PERINATAL JOURNAL

Original Article

Perinatal Journal 2025; 33(2):343-352

https://doi.org/10.57239/prn.25.03320039

Enhancing geometry understanding through illustrated storybooks based on local wisdom: A developmental study for elementary school students

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Abstract

This study explores the development and effectiveness of an illustrated storybook based on local wisdom, aimed at improving second-grade students' understanding of geometry. Traditional teaching methods often fail to engage young learners with abstract mathematical concepts, particularly in geometry. This study proposes a solution by integrating Lombok's local wisdom into the learning materials, making the content culturally relevant and accessible. The research follows the Research and Development (R&D) approach using the ADDIE model, involving stages of analysis, design, development, implementation, and evaluation. The storybook was evaluated through expert validation, student feedback, and pre- and post-tests. Results showed significant improvements in students' understanding, with average post-test scores rising from 46.92 to 87.93. Expert validation scores of 96% for content and 95% for media design confirmed the book's effectiveness. The findings suggest that local wisdom-based teaching materials not only enhance student engagement but also facilitate deeper conceptual understanding. This research contributes to the growing body of knowledge on integrating cultural elements into education, particularly in mathematics.

Keywords: Local wisdom, Geometry teaching, Illustrated storybooks, Educational development

Introduction

In the realm of education, mathematics is widely recognized as a crucial component in fostering cognitive development, critical thinking, and problem-solving skills among students. Mathematical learning is fundamental to academic success and essential for navigating real-life challenges. The role of mathematics in developing critical thinking is particularly pronounced; research indicates that effective mathematics education can significantly enhance students' abilities to think critically and make reasoned decisions (Sachdeva & Eggen, 2021; Yanuari & Turmudi, 2023)

However, many students, particularly at the elementary level, face substantial challenges in grasping certain mathematical concepts, especially those involving geometry. One primary issue is the complexity and abstract nature of these concepts, which can be daunting for young learners (Herbst & Kosko, 2014; Nahdi et al., 2024). Traditional teaching methods often exacerbate these challenges, as they typically emphasize rote memorization and rely on textbooks that lack interactive or engaging elements. Consequently, students may struggle to make connections between abstract mathematical ideas and their practical applications in everyday life (Nuryadin et al., 2023).

To address these challenges, recent literature emphasizes the necessity of adopting innovative and contextualized teaching strategies. Such approaches can effectively bridge the divide between abstract mathematics and students' real-world experiences (Kyeremeh et al., 2024; Ng, 2011). For instance, integrating local wisdom and cultural knowledge into the mathematics curriculum has shown promise in enhancing engagement and understanding, particularly in culturally diverse regions (Ng, 2011). This strategy acknowledges the richness of local traditions and perspectives, thereby creating more relatable and engaging learning experiences for students. It also helps accommodate the ethnomathematics field, which seeks to relate mathematical learning with cultural context, making the subject more accessible and meaningful (Kyeremeh et al., 2024).

Moreover, the use of modern technology, such as augmented reality, in teaching geometry can

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significantly enhance students' engagement and understanding of complex concepts (Nuryadin et al., 2023). This technological integration not only supports teachers' instructional practices but also helps develop students' digital literacy and critical thinking skills, which are essential in contemporary education (Kuntze et al., 2017; Li & Yu, 2022)

Local wisdom, which encompasses cultural traditions, folklore, customs, and practices passed through generations, serves as a vital resource for enhancing educational materials. Integrating local wisdom into curricula can transform the educational experience, making it more meaningful and accessible for students. This integration is crucial as it establishes connections with students' daily lives and environments, fostering relatable educational experiences.

Research indicates that local wisdom helps anchor academic content within the cultural and contextual realities of students.(Aulia et al., 2019) suggest that ethnomathematics-based contextual learning significantly improves students' problem-solving abilities and cultural appreciation, thereby creating a framework that encourages engagement and pride in cultural heritage. (Forrester & Clarkson, 2023) emphasize that culturally-conscious mathematics teaching practices promote instructional approaches that are contextualized and relevant to students' lives, enhancing their experience and understanding of mathematics.

