Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram
https://e-journal.undikma.ac.id/index.php/prismasains/index
e-mail: prismasains.pkpsm@gmail.com

July 2025. Vol. 13, No. 3
p-ISSN: 2338-4530
e-ISSN: 2540-7899
pp. 649-661

Development of PBL Integrated Ethnomathematics Learning Tools to Develop Mathematical Problem-Solving Skills in Elementary School

*** Risma Firda Diana, Pratama Surya Bagus Kususma**
Faculty of Tarbiyah, Institut Al Fithrah Surabaya. Jl. Kedinding Lor No.30, Surabaya, Indonesia. Postal code: 60129.
*Corresponding Author e-mail: rismafirdiamtk@gmail.com

Received: May 2025; Revised: July 2025; Published: July 2025

Abstract

The low mathematical problem-solving ability of elementary school students is a crucial issue in mathematics learning that has not been optimally addressed. Initial studies suggest that existing learning tools lack cultural context and integration of innovative learning models. Previous research has focused on partial or higher grade levels, leaving gaps in the development of comprehensive problem-based tools for early grade students with local contexts. This research aimed to create Problem-Based Learning (PBL) tools that incorporate ethnomathematics, with the goal of improving students' mathematical problem-solving skills effectively, practically, and authentically, by utilizing the ADDIE development framework. The research instruments used include learning tools, validation sheets, student response questionnaires, and teacher activity observation sheets. The results demonstrated the validity, practicality, and efficacy of the developed products. The mean percentage of validation for learning module, student response questionnaires, and mathematical problem-solving ability tests was 88.5%, 90%, and 85%, respectively, in the valid category. The average practicality score of the learning tools, assessed through student feedback questionnaires and learning implementation observation forms, was found to be 83.85%, which falls within the practical category. Additionally, the results from the mathematical problem-solving assessments indicated that 80% of the students achieved scores exceeding the minimum competency requirements.

Keywords: Learning tool, Problem Based Learning, Ethnomatematics

How to Cite: Diana, R. F., & Kusuma, P. S. B. (2025). Development of PBL Integrated Ethnomathematics Learning Tools to Develop Mathematical Problem-Solving Skills in Elementary School. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *13*(3), 649–661. https://doi.org/10.33394/j-ps.v13i3.15868

https://doi.org/10.33394/j-ps.v13i3.15868

INTRODUCTION

Students' mathematical problem-solving abilities are linked to their capacity to utilize mathematical concepts in addressing real-world issues. This skill is of particular importance for students to acquire from an early age, as it enables them to effectively navigate increasingly complex problems that arise throughout their lifetimes. A recent study by Hartatiana and Wardani (2021) revealed that problem-solving skills among Indonesian students remain below average (Hartatiana & Wardani, 2021). Moreover, the findings from the 2022 PISA test revealed a decline in the performance of Indonesian students, highlighting the need for greater emphasis on mathematical problem-solving skills (Wijaya et al., 2024). Furthermore, students will have good problem-solving skills if they are able to understand and define problems well so that they can find alternative solutions to those problems (Sinaga et al., 2023a). Students experience difficulties in understanding problems due to a lack of motivation, concentration, literacy, reasoning, and mathematical communication skills (A et al., 2024). Moreover, student motivation in participating in learning in the independent curriculum is still lacking, thereby creating obstacles to the achievement of mathematical problem-solving competencies (Diana et al., 2024). This issue demands significant focus, as inadequate mathematical problem-solving skills can impede students' preparedness for globalization and the challenges of the 21st century, which prioritize critical thinking abilities. Consequently, a pedagogical model is essential to assist students in enhancing their problem-solving skills.

Problem-Based Learning (PBL) is a highly effective educational approach that enhances students' mathematical problem-solving abilities by fostering their critical and creative thinking skills (Asmiyunda & Hardeli, 2023). As a student-centered learning model, PBL allows learners to engage with real-world issues, providing them with the chance to solve practical problems. This problem-solving framework is structured to promote critical and creative thinking while enabling students to apply mathematical concepts in relevant contexts. PBL has been demonstrated to assist educators in comprehensively elucidating mathematical concepts (Boye & Agyei, 2023). This is due to the fact that PBL facilitates the connection between mathematics and real-life contexts that are relevant to students, thereby making them more active and motivated to learn. However, the PBL model is not without its limitations if it is not integrated with a contextual approach that is appropriate to students' needs (Sumarni, 2013).

The implementation of the PBL model can be optimized through integration with ethnomathematics, which links mathematical concepts to students' local culture (Zaenuri et al., 2020). Ethnomathematics enables students to learn mathematics within their cultural context, making it more relevant and easier to understand. Research by Kamidah demonstrates that combining PBL with ethnomathematics can provide additional benefits in enhancing students' problem-solving skills, as it encourages critical thinking (Kamidah et al., 2023). The incorporation of ethnomathematics has been demonstrated to enhance the significance and enjoyment of mathematics education (Rodríguez-Nieto et al., 2025). By incorporating cultural contexts, students can relate mathematical concepts to their everyday experiences, which ultimately improves their critical thinking and mathematical problem-solving skills.

