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Describing Manipulative Media Use in Mathematics Learning: Students' Understanding, Engagement, and Teacher Guidance

Anna Kurniawati, Riyadi, Septi Triyani

Universitas Sebelas Maret
riyadi_pgsd_fkip@staff.uns.ac.id

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Abstract
This study aims to describe students' experiences and perceptions of using manipulative media in learning whole-number addition and subtraction in elementary school. A descriptive qualitative approach was employed, involving 15 second-grade students and one classroom teacher selected through purposive sampling. Data were collected through interviews, open-ended questionnaires, and participant observation, and analyzed using the Miles and Huberman model, including data reduction, data display, and conclusion drawing. The findings show that the use of manipulative media enhances students' conceptual understanding by transforming abstract mathematical concepts into concrete representations, while also increasing engagement, motivation, and self-confidence in learning mathematics. Most students expressed positive perceptions, indicating that manipulative media helped them visualize and understand mathematical operations more easily; however, some students experienced initial difficulties, highlighting the importance of teacher guidance. The study implies that manipulative media can be an effective instructional strategy to improve mathematics learning in elementary schools, although its effectiveness depends on proper implementation and teacher support. This study is limited by a small sample size and short duration; therefore, future research is recommended to involve larger and more diverse participants and longer observation periods to obtain more comprehensive findings.
Keywords: *Manipulative media, Mathematics learning, Conceptual understanding, Student engagement, Student perceptions.*

Abstrak
Penelitian ini bertujuan untuk mendeskripsikan pengalaman dan persepsi siswa dalam menggunakan media manipulatif pada pembelajaran penjumlahan dan pengurangan bilangan cacah di sekolah dasar. Penelitian ini menggunakan pendekatan kualitatif deskriptif dengan melibatkan 15 siswa kelas II dan satu guru kelas yang dipilih melalui teknik purposive sampling. Pengumpulan data dilakukan melalui wawancara, angket terbuka, dan observasi partisipatif, kemudian dianalisis menggunakan model Miles dan Huberman yang meliputi reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa penggunaan media manipulatif mampu meningkatkan pemahaman konseptual siswa dengan mengubah konsep matematika yang abstrak menjadi lebih konkret, serta meningkatkan keterlibatan, motivasi, dan kepercayaan diri siswa dalam belajar matematika. Sebagian besar siswa menunjukkan persepsi positif karena media manipulatif membantu mereka memvisualisasikan dan memahami operasi matematika dengan lebih mudah, meskipun beberapa siswa mengalami kesulitan pada tahap awal penggunaan sehingga memerlukan bimbingan guru. Penelitian ini mengimplikasikan bahwa media manipulatif dapat menjadi strategi pembelajaran yang efektif dalam meningkatkan kualitas pembelajaran matematika di sekolah dasar, namun efektivitasnya sangat bergantung pada cara implementasi dan dukungan guru. Penelitian ini memiliki keterbatasan pada jumlah sampel yang kecil dan durasi penelitian yang singkat, sehingga penelitian selanjutnya disarankan melibatkan partisipan yang lebih banyak dan beragam serta dilakukan dalam jangka waktu yang lebih panjang untuk memperoleh hasil yang lebih komprehensif.
Kata kunci: *Media manipulative, Pembelajaran matematika, Pemahaman konseptual, Keterlibatan siswa, Persepsi siswa.*

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INTRODUCTION

Mathematics education in elementary school plays an important role in building a strong foundation of mathematical knowledge for students (Safari & Nurhida, 2024). Effective mathematics instruction does not only emphasize conceptual understanding in theory, but also uses engaging approaches that support active student participation (Maghfiroh et al., 2024). One method that has been increasingly used in mathematics learning is the use of manipulative media, which involves physical objects that students can move and handle to visualize mathematical concepts. Manipulative media has been shown to help students understand mathematics in a more concrete and interactive way, especially for topics that are often difficult to grasp, such as whole-number addition and subtraction (Styasih, 2021).

The use of manipulative media in mathematics learning, particularly in elementary schools, has gained more attention as an alternative strategy to address students' difficulties in understanding basic mathematical concepts (Farhana et al., 2022). Classroom observations in several elementary schools indicate that many students struggle with whole-number addition and subtraction. This difficulty affects their learning motivation, which tends to decrease when they find the material challenging. Several studies report that learning aids or manipulative media can improve students' understanding of mathematics because these tools allow students to interact directly with the concepts being learned (Tholib, 2022; Pramudita, 2023; Sintowati, 2024).