In mathematics education, particularly in geometry, students often face challenges with abstract concepts. Incorporating community-based examples can illuminate geometric principles through familiar contexts. Wu (2020) also supports the notion that integrating intangible cultural heritage into educational contexts enhances engagement and helps students grasp complex ideas (Balantes & Tonga, 2020).

The central issue this study addresses is the pressing need for engaging and culturally relevant teaching materials in elementary schools, especially in the domain of geometry. Traditional educational practices often rely heavily on standard textbooks that do not effectively connect mathematical concepts to students lived experiences. This disconnect can severely undermine students' understanding and application of geometric principles. Research indicates that when students are unable to relate mathematical concepts to their own lives, their motivation and interest in the material diminish significantly (Chowdhuri, 2022; Jam et al., 2025).

Moreover, textbooks are shown to significantly impact teaching styles and strategies, acting as a central resource in the mathematics classroom that shapes instructional methods (Pavešić & Cankar, 2022). They often reflect social and cultural perspectives that can either enrich or limit a student's educational experience. (Ahl, 2016) emphasizes the influence of research findings on textbook content and the necessity for textbooks to embody diverse approaches to mathematical concepts, thus enabling broader interpretations and understandings among students (Ahl, 2016). The educational community must prioritize the development of teaching materials that foster an inclusive learning environment and encourage students to connect mathematics with their personal contexts, thereby enhancing their educational engagement and success in geometry and beyond (İNCİKABI et al., 2023).

Transitioning to more engaging teaching resources, especially those that leverage technology and interactive dynamics, is essential for addressing student disengagement. For instance, as shown in studies, the use of digital mathematics textbooks can promote active participation and provide automated feedback that further supports students' learning processes (Rezat, 2021). This methodological shift is crucial for fostering a deeper understanding of mathematics among students, particularly in geometry, where visualization and hands-on engagement are key (Almeida & Castro, 2021; Kholid et al., 2022). Hence, developing culturally relevant and engaging teaching materials tailored to the diverse backgrounds of students is not only important but necessary for effective mathematics education in elementary schools.

This study proposes the development of more interactive and contextually grounded teaching materials to enhance student understanding and engagement in the teaching of geometry in elementary schools. The reliance on standard textbooks, which fail to connect mathematical concepts with students lived experiences, often

hinders their comprehension. Geometry's abstract nature presents difficulties in understanding the material, which negatively impacts students' academic performance (Alditia et al., 2023). Additionally, the limited use of alternative teaching resources, such as interactive learning tools or culturally relevant materials, exacerbates student disengagement.

The integration of local cultural elements into teaching materials has been widely recognized as an effective strategy to enhance student engagement and comprehension. Mumu and Aninam (2020) emphasized that connecting educational content, such as mathematical concepts, to real-world problems familiar to students can significantly augment their understanding and application of the material (Kartika & Lestari, 2024). This principle is supported by various studies that demonstrate improved student engagement through culturally responsive pedagogy, which integrates students' cultural backgrounds into learning activities. For example, (Sawita et al., 2024) conducted a systematic review showing that incorporating local cultural content, such as folklore, in educational settings fosters greater engagement and motivation among students. Such findings underscore the importance of contextualizing the curriculum to the lived experiences of learners, facilitating better comprehension and retention of knowledge (Ardiawan et al., 2024; Ratminingsih et al., 2020).

As a specific solution to the challenges of teaching geometry, the development of illustrated storybooks based on local wisdom presents an effective alternative. These storybooks combine visual imagery with textual content, making abstract concepts more tangible and easier for young learners to understand (Amril & Pransiska, 2021). Using local symbols, traditional patterns, or folklore in these books can provide concrete examples of geometric principles, making the material more accessible and meaningful. Research by Ardana, et al (2024) indicates that the integration of local wisdom into teaching materials enhances student understanding and engagement across various subjects, though its application in geometry instruction requires further development (Ardana et al., 2024).

