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Analysis of the Need for the Development of Ethnomathematics-Based Flipbook Media to Improve Understanding of Measurement Concepts in Elementary Schools

Dinda Arofahtul Munawwaroh*
Faculty of Education, State University of Surabaya, Surabaya, Indonesia

Neni Mariana
Faculty of Education, State University of Surabaya, Surabaya, Indonesia

Rooselyna Ekawati
Faculty of Mathematics and Natural Science, State University of Surabaya, Surabaya, Indonesia

***Corresponding Author:** 24010855003@mhs.unesa.ac.id

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Abstract
The purpose of this study is to analyze the need for the development of ethnomathematics-based flipbook media to improve students' understanding of measurement materials in grade III of elementary school. The research method used is qualitative with a descriptive approach. The study involved 3 third-grade teachers and observations in two public elementary schools in Surabaya, conducted over a period of three weeks. Data was collected through in-depth interviews with teachers, participatory observations in the classroom, and documentation studies of the curriculum and teaching materials used. The results of the study show that measurement learning is still dominated by lecture methods and the use of textbooks, so that students have difficulty in understanding abstract concepts. Teachers have also not integrated elements of local culture in learning, although the concept of traditional units of measurement such as cubits and depa is still used in daily life. Data were analyzed using qualitative thematic analysis to identify patterns and needs in the current learning process. Therefore, it is necessary to develop ethnomathematics-based digital flipbook media that can present interactive illustrations, visual simulations, and connect measurement concepts with local cultural practices. The conclusion of this study emphasizes that digital flipbooks can be an innovative solution in improving students' understanding of measurement materials by contextualizing abstract mathematical concepts with familiar cultural practices, while supporting an exploratory approach in the Independent Curriculum. The recommendation of this study is a trial of flipbook media to measure its effectiveness in increasing student engagement and understanding in mathematics learning.

INTRODUCTION

Mathematics education in elementary school has an important role in shaping students' logical and analytical mindset from an early age. However, many students have difficulty understanding mathematical concepts, especially in measurement materials that demand abstract understanding and practical skills (Widyatma & Ramadhani, 2024). Learning that is too theoretical and lacks involvement in local culture often leads to a lack of connection between the teaching material and the real lives of students (Fahlevi, 2022). Therefore, an approach is needed that can connect mathematical concepts with daily life, one of which is through ethnomathematics. This approach integrates cultural elements in mathematics learning so that students can better understand concepts contextually. Ethnomathematics draws on the theory of contextual learning, where students' prior knowledge and real-world experiences are used as anchors for new learning (Adam et al., 2003; D'Ambrosio, 1985). In this framework, mathematical concepts are not taught as isolated abstractions but as embedded practices in community activities, enabling more meaningful and retained learning. In this context, ethnomathematics-based learning media can be a solution to improve understanding of measurement concepts in grade III elementary school.

The use of appropriate learning media can increase students' interest in learning and clarify the concepts taught (Putri, 2024). One of the effective mediums in 21st-century learning is digital flipbooks, which combine text, images, and animations in one interactive format (Santia & Nurmayani, 2023). Ethnomathematics-based flipbooks not only help students understand mathematical concepts more concretely, but also preserve local wisdom through cultural integration in learning (Ratriana et al., 2021). In addition, digital-based learning is in line with technological developments and the needs of today's digital generation. Therefore, the development of ethnomathematics-based flipbook media for measurement materials in grade III elementary school is a relevant and necessary innovation.

Measurement material is one of the topics in mathematics that requires conceptual understanding and practical skills (Prihapsari et al., 2023). However, many students have difficulty understanding the concepts of length, area, and volume units because learning is still abstract (Nurhayati, 2022). Teachers often use lecture and textbook methods without providing direct experience to students, making the concept of measurement difficult to understand (Istiqomah et al., 2023). Research by Kurniawati et al. (2021) shows that students are more likely to understand the concept of measurement if they are associated with concrete objects in daily life. Therefore, learning media that is able to connect theory with practice in a more real and interesting way is needed.

Ethnomathematics is an approach that relates the concept of mathematics to the culture and daily life of the community. This approach has been proven to be able to improve students' understanding of mathematical concepts because it provides a more relevant and meaningful context (Solihin & Habibie, 2024). From a constructivist perspective, learning becomes more effective when students actively construct knowledge based on cultural and social experiences (Vygotsky, 1978). Ethnomathematics fosters this process by contextualizing mathematical ideas within familiar cultural narratives, tools, and practices. In the context of measurement, many local cultures in Indonesia have traditional measurement systems that can be used as a bridge in understanding modern concepts. For example, the use of hasta, depa, and tumbak in Javanese culture can be the first step for students to understand the concept of length units before getting to know meters and centimeters in the metric system. Thus, ethnomathematics-based flipbook media can be an effective tool in bridging mathematical concepts with students' realities.