Effective learning requires appropriate models and approaches, as well as structured lesson planning to support the implementation of both (Zaini, 2018). An important aspect that constitutes the initial stage of instructional planning is the development of instructional materials such as the Lesson Plan (RPP), Student Worksheets (LKPD), and learning materials, which are key elements to ensure that instructional strategies can be effectively implemented in the classroom (Hanum, 2017). A series of observations and reflections on teaching practices in several elementary schools in Surabaya at the end of 2024 revealed critical issues hindering the optimization of curriculum objectives, particularly in the development of mathematical problem-solving skills. The prevailing tendency among teachers was to depend on ready-made teaching materials obtained from digital platforms such as Merdeka Mengajar, teacher collaborations, or ad-hoc adaptations. Despite the increased accessibility of these resources, there is often a lack of consideration for the unique characteristics and local contexts of students within each academic class. Consequently, mathematical learning becomes abstract, disconnected from students' reality, and fails to stimulate reasoning and the application of concepts in real-life contexts. This condition directly weakens efforts to develop students' mathematical problem-solving skills, which require relevant, adaptive, and concrete experience-based learning. Conventional pedagogical methods and non-contextual teaching tools have been shown to yield procedural understanding. However, the development of problem-solving skills, which require analytical and synthetic thinking capacities, is best cultivated through exposure to meaningful problems for students. Moreover, the tools required are not merely variations of existing ones, but rather those that deliberately integrate effective learning models such as Problem-Based Learning (PBL) and local wisdom through an ethnomathematics approach. This integration offers a solution to bridge the gap between abstract mathematical concepts and students' reality, thereby creating relevant learning experiences that directly contribute to improving mathematical problem-solving skills. Consequently, the development of PBL-based learning tools integrated with ethnomathematics has become an urgent necessity to ensure that teachers possess pedagogical instruments that are genuinely contextual, responsive, and capable of delivering effective and optimal learning.

Consequently, there is a need for a PBL-based learning tool integrated with ethnomathematics to enhance the problem-solving abilities of elementary school students. A systematic literature review conducted by Putra, which analyzed 16 articles, reveals that PBL instruction utilizing an ethnomathematics approach is effective in enhancing problem-solving skills (Putra & Waluya, 2023). However, these studies were often conducted for junior high school students with geometry material and only used worksheets as learning materials. The objective of the research was to ascertain the efficacy of a combination of PBL and ethnomathematics, as evidenced by published articles, without the development of a tangible product. Concurrent with these efforts, the research endeavor will involve the development of a product, namely PBL-based teaching tools integrated with ethnomathematics. Furthermore, a study by Cahya on the development of PBL-based worksheets incorporating ethnomathematics demonstrated improvements in mathematical problem-solving skills among junior high school students (Cahya & Siregar, 2023). A comparison of the present study and previous ones reveals notable distinctions, particularly with respect to the research subjects, who in this case are elementary school students. Moreover, this study not only develops LKPD but also develops lesson plans or learning modules using the PBL learning model.

METHOD

The present study employs a development research design that follows the ADDIE model, which includes five phases: Analyze, Design, Develop, Implement, and Evaluate). Each stage in this model supports development that focuses on needs analysis, appropriate design, tool development, planned implementation, and evaluation, which is important for continuous improvement. The analyze stage involves identifying problems and student needs in mathematics learning in accordance with the Merdeka curriculum. The design stage involves designing PBL-based learning tools integrated with ethnomathematics and designing teacher activity observation sheets, student questionnaires, mathematical problem-solving tests, and validation sheets. The design of this learning tool is predicated on the explicit integration of the syntax of the Problem-Based Learning (PBL) model. This learning tool also integrates ethnomathematics elements through the use of local culture in East Java. The operationalization of cultural content into mathematical inquiries and activities is facilitated through the utilization of objects with which students are familiar, particularly those associated with traditional markets. For instance, the notion of data grouping is incorporated through activities such as the classification of traditional food types (e.g., sweet/salty, fried/steamed), musical instruments (wind/percussion), or decorations (made of wood/clay). The concept of data ordering is applied in a variety of contexts, including the arrangement of food prices, the size of musical instruments, and the number of elements in bamboo weaving. Cultural objects such as klepon, gamelan, bamboo weaving, and Malangan masks directly serve as the context for problem-solving questions, enabling students to connect abstract mathematical concepts with their cultural reality.

The development stage involves the creation and compilation of learning tools, the design of teacher activity observation sheets, the formulation of student questionnaires, and the construction of mathematical problem-solving tests that have been designed. The learning tools are systematically compiled, encompassing a cover page, table of contents, teaching modules/lesson plans, student worksheets, test outlines, test instruments, answer keys, and assessment rubrics. Following the development of these tools and instruments, they undergo validation by two experts with pertinent expertise: a mathematics education lecturer who possesses a comprehensive understanding of curriculum development and educational evaluation instruments, and an experienced MI/SD classroom teacher who is well-versed in the actual learning conditions prevalent in elementary schools. The instrument validation process is conducted using a validation sheet that includes assessments of content validity, construct validity, language appropriateness, format, and practicality. Each aspect is assessed quantitatively, and validators also provide qualitative feedback for improvement. Feedback and suggestions from validators serve as the foundation for revising the instruments to enhance their quality.