The aim of this research is to design and assess the effectiveness of an illustrated storybook that incorporates local wisdom to enhance the understanding of geometry among second-grade students. By integrating cultural elements from Lombok, the study seeks to make the learning content more relevant, engaging, and accessible for young learners. This approach is intended to bridge the gap between abstract mathematical concepts and students' real-world experiences, thereby promoting a deeper and

Research questions; (1) What are the validation results from subject matter experts and media design experts regarding the development of picture story books based on local wisdom on geometry material to improve the understanding of second grade students? (2) How do students respond to the development of picture story books based on local wisdom on geometry material to improve the understanding of second grade students? (3) What is the impact of using picture story books based on local wisdom on students' academic achievement on geometry material, as measured by the results of the initial and final tests?

Method

This chapter outlines the research methodology used in this study, which aims to develop illustrated storybooks based on local wisdom for teaching geometry to second-grade students. The research methodology follows the Research and Development (R&D) approach, employing the ADDIE model. The methodology is explained in detail, covering the research design, research stages, data collection methods, and the instruments used in the study.

Research design

The research design used in this study is a Research and Development (R&D) method, which is specifically focused on the creation and validation of new educational products. The Research and Development (R&D) method is fundamental in educational research, particularly concerning the creation and validation of innovative educational products. Central to this approach is a systematic development methodology aimed at solving specific educational problems effectively. The R&D method focuses on producing functional educational products tailored for practical use in classrooms, emphasizing tangible outcomes over mere

theoretical exploration. Their work illustrates how R&D integrates the creation and validation phases to meet educational needs (Ramadlani & Fikri, 2023). This study follows the ADDIE model, which includes five stages: Analysed, Design, Development, Implementation, and Evaluation.

The development of the illustrated storybook based on local wisdom is aimed at improving the comprehension of geometry material for second-grade students at SDN 3 Darmasari. The study will be conducted on a sample of 21 second-grade students, and the effectiveness of the developed book will be assessed through pre-test and post-test results, as well as student and teacher feedback.

Research stages

The research follows the ADDIE model, which consists of five stages: (1) Analysed: In this phase, the researcher conducted a preliminary study to assess the needs of students and teachers. This included observing the classroom situation, the current teaching methods, and the use of existing teaching materials. The analysis aimed to identify gaps in learning resources and determine the necessary improvements; (2) Design: The design stage involved planning the content and structure of the illustrated storybook. Based on the findings from the analysis phase, the book was designed to incorporate local wisdom from Lombok, specifically focusing on geometry material. The design also included choosing appropriate visuals and creating a narrative that would engage the students; (3) Development: This phase focused on the actual creation of the illustrated storybook. The book was developed using the content identified in the design phase, with illustrations and text that integrate local wisdom to explain geometric concepts. The development stage also involved preparing the necessary materials, such as layout designs and instructional aids; (4) Implementation: The developed storybook was then tested in a real classroom setting at SDN 3 Darmasari. The implementation phase aimed to observe the effectiveness of the storybook in improving students' understanding of geometry. Teachers and students provided feedback on the use of the book during the lessons; and (5) Evaluation: The final stage of the ADDIE model involved evaluating the developed book's effectiveness based on student performance in the pre-test and post-test, as well as the feedback collected from students and teachers. This evaluation determined whether the book achieved its intended goals and provided insights for further revisions.

Data collection methods

The data collection methods employed in this study include validation by experts, surveys, and tests. These methods were chosen to ensure that the data gathered would be both comprehensive and reliable.

