ENHANCING PROBLEM-SOLVING SKILLS THROUGH NUMERACY INSTRUMENT DESIGN: INCORPORATING PANDEGLANG’S LOCAL WISDOM IN GEOMETRY CONTENT

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ABSTRACT

Problem solving is a crucial aspect of the education curriculum, as it reflects the skills expected to be possessed by students. Indicating that the majority of students face difficulties in this process. Studies also indicate that numeracy literacy plays a significant role in enhancing mathematical problem-solving skills. This research aims to develop a numeracy literacy assessment that integrates Pandeglang Regency’s local knowledge, with a particular emphasis on geometry, to enhance the mathematical problem-solving abilities of Grade IX. This study fits into the Tessmer formative research model, which is related to the category of development research. The study involved 35 ninth-grade students from MTsN 2 Pandeglang as participants. Various tools were used to gather data, such as validation sheets, interview guidelines, and numeracy literacy tests inspired by local knowledge in the Pandeglang Regency. The analysis process included assessing these tools’ effectiveness, reliability, and precision through expert assessments and statistical methods. The study’s conclusions show that the developed test's quality comprises moderate difficulty for each of the three items, good validity, and satisfactory item discrimination.

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INTRODUCTION

One of the fundamental mathematical skills that high school students should possess is the ability to solve problems. This skill is crucial as it correlates with high student achievement, emphasizing learning strategies that prioritize problem-solving. Moreover, problem-solving skills in mathematics can enable students to discover mathematical concepts and enhance their logical thinking abilities independently (Hasibuan et al., 2019). This assertion is echoed by Ilyas (2015) He defines mathematical problem-solving as an individual effort utilizing mathematical concepts, properties, principles, theorems, and reasoning to solve mathematical problems. It is expected that through problem-solving skills, students can independently discover mathematical concepts (Hendriana & Soemarmo, 2019).

Problem-solving skills are essential in nearly every competency standard and basic competency. However, not all students can effectively solve problems. Sugandi (2013), indicates that the results of students' mathematical problem-solving learning are still low, suggesting that the majority of students find the problem-solving process challenging. Proficiency in numeracy literacy notably impacts the enhancement of mathematical problem-solving abilities (Alfiah et al., 2020).

In today's era of technological and informational progress, mastery of numeracy literacy, which involves understanding and utilizing mathematical concepts in daily contexts, is recognized as a crucial skill (Meeks et al., 2014). Enhancing numeracy literacy not only impacts an individual's capability to address mathematical challenges but also holds significant importance in decision-making across various facets of daily life (Domu et al., 2023; Han et al., 2017).

In the 21st century, numerical literacy, also called mathematical literacy, must underscore the evolving dynamics intertwined with science, technology, and the professional landscape, all inherently linked to activities involving calculations and numerical concepts (Goos et al., 2011). According to Dikmen Kemendikbud (2021), numeracy involves using numerical information, data, and mathematical symbols and applying conceptual and operational skills to tackle practical challenges in everyday life and decision-making processes. This definition aligns with the definition of numeracy skills (2022) within the Minimum Competency Assessment (AKM) framework. It encompasses the aptitude to utilize mathematical concepts, methods, factual knowledge, and resources for critical thinking,
enabling the resolution of everyday issues across various contexts pertinent to individuals as both Indonesian and global citizens.

In formal education, many students encounter difficulties in cultivating robust numerical literacy. Mathematics instruction often emphasizes mastering foundational concepts and skills, lacking explicit integration with real-world scenarios. Consequently, this approach may result in a dearth of student motivation and interest toward the subject. Researchers such as Agustina et al. (2022); Mutmainah, (2022); Patta et al. (2022), argue that learning within the context of everyday life offers a potent strategy for augmenting students' numerical literacy. This involves establishing connections between numerical concepts and skills and their application in real-life situations. Istiana et al. (2020) suggests that by incorporating real-world problems reflective of students' daily experiences, learners can discern the practicality and relevance of mathematics in familiar contexts. This approach helps students appreciate the significance of mathematics in surmounting challenges and making informed decisions based on numeracy applications in real life.