In the subsequent phase of implementation, the efficacy of these tools is to be assessed through their integration into a classroom setting. During the implementation phase, data was collected through the observation of teacher and student activities using observation sheets and through the distribution of student response questionnaires after learning. Data regarding mathematical problem-solving ability was also collected. The evaluation phase focuses on gathering data and feedback from this implementation to assess the validity, practicality, and effectiveness of the developed tools.

The subjects of the experiment were 30 first-grade students at MI Ibnu Husain Surabaya. The first grade was selected as the subject of the study, given the recognition that students at the lower grade level are a group of children who are in the early stages of cognitive development, including mathematical problem-solving skills. At this stage, it is essential to foster the ability to identify and solve problems, which is crucial for developing critical and analytical thinking skills from a young age. Thus, structured training and the use of suitable learning tools are anticipated to establish a solid foundation for cultivating advanced problem-solving skills. The researchers employed three primary data collection techniques: product validation, observation, questionnaire distribution, and mathematical problem-solving tests. The research instruments included learning tools consisting of learning module and student worksheets, student response questionnaires, teacher activity observation sheets, mathematical problem-solving tests, and validation sheets. The learning tools developed integrate East Javanese culture, specifically traditional objects from East Java that are sold in traditional markets in East Java. Additionally, the learning tools are problem-based to develop students' mathematical problem-solving skills.

The data analysis in this study includes various analytical methods, such as feasibility analysis, practicality analysis, and effectiveness analysis. The feasibility analysis was performed by two validators: a lecturer from the elementary school teacher education department and a classroom teacher from MI/SD. The instruments that have been validated include learning modules, worksheets, and mathematical problem-solving tests. The calculation of validity scores was performed using the following formula:

$$\text{Validity} = \frac{\text{Total validation score}}{\text{Maximum total score}} \times 100\%$$

Subsequently, the percentage scores obtained will be categorized as follows (Fatmawati, 2016).

Table 1. Criteria Validity

Percentage	Criteria
85.01 to 100	valid
70.01 to 85	sufficiently valid
50.01 to 70	less valid
1.00 to 50	not valid

The practicality analysis relied on scores gathered from two sources: student response questionnaires and teacher activity observation sheets (learning implementation). A practical analysis was conducted using two methods: learning implementation analysis and student response questionnaire analysis. The process of learning implementation analysis entails a systematic assessment of the implementation of the learning steps contained within a given learning module. This assessment employs a structured scale, ranging from 1 to 4, to quantify the quality of implementation. Two observers are tasked with documenting their observations on the designated teacher activity observation sheet, providing a comprehensive evaluation of the implementation process. The following calculation will determine the percentage of learning implementation.

$$\text{Percentage of learning implementation} = \frac{\text{Total score}}{\text{Total maximum score}} \times 100\%$$

Next, the final score for learning implementation is calculated using the following formula

$$\frac{\text{percentage from observer 1} + \text{percentage from observer 2}}{2}$$

Furthermore, the student response questionnaire contained 10 statements with 'Yes' or 'No' options. The results of the student response questionnaire were analyzed using the Guttman scale, which assigned a score of 1 to each "Yes" answer and a score of 0 to each "No" answer. Student questionnaire scores were then calculated as follows:

$$\text{Percentage of student response questionnaire scores} = \frac{\text{Total score}}{\text{Total maximum score}} \times 100\%$$

Subsequently, the mean values of the learning implementation scores and the student response questionnaire scores were calculated to determine practicality. The practicality criteria presents in Table 2.

Table 2. Praticality Criteria

Percentage	Criteria
85,01% to 100%	very practical
75,01% to 85%	practical
65,01% to 75%	quite practical
55,01% to 65%	not very practical
0% to 55%	not practical

The present study will utilize mathematical problem-solving test scores to conduct an analysis of effectiveness. The efficacy of a product is determined by the proportion of students who achieve a passing score on the mathematical problem-solving test, with a threshold of at least 75%. The minimum passing grade for MI Ibnu Husain is 75.

RESULTS AND DISCUSSION

During the analysis stage, gaps were identified between the objectives of the Merdeka curriculum and the actual conditions of mathematics learning in elementary schools. A review of the literature shows that students' poor problem-solving skills in mathematics are the root cause of problems that have not been systematically addressed (Wahyuni et al., 2024). This finding aligns with the observations indicating that elementary school students exhibit deficient problem-solving skills (Suryani, 2023). The efficacy of mathematical problem-solving skills in influencing students' comprehension of mathematics has been a subject of considerable interest in the academic community (Sinaga et al., 2023b). Students who demonstrate deficient mathematical problem-solving skills may encounter challenges when attempting to solve problems in their daily lives. This condition is contradictory to the principles of the Merdeka Curriculum, which prioritize the cultivation of critical thinking competencies through a problem-solving approach in mathematics education.