In the digital era, the integration of technology in mathematics learning is increasingly a need to increase learning effectiveness (Isti'ana, 2024). The use of digital media such as interactive flipbooks has been shown to increase students' understanding and motivation to learn (Lestari et al., 2025). Flipbooks allow for the presentation of materials that are more flexible, interactive, and accessible at any time, so that students can learn at their own pace (Wibowo et al., 2025). In the context of ethnomathematics, the use of digital technology can enrich the learning experience by displaying animations, cultural illustrations, and interactive simulations that clarify the concept of measurement (Solihin et al., 2024). Therefore, the development of ethnomathematics-based flipbook media is very relevant to be applied in mathematics learning in elementary schools.

Before developing ethnomathematics-based flipbook media, it is necessary to conduct a needs analysis to understand current learning conditions and challenges faced by teachers and students (Susiliastini & Sujana, 2022). A preliminary study conducted in one of the primary schools showed that most students had difficulty in understanding the concept of measurement due to a lack of involvement in real experience (Sholeh & Fahrurozi, 2021). In addition, interviews with teachers revealed that the learning media used is still limited to textbooks and whiteboards, making it less attractive to students (Mamase, 2019). Based on the results of this analysis, a more interactive media, based on local culture, and in accordance with technological developments is needed to improve students' understanding of measurement materials.

While previous studies have explored either ethnomathematics or digital media separately in the context of learning mathematics, there is limited research integrating both approaches specifically for measurement concepts in lower elementary grades. Moreover, little has been done to design media that operationalizes local measurement practices within interactive digital formats. This study

aims to analyze the need for the development of ethnomathematics-based flipbook media for measurement materials in grade III elementary school. In particular, this study will identify the obstacles faced by students in understanding the concept of measurement, explore relevant ethnomathematical elements to be developed in learning media, and design an initial design of flipbook media that suits learning needs. With this research, it is hoped that it can contribute to the development of innovative learning media that is able to improve the quality of mathematics learning in elementary schools.

METHODS

This study uses a qualitative method with a descriptive approach that aims to analyze the need for the development of ethnomathematics-based flipbook media in grade III elementary school measurement materials. This approach was chosen because it allows researchers to explore in-depth information about learning conditions, obstacles faced, and the potential integration of cultural elements in learning media. The location of this research is SDN Tambakrigadung 2, Tikung District, Lamongan Regency, which was chosen based on the consideration that this school has the characteristics of a rich cultural environment and is relevant to the ethnomathematical concept that will be developed in the learning media. The school is located in a rural area where traditional units of measurement such as depa, hasta, and tumbak are still commonly used in daily activities such as farming, tailoring, and building traditional houses, providing a strong contextual basis for ethnomathematical integration.

The subjects in this study consisted of grade III teachers, grade III students, and school principals, who were selected using purposive sampling techniques based on their direct involvement in the mathematics learning process. Specifically, participants included one classroom teacher with over 10 years of teaching experience, the school principal, and 20 third-grade students (11 boys and 9 girls) aged 8–9 years. The selection criteria for teachers and principals were based on their active role in curriculum implementation and their familiarity with both school culture and student learning challenges. Meanwhile, students were selected as respondents to provide insight into learning experiences and media preferences. The data in this study was collected through in-depth interviews, participatory observations, and documentation studies to obtain a comprehensive picture of media development needs. Interviews were conducted with teachers to explore information related to the learning methods used, obstacles in teaching measurement concepts, and the need for more innovative learning media. Meanwhile, observations were carried out to observe how the learning process took place, the level of student involvement, and the use of media that had been applied previously. The documentation study was used to analyze the curriculum, textbooks, and teaching materials used as a reference in the development of flipbook media.

The data analysis technique in this study uses the Miles & Huberman (1994) model which consists of data reduction, data presentation, and conclusion drawn. The data obtained from interviews and observations were reduced to identify information relevant to the needs of media development. Furthermore, the data that has been compiled is presented in the form of a descriptive narrative to gain a clearer understanding of the phenomena that occur in the field. The last step is to draw conclusions based on research findings to design recommendations in the development of ethnomathematics-based flipbook media.