1. ***Validation by experts:*** Expert validation was used to assess the content and design of the illustrated storybook. The validation was conducted by two groups of experts: material experts and media experts. The material experts evaluated the relevance and accuracy of the content, while the media experts assessed the visual design and the appropriateness of the book for second-grade students. The experts provided feedback and suggestions for improving the book.
2. ***Surveys:*** Surveys were used to gather feedback from students and teachers regarding the usability and effectiveness of the storybook. The student survey aimed to assess students' responses to the book's design, content, and engagement level. The teacher survey focused on the practicality of the book in a classroom setting and its potential impact on students' learning.
3. ***Tests:*** Pre-tests and post-tests were administered to measure the improvement in students' understanding of geometry after using the illustrated storybook. The tests consisted of multiple-choice and essay questions based on the geometry content in the book. The pre-test was conducted before the implementation of the book, and the post-test was given after the students had used the book for a set period. The results of these tests were analysed to determine the effectiveness of the book in enhancing students' comprehension of the material.

Research instruments

1. ***Validation sheets:*** The validation sheets were used by the experts to assess the content and design of the illustrated storybook. These sheets were structured to

provide a clear and systematic evaluation of different aspects of the book, including the accuracy of the material, the quality of the illustrations, and the overall effectiveness of the book in conveying the intended concepts.

2. ***Student response questionnaire:*** The student response questionnaire collected feedback from students on their experience with the book. The questionnaire included questions about the book's visual appeal, the clarity of the content, and its ability to engage students in learning. This questionnaire was administered after the students had used the book for a set period.
3. ***Teacher response questionnaire:*** The teacher response questionnaire gathered information on how practical the book was in the classroom and whether it helped students understand the geometry material more effectively. Teachers were asked to rate the usability of the book and provide suggestions for improvement.
4. ***Pre-test and post-test:*** The pre-test and post-test were designed to measure students' understanding of the geometry material before and after using the illustrated storybook. The tests included both multiple-choice questions and essay questions that assessed the students' ability to apply geometric concepts. The pre-test was administered at the beginning of the study, and the post-test was given after the students had used the storybook.

Data analysis

The data collected from the validation sheets, surveys, and tests were analyzed to determine the effectiveness of the illustrated storybook in improving students' understanding of geometry. The analysis included both qualitative and quantitative methods.

Qualitative data analysis: The feedback provided by the experts and teachers was analysed qualitatively to identify key themes and areas for improvement. The expert validation scores were used to assess the content and design of the book, while the teacher feedback was used to evaluate the book's practicality and effectiveness in the classroom.

Quantitative Data Analysis: The pre-test and post-test results were analysed using statistical methods to determine if there was a significant improvement in students' understanding of geometry after using the storybook. The results of the student response questionnaire were also analyzed to assess students' engagement with the book. The scores were compared using descriptive statistics to assess the effectiveness of the book in achieving its learning objectives.

Results

In response to this question, that the validation results from subject matter experts and media design experts indicate a high level of approval for the development of the illustrated storybook. The validation by media experts yielded a score of 81 (95%), categorizing the book as "very feasible" with a recommendation for revisions. The validation by subject matter experts received a score of 58 (96%), which also places it in the "very feasible" category. These results affirm that the illustrated storybook is an effective and appropriate tool for teaching geometry to second-grade students.

In response to this question, the student responses to the illustrated storybook based on local wisdom were gathered using a student response questionnaire, which consisted of 10 components of questions, with 21 student respondents. The data regarding student responses were used to determine the extent to which students engaged with the illustrated storybook product based on local wisdom and its practicality. Among the 10 components, with a total of 203 "Yes" answers and 8 "No" answers from the respondents, the percentage of students who answered 'Yes' was calculated as follows:

$$P = (\sum X) / (\sum Xi) \times 100\%$$

$$P = 202 / 210 \times 100\%$$

$$P = 96\%$$

This percentage indicates that 96% of the students provided positive feedback, highlighting the effectiveness and practicality of the illustrated storybook as a learning tool.

In response to this question, The pre-test and post-

test scores for the students. The table highlights the significant improvement in students' understanding of geometry after using the illustrated storybook.

