2022). Layout part profile Pancasila students, achievements learning, and learning objectives can be seen in Figure 3.

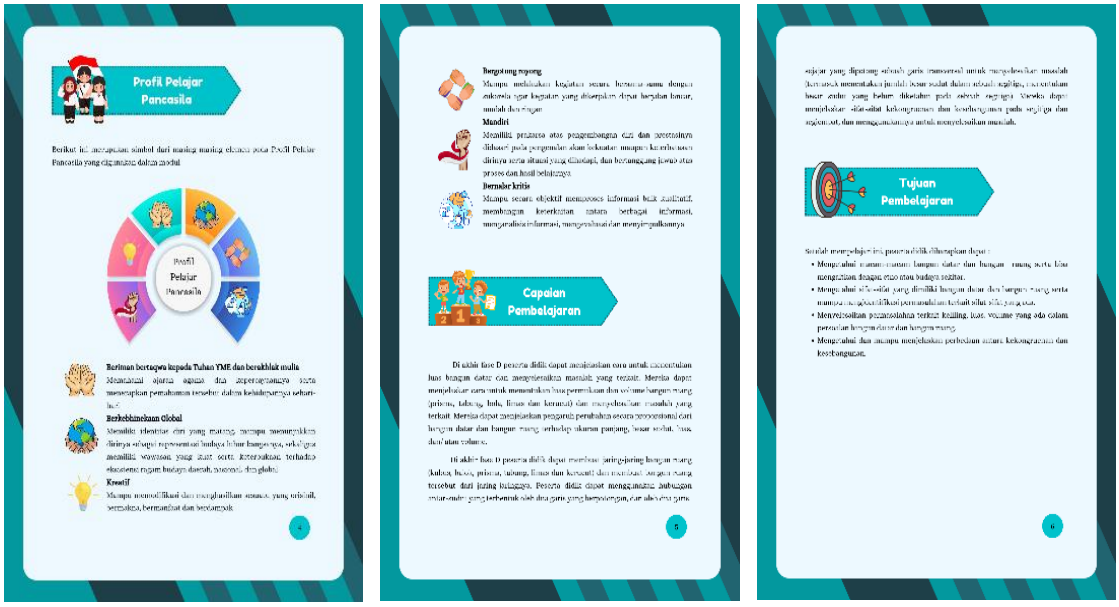

Figure 3. Pancasila Student Profile, Learning Achievements, and Learning Objectives

Pre-Test, Apperception, and Concept Map is as following: Pre-Test, contains exam questions given before studying the module. The aim is to assess students' initial knowledge. Apperception, provides description general about material to be studied, helping students prepare themselves mentally for the topics. Concept Maps, presenting a brief sequence of the material outlined in the module. A concept map is a visual diagram designed to present learning material, aiming to enhance students' cognitive function so that the content can be understood more effectively and efficiently (Syawaludin & Sutama, 2020). Layout part pre-test, apperception, and map draft can seen in Figure 4.

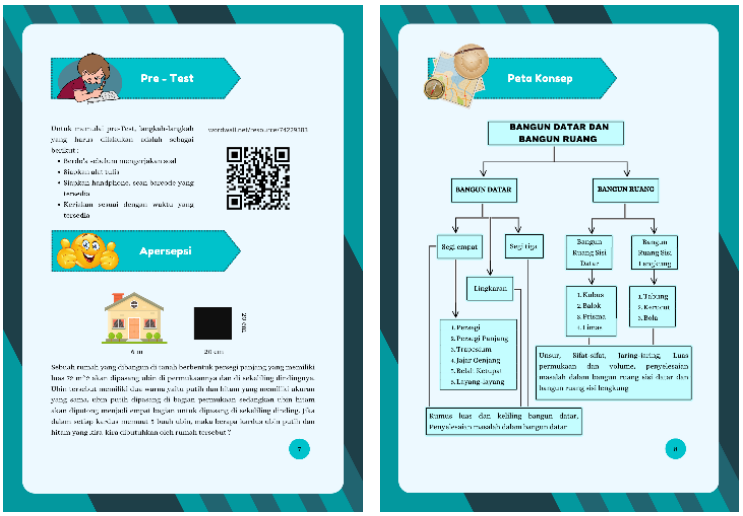

Figure 4. Pre-Test, Apperception, and Concept Map

Material Explanation section, examples questions and activities reasoning critical is as following: Explanation material, giving knowledge about flat and solid geometry material, associated with ethnomathematics and wisdom local Bojonegoro. Sample questions, containing sample questions and their solutions to help students understand the material better. Critical reasoning activities, containing questions designed to improve students' critical reasoning skills. Critical thinking is a skill in analyzing information logically, evaluating arguments objectively, and making decisions based on rational reasons and supported by appropriate evidence (Mislah, et al., 2024). These questions also challenge students to develop their creativity. The layout of the material explanation section, sample questions, and critical reasoning activities can be seen in Figure 5.