To ensure the validity of the data, this study applied triangulation of sources and techniques. Source triangulation is done by comparing information from various research subjects, such as teachers, students, and principals, to ensure the accuracy of the data obtained. Meanwhile, technical triangulation is carried out by combining interview, observation, and documentation methods to obtain more accurate and reliable data. Thus, the results of this study are expected to provide a valid and objective picture of the need for the development of ethnomathematics-based flipbook media in mathematics learning in grade III of elementary school.

RESULTS AND DISCUSSION

Research Results

Based on the results of data collection through in-depth interviews, participatory observations, and documentation studies, it was found that mathematics learning in measurement materials at SDN Tambakrigadung 2, Tikung District, Lamongan Regency still faces several challenges. Grade III teachers still rely on lecture methods and the use of textbooks as the main medium in learning. From the results of the interview, the teacher stated that this approach often makes it difficult for students to understand the concepts of units of length, area, and volume because the material presented is still abstract. The teacher also said that the limitations of learning media are one of the main obstacles in improving student understanding. Meanwhile, students tend to have difficulty in connecting the concept of measurement with daily life, so they just memorize without understanding the essence of the concept. For example, several students were observed misestimating object lengths, confusing units such as meters with centimeters, and were unable to apply formulas for area to real contexts like floor tiles or fields.

Participatory observations conducted during the learning process show that student involvement in understanding the measurement material is still low. Students appear passive in learning activities, especially when the teacher explains measurement concepts verbally in the absence of adequate visual aids. The media used in learning is limited to static images in the textbook, without any interactive media that can increase student engagement. In addition, teachers do not take advantage of local cultural elements in teaching the concept of measurement, even though in the environment around students there are still traditional practices in measuring length and area, such as the use of hats, steps, and footsteps in daily life. This shows that the potential of ethnomathematics in learning has not been utilized optimally.

The results of the documentation study show that the curriculum used in this school refers to the Independent Curriculum with a project-based approach and contextual exploration of concepts. However, in its implementation, there is still a gap between the demands of the curriculum and the practice of learning in the classroom. The textbooks used only provide examples of measurements in a formal context, without linking the concept to the local culture or the real experience of the students. In addition, no digital-based references or teaching media were found that could be used to support the understanding of measurement concepts in a more interactive manner.

Table 1. Research Findings and Their Implications

Aspect	Research Findings	Implications
Teaching Methods	Teachers still rely on lectures and textbooks as the main instructional methods.	There is a need for more interactive, digital-based media to increase student engagement.
Student Engagement	Students tend to be passive as the learning process is abstract and lacks engaging visual aids.	Developed media should incorporate visual elements, animations, and interactive simulations.
Learning Media Used	Media is limited to static images in textbooks, without the use of digital tools.	Digital flipbooks can offer a more flexible and engaging alternative for students.
Integration of Ethnomathematics	Measurement concepts are not yet connected to local cultural units like *hasta*, *depa*, and *tumbak*.	Media should link measurement concepts with local cultural practices to enhance contextual understanding.
Implemented Curriculum	The Merdeka Curriculum emphasizes exploration, but classroom practice still lacks support.	Learning media must be developed to align with the exploratory approach of the Merdeka Curriculum.
Learning Challenges	Students struggle to understand length, area, and volume due to a lack of real-life experiences.	Media should provide hands-on, experiential learning opportunities.
Interest in Digital Media	Students show more interest in technology-based learning than printed books.	Digital flipbooks are suitable for today's digitally native learners.

Table 1 outlines the findings of the research and their implications for classroom learning, especially in the context of mathematics instruction. The data show that teachers predominantly use traditional lecture-based methods and rely heavily on textbooks, which results in low student engagement. Students often appear passive, as the lessons lack visual and interactive components that could make abstract concepts more accessible. The learning media in use are largely limited to static images in textbooks, without the support of digital tools. Furthermore, the integration of local cultural knowledge—such as traditional measurement units like *hasta*, *depa*, and *tumbak*—has not yet been implemented in the curriculum, reducing the contextual relevance of the material. Although the Merdeka Curriculum encourages exploration-based learning, its actual application in classrooms remains limited. Students also struggle with understanding measurement due to a lack of real-life, hands-on learning experiences. Finally, the research reveals that students show a strong preference for digital learning tools, suggesting that a shift toward interactive digital flipbooks could better match their learning styles and increase motivation.

Table 2. Development Needs for Ethnomathematics-Based Flipbook Media

Aspect	Identified Needs	Justification for Development
Media Interactivity	More interactive media is needed to help students grasp measurement concepts.	Engaging media enhances student participation and conceptual understanding.
Integration of Local Culture	Concepts should connect with local cultural units like *hasta*, *depa*, *tumbak*.	Cultural context enables students to understand concepts more meaningfully.
Concept Visualization	Media should include illustrations, animations, and simulations.	Visual presentation supports comprehension of abstract concepts.
Curriculum Alignment	Media must support the concept exploration approach of the Merdeka Curriculum.	Flipbooks can be designed with project-based and exploratory content to fit curriculum goals.
Media Accessibility	Media should be digitally accessible via devices like laptops and tablets.	Digital flipbooks allow flexible learning both at school and at home.
Contextual Learning	Measurement concepts need to relate to students' real-life experiences.	Contextual learning helps students understand the practical use of what they learn.
Support for Independent Study	Media should enable students to study independently outside of school hours.	Interactive flipbooks encourage self-exploration and learning beyond the classroom.

Table 2 presents the specific development needs for ethnomathematics-based flipbook media, grounded in the findings from the study. One of the primary needs is interactivity, as students require more dynamic media to effectively grasp measurement concepts. Integrating local cultural elements such as *hasta*, *depa*, and *tumbak* is essential for making learning more meaningful and rooted in students' real-world contexts. Visual representation through illustrations, animations, and simulations is also crucial to support understanding of abstract mathematical ideas. Additionally, the media must align with the Merdeka Curriculum, which promotes exploration and student-centered learning approaches. Accessibility is another key factor, emphasizing the importance of digital media that can be used on various devices both in and outside of school. The table also highlights the need for contextual learning by connecting mathematical concepts with daily life experiences. Lastly, there is a growing demand for media that supports independent learning, allowing students to study at their own pace beyond regular classroom hours.

Discussion

This study reveals that mathematics learning, especially in measurement materials in grade III of SDN Tambakrigadung 2, still faces several challenges. Teachers still rely on conventional methods such as lectures and the use of textbooks as the main source in teaching. This is in line with Santi et al. (2021) who stated that many mathematics learning in elementary schools is still teacher-centered, so students are less active in exploring concepts independently. As a result, students have difficulty

understanding the concept of measurement because of its abstract nature and require more concrete visualization. For instance, students often confused the order of units (mm–cm–m), and some believed that 1 m = 1000 cm, indicating conceptual misunderstanding. Therefore, more innovative and interactive learning media is needed to increase student engagement and understanding of the material taught.

The results of the observation show that student involvement in learning is still low, especially when teachers only use textbooks without additional media. According to Melati et al. (2023), it is emphasized that learning based on interactive media can increase student engagement and motivation in understanding abstract concepts. This low student involvement has implications for low understanding of concepts, making learning less effective. In addition, students tend to memorize measurement formulas without understanding how the concept is applied in daily life. Thus, it is necessary to develop media that can provide a more interesting learning experience, one of which is through the use of ethnomathematics-based digital flipbooks.

Digital flipbook media offers an advantage in presenting measurement concepts in a more visual and interactive way. Research by Hariyono & Widhi (2021) shows that the use of digital-based media in mathematics learning can significantly improve students' conceptual understanding. Flipbooks can present illustrations, animations, and interactive simulations that help students understand the relationship between measurement concepts and their applications in everyday life. With interactive features, students can not only read the text but also see real examples packaged in digital format. However, not all students may respond equally well to digital content especially those with limited access to devices or with lower digital literacy. This creates a potential limitation that needs to be addressed in the implementation phase.

One of the important aspects in the development of learning media is the integration of ethnomathematics as part of a contextual approach in mathematics learning. Research by Fatimah et al. (2024) shows that the application of ethnomathematics in learning can improve students' conceptual understanding by associating mathematical concepts with the local culture they are familiar with. In the context of this study, culture-based measurements such as the use of hats, depa, and spears are still used by the community around SDN Tambakrigadung 2 in their daily lives. However, the results of the study show that this practice has not been utilized in learning in schools. By integrating ethnomathematical concepts in digital flipbooks, students can more easily connect new knowledge with their everyday experiences. Despite its potential, critics of ethnomathematics argue that over-reliance on local knowledge could limit students' exposure to formal mathematical standards if not carefully integrated (Maulidafi & Abadiyah, 2022; Wiryanto et al., 2024). Thus, a balanced approach is essential.