To further support these findings, recent preliminary observations in a public elementary school in Wonogiri Regency indicate that students' initial mathematics achievement in whole-number operations remains relatively low. Based on teacher records, only about 45% of second-grade students were able to correctly solve addition and subtraction problems, while the remaining 55% still made conceptual errors. These difficulties are reflected in students' inability to connect numerical symbols with real quantities and in their reliance on memorization rather than understanding. Furthermore, classroom assessments indicate that many students require repeated explanations before grasping basic concepts. This condition highlights a significant gap between expected learning outcomes and students' actual performance in mathematics.

At the national and international levels, students' mathematical performance also indicates ongoing challenges. The results of the Programme for International Student Assessment (PISA) show that Indonesian students consistently score below the OECD average in mathematics, particularly in problem-solving and conceptual understanding (Fenanlampir et al., 2019). Similarly, data from the Minimum Competency Assessment (AKM) reveal that many elementary students are still at the basic level of numeracy, indicating limited ability to apply mathematical concepts in real contexts (Astriani & Akyuni, 2024). These findings suggest that difficulties in mathematics learning are not only local but also part of a broader educational issue. This indicates an urgent need to strengthen foundational mathematical understanding from the early grades. Therefore, innovative and meaningful learning approaches, such as the use of manipulative media, are needed to support students' conceptual development.

However, although many teachers have introduced manipulative media, they do not always use it optimally. Factors such as limited instructional time, insufficient training in the use of manipulative media, and inadequate educational resources often hinder implementation. In addition, although many studies support the effectiveness of manipulative media, relatively few studies explore students' lived experiences and perceptions of using manipulative media, particularly in the context of whole-number addition and subtraction in second-grade classrooms.

Despite the growing body of research on the use of manipulative media in mathematics learning, a critical gap remains in understanding how students experience and perceive its use in classroom contexts. Most existing studies predominantly focus

on measuring learning outcomes and demonstrating the effectiveness of manipulative media, often through quantitative approaches. However, these studies provide limited insight into how students actively engage with manipulatives, how they construct meaning from hands-on activities, and how they interpret the learning process. Furthermore, the perspectives of second-grade elementary students who are at a crucial stage of developing foundational mathematical concepts are rarely explored in depth. This lack of qualitative, experience-based evidence indicates a significant gap in the literature, particularly in explaining the relationship between manipulative media, students' conceptual understanding, engagement, and teacher guidance from the students' point of view. Therefore, a descriptive qualitative approach is necessary to provide a more comprehensive and contextualized understanding of students' learning experiences.

Previous studies consistently highlight the benefits of manipulative media in improving students' conceptual understanding in mathematics. For instance, Murni et al. (2022) found that the use of manipulative media significantly improved students' mathematics achievement. Similarly, Khasiyati (2017) reported that physical learning aids could accelerate students' conceptual understanding of mathematical concepts. In addition, other studies (Tholib, 2022; Pramudita, 2023; Sintowati, 2024) emphasize that manipulative media supports interactive and meaningful learning processes. However, despite these consistent findings, most studies primarily focus on measurable learning outcomes and instructional effectiveness, with limited attention given to students' subjective experiences during the learning process.

Building on this gap, previous studies also show that how students perceive the use of manipulative media, how they engage with it, and how teacher guidance influences their learning experiences, particularly at the second-grade level. This indicates a clear gap in the literature, where the experiential and perceptual dimensions of learning with manipulative media remain underexplored. Therefore, further research is needed to provide a deeper and more holistic understanding of students' experiences, rather than focusing solely on learning outcomes.

From a constructivist perspective, Palupi (2020) argues that students build knowledge through interaction with their environment, and manipulative media provides opportunities for active and concrete learning. Susanti and Solihin (2025) also found that students who learn with manipulative media tend to be more motivated and develop better mathematical understanding. However, these findings require deeper investigation to determine whether students' experiences with manipulative media genuinely increase engagement and motivation, or whether other factors also contribute.

This study is urgent because it addresses the existing knowledge gap by examining students' experiences and perceptions of manipulative media in learning whole-number addition and subtraction. If researchers and teachers do not consider students' experiences, the design and implementation of manipulative media may not reach its full potential, and it may even reduce students' motivation if it does not match their needs and preferences. Therefore, this study aims to provide a more comprehensive understanding of the effectiveness of manipulative media from the perspective of students' experiences. The findings may support teachers and education policymakers in developing learning strategies that better align with students' needs.

