

NEEDS ANALYSIS OF LOCAL WISDOM-BASED NUMBER WHEEL MEDIA IN ELEMENTARY SCHOOL MATHEMATICS LEARNING

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ABSTRACT

Mathematics learning in elementary schools, particularly arithmetic operations in second grade, requires concrete, interactive, and contextual learning experiences to support students' conceptual understanding and learning outcomes. However, classroom practices remain predominantly textbook-centered and lack interactive and culturally relevant learning media, resulting in low achievement in arithmetic. Integrating local wisdom into learning media is considered an effective approach to enhance students' engagement and contextual understanding. Therefore, this study aims to analyze the need for developing local wisdom-based Number Wheel media in elementary mathematics learning. This study employed a research-and-development design, focusing on the needs-analysis stage. The participants consisted of four second-grade teachers and 69 second-grade students from four elementary schools in Cluster 2, Selemadeg District. Data were collected through observations, interviews, questionnaires, and document analysis, and analyzed using descriptive quantitative and qualitative techniques. The results revealed that students' mastery of arithmetic was low, with only 39.1% achieving the minimum competency level, and that teachers had limited access to interactive and culturally contextualized learning media. The novelty of this study lies in providing empirical evidence of the need for local wisdom-based Number Wheel media as an interactive, manipulative learning tool integrating cultural elements to support elementary mathematics learning. This study concludes that needs analysis provides a strong foundation for developing culturally relevant learning media to improve students' arithmetic learning outcomes and enhance the quality of mathematics instruction.

Keywords: arithmetic, local wisdom, needs analysis, number wheel media, mathematics

INTRODUCTION

Mathematics learning in elementary schools plays a crucial role in developing students' numeracy skills and learning outcomes as a foundation for understanding more advanced mathematical concepts. In second-grade elementary school, mastery of arithmetic operations such as addition and subtraction is an essential competency that supports the development of mathematical thinking and problem-solving skills (Kilpatrick et al., 2001). Mathematics instruction should emphasize conceptual understanding, procedural fluency, and meaningful learning experiences supported by appropriate instructional strategies and learning media (Reys et al., 2020; Schoenfeld, 2020). Therefore, mathematics instruction at this level must provide meaningful, contextual, and developmentally appropriate learning experiences to support students' conceptual understanding and success in learning. However, mathematics learning in elementary schools still faces significant challenges, particularly in students' low arithmetic learning outcomes. Many students struggle to understand mathematical concepts due to the dominance of conventional teaching methods, such as lectures and textbook-centered instruction, and the limited use of interactive learning media (Hiebert & Grouws, 2007). As a result, mathematics learning often becomes abstract and less meaningful, which negatively affects students' engagement and achievement.

From a cognitive development perspective, second-grade students are in the concrete operational stage, requiring learning experiences involving manipulative, visual, and contextual activities to support conceptual understanding (Piaget, 1970). Manipulative learning media help students connect abstract mathematical symbols with concrete representations, thereby improving engagement and learning outcomes (Bruner, 1966; Moyer, Bolyard, & Spikell, 2002). In addition, integrating local wisdom into learning media provides culturally relevant contexts that enhance students' motivation and make learning more meaningful and relevant to their daily lives.

Preliminary findings conducted in Cluster 2, Selemadeg District, revealed that students' arithmetic learning outcomes remain low, with only 39.1% achieving the minimum mastery level. Classroom observations indicated that teachers primarily rely on conventional teaching methods and have limited access to interactive and culturally contextualized learning media. Although previous studies have demonstrated the effectiveness of manipulative learning media in improving mathematics learning outcomes (Sarama & Clements, 2009; Putra & Wulandari, 2021), little research has examined needs analysis as a foundation for developing local wisdom-based learning media, particularly Number Wheel media for second-grade elementary students.

Based on these gaps, conducting a needs analysis is essential to identify learning needs and provide a foundation for developing appropriate learning media aligned with students' characteristics and cultural contexts. Therefore, this study aims to analyze the need for developing local wisdom-based Number Wheel media in elementary school mathematics learning. The findings are expected to contribute theoretically to the development of culturally contextualized mathematics learning media and practically to support teachers in improving the quality and effectiveness of mathematics instruction in elementary schools.

LITERATURE REVIEW

Mathematics learning media, such as number wheels and locally wisdom-based instructional materials, have been shown to improve students' conceptual understanding and learning outcomes by providing concrete and culturally meaningful learning experiences (Hidayat et al., 2023; Ningrum, 2024). Context-based and culturally integrated learning approaches also enhance students' engagement and motivation by connecting mathematical concepts with real-life cultural practices (Martir et al., 2024; Wiana, 2018). In addition, innovative instructional approaches and student-centered learning strategies significantly improve students' mathematical thinking and conceptual understanding (Boaler, 2016; Yilmaz, 2017).