The Independent Curriculum implemented at SDN Tambakrigadung 2 has provided space for teachers to develop more exploratory and project-based learning methods. However, in practice, there is still a gap between curriculum demands and classroom implementation. Research by Simanjuntak & Murniarti (2024) emphasizes that the success of the implementation of the Independent Curriculum depends on the availability of learning resources that support exploration-based and contextual learning. Ethnomathematics-based digital flipbooks can be one of the solutions to bridge this gap by providing materials that are more in line with a curriculum approach that emphasizes exploration and problem-solving.

In addition to the curriculum aspect, technology factors are also an important consideration in the development of learning media. Research by Rachman & Verawati (2022) shows that elementary school students are increasingly accustomed to the use of digital devices in their learning activities. With access to devices such as tablets or computers at school, digital flipbook media can become a more relevant means of learning for today's generation. The advantage of flipbooks compared to printed books is their ability to present material in a more dynamic way, with a combination of text, images, audio, and animation. This can help students with various learning styles, both more visual, auditory, and kinesthetic.

Although the development of digital media has many benefits, the challenges in its implementation also need to be considered. Research by Muslimin & Fatimah (2024) states that one of the main obstacles in the implementation of digital media in elementary schools is the readiness of teachers to use it. Therefore, in the development of ethnomathematics-based digital flipbooks, there needs to be training for teachers so that they are able to integrate this media effectively in the learning process. In addition, the accessibility of digital devices for students must also be considered so that there is no gap in their use. Another consideration is the sustainability of the use of such media schools may face budget or infrastructure limitations that affect continued usage.

Taking into account the various findings in this study, the development of ethnomathematics-based flipbooks has great potential in improving the quality of measurement learning in grade III elementary schools. Research by Solihin & Rahmawati (2024) shows that ethnomathematics-based learning media can improve students' critical thinking skills because they are invited to connect mathematical concepts with real experiences. Therefore, the development of this flipbook not only aims to improve the understanding of measurement concepts, but also to foster critical thinking and problem-solving skills in students.

As a next step, the development of flipbooks should pay attention to an attractive design and in accordance with the characteristics of elementary school students. Research by Hermawan & Hadi (2024) confirms that the design of interesting and interactive learning media can increase the attractiveness and effectiveness of learning. Therefore, in designing this digital flipbook, it is necessary to pay attention to visual aspects, easy navigation, and content that is in accordance with the level of cognitive development of students. With the right approach, ethnomathematics-based digital flipbooks are expected to become effective and sustainable learning innovations.

Based on the overall discussion, it can be concluded that while ethnomathematics-based flipbooks hold promise, their development must be approached critically balancing cultural integration with formal standards, ensuring access and usability for all learners, and providing adequate support for teachers. By combining elements of local culture, digital visualization, and an interactive approach, these media can bridge the gap between abstract concepts in mathematics and students' real experiences. In addition, the development of this media is also in line with the demands of the Independent Curriculum which emphasizes exploration, contextualization, and problem-solving in learning. Therefore, the next step is to conduct a trial of this flipbook media to measure its effectiveness in improving understanding of measurement concepts in elementary schools.

CONCLUSION

Based on the results of the research, it can be concluded that the learning of measurement materials in grade III of SDN Tambakrigadung 2 still faces various obstacles, especially in terms of student involvement and concept understanding. The use of lecture methods and textbooks as the main medium is less effective in helping students understand the concept of measurement in depth. Therefore, the development of more interactive and contextual learning media is needed. The use of ethnomathematics-based digital flipbooks is an innovative solution to improve students' understanding of measurement concepts. This medium allows students to learn through more interesting illustrations, animations, and simulations and relate the concept of measurement to local cultures such as the hasta, depa, and tumbak. With this approach, students can more easily understand and apply the concept of measurement in their daily lives. In addition, the development of this flipbook is also in line with the demands of the Independent Curriculum which emphasizes exploration-based learning and problem-solving. However, the successful implementation of this media requires support from teachers, digital infrastructure readiness, and training in its use.

Therefore, further trials are needed to measure the effectiveness of this flipbook in improving students' understanding of measurement materials in elementary schools. In addition, future research should explore the scalability of ethnomathematics-based digital media across different regions and

grade levels, as well as investigate its long-term impact on students' mathematical thinking and cultural awareness.

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