According to Lusiana (2018), local wisdom possesses distinct attributes that can be introduced and harnessed within the educational setting. Integrating local wisdom into developing numeracy literacy resources gives students a meaningful framework. This integration adds depth to mathematics education by linking mathematical concepts and skills with familiar real-life situations. Moreover, incorporating local wisdom into math teaching can ignite students' curiosity, promoting an appreciation for and acknowledgment of cultural diversity.

In the context of culturally based numeracy, several studies have been conducted. For instance, Juhaevah (2022) conducted research on the development of assessments focusing on mathematical problems while considering the Maluku culture. Darmawisada (2022) developed a numeracy test of the AKM type using the socio-cultural context of Bali. Another study by Sirait et al. (2022) explored students' abilities to solve numeracy problems infused with local wisdom on Pulau Buano. They explored the implementation of a cooperative learning approach rooted in local wisdom to elevate numeracy literacy levels in primary schools. In a separate investigation, Wardhani (2022) delved into the creation of instructional videos centered around numeracy and local wisdom for elementary school students. Furthermore,
Putri et al (2022) scrutinized the design of Mathematics instructional resources incorporating the cultural practices of the Using tribe, assessing their influence on students numeracy abilities. Overall, the findings from these studies indicate that incorporating local wisdom effectively improves students' numeracy skills by integrating local cultural elements.

This study highlights the innovation in developing a numeracy literacy instrument design by incorporating local wisdom in the Pandeglang Regency. The research depicts efforts to integrate local values, traditions, and wisdom into the question items used to assess problem-solving abilities through numeracy literacy at the junior high school level. The questions to be developed focus on the geometry domain with cognitive levels of knowing, applying, and reasoning. Through this study, the author aims to create question items that assess problem-solving abilities through numeracy literacy and reflect the cultural context of daily lives in Pandeglang Regency. This research is grounded in the awareness of the importance of strengthening cultural identity and the relevance of mathematics to real-life situations. However, one drawback of using research in developing numeracy literacy questions with local wisdom is the limited generalization of results, and it can also create an imbalance in assessment, especially if students unfamiliar with the local wisdom find it difficult to answer the questions.

Researhing the customs and environment of the local community and the local wisdom prevalent in Pandeglang Regency is a necessary step in creating question items. This study's content centers on the traditional fishing gear (Bubu), unique local foods (Jojorong Cake), and sailboats frequently used by Pandeglang's coastal communities. The author considers how to use these aspects of local wisdom when creating numeracy literacy questions to place students in meaningful and pertinent contexts. The study's results suggest combining numeracy literacy with local wisdom can boost mathematical problem-solving proficiency. However, recent literature reviews reveal the absence of numeracy literacy assessment tools integrating local wisdom to evaluate problem-solving capabilities, particularly within Pandeglang Regency's local wisdom. By adopting a creative methodology grounded in indigenous knowledge, this study promises to significantly improve problem-solving abilities through numeracy tools influenced by local wisdom. This study has the potential to significantly advance contextualized numeracy literacy assessments that improve the mathematical learning process for students in the Pandeglang Regency by adopting this
creative approach based on local knowledge. Researchers, educators, and others working in education can all benefit from this article.

METHOD

A research and development framework was employed for this research methodology. Following Zulkardi (2002) The question development process comprised two main phases: the initial stage and the formative evaluation stage. During the formative evaluation stage, the approach aligned with Tessmer (1998) Methodology, encompassing self-assessment, prototyping (including expert review, one-to-one, and small group feedback), and field testing.

In the primary stage, the researcher assessed students, analyzed the junior high school curriculum, and modified numeracy literacy tools by integrating local wisdom. Subsequently, during the formative evaluation phase, the design of the question instruments, including the grid of numeracy literacy tools based on local wisdom, was carried out.

During the formative evaluation phase, the initial step involved self-assessment, where the researcher evaluated the results of the formulated questions. These results were referred to as prototype I. Subsequently, the prototyping phase included expert review, one-to-one, and small group interactions. The expert review phase constitutes a validity assessment conducted by experienced professionals or educators. They evaluate prototype I by thoroughly analyzing its content, structure, and language, providing recommendations documented in validation sheets and question cards. The specifics of this prototype are outlined in Table 1 below.