This study contributes novelty through its approach, which focuses on describing students' experiences of learning mathematics using manipulative media. Using a descriptive qualitative approach, this study explores, second-grade students' subjective perceptions and lived experiences related to manipulative media, an area that has not been widely examined in depth. Another contribution lies in its focus on second grade, a critical stage when students begin to learn fundamental mathematics concepts, as well as the use of questionnaires and interviews designed to fit students' age and abilities.

This study is expected to provide new insights into how manipulative media influences student motivation and engagement, which may help improve the quality of mathematics learning at the elementary level.

This study aims to explore students' experiences and perceptions of using manipulative media in learning whole-number addition and subtraction. The research questions are: (1) How do students experience the use of manipulative media to understand whole-number addition and subtraction concepts? and (2) What are students' perceptions of the effectiveness of manipulative media in facilitating their understanding of these concepts? The purpose of this study is to understand how manipulative media affects students' understanding and motivation in learning mathematics.

METHOD

This study employed a descriptive qualitative approach to describe second-grade elementary students' experiences and perceptions of using manipulative media in learning whole-number addition and subtraction. Qualitative descriptive research aims to provide a comprehensive summary of events in everyday terms and focuses on understanding phenomena based on participants' perspectives (Doyle et al., 2020). In addition, according to Hancock (2001), qualitative research is used to explore and understand the meaning individuals or groups ascribe to a social or human problem. Therefore, this approach was considered appropriate to capture students' learning experiences and classroom interactions in a natural setting.

The participants of this study were 15 second-grade students and one classroom teacher at SD Negeri 1 Kedungrejo. The participants were selected using purposive sampling, which involves selecting individuals who have direct experience with the phenomenon being studied (Sugiyono, 2019). The criteria for selecting students were those who actively participated in mathematics learning activities using manipulative media. The classroom teacher was included to provide additional insights into the implementation of manipulative media and the learning process.

This study was conducted over four weeks, consisting of eight learning sessions, with each session lasting approximately 60 minutes. Observations were carried out during each session to capture students' interactions, engagement, and responses during the learning process.Data were collected using interviews, open-ended questionnaires, and observation. Interviews were conducted using a semi-structured format to allow flexibility in exploring participants' responses while still focusing on the research objectives (Hancock, 2001). The interview questions focused on students' conceptual understanding, engagement, and perceptions of the use of manipulative media.

The open-ended questionnaire was designed using simple language suitable for second-grade students and included a pictorial (emoji-based) response scale to facilitate understanding. The questionnaire was developed based on key indicators: (1) conceptual understanding, (2) student engagement, and (3) teacher guidance. The instrument was reviewed by an expert in elementary education to ensure its content validity.

Observation was conducted using an observation sheet based on indicators of student engagement (active participation, interaction with manipulatives, responsiveness) and teacher guidance (instruction clarity, facilitation, feedback). The researcher acted as a non-participant observer to minimize disruption and maintain the natural classroom environment.

Data analysis followed the Miles and Huberman interactive model, which consists of data reduction, data display, and conclusion drawing/verification (Sugiyono, 2019). Data analysis began with data coding, where important statements from interviews,

questionnaires, and observations were identified and categorized. These codes were then grouped into broader themes, such as conceptual understanding, student engagement, and teacher guidance. The final step involved interpreting the data to identify patterns and draw meaningful conclusions.

To ensure the trustworthiness of the data, this study applied triangulation techniques, by comparing data from interviews, questionnaires, and observations (Sugiyono, 2019). In addition, member checking was conducted by confirming the findings with participants to ensure the accuracy and credibility of the data interpretation.

RESULT AND DISCUSSION

Result

This study aimed to explore students' experiences and perceptions regarding the use of manipulative media in mathematics learning, particularly for whole-number addition and subtraction concepts. Based on data collected through interviews, questionnaires, and participant observation, the findings show that the use of manipulative media had a positive impact on students' understanding and engagement. The following section presents the research results related to students' experiences and their perceptions of the effectiveness of manipulative media in mathematics learning. The study also includes documentation of classroom activities in which students used manipulative media to understand whole-number addition and subtraction concepts.

Figure 1. The teacher explains the lesson and provides instructions on how to use the manipulative media

Figure 2. Discussion session and question-and-answer session

Figure 3 The teacher guides group work

1. Students' Experiences in Using Manipulative Media

The use of manipulative media in mathematics learning had a meaningful impact on students' experiences in understanding whole-number addition and subtraction. Based on student interviews, many students reported that they understood mathematical concepts more easily after using teaching aids such as number blocks and other objects. For example, Student A stated, *"I understand addition more easily with number blocks, because I can see them and move them."* Student B also said, *"The teaching aid helps me understand better, because I can touch and manipulate the numbers myself."* These responses indicate that manipulative media provides a more concrete learning experience and supports deeper understanding compared to traditional instructional methods.

Further responses from other students strengthen this finding. Student D mentioned, *"When I use the blocks, I can count step by step, so I don't get confused,"* while Student E stated, *"It is easier to understand because I can see the numbers directly."* These responses suggest that manipulative media helps students connect abstract mathematical symbols with concrete representations, enabling them to construct meaning through direct interaction. As a result, students are able to reduce confusion and better understand the relationships between numbers and operations.

However, several students reported difficulties at the beginning of using manipulative media. For instance, Student C explained, *"At first I was confused about how to use it, but after trying, I understood more."* This suggests that although manipulative media can improve students' understanding, an adaptation process is required before students can fully benefit from the tools. It also indicates that learning with manipulatives is not automatically effective without proper guidance and support from the teacher.

The questionnaire results also supported these findings. Most students (80 percent) selected the smiling emoji (😊) on the emotion scale, indicating that they felt happy and helped by the use of manipulative media. In addition, 60 percent of students reported feeling more confident in solving whole-number addition and subtraction problems after using the teaching aids. These results do not merely represent numerical data but reflect students' positive emotional and cognitive responses toward the learning process. The high percentage of positive responses suggests that manipulative media enhances not only conceptual understanding but also students' motivation, confidence, and engagement in mathematics learning. Meanwhile, the presence of neutral and less positive responses indicates that some students still experienced initial challenges, particularly in adapting to new learning tools.

In addition, participant observation during the learning process showed that students participated more actively in discussions and group activities when manipulative media was used. Students who previously tended to be passive in mathematics lessons appeared more engaged and interested in the material. For example, when students used number blocks to solve addition problems, they showed greater enthusiasm in completing tasks and discussing answers with their peers. This increased engagement indicates that manipulative media creates a more interactive learning environment, which encourages students to be actively involved in constructing their understanding.

On the other hand, some students who learned more slowly required additional support from the teacher to ensure they could follow the lesson effectively. This finding highlights that although manipulative media supports active learning, its effectiveness varies depending on students' learning readiness and prior knowledge.

These student experiences were also supported by the teacher's observations. The teacher stated that manipulative media helped students understand mathematics more easily and increased their engagement during learning. The teacher noted, *"Students are more active when using teaching aids. They do not only listen to explanations, but they also interact directly with the material, which helps them understand the concepts."* However, the teacher also highlighted that some students needed extra guidance, especially at the beginning of using manipulative media, to help them use the tools effectively. This indicates that teacher guidance plays a crucial role in facilitating the effective use of manipulatives, particularly in helping students transition from initial confusion to meaningful understanding.

Overall, findings from interviews, questionnaires, and observations indicate that the use of manipulative media in mathematics learning, particularly in whole-number addition and subtraction, had a positive impact on students' learning experiences. Manipulative media not only supported students' understanding but also improved their motivation and engagement. These aspects appear to be interconnected, as increased engagement contributes to better understanding, which in turn enhances students' confidence in learning. However, to maximize the benefits of manipulative media, teachers need to provide additional guidance for students who require support, especially during the initial stage of using the tools.

2. Students' Perceptions of the Effectiveness of Manipulative Media

This study found that most students had positive perceptions of the effectiveness of manipulative media in helping them understand whole-number addition and subtraction concepts. Based on interviews, most students reported that manipulative media made it easier to visualize numbers and mathematical operations that previously felt abstract and difficult to understand. For instance, Student A said, *"With the teaching aid, I can see the total directly and move the number blocks, so it is easier to understand."* Student B added, *"The teaching aid makes it easier for me to understand because I can see and feel how numbers are combined or separated."* These responses indicate that manipulative media enables students to transform abