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Development of E-Module Based on Ethnomathematics to Improve Problem Solving Skills on Integer Material for Class VI Elementary School Students

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Abstract. This research aims to develop an ethnomathematics-based E-Module as a solution to enhance students' problem-solving abilities, particularly in integers for sixth-grade students. The study employs a Research and Development (R&D) approach using the ADDIE development model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. This method integrates local cultural elements to strengthen the relevance and understanding of mathematical concepts among students. The research findings indicate that the ethnomathematics-based E-Module effectively improves students' problem-solving skills. During the pretest stage, the average student score was 70.30 with a proficiency rate of 40.75%, which increased to 85 with a proficiency rate of 86.88% in the posttest after using the E-Module. Expert evaluations also confirm the module's high suitability for educational contexts, with validation scores ranging from 85-95%. Furthermore, the E-Module not only facilitates students' understanding of integer concepts but also enhances their problem-solving skills through culturally relevant approaches. The implications of this research suggest further development in mathematics education by leveraging technology to enhance student engagement and understanding.

Keywords: Ethnomathematics-based E-Module, student skills, problem-solving, integer concepts

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INTRODUCTION

Learning mathematics in elementary schools requires the right approach so that students can master problem solving skills well. Problem solving skills are one of the crucial competencies in mathematics, because they not only require mastery of concepts, but also the ability to apply these concepts in different problem contexts (Afriliziana et al., 2021; Vitriani et al, 2023). Ethnomathematics is one approach that provides solutions to integrate cultural and local contexts in mathematics learning. Ethnomathematics views mathematics as part of human culture and emphasizes the use of cultural context as a tool for teaching mathematical concepts. Mathematics is not only a product of the human mind but also a reflection of local culture and wisdom (Kurniasari et al., 2018; Irawan, Lestari, & Rahayu (2022).

The reality of mathematics learning in elementary schools often does not fully implement an approach that focuses on understanding and problem-solving skills (Afriliziana et al., 2021; Heswari et al., 2021). Many mathematics curricula still focus on routine teaching and mastery of algorithms, without giving enough time and attention to developing a deep understanding of mathematical concepts and problem-solving skills. This can result in students only memorizing procedures without truly understanding the application and significance of what they are learning (Widiantari et al., 2022). The lack of focus on problem-solving can also reduce students' ability to apply mathematical concepts in real-life contexts, limiting the development of their critical and creative thinking skills.

E-modules based on ethnomathematics offer an innovative approach to improving students' problem-solving skills in grade VI integer material (Widiantari et al., 2022). The ethnomathematics approach allows integration between mathematics and students' local culture, making learning more relevant and interesting for them. By incorporating students' cultural and daily life contexts into learning, this e-module can help students understand mathematical concepts more deeply and meaningfully (Erva et al, 2022).

E-modules based on ethnomathematics can provide case studies or examples related to students' local culture in solving mathematical problems (Rizal et al., 2021; Setiana & Nuryadi, 2022; Erva, Yulia & Nisa, 2022). This not only facilitates concrete understanding of concepts but also builds students' critical and creative thinking skills as they relate mathematics to their daily experiences and lives. E-modules can be designed to offer interactive activities and simulations that support problem solving (Kurniasari et al., 2018; Rizal et al., 2021). For example, students can be asked to solve problems related to real-life situations that are relevant to their lives, such as household financial problems or traditional farming. This not only helps them understand the applications of mathematics in everyday life but also increases their confidence in using mathematical skills to solve real-world problems.

By integrating ethnomathematics-based e-modules into mathematics learning, we can expect significant improvements in students' problem-solving skills, while strengthening the link between the mathematics curriculum and the realities of their lives (Suryaningsih & Putriyani, 2022). However, successful implementation requires strong support from schools, trained teachers, and adequate technological infrastructure to ensure that E-Modules can be utilized effectively in the learning process. Schools need to adopt policies that support the integration of technology into the curriculum and provide adequate means for access and use of digital modules. Trained teachers can harness the full potential of E-Modules by developing technology-oriented teaching strategies, facilitating module-based discussions and activities, and providing support and guidance to students in their use. In addition, it is important for schools and teachers to continuously evaluate and adjust E-Modules according to student needs and responses (Ratriana et al., 2021; Nisa et al, 2022).

Maintaining relevant and up-to-date content in the module as well as implementing student feedback and periodic evaluation can improve the effectiveness and relevance of the module in supporting learning objectives. Thus, collaborative efforts between schools, teachers, and technology developers will provide a solid foundation for successful and sustainable implementation of E-Modules in mathematics education.

The module is a learning resource that can help students become independent in learning. The developed module is designed to be adjusted to the criteria of a good module, namely self-instruction, self-contained, stand-alone, adaptive and user friendly.

Previous studies have shown that the application of ethnomathematics approaches can improve students' interest and understanding of mathematics. For example, research by Nugraha & Novaliyosi (2023) on the use of geometric structures in African culture shows that this approach can provide a more vivid and meaningful picture for students in understanding geometric concepts. Likewise, research by Afriliziana et al. (2021), which highlights the importance of incorporating culture into mathematics learning to motivate students from diverse ethnic backgrounds. The purpose of this study is to develop an ethnomathematics-based mathematics e-module as a solution to improve students' problem-solving abilities, especially in integer material in grade VI of elementary school.

METHODOLOGY

This study uses a research and development method that aims to create and test the effectiveness of a particular product. The model used for module development is the ADDIE model, which applies a systematic approach by dividing the planning process into several steps, so that the steps are arranged logically based on the input and output of each stage. The ADDIE model development process involves evaluation by a team of experts, individual testing, and limited and large-scale trials, followed by revisions to refine the final product, so that the product developed meets the established criteria and has been thoroughly tested (Rahmaniah & Zainuddin, 2023). The ADDIE model consists of five stages of product development according to previously conducted research which can be seen in Figure 1.

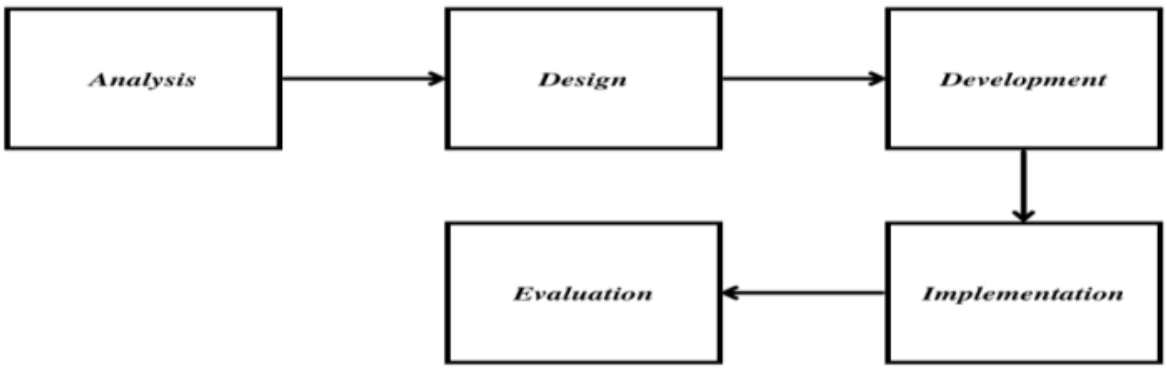

Figure 1. Model ADDIE (Rahmaniah & Zainuddin, 2023)

This development uses assessments from media experts, material experts, and practitioners. With the results of these calculations, what will be done in the final step is to conclude the results of the calculations and present them according to the following criteria:

Table 1. Presentase & Result Criteria

Presentase	Criteria
76% - 100%	Very Worthy
51% - 75%	Worthy
26% - 50%	Quite Worthy
0% - 25%	Less Worthy

RESULTS AND DISCUSSION

This study develops an ethnomathematics-based E-Module to improve students' problem-solving skills on integer material in grade VI. The development of this E-Module uses the ADDIE model which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation.

First, the analysis stage is carried out by collecting data and information through observation and interviews at Gamol State Elementary School. The purpose of this activity is to obtain analytical materials regarding learning integers, understanding learning objectives, curriculum, and existing teaching materials. Students often have difficulty understanding integer arithmetic operations due to limitations in understanding basic concepts and the lack of available teaching materials. The existing textbooks from the government do not explain the material and formulas needed in detail. In addition, there has been no application of technology-based teaching materials such as digital modules in the school.

The results of structured interviews conducted with teachers also stated that the problem-solving skills possessed by students were still very low. The results of the interviews also showed that schools still had limited teaching materials as evidenced by the lack of variation in the teaching materials available, especially modules. The learning approaches used were also not varied, especially the ethnomathematics approach had not been implemented in mathematics learning. Based on the results of the needs analysis, it can be concluded that it is necessary to develop an ethnomathematics-based module to improve problem solving skills in elementary school mathematics learning.

Second, the design stage begins with compiling the analysis results, determining core competencies, basic competencies, learning objectives, and considering existing teaching materials. Based on this, learning activities are developed and a digital module draft is made. The developed e-module is expected to make it easier for students to access and understand the material via smartphones, as well as help them improve their understanding

and mathematical skills. The module is also designed by integrating ethnomathematics, namely by integrating local culture in Yogyakarta with mathematical material.

The module developed in this study has been adjusted to the criteria of a good module, namely developed with self-instruction criteria: the module is equipped with clear instructions, making it easier for students to learn independently without requiring assistance from teachers or parents. The module developed has also met the principle of self-contain: which is developed with complete material without relying on other learning resources. The module developed also meets the stand-alone criteria because it can be learned easily and clearly, and is developed according to the adaptive and user-friendly criteria.

Third, the stage of developing various activities such as understanding, reading, and practicing questions, which contain elements of ethnomathematics to link the material to local culture. Suggestions from validation experts are implemented, including the addition of instructions for working on questions, explanations of ethnomathematics concepts, and introduction of student books at the beginning of the module. Practice questions are also made more interactive to make it easier for students to work on questions.

Fourth, the implementation stage is carried out by testing the developed module activity on grade VI students of Gamol State Elementary School. The trial was conducted to assess the effectiveness of the module in helping students understand integer material and apply problem-solving skills. Feedback from students and teachers was collected to assess the success of the module in the context of real learning. The next results are seen from the implementation stage, namely conducting a limited trial on 25 students. The limited test was carried out by giving a pretest and posttest to work on the questions contained in the e-module that had been developed. That way, this stage will show the results of how high the level of effectiveness of the ethnomathematics-based digital mathematics module is in improving students' skills in problem solving. The percentage level of the results obtained in this digital module is.

Table 2. Results of Pretest and Posttest of Student Completion

Activities	Average Value	Completion
Pretest	70,30	40,75%
Posttest	85	86,88%

Based on the pretest results, it can be seen that the development of ethnomathematics-based E-Module has a positive influence on students' problem-solving skills in integer material in grade VI. In the early stages, a pretest was conducted to measure students' initial abilities before using the E-Module. The pretest results showed that the average student score was 70.30 with a completion percentage of 40.75%. This value indicates that students still do not fully understand the concept of integers and are less familiar with solving problems related to the material. Based on the posttest results after using the ethnomathematics-based E-Module, a posttest was conducted to assess the improvement in students' abilities. The posttest results showed that the average student score increased to 85 with a completion percentage of 86.88%. This shows that after learning using the E-Module, students can understand the concept of integers better and are able to solve problems effectively. Comparison of the pretest and posttest results showed a significant increase in students' problem-solving skills.

The percentage of completion increased from 40.75% to 86.88%, and the average student score increased from 70.30 to 85. This indicates that the ethnomathematics-based E-Module is effective in helping students understand integer material and improving problem-solving skills. At the evaluation stage, this E-Module has been carried out by experts including media, material, and practitioner validation. The criticisms and suggestions given are used to revise and improve the E-Module. The validation results by media experts show a total score of 85 with a percentage of 85%, material experts give a total score of 90 with a percentage of 90%, and practitioner experts give a total score of 95 with a percentage of 95%. This evaluation indicates that the module is very feasible and in accordance with learning objectives.

The results of the study indicate that the development of ethnomathematics-based E-Module successfully improved students' problem-solving skills in integer material in grade VI. This E-Module combines local cultural elements with mathematical concepts, creating a relevant and interesting context for students. This is in line with the theory that cultural context can facilitate more meaningful learning by making the material easier to understand and relevant to students. The increase in the average score from 70.30 in the pretest to 85 in the posttest indicates that the ethnomathematics approach helps students understand the concept of integers more effectively. The ADDIE model used in the development of the E-Module consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. Each stage contributes significantly to the final quality of the module. The analysis stage provides an in-depth understanding of student needs and deficiencies in existing teaching materials. The design and development stages produce a well-structured module that is tailored to core competencies and learning needs. The implementation of the module trial on students and evaluation by experts ensure that this E-Module is effective and feasible to use in real learning

contexts. Expert validation showing high scores also confirms that the module development process is running according to plan and producing products that meet learning standards (Yuniharto, Pardimin, & Nisa, 2024).

The increase in the percentage of completion from 40.75% in the pretest to 86.88% in the posttest indicates that the E-Module not only improves students' understanding of integers but also their problem-solving skills. This module is designed to be interactive and easily accessible via smartphones, making it easier for students to access and understand the material anytime and anywhere. By integrating activities containing ethnomathematics elements, this module has succeeded in making students more interested and motivated in learning integer material, which was previously considered difficult (Heswari et al., 2021; Kurniasari et al., 2018). The integration of ethnomathematics in the E-Module allows students to see mathematics as part of their daily lives. The cultural context included in the module helps students relate mathematical concepts to their own experiences, which strengthens their understanding of the material. The use of local cultural elements not only makes the material more interesting but also increases the appeal of learning and student engagement.

This supports the view that culturally relevant teaching can increase student engagement and facilitate deeper understanding. The findings of this study are supported by other studies that show the great potential of technology-based E-Modules, especially those integrating cultural elements, in increasing learning effectiveness (Nurmaya, 2021; Rahmaniah & Zainuddin, 2023). Digital modules provide flexibility and accessibility that cannot be achieved by conventional teaching materials (Afriliziana et al., 2021; Irawan et al., 2022; Nadhilah et al., 2020; Setiana & Nuryadi, 2022).

The studies mentioned above consistently show that the use of technology-based E-Modules, integrated with local cultural elements, has a significant positive impact on learning (Rahmaniah & Zainuddin, 2023; Suranti, 2022). This approach not only helps strengthen students' understanding of mathematical concepts but also increases their motivation and engagement in the teaching and learning process (Fitra & Maksum, 2021; Manalu et al., 2022). For example, the ethnomathematics approach not only allows students to see the relevance of mathematical concepts in their own cultural context but also increases their confidence in solving complex problems. In addition, the advantages of digital modules in providing flexibility and accessibility are important factors in overcoming obstacles that are often experienced in traditional learning (Afriliziana et al., 2021). Students can access materials independently, follow their own learning rhythm, and use various interesting media to deepen their understanding (Sintiya et al., 2021; Suryaningsih & Putriyani, 2022; Susilowati, 2022).

Thus, the use of technology in education not only increases learning efficiency but also creates a more inclusive and engaging learning environment for students from various cultural and environmental backgrounds. For the future, it is recommended that the development of digital teaching materials consider approaches that are relevant to students' culture to increase engagement and understanding (Arafik et al, 2022). In addition, providing training for teachers to optimize the use of E-Modules can further increase the effectiveness of their implementation in daily learning (Heswari et al., 2021). Further studies can also explore the application of ethnomathematics in various topics and levels of education to understand its broader impact.

This is also an implementation of learning based on the technological pedagogical content knowledge (TPACK) approach which is believed to be able to equip students to adapt in the 21st century, including honing students' abilities to have high creativity, as well as honing students' critical reasoning (Ningsih, Nisa & Bariyah, 2024).

This is also supported by research conducted by Winarsih & Nisa (2024) which explains that the integration of technology in the learning process can improve critical reasoning in elementary school students. The use of this technology can be done to hone students by presenting various cases that can be visualized through videos, images, or other visualizations so that they can help students concretize the objects being studied.

In addition to increasing students' creativity and critical reasoning, the use of technology can also increase student activity in the learning process. This is because through the use of technology, learning becomes interesting and not boring. This is in accordance with research conducted by Handoyo & Nisa (2023) which states that the use of technology in learning in elementary schools can increase student activity in the learning process.

The weakness of this research is that it is still limited to one approach, namely ethnomathematics, and is still limited to improving students' problem-solving skills. Input for further research is that variations in teaching materials can be developed with a variety of approaches to improve the quality of learning, especially mathematics.

CONCLUSION

The development of ethnomathematics-based E-Module has successfully improved students' problem-solving skills in integer material in grade VI. This module, which integrates mathematical concepts with local cultural elements, provides a relevant and interesting context, making it easier for students to understand the material and apply problem-solving skills. The implementation of this E-Module showed a significant increase in students' understanding and skills, and received very positive assessments from experts, indicating that

this module is effective and feasible to use in learning. Its interactive features and accessibility through digital devices also allow students to learn more flexibly and efficiently, making learning more contextual, meaningful, and increasing their engagement with the material.

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