<table>
<thead>
<tr>
<th>No</th>
<th>Characteristics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Content/Substance</td>
<td>The items align with the problem-solving indicators, and the stimulus utilizes images, graphs, tables, and other elements pertinent to real-life situations.</td>
</tr>
<tr>
<td>2</td>
<td>Construction</td>
<td>The questions follow the guidelines for creating items to assess mathematical problem-solving skills. They are suitable for junior high school students and cover diverse concepts.</td>
</tr>
<tr>
<td>3</td>
<td>Language</td>
<td>Following PUEBI (Pedoman Umum Ejaan Bahasa Indonesia), the questions avoid ambiguous interpretations, and the constraints of both questions and answers are clearly defined.</td>
</tr>
</tbody>
</table>

Simultaneously with the expert review, the one-to-one stage was conducted. During this phase, Prototype I was tested on three selected students as testers. They were instructed to attempt the developed questions and provide comments or feedback based on their experience. The insights gained from the expert review and one-to-one stages were used to refine
Prototype I. After revising Prototype I, Prototype II was created. Subsequently, Prototype II underwent testing in the small group stage. In this phase, three students were assigned to solve the questions in Prototype II and offer feedback on their experience. The feedback and observations from this small group stage were considered in further refining Prototype II.

The outcomes of revising Prototype II are denoted as Prototype III. Prior to advancing to the field test phase, a preliminary trial was conducted to assess the difficulty level discriminative power, and reliability of the questions. The trial results were scrutinized and discussed to offer recommendations for enhancing Prototype III, aiming to create the ultimate prototype. This final prototype is slated for testing on the research subjects, comprising ten students from class IX J at MTs Negeri 2 Pandeglang during the second semester of 2022/2023. The field test results will be instrumental in calculating individual student scores and will serve as the foundation for evaluating numeracy literacy within the context of local wisdom.

In this study, two types of data collection instruments were used, namely validation sheets and tests. Validation sheets were used to obtain information from experts as expert assessments aimed at providing input and suggestions regarding the questions generated. Meanwhile, tests were used to obtain information about the practicality and effectiveness of the developed questions and to measure the effectiveness of the local wisdom context.

The data analysis method employed in this study aimed to evaluate the developed instruments' appropriateness, quality, and accuracy. The criteria for instrument development were derived from Nieveen's framework (2007), which includes validity, practicality, and effectiveness. Validity is confirmed through expert validation, ensuring the questions are robust in content, structure, and language. Practicality is affirmed when the developed questions are considered applicable by all mathematics education practitioners, as validated by the experts. The content validity categories to be validated by validators are outlined in Table 1. The data analysis utilized in this research comprises qualitative descriptive analysis and quantitative analysis. Qualitative descriptive data encompass feedback, responses, critiques, suggestions, and enhancements from supervisors, teachers, and students regarding each point qualitatively described in the Tessmer flow development procedure. Meanwhile, quantitative analysis involves data collected from respondents filling out instrument sheets containing numeracy literacy questions based on local wisdom.
RESULT AND DISCUSSION

Preliminary Stage or Preparation Stage

In this stage, the content within the domain of Numeracy Literacy is identified by analyzing students, the junior high school curriculum, Numeracy Literacy questions, and local wisdom that can be integrated as context. This stage aims to identify and select significant materials that will serve as the content domain for the questions to be developed. The next steps include creating question cards, arranging question grids, and developing numeracy literacy instrument questions. Figure 1 shows an example question from the initial product (Prototype I) before being verified by experts.

![Figure 1. One Question in Prototype 1 Before Validation](image)

Based on the information above, perform the following steps:

a) Sketch the shape of the Jojorong cake packaging into a solid figure you have learned before! Complete the drawing with known and inquired elements!

b) Is the data above sufficient to calculate the approximate volume of one package of Jojorong cake? If so, try to calculate the solutions to questions 2, 3, and 4!

c) Include the concepts and formulas used in each step of the solution.

d) Check the correctness of the solutions obtained!

e) Then, put a check mark (√) in the box next to the following statements that are correct!