Furthermore, integrating local wisdom into learning media provides meaningful, culturally relevant learning experiences by connecting mathematical concepts to students' real-life cultural contexts, thereby enhancing motivation, engagement, and learning outcomes (D'Ambrosio, 2001; Wijaya et al., 2020; Utami et al., 2022). However, preliminary observations indicate that mathematics learning remains dominated by conventional teaching methods, with limited use of interactive and culturally contextualized media, resulting in low arithmetic learning outcomes. Needs analysis is a critical step in instructional design to identify gaps between existing learning conditions and desired outcomes, ensuring the development of effective and relevant learning media (Molenda, 2015; Gresalfi & Cobb, 2020). However, research has been limited on systematic needs analysis as a basis for developing local wisdom-based Number Wheel media to improve arithmetic learning outcomes. Therefore, this study aims to analyze the need for developing local wisdom-based Number Wheel media to support meaningful and effective mathematics learning in elementary school.

However, although previous studies have examined the effectiveness of manipulative and culturally integrated learning media, limited research has specifically focused on needs analysis as a foundational stage for developing local wisdom-based Number Wheel media for

elementary mathematics learning. Therefore, this study addresses the gap by analyzing the need to develop such media based on actual classroom conditions.

METHODOLOGY

This study employed a research and development (R&D) design with a descriptive quantitative approach, focusing on the needs analysis stage as the foundation for developing a local wisdom-based Number Wheel learning media to improve second-grade elementary students' arithmetic learning outcomes. The needs analysis stage was conducted to identify current instructional practices, the availability of learning media, student characteristics, and the needs of teachers and students for culturally relevant and interactive mathematics learning media.

The research subjects consisted of four second-grade teachers and 69 second-grade students from four elementary schools in Cluster 2, Selemadeg District. The subjects were selected using purposive sampling, considering their direct involvement in mathematics instruction, particularly in arithmetic operations. These participants were considered representative in providing comprehensive information on instructional conditions and the need to develop local wisdom-based learning media.

The research instruments included classroom observation sheets, interview guidelines for teachers and students, learning media needs questionnaires, and documentation sheets of students' arithmetic learning outcomes. The needs questionnaire was developed based on indicators of concrete, interactive, contextual learning, and integration of local wisdom in mathematics learning. The instruments were validated by experts in elementary education and learning media to ensure content validity. Reliability testing was conducted using internal consistency analysis, which showed a high reliability coefficient, indicating that the instruments were suitable for data collection.

Data were collected through direct classroom observations to examine current teaching practices, distribution of questionnaires to teachers and students to identify media needs, structured interviews to obtain in-depth information regarding instructional challenges and media requirements, and document analysis of students' arithmetic learning outcomes. These multiple data sources were used to ensure comprehensive and reliable findings.

Quantitative data were analyzed using descriptive statistics to determine students' mastery levels and identify trends in learning media needs. Meanwhile, qualitative data were analyzed through data reduction, data categorization, and conclusion drawing. The qualitative analysis focused on identifying key instructional issues, including the limited availability of interactive and concrete learning media, low student engagement in mathematics, and the need to develop local wisdom-based Number Wheel media to support contextual and meaningful arithmetic learning.

RESULT AND DISCUSSION

Result

The findings indicate that mathematics learning, particularly arithmetic operations in second-grade elementary school, has not optimally supported students' arithmetic learning outcomes. These findings were obtained through classroom observations, media needs questionnaires, interviews with teachers and students, and analysis of students' learning outcome documents. Overall, instruction remains dominated by conventional teaching approaches with limited use of interactive, concrete, and culturally contextualized learning media.

a. Limited Availability of Local Wisdom-Based Mathematics Learning Media

Classroom observations revealed that mathematics instruction primarily relies on textbooks and written exercises, with minimal use of manipulative learning media. Teachers typically explain addition and subtraction concepts through verbal instruction without the support of

concrete instructional tools. Furthermore, the learning media used in classrooms have not integrated elements of local wisdom to help students connect mathematical concepts to their cultural and real-life contexts.

This condition reduces student engagement and limits opportunities for students to develop meaningful understanding through active learning experiences. Mathematics learning presented abstractly, without concrete media support, tends to hinder students' ability to understand arithmetic concepts effectively, resulting in lower learning outcomes (Bruner, 1966).

b. Low Arithmetic Learning Outcomes of Students

The analysis of students' learning outcome documents indicates that students' arithmetic learning outcomes remain low. The summary of students' mastery of learning is presented in Table 1.