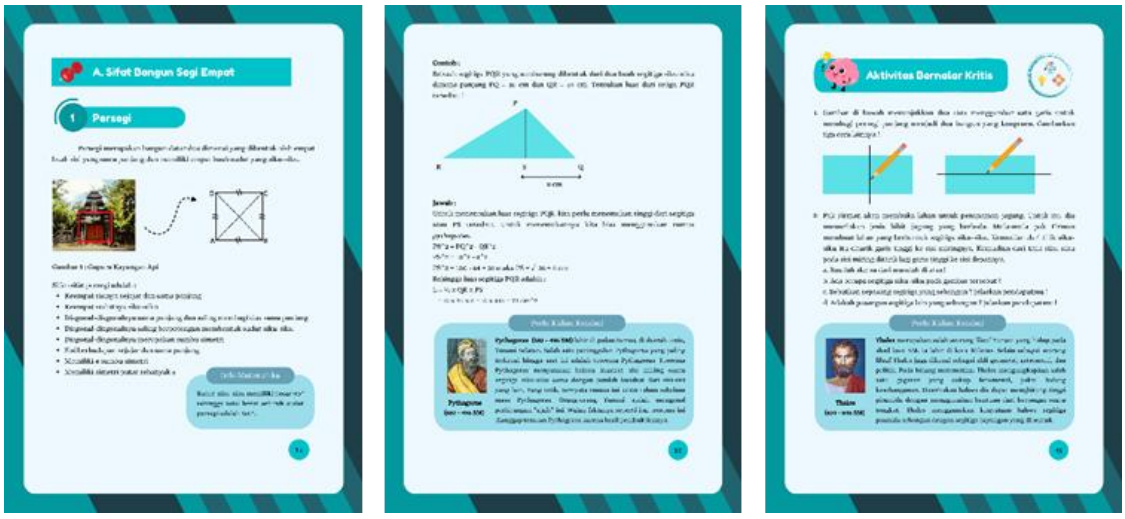

Figure 5. Explanation of Material, Example Questions, and Critical Thinking Activities

Competency test section, glossary, and bibliography is as the following: competency test, contains purposeful questions For evaluate understanding and mastery student to material covered in the module. glossary, containing definitions of terms, difficult words, and concepts that are not yet understood that are used in the module, arranged alphabetically, bibliography, containing sources and references used by the author in developing the module. The layout of the competency test section, glossary, and bibliography can be seen in Figure 6.

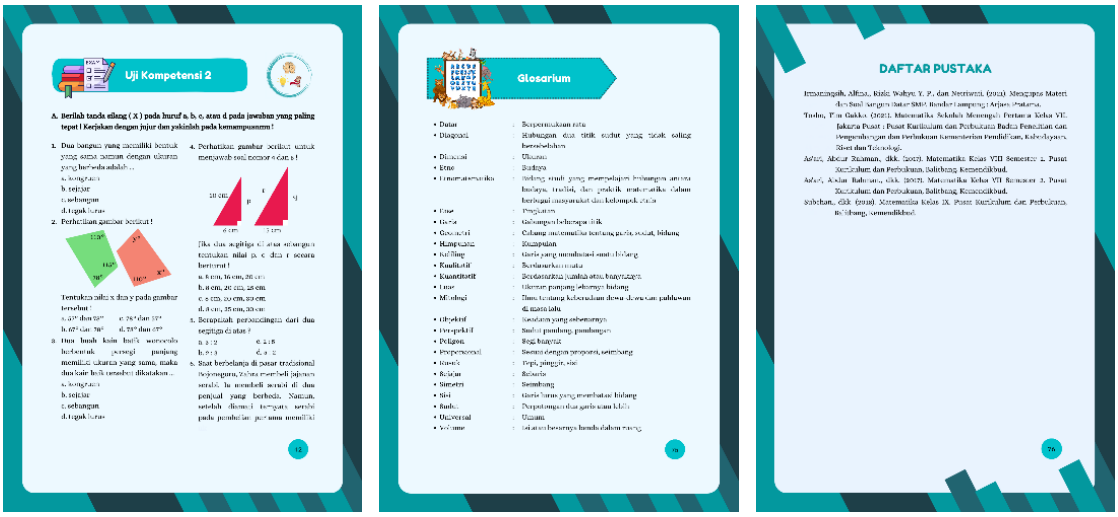

Figure 6. Competency Test, Glossary, and References

Next, the module prototype underwent a validity test that focused on aspects of media feasibility and content suitability by validators (media experts and content experts). The following are the results of the module validity based on the validator's assessment.