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The vertical side of the cake container is rectangular.</td>
</tr>
<tr>
<td>2</td>
<td>The approximate volume of one Jojorong Cake package contains 200 cm³ of cake batter.</td>
</tr>
<tr>
<td>3</td>
<td>If we have 2 liters of Jojorong Cake batter, it will produce 10 Jojorong Cakes with containers as shown in the picture.</td>
</tr>
<tr>
<td>4</td>
<td>If the top of the Jojorong Cake is to be covered, at least 40 cm² of banana leaves are needed for each cake.</td>
</tr>
</tbody>
</table>

**Expert Review**

Two validators with doctoral degrees and three junior high school mathematics subject teachers are involved at this stage. Based on the validation conducted by experts and peers, it can be concluded that the problem-solving questions developed demonstrate a satisfactory level of validity. However, adjustments are required, as per the suggestions and feedback provided by the validators. Out of the total of 3 questions, 2 require revisions based on the
insights and comments provided by the validators.

One to One

During the one-to-one phase, Prototype I was formulated and administered to 3 students with varying proficiency levels: high, medium, and low. All these students were enrolled at MTsN 2 Pandeglang, Banten. Each student was given three questions to complete within a 30-minute timeframe. Additionally, they were asked to provide their opinions, comments, and suggestions on the questions. The objective of this phase was to observe the students' responses and identify any challenges encountered while addressing the questions. From the brief discussions with students regarding the feedback provided, it was determined that only 1 question required revision. This indicates that the formulated questions demonstrate a satisfactory level of practicality. Following feedback from experts, peers, and the one-to-one process, the questions in Prototype I were refined and revised. One of the questions that underwent revision in Prototype I, later referred to as Prototype II, can be observed in Figure 2.

![Jojorong Cake](image)

Jojorong Cake, a specialty of Pandeglang, Banten, is made from rice flour and coconut milk mixed with palm sugar. The cake is wrapped in a container resembling a rectangular prism made of banana leaves tied with toothpicks or skewers at each end.

Based on the information above, perform the following steps:

a) Sketch the shape of the Jojorong cake packaging into a solid figure you have learned before! Complete the drawing with known and inquired elements!

b) Is the data above sufficient to calculate the approximate volume of one package of Jojorong cake? If so, try to calculate the solutions to questions 2, 3, and 4!

c) Include the concepts and formulas used in each step of the solution.

d) Check the correctness of the solutions obtained!

e) Then, put a check mark (✓) in the box next to the following statements that are correct!

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<td>If we have 2 liters of Jojorong Cake batter, it will produce 10 Jojorong Cakes with containers as shown in the picture.</td>
</tr>
</tbody>
</table>

Figure 2. Revision of Prototype I (Prototype II)

Small Group

This phase aims to evaluate the feasibility of the problem-solving questions in Prototype II. The small group test involves five students from class IX J at MTsN 2 Pandeglang. These students are directed to solve the problem-solving questions provided by the author. Upon completing the numeracy literacy questions, students are asked to express their thoughts on the questions they worked on by responding to specific queries on the
provided sheet. According to the results of the small group trial, it is evident that one out of the three questions requires revision, particularly in the stimulus section. Table 2 below will illustrate the modifications before and after the revision based on the results of the small group trial.