Table 1. Students' Arithmetic Learning Mastery

Total Students	Students Achieved Mastery	Students Did Not Achieve Mastery	Mastery Percentage
69	27	42	39.1%

(Source: Research data, 2026)

As shown in Table 1, most students did not achieve the expected level of mastery. The mastery percentage of 39.1% indicates that the current mathematics instruction has not effectively supported students' learning outcomes in arithmetic. Interviews with teachers also revealed that students have difficulty understanding arithmetic concepts, particularly when interactive, concrete learning media are not used to support instruction. These findings suggest that appropriate instructional media are essential to improving students' mathematics learning outcomes (Hiebert & Grouws, 2007).

c. Needs Analysis of Local Wisdom-Based Number Wheel Media

The results of the needs questionnaire indicate that both teachers and students expressed the need for more concrete, interactive, and contextual mathematics learning media. Most teachers reported that currently available media are limited and do not adequately support active student engagement in learning arithmetic operations. Teachers also emphasized the importance of integrating local wisdom into learning media to enhance students' cultural relevance and motivation to learn.

Students showed positive responses to interactive learning media that enable them to participate actively in learning activities. The local wisdom-based Number Wheel media was identified as a potential instructional tool to support students' understanding of arithmetic operations through visual and manipulative learning activities. These findings suggest that contextual and manipulative learning media play a significant role in improving student engagement and learning outcomes (Moyer, Bolyard, & Spikell, 2002).

Discussion

a. The Relationship Between Student Characteristics and the Need for Local Wisdom-Based Manipulative Media

Mathematics learning at the elementary level should align with students' stage of cognitive development. Second-grade students are in the concrete operational stage, where learning is most effective when supported by concrete, visual, and contextual experiences (Piaget, 1970). The findings of this study indicate that the limited use of manipulative learning media contributes to low arithmetic learning outcomes.

Integrating local wisdom into learning media can provide culturally meaningful learning experiences that enhance student engagement and understanding. Contextual learning helps students connect mathematical concepts with familiar cultural contexts, making learning more

meaningful and effective. Manipulative media enable students to connect concrete representations with abstract mathematical symbols, thereby facilitating deeper conceptual understanding and improving learning outcomes (Uttal, Scudder, & DeLoache, 1997).

b. The Urgency of Developing Local Wisdom–Based Number Wheel Media

The needs analysis findings indicate that currently available mathematics learning media do not adequately meet the learning needs of second-grade students. The local wisdom–based Number Wheel media has strong potential as an interactive manipulative learning tool that supports students' arithmetic learning through visual and kinesthetic activities. This media allows students to actively engage in learning and directly observe relationships between numbers.

The integration of local wisdom elements into the Number Wheel media enhances the cultural relevance of mathematics learning, making instruction more meaningful and engaging. This approach aligns with active learning principles, which emphasize student engagement as a key factor in improving learning outcomes (Sarama & Clements, 2009).

Unlike previous studies that primarily focused on testing the effectiveness of learning media, this study emphasizes the importance of needs analysis as a foundational step in media development. The needs analysis provides empirical evidence to support the development of local wisdom–based Number Wheel media that align with students' characteristics, instructional content, and cultural context. This finding supports previous research indicating that number wheel media can improve students' mathematics learning outcomes (Putra & Wulandari, 2021).

c. Implications for Mathematics Learning Media Development

The findings of this study indicate that low arithmetic learning outcomes are influenced not only by student factors but also by the limited availability of appropriate learning media. Therefore, developing local wisdom-based Number Wheel media is essential to support effective and meaningful mathematics instruction.

This study provides empirical evidence that needs analysis is a crucial stage in developing effective learning media. Media developed to address actual instructional needs are more likely to improve student learning outcomes because they align with students' characteristics, instructional goals, and cultural context (Kilpatrick, Swafford, & Findell, 2001).

These findings have practical implications for teachers in designing culturally relevant and interactive mathematics learning experiences. Additionally, this study contributes theoretically to the development of culturally integrated mathematics learning media and supports efforts to improve the quality of elementary mathematics education.

CONCLUSION

This analysis reveals that conventional instructional practices still dominate second-grade elementary mathematics learning and lack interactive, culturally contextualized learning media, resulting in low arithmetic learning outcomes. Teachers face limitations in providing engaging and meaningful instructional tools that align with students' cognitive development and learning characteristics. The findings indicate that local wisdom-based Number Wheel media is highly needed as an interactive manipulative learning tool that integrates cultural context and supports conceptual understanding. Therefore, the development of local wisdom-based Number Wheel media is essential to support effective, meaningful, and culturally relevant mathematics learning and improve students' arithmetic learning outcomes in elementary schools.

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