One factor influencing students' subpar problem-solving skills is the dearth of learning resources that support these skills (Chirimbana et al., 2022). Subsequent field observations indicated that the majority of learning tools employed by teachers were procedural and lacked ethnomathematics, a term which denotes the integration of students' culture and mathematics. This integration is essential for facilitating a connection between abstract mathematical concepts and the cultural realities of the students. The study's findings served as the foundation for the development of ethnomathematics-integrated PBL learning tools that meet the criteria of contextuality, adaptability, and cognitive appropriateness for elementary school students. This initiative was undertaken as a transformative endeavor to align the pedagogical approaches of the Merdeka Curriculum with the socio-cultural realities of students, employing a holistic and quantifiable methodology.

The present study's design phase yielded a prototype learning tools that includes learning module, student worksheets (LKPD), and a grid for testing mathematical problem-solving skills. The integration of these elements into the PBL model is a notable aspect of the curriculum, reflecting an emphasis on the cultural nuances of East Javanese heritage. The PBL syntax used includes problem orientation, students being organized to learn in groups, investigation being guided, investigation results being developed and presented, and the problem-solving process being analyzed and evaluated. The local culture selected for this study includes objects commonly found in traditional markets in East Java, categorized into the following: food, traditional musical instruments, household appliances, and decorations. The culinary items utilized in this context include klepon, putu ayu, wingko, rawon, getuk pisang, and tahu campur. The following instruments are representative of traditional musical instruments in this region: kendang, gamelan, bamboo flute, and angklung. Household items include bamboo weaving and ijuk brooms. The exhibition features a variety of cultural elements, including Malangan masks, miniature Reog Ponorogo, and Dinoyo ceramics, which provide a rich visual backdrop to the narratives presented. The curation of local cultural elements is informed by the emotional connection students have with these objects. Moreover, the incorporation of indigenous cultural elements into mathematics learning resources has been demonstrated to improve student motivation and understanding of mathematical concepts. (Fitri & Sari, 2025).

Figure 1. Cover and table of Content

The learning tools design in the design stage uses data grouping and sorting material for grade 1. This concept is realized through activities of grouping and sorting cultural objects sold in traditional markets based on quantity and category. Additionally, in this stage, validity analysis instruments are designed, including a validation sheet, and practicality analysis instruments, such as a student response questionnaire and a teacher activity observation sheet. The data collected from these instruments is intended to be used to evaluate and revise the learning tool prototype. This process of evaluation will culminate in a tool that has been determined to be valid and practical, and which has been shown to be effective in enhancing the mathematical problem-solving skills of students enrolled in elementary schools (SD/MI).

During the development stage, the learning tools designed in the previous stage are compiled into a complete set. This set includes a cover, table of contents, learning module, student worksheets (LKPD), mathematical problem-solving tests, test instruments, answer keys, and assessment rubrics. The cover displays the title of the mathematics learning tool, which is based on ethnomathematics and the Merdeka curriculum. The table of contents outlines the structure of the learning tool from the learning modules to the assessment rubric for mathematical problem-solving skills. Figure 1 below is the cover and table of contents of learning tools.

The learning modules contain the school identity, learning outcomes, learning objectives, learning media, learning steps, student reflections, teacher reflections, enrichment, and remediation. Figures 2 is the learning modules.

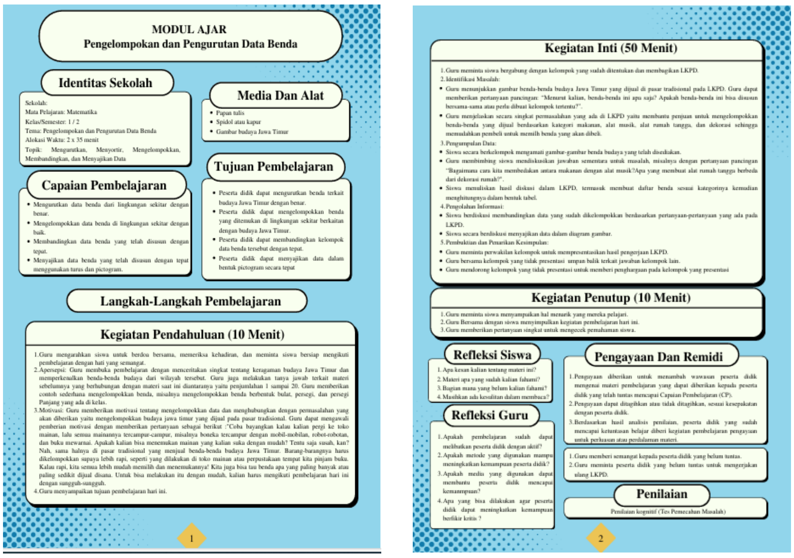

Figure 2. Learning Module

The LKPD includes a cover, group identity, instructions, motivation, and tasks featuring local cultural images organized based on PBL syntax. Figure 3 below shows some examples of LKPD.