### Table 2. Changes Before and After Revision

<table>
<thead>
<tr>
<th>Findings/ Suggestions</th>
<th>Before Revision</th>
<th>After Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>The stimulus sentence needs to be simplified, as students are still confused about understanding the spatial structure of the 'kue jojorong.' Therefore, it is necessary to mention the spatial structure that depicts the 'kue jojorong.'</td>
<td>Jojorong cake is a traditional culinary delicacy from Banten, particularly Pandeglang Regency. It is crafted from rice flour and coconut milk, infused with palm sugar. The cake is enclosed in a container or mold resembling a rectangular prism made from banana leaves, with each end secured using toothpicks or small sticks.</td>
<td>Kue Jojorong is a specialty food from Banten, specifically from Pandeglang Regency. The cake bowl is made from banana leaves, shaped like a rectangular prism, and each end is tied using toothpicks or small sticks.</td>
</tr>
</tbody>
</table>

a) The stimulus sentence is overly lengthy and disconnected from the main question. Thus, it requires simplification to focus on the core query.

b) The sentence in question 2a needs to be revised as it involves the triangle KLM in its congruency.

i) The boat equipped with a sail is designed to harness wind energy for movement. The diagram next to it depicts a sailboat, where the black and red lines represent the ropes attaching the sailcloth to the mast. Triangle ABC is similar to triangle DEF. With rope lengths $AB = 6$ m, $BE = 4$ m, $KL = 3$ m dan $LM = 5$ m.

b) Sketch the similarity shapes between triangles ABC, DEF, and KLM! Complete the drawings with the known and unknown elements!

The students are still confused in interpreting the type of three-dimensional figure used in the fish trap, so the three-dimensional figure that represents the shape of the fish trap needs to be specified.

Bubu is a traditional fishing tool used in several coastal or aquatic regions. It is designed to catch fish by trapping them in a specific structure. This tool is typically made from solid weaving or net materials such as rattan, bamboo, or synthetic materials like nylon. The fish trapped in the fish trap are approximately 100 fish/m$^3$, and the average weight of the fish is 80 grams. Here are some types of fish traps commonly used by fishermen.

Bubu is a traditional fishing tool used in several coastal or aquatic regions. The fish trapped in the fish trap are approximately 100 fish/m$^3$, and the average weight of the fish is 80 grams. Figure A shows a fish trap resembling a cylindrical structure, Figure B shows a fish trap resembling a combination of a cylindrical and cone structure, Figure C shows a fish trap resembling a cone, and Figure D shows a fish trap resembling a rectangular prism.

Before proceeding to the field test phase, Prototype II was tested with the participation of 10 students from class IX.J at MTsN 2 Pandeglang. According to the data in Table 3, it is evident that all three questions exhibit a moderate difficulty level and acceptable discriminative power, and they are considered valid with high reliability. The criteria for determining or interpreting the difficulty level, discriminative power, and reliability followed the classification suggested by Arikunto (2007). The levels of difficulty and discriminative
power of the test items in the trial are presented in Table 3 below.

<table>
<thead>
<tr>
<th>Test Item</th>
<th>Difficulty Index</th>
<th>Criteria Discrimination Index</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.59 Medium</td>
<td>0.42 Good</td>
<td>Valid 0.661</td>
</tr>
<tr>
<td>2</td>
<td>0.55 Medium</td>
<td>0.45 Good</td>
<td>Valid 0.853</td>
</tr>
<tr>
<td>3</td>
<td>0.42 Medium</td>
<td>0.58 Good</td>
<td>Valid 0.933</td>
</tr>
</tbody>
</table>

According to the data in Table 3, all three questions exhibit a moderate difficulty level and acceptable discriminative power, and they are considered valid with high reliability.

**Field Test**

After developing a valid and practical Prototype III, a field test was conducted to observe its potential impact on students' mathematical reasoning abilities. The field test was conducted in class IX.I at MTsN 2 Pandeglang, consisting of 20 students. Students were asked to choose the correct answer from the provided options and explain the reasons or steps they used to support their answers. An example of a student's response to Prototype III can be seen in Figure 3.

![Figure 3. Example of Student's Response to Prototype III](image)

The data obtained from the test, utilized to gauge students' mathematical problem-solving proficiency, were analyzed based on the cumulative scores achieved during the test. Subsequently, the data underwent analysis and conversion into qualitative data to ascertain the students' levels of mathematical problem-solving abilities. The categories for determining the students' mathematical problem-solving abilities are as follows:
Table 4. Determination of Categories of Students’ Mathematical Problem-Solving Abilities

<table>
<thead>
<tr>
<th>Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>76 – 100</td>
<td>Excellent</td>
</tr>
<tr>
<td>51 – 75</td>
<td>Good</td>
</tr>
<tr>
<td>26 – 50</td>
<td>Average</td>
</tr>
<tr>
<td>0 – 25</td>
<td>Passed Conditionally</td>
</tr>
</tbody>
</table>

Results of the analysis of students’ problem-solving skills can be found in Table 5.

Table 5. Average Frequency Distribution of Student Test During Field Test

<table>
<thead>
<tr>
<th>Score Interval</th>
<th>Category</th>
<th>Frequency</th>
<th>Average %</th>
</tr>
</thead>
<tbody>
<tr>
<td>76 – 100</td>
<td>Excellent</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>51 – 75</td>
<td>Good</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>26 – 50</td>
<td>Average</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>0 – 25</td>
<td>Passed Conditionally</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Number of Subjects</td>
<td></td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>Average Score</td>
<td></td>
<td>59.45</td>
<td>GOOD</td>
</tr>
</tbody>
</table>

Based on the results of the mathematical problem-solving test during the field test with 20 students, it can be concluded that four students (20%) have excellent problem-solving skills, eight students (40%) have good problem-solving skills, seven students (35%) have satisfactory problem-solving skills, and one student (5%) has insufficient problem-solving skills. This study produced three items of mathematical problem-solving questions of numeracy literacy type based on local wisdom for Grade IX of Junior High School, covering the topic of shapes and space. The development process followed the steps outlined by Tessmer (1998). Experts’ description of the preparation phase and the content validity test indicated that the developed questions align with the indicators of mathematical problem-solving within the numeracy literacy domain. Based on the analysis of student responses during the field test, it is evident that some students exhibit good mathematical problem-solving skills in answering the three numeracy literacy questions based on local wisdom. This is observed through the provided answers and solution steps on the answer sheets. Mathematical problem-solving indicators (Hendriana & Soemarmo, 2019), such as identifying sufficient elements for problem-solving, selecting and implementing strategies to solve problems, performing calculations, and interpreting and verifying the solution to the original problem, were evident in the students’ responses.

This is demonstrated by some students providing accurate answers and exhibiting indicators of mathematical problem-solving in their responses. Additionally, from the comments made by students during the field test, it is known that, in general, the numeracy literacy questions based on local wisdom provided can stimulate students to think more
critically and require them to use their reasoning and logic in solving the problems. Students are also interested in the local wisdom context, closely related to their daily lives. The research asserts that proficiency in numeracy literacy contributes to effective problem-solving by empowering students to apply numerical concepts and mathematical skills daily.

The study by Mahmud & Pratiwi (2019) Indicates that numeracy literacy allows students to apply mathematical concepts in everyday life and analyze information to predict and draw conclusions. Meanwhile, the research by Aulia et al., (2023); Fajarini (2014); Wulandari & Puspadewi (2016) This study demonstrates that the application of local wisdom in educational contexts can enhance students' interest and enrich their learning experiences. By integrating numeracy literacy and local wisdom, learning can become more contextual and relevant for students, helping them develop better mathematical problem-solving skills while understanding and appreciating their local culture.

CONCLUSION

Based on the study's findings, it can be concluded that the local wisdom-based numeracy literacy problem-solving questions satisfy practicality and validity requirements. The theoretical validity is substantiated through the evaluations by validators, who unanimously agreed that the questions exhibit quality in terms of content, construction, and language. Concurrently, the one-to-one and small-group trial results affirm that all students can proficiently utilize the question instruments.

In this study, the author provides several suggestions for the future development of numeracy instruments. First, further testing of this numeracy instrument needs to be conducted with a larger sample size at all levels and in various regions in Indonesia. Second, developing numeracy instruments with more varied and diverse contexts of local wisdom in Indonesia is necessary. Third, training for mathematics teachers is needed to develop numeracy instruments that align with the context of local wisdom in their respective regions. Fourth, further research is needed to measure the effectiveness of using numeracy instruments in the context of local wisdom in improving students' mathematical problem-solving abilities.

REFERENCES