Table 1. Pre-test and post-test scores

Test Type	Average Score
Pre-test	46.92
Post-test	87.93

Discussion

The results of expert validation, student responses, and test scores will be discussed in relation to the hypothesis that integrating local wisdom into teaching materials can enhance students' understanding of geometric concepts. The findings will be compared with the literature on the use of local wisdom in educational materials and its impact on students' learning outcomes.

Expert validation results

Expert validation was conducted to assess the content and design of the illustrated storybook, which was intended to integrate local wisdom into geometry instruction. The validation process involved two groups of experts: material experts and media experts. The material experts evaluated the accuracy and relevance of the content, while the media experts assessed the visual appeal and the suitability of the book for second-grade students.

The results of the validation by the material experts showed that the content of the book was highly valid. The material experts gave the book a score of 96%, indicating that the content was considered very feasible for teaching geometry to second-grade students. This score reflects the alignment of the material with the curriculum and the appropriateness of the local wisdom integrated into the content. The inclusion of local wisdom, such as traditional architecture and local patterns, was found to be an effective way of contextualizing the geometric concepts, making them more relatable to the students' daily lives.

The validation by the media experts also yielded a high score of 95%. The media experts evaluated the design and visual aspects of the storybook, including the clarity of illustrations, the appeal of the layout, and the appropriateness of the visuals for second-grade students. The results of the study indicate that the book design is effective in capturing students' attention and supporting the learning process. The visuals were considered engaging and informative, which aligns with previous research findings that demonstrate the effectiveness of using illustrated books as media for elementary school students (Khoirunna'imah & Anbiya, 2024).

Student responses

The student response questionnaire was used to gather feedback on the book's usability and its impact on student engagement and learning. The questionnaire included questions about the book's design, the clarity of the content, and its ability to engage students. The results of the questionnaire indicated that the illustrated storybook was highly effective in engaging students and helping them understand the geometry material.

The overall approval rate for the book from the student responses was 96%, indicating that the students found the book to be very appealing and useful for learning. Students rated the visuals and the integration of local wisdom highly, with many reporting that the book made the geometry material easier to understand. The results also indicated that the students appreciated the cultural relevance of the book, as the local wisdom provided a context that they were familiar with. This aligns with the findings of (Misbah et al., 2020; Moghavvemi et al., 2025), who found that integrating local wisdom into teaching materials helps students connect abstract concepts with real-world experiences, leading to better comprehension and engagement.

The positive response from students reinforces the argument that the integration of local wisdom in educational materials can enhance students' learning experiences by making abstract concepts more concrete and relatable. The use of familiar cultural references not only increases students' engagement but also helps them better retain the information by linking it to their personal experiences.

Impact on academic performance

The effectiveness of the illustrated storybook was also assessed through pre-test and post-test results.

The pre-test was administered before the students used the storybook, and the post-test was given after they had completed the lessons using the storybook. Both tests included multiple-choice and essay questions related to geometric concepts such as shapes, sides, and angles.

The pre-test results showed that the students had a low level of understanding of the geometry material, with an average score of 46.92. This reflects the difficulties that second-grade students often encounter when learning abstract mathematical concepts, as noted by (Alditia et al., 2023). However, the post-test results demonstrated a significant improvement in students' understanding, with an average score of 87.93. This increase in the post-test scores indicates that the use of the illustrated storybook based on local wisdom had a positive effect on students' understanding of geometry.

The improvement in test scores is consistent with the findings of previous studies that have demonstrated the effectiveness of using culturally relevant materials in improving students' understanding of academic content. Risdiana and Yunika (2023) found that using illustrated storybooks based on local wisdom helped students in a different context achieve better learning outcomes. Similarly, the positive results in this study suggest that integrating local wisdom into geometry instruction not only enhances students' engagement but also improves their academic performance.