Figure 3. LKPD

The mathematical problem-solving test grid includes question numbers, learning objectives, question indicators, content, and the question format based on Bloom's taxonomy.

The mathematical problem-solving instrument contains five problems organized based on the grid. Figure 4 below are the outline and test of mathematical problem-solving skills

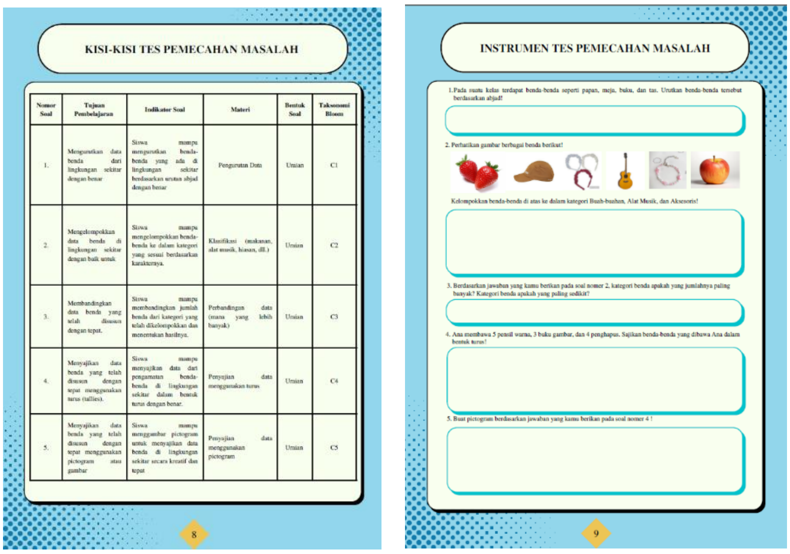

Figure 4. Outline and Test Mathematical Problem solving skills

The answer key provides alternative answers to the test instrument. The assessment rubric provides guidelines for evaluating the test instrument and consists of criteria, descriptions, and maximum scores for each question. It also provides guidelines for calculating the final score. Figure 5 below are the answer key and assessment rubric.

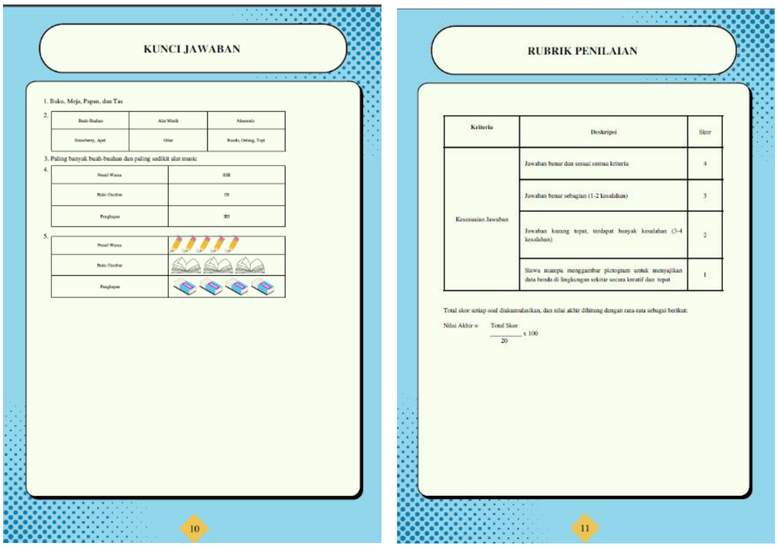

Figure 5. The Answer Key and Assessment Rubric

The learning tools developed were then subjected to a process of validation by two experts in the field, who provided criticism and suggestions for revision. Following this, the tools were put to the test in the subsequent implementation stage. The validation team comprised one elementary school mathematics instructor and one mathematics education lecturer. The validation results from both experts indicated that the developed learning tools, which include learning modules, worksheets, and mathematical problem-solving tests, are valid and suitable for use with minor revisions. This finding indicates that the product developed aligns with established curriculum standards and research goals (Gupta, 2023). The validation results are presented in Figure 6.

During the implementation stage, the ethnomathematics-integrated, PBL-based learning tools that had been developed were tested in the field to explore their practicality and effectiveness in improving the mathematical problem solving skills of the students. The trial was conducted on 30 students enrolled at MI Ibnu Husain Surabaya for a period of two days. During the learning process, two observers systematically recorded their observations. The goal was to assess the implementation of the learning tools in the classroom environment. This observation is important for more than one reason. First, it can be used to assess the alignment of implementation with the instructional design. Second, it can provide authentic data regarding the practicality of using the learning tools in real-world learning conditions. (Landong, 2023).

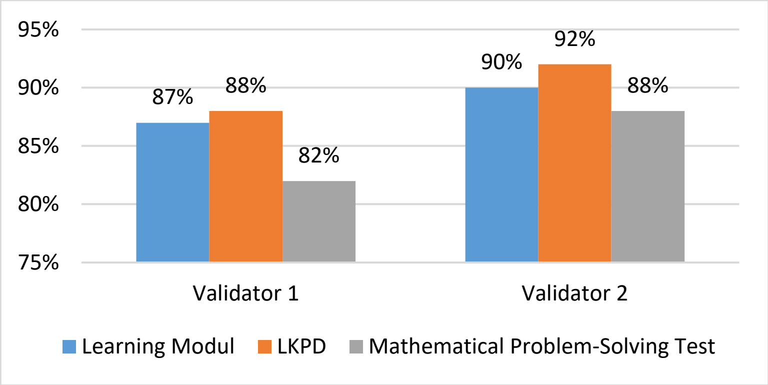

Figure 6. Diagram of The Validation Result

The practicality of the tools was analyzed based on student responses collected through questionnaires at the end of the learning process. Additionally, observations of the implementation of learning were utilized to inform the analysis. The observation results showed an average score of 84.375% for the implementation of learning. The student response questionnaire showed an average score of 83.33%. Consequently, the mean practicality score of the developed learning tool was 83.85% in the practical category. The practical nature of the developed tool is characterized by its ease of implementation in educational settings, thereby fostering a positive learning experience for students(Sujariati et al., 2024). The practice teacher implemented all learning steps in the learning module sequentially, indicating that these steps were easy to implement in actual learning. Furthermore, the students' unanimous concurrence with the statement that the learning process was both straightforward and pleasurable was noteworthy. This finding aligns with the research conducted by Wulandari et al., which indicated that students exhibited high levels of satisfaction and motivation in their mathematics learning when local cultural elements were incorporated (Wulandari et al., 2024).

Moreover, the results of mathematical problem-solving tests administered post-learning process demonstrated that 24 out of 30 students (80%) attained scores above the Minimum Passing Criteria (KKM). This outcome demonstrates the efficacy of the integrated ethnomathematics-based PBL learning tools developed in fostering students' mathematical problem-solving competencies. This finding is consistent with the research that has been conducted on the effectiveness of ethnomathematics-based PBL models in improving elementary students' mathematical problem-solving skills (Andriyanti & Prihastari, 2023). PBL syntax guides students to identify problems (based on local culture), formulate hypotheses, collect and analyze data, and present solutions. This process directly trains high-level thinking skills that are essential for developing problem-solving abilities. Furthermore, the PBL learning model fosters active learning, wherein students are expected to comprehend the material independently through the investigation of the problems provided. This approach aligns with constructivist learning theory, which posits that students develop a deep understanding of a subject by discovering new knowledge through real-world experiences designed by teachers in the learning process. By posing investigative problems, teachers facilitate this process, ensuring that students engage in constructivist learning (Bishara, 2021).

The products developed are not only PBL-based but also integrate ethnomathematics, where the problems presented in the developed products are contextual problems in the form of local cultures that are familiar to students, thereby helping students understand the material and achieve mathematical problem-solving competencies. The presentation of problems in the LKPD uses concrete images because, according to Piaget, first-grade students are in the concrete operational stage, making it easier for them to understand concepts that are concrete and related to their direct experiences (Kholiq, 2020). Therefore, products derived from a PBL model, when integrated with ethnomathematics, have the potential to function as a framework that facilitates the development of mathematical problem-solving competencies among students. The rationale underlying this phenomenon pertains to the integration of concrete images within the developed products. These images serve a dual purpose: they facilitate comprehension of problem-solving concepts for students and promote discourse within the PBL syntax framework. This discourse, in turn, has the potential to enhance students' intrinsic motivation to engage in problem-solving activities (Fernández et al., 2015). Scaffolding can be defined as the gradual support provided to help students achieve higher levels of understanding. A subsequent meta-analysis by Apriatni further corroborated these findings, demonstrating that ethnomathematics had a substantial impact on enhancing mathematical problem-solving abilities. This finding suggests that a culturally grounded contextual approach is indeed effective (Apriatni et al., 2022).

The concept of ethnomathematics serves as a crucial link between the abstract mathematical concepts and the cultural reality of the students. By presenting mathematical problems in familiar local cultural contexts, such as counting the number of elements in a bamboo weave or sorting the prices of market snacks, students feel more motivated and able to connect mathematical concepts with their daily lives. This finding aligns with Vygotsky's socio-cultural learning theory, which underscores the significance of social and cultural interaction in cognitive development (Das, 2020). The application of Vygotsky's socio-cultural theory supports students in developing mathematical problem-solving skills because students interact with their environment and construct knowledge through cultural mediation (Hiltrimartin et al., 2024). The integration of ethnomathematics in this tool functions as a cultural mediator, facilitating the development of mathematical problem-solving skills among students. The relevant cultural context serves to enhance the relevance and significance of the learning experience. Therefore, the effectiveness of this learning tool is a synergy between the strengths of the PBL model in facilitating active learning and problem solving and the contribution of ethnomathematics in providing a relevant and motivating context for students. This combination, reinforced by visual presentations appropriate to the cognitive development stage of students, successfully creates a conducive learning environment for the development of mathematical problem-solving skills in elementary school students.

CONCLUSION

Mathematical learning tools based on PBL that integrate ethnomathematics effectively improve students' ability to solve mathematical problems. The implementation of PBL involves several stages, namely, problem-focusing, organizing students into groups, leading investigations, developing and presenting findings, and analyzing and evaluating the problem-solving process. This tool adopts traditional objects from traditional markets as a local cultural context. The Validation findings indicate that the learning module, student worksheets (LKPD), and mathematical problem solving tests meet the criteria of validity and feasibility. The practicality of the tool, based on student response questionnaires and observations of the implementation of learning, reached 83.85%, indicating a practical category. The evaluation of mathematical problem solving skills after learning showed that 80% of the students exceeded the Minimum Competency Criteria. Therefore, the learning tool has been demonstrated to be valid, practical, and effective in developing students' mathematical problem-solving skills. The effectiveness of this learning tool is a synergy between the strengths of the PBL model in facilitating active learning and problem solving and the contribution of ethnomathematics in providing a relevant and motivating context for students to develop their mathematical problem-solving skills

RECOMMENDATION

This study integrates local culture in the form of traditional objects sold in traditional markets in East Java. It is recommended that future research should explore other elements of the local culture of East Java in the development of similar learning tools for different subjects and at different grade levels. In addition, research can also explore local cultures from other provinces.

REFERENCES

A, A. W., Kusuma, Y. S., Juandi, D., Turmudi, T., Buhaerah, B., & Syaiful, S. (2024). Understanding Students' Struggles in Solving Mathematical Problems: A Systematic Literature Review Using Polya's Framework. *Jurnal Pendidikan Progresif*, *14*(3), Article 3.

Andriyanti, B. W., & Prihastari, E. B. (2023). Efektivitas Model PBL Berbasis Etnomatematika Terhadap Kemampuan Pemecahan Masalah Matematika Sekolah Dasar. *Caruban: Jurnal Ilmiah Ilmu Pendidikan Dasar*, *6*(1), Article 1. https://doi.org/10.33603/caruban.v6i1.7854

Apriatni, S., Syamsuri, S., Nindiasari, H., & Sukirwan, S. (2022). The influence of ethnomathematics based learning on mathematics problem-solving ability: a meta-analysis. *Jurnal Pendidikan Matematika (JUPITEK)*, *5*(1), Article 1. https://doi.org/10.30598/jupitekvol5iss1pp23-33

Asmiyunda, A., & Hardeli, H. (2023). The Effect of Problem-Based Learning (PBL) on Learning Outcomes: Meta-Analysis. *PEDAGOGIA*, *21*(2), Article 2. https://doi.org/10.17509/pdgia.v21i2.65061

Bishara, S. (2021). The cultivation of self-directed learning in teaching mathematics. *World Journal on Educational Technology: Current Issues*, *13*(1), 82–95. https://doi.org/10.18844/wjet.v13i1.5401

Boye, E. S., & Agyei, D. D. (2023). Effectiveness of problem-based learning strategy in improving teaching and learning of mathematics for pre-service teachers in Ghana. *Social Sciences & Humanities Open*, *7*(1), 100453. https://doi.org/10.1016/j.ssaho.2023.100453

Cahya, N., & Siregar, B. H. (2023). Pengembangan LKPD Berbasis PBL Bernuansa Etnomatematika untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa Kelas VII SMP. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *7*(3), Article 3. https://doi.org/10.31004/cendekia.v7i3.2923

Chirimbana, M., Nghipandulwa, L. T., & Kamati, F. N. (2022). An Investigation of the Factors That Contribute to Poor Problem-Solving Skills in Grade 8 Mathematics Learners in Namibia. *Open Journal of Social Sciences*, *10*(12), Article 12. https://doi.org/10.4236/jss.2022.1012042

Das, K. (2020). Realistic Mathematics & Vygotsky's Theories in Mathematics Education. *Shanlax International Journal of Education*, *9*(1), 104–108. https://doi.org/10.34293/education.v9i1.3346

Diana, R. F., Ixfina, F. D., & Nurdianah, L. (2024). Reflections on the implementation of the merdeka curriculum at the primary level in Surabaya. *Al-Fikru: Jurnal Pendidikan Dan Sains*, *5*(2), Article 2. https://doi.org/10.55210/al-fikru.v5i2.1925

Fatmawati, A. (2016). Pengembangan Perangkat Pembelajaran Konsep Pencemaran Lingkungan Menggunakan Model Pembelajaran Berdasarkan Masalah Untuk SMA Kelas X. *EduSains*, *4*(2).

Fernández, M., Wegerif, R., Mercer, N., & Rojas-Drummond, S. (2015). *Re-conceptualizing "Scaffolding" and the Zone of Proximal Development in the Context of Symmetrical Collaborative Learning*. *50*(1), 54–72.

Fitri, A., & Sari, A. C. (2025). Development of an Ethnomathematics Module Based on the Pancasila Student Profile in Learning Flat and Solid Geometry. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *13*(2), 221–232. https://doi.org/10.33394/j-ps.v13i2.14690

Gupta, K. (2023). Validity and Reliability of Students' Assessment: Case for Recognition as a Unified Concept of Valid Reliability. *International Journal of Applied and Basic Medical Research*, *13*(3), 129–132. https://doi.org/10.4103/ijabmr.ijabmr_382_23

Hanum, L. (2017). *Perencanaan Pembelajaran*. Syiah Kuala University Press.

Hartatiana, H., & Wardani, A. K. (2021). Design mathematics problem solving tasks: students response. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(2), Article 2. https://doi.org/10.24127/ajpm.v10i2.3334

Hiltrimartin, C., Afifah, A., Scristia, Pratiwi, W. D., Handrianto, C., & Rahman, M. A. (2024). Analyzing Students' Thinking in Mathematical Problem Solving Using Vygotskian Sociocultural Theory. *Revista de Gestão Social e Ambiental*, *18*(1), e04802–e04802. https://doi.org/10.24857/rgsa.v18n1-105

Kamidah, N., . Z., & Junaedi, I. (2023). Development of Teaching Materials Using Problem-Based Learning (PBL) Models with Ethnomathematics Nuances to Improve Students' Critical Thinking Ability. *International Journal of Research and Review*, *10*(8), 228–235. https://doi.org/10.52403/ijrr.20230829

Kholiq, A. (2020). How is Piaget's Theory Used to Test The Cognitive Readiness of Early Childhood in School? *Indonesian Journal of Early Childhood Education Studies*, *9*(1), 24-28.

Landong, A. (2023). *Penelitian Sekolah Dasar: Teori, Jenis, dan Contohnya* (1st ed.). Jejak Pustaka.

Putra, T. J., & Waluya, S. B. (2023). Systematic Literature Review: Implementasi Pembelajaran PBL dengan Pendekatan Etnomatematika terhadap Kemampuan Pemecahan Masalah. *SEMANTIK: Prosiding Seminar Nasional Pendidikan Matematika*, *1*(1), 466–475.

Rodríguez-Nieto, C. A., Pabón-Navarro, M. L., Cantillo-Rudas, B. M., Sudirman, & Moll, V. F. (2025). The potential of ethnomathematical and mathematical connections in the pre-service mathematics teachers' meaningful learning when problems-solving about brick-making. *Infinity Journal*, *14*(2), 419–444. https://doi.org/10.22460/infinity.v14i2.p419-444

Sinaga, B., Sitorus, J., & Situmeang, T. (2023a). The influence of students' problem-solving understanding and results of students' mathematics learning. *Frontiers in Education*, *8*. https://doi.org/10.3389/feduc.2023.1088556

Sinaga, B., Sitorus, J., & Situmeang, T. (2023b). The influence of students' problem-solving understanding and results of students' mathematics learning. *Frontiers in Education*, *8*. https://doi.org/10.3389/feduc.2023.1088556

Sujariati, S., Wanci, R., & Rampeng, R. (2024). Practicality and Validity of the Instructional Speaking Materials Developed Based on CLT. *Journal of Innovation in Educational and Cultural Research*, *5*(4), 678–692. https://doi.org/10.46843/jiecr.v5i4.2003

Sumarni, W. (2013). The Strengths and Weaknesses of the Implementation of Project Based Learning: A Review. *International Journal of Science and Research (IJSR)*, *4*(3), 478–484.

Suryani, N. (2023). Upaya Meningkatkan Kemampuan Pemecahan Masalah Matematika Melalui Penerapan Model Problembased Learning Di Kelas III Sekolah Dasar. *Journal of Innovation in Primary Education*, *2*(1), Article 1.

Wahyuni, N., Mulyono, D., & Mawardi, D. N. (2024). Kemampuan pemecahan masalah matematika siswa melalui model problem based learning berbantuan media pembelajaran. *Jurnal Penelitian Pembelajaran Matematika Sekolah (JP2MS)*, *8*(2), Article 2. https://doi.org/10.33369/jp2ms.8.2.153-166

Wijaya, T. T., Hidayat, W., Hermita, N., Alim, J. A., & Talib, C. A. (2024). Exploring contributing factors to PISA 2022 mathematics achievement: Insights from Indonesian teachers. *Infinity Journal*, *13*(1), 139–156. https://doi.org/10.22460/infinity.v13i1.p139-156

Wulandari, D. U., Mariana, N., Wiryanto, W., & Amien, M. S. (2024). Integration of Ethnomathematics Teaching Materials in Mathematics Learning in Elementary School. *IJORER : International Journal of Recent Educational Research*, *5*(1), Article 1. https://doi.org/10.46245/ijorer.v5i1.542

Zaenuri, Imam, F., & Nugroho, S. E. (2020). The effectiveness of problem based learning (PBL) model with ethnomatematics to improve mathematics literation ability of high school students. *Journal of Physics: Conference Series*, *1567*(2), 022086. https://doi.org/10.1088/1742-6596/1567/2/022086

Zaini, M. (2018). The Effectiveness of Learning Implementation Plan Tool Through Design-Based Research. *The Open Psychology Journal*, *11*, 271–278. https://doi.org/10.2174/1874350101811010271