Table 2. Expert Validity Results

Validators	Validity Value (*Aiken V*)
Media Expert	0.82
Ingredients The experts	0.85

Based on interpretation Aiken's V results, $V < 0.6$ = Less valid, $0.6 \leq V < 0.8$ = Quite valid, $V \geq 0.8$ = Very valid, as according to (Aiken, 1985) an Aiken index value above 0.80 indicates high agreement between validators. Results evaluation media expert, validity module from aspect The suitability of the media obtained Aiken's V = 0.82 which means it is in the very valid category. Based on evaluation material expert, validity module from In terms of material suitability, Aiken's V = 0.85 was obtained, which means it is in the very valid category.

Implementation Stage

Apsari & Rizki (2018) trials can be conducted on students, namely limited to small group trials. After the module is declared very valid and has been revised based on suggestions from the validator, the module is then tested on teachers and students (small groups) to determine its practicality based on users (teachers and students). After being declared practical, the module is used in classroom learning activities (field trials) to determine the potential influence of the module on student learning outcomes.

Evaluation Stage

At the evaluation stage, an analysis was carried out on the user response questionnaire (teachers and students) to determine the practicality of the module and a trial of student learning outcomes to determine the potential influence of the module on student learning outcomes. The following are the results of practical responses from users (teachers and students) to the module that has been developed.

Table 3. Results of User Practicality Response Questionnaire

Respondents	Practical Results
Teacher	84%
Student	97.2%

Based on the results of the calculation of the teacher's practicality questionnaire, it showed a positive response to the module of 84% with the criteria of very practical and the student's practicality questionnaire also showed a positive response to module of 97.2% with very practical criteria. Practicality high module (97.2 %) shows its uses in the environment class real. In line with the research results (Pratiwi & Pujiastuti, 2020) regarding exploration ethnomathematics in games traditional marbles. That research show game marbles and its relationship to geometric concepts (circles, spheres, triangles) as well draft distance, which can be used in learning. This supports idea that culture can be integrated into mathematical materials to make learning more contextual and interesting. However, the research nature descriptive and does not present quantitative data on improvements students' mathematical understanding after use game marbles as a learning medium.

Meanwhile, to find out potential the influence of e-modules to student learning outcomes using statistical tests descriptive and with Minimum Completeness Criteria. Students are declared complete if their learning outcomes are more than or equal to the applicable KKM (Minimum Completeness Criteria) score, namely 70 (Sintiya, et al., 2021). From the test results obtained as many as 22 students (75.9%) were included in the completed category, and as many as 7 students (24.1%) were included in the uncompleted category. So, it can be concluded that the module that has been developed own potential influence to student learning outcomes are in the good category. Furthermore, analysis is carried out using one sample t-test for to test whether the average learning outcomes of students who use e-modules in a way significantly higher from the Minimum Completion Criteria (KKM) 70. The t-test results show that t-count = 3.21 while t-table = 2.04 at the level significance of 0.05. Because t-count > t-table and p-value = 0.002 < 0.05, it can be concluded that e-module usage influential significant to improvement student learning outcomes. This is confirmed by research (Dewi, et al., 2024) where the t test results obtained a Sig value. (2-tailed) 0.00<0.005 with a t-count of 15.628, test) which shows that there is a significant difference, so that the use of e-modules is proven to be effective in improving student learning outcomes in the material for testing the validity and reliability of instruments in the high effectiveness category.

CONCLUSION

The research on the development of this module produced a mathematics companion book based on Pancasila student profiles that discusses the material of flat and spatial figures for grade VIII junior high school students. This module is contextualized in the local ethnomathematics wisdom of Bojonegoro. The development of an ethnomathematics module based on Pancasila geometry material student profiles includes the analysis stage (curriculum analysis, analysis of student characteristics, and media analysis), the design stage (creation of module frameworks and research instruments), the development stage (module preparation and validity testing), the implementation stage (small group trials and field trials), and the evaluation stage (analysis of teacher and student response questionnaires). Based on the results of the validity test from experts, the ethnomathematics module based on local wisdom of Bojonegoro City on the material of flat and spatial figures for grade VIII junior high school shows high validity (Media = 0.82; Materials = 0.85), practicality (Teachers = 84%; Students = 97.2%), and effectiveness (mastery level 75.9%). This module has proven to be very valid, practical, and shows a positive impact on student learning outcomes, making it suitable for use in learning.

RECOMMENDATION

The challenge in the application module of ethnomathematics based on local wisdom of Bojonegoro City on the material of solid and flat shapes is the small number of samples (N = 29) so that it can limit generalization. Therefore, further research is needed to expand the sample to include several schools. Further research should examine the long-term effects of

retention of ethnomathematics-based modules and expand their application to other cultural contexts. Researchers in various regions are advised to continue ethnomathematics research on local culture, be it historical heritage, traditional games, traditional dances, regional specialties, and so on. The cultural elements that are raised are expected to improve students' understanding of learning mathematics not only limited to geometric material but also exploring other mathematical topics.

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