The integration of local wisdom in educational materials, particularly in mathematics, has been shown to improve student engagement and understanding. The findings of this study align with the results of (Sri Supiyati et al., 2023) and (Nur et al., 2020), who have indicated that such integration provides students with a relevant context that enhances their grasp of abstract. These studies emphasize the critical role of local wisdom, arguing that contextualizing educational content makes it more relatable and accessible to students, thereby facilitating deeper learning experiences.

Furthermore, the incorporation of local wisdom within geometry lessons allowed students to make connections between abstract mathematical concepts and their everyday lives. This approach not only made the learning content more meaningful but also exemplified how contextualized education can enhance students' perception and understanding of the subject matter. By situating learning in familiar contexts, educators can effectively bridge the gap between theoretical knowledge and practical application, leading to improved educational outcomes.

Implications for teaching geometry

The results of this study have important implications for the teaching of geometry in elementary schools. First, they suggest that integrating local wisdom into mathematics instruction can make abstract concepts more accessible and engaging for students. The use of culturally relevant materials, such as illustrated storybooks, can help students relate to the material and understand it in a way that is meaningful to them. By incorporating local knowledge and cultural references, teachers can create a more engaging and effective learning environment.

Second, the positive impact of the illustrated storybook on students' understanding of geometry highlights the potential for using innovative teaching materials in other areas of mathematics and other subjects. The success of this study suggests that similar approaches could be applied to other mathematical concepts, as well as to other subjects where students struggle with abstract concepts.

Moreover, the findings suggest that teachers can benefit from using diverse teaching materials that not only meet curriculum standards but also reflect students' cultural backgrounds. This approach can help bridge the gap between abstract academic concepts and students' real-world experiences, fostering a deeper understanding and greater interest in learning.

Conclusion

This study developed an illustrated storybook based on local wisdom to improve second-grade students' understanding of geometry. The results showed that the storybook significantly enhanced students' comprehension, as indicated by the improvement in their post-test scores (from an average of 46.92 in the pre-test to 87.93 in the post-test). Expert validation and student feedback confirmed that the book was both relevant and engaging, with high approval

ratings from both material and media experts (96% and 95%, respectively) and a 96% approval rate from students.

The findings highlight the effectiveness of integrating local wisdom into educational materials, demonstrating that culturally relevant resources can bridge the gap between abstract concepts and students' real-world experiences. This approach not only increased engagement but also facilitated deeper understanding.

This research contributes to the growing body of knowledge on the use of local wisdom in education, particularly in the context of mathematics instruction. It underscores the potential of integrating culturally relevant materials to enhance student learning outcomes. Future research could explore the broader application of this approach across other subjects and educational levels, as well as the long-term effects of using culturally integrated teaching materials.

Recommendations

While the results of this study are promising, there are some limitations that should be acknowledged. The sample size of 21 second-grade students from a single school limits the generalizability of the findings. Further research with larger sample sizes across multiple schools would be necessary to determine whether the findings can be applied more broadly. Additionally, the study focused specifically on geometry, and it would be beneficial to explore whether the use of local wisdom in teaching other mathematical concepts or subjects would yield similar results. Future studies could also examine the long-term impact of using such teaching materials on students' overall academic performance and engagement.

Based on the limitations of this study, the following recommendations are made for future research; First, Broader Sample Size and Diverse Settings: Future studies should involve a larger and more diverse sample size, including students from multiple schools across different regions, to enhance the generalizability of the findings and assess the broader applicability of the results.

Second, exploring Other Mathematical Concepts: While this study focused on geometry, future research should examine the effectiveness of integrating local wisdom into the teaching of other mathematical topics, such as algebra, statistics, or arithmetic, to determine whether similar improvements in student understanding and engagement can be achieved.

Finally, comparative studies between local wisdom-based and traditional teaching materials would further help to identify the specific benefits of culturally relevant content and offer insights into its role in enhancing students' critical thinking and problem-solving skills. And Future research could also explore the potential of using local wisdom in other subjects beyond mathematics, such as science, social studies, and language arts, to evaluate its potential as a cross-disciplinary educational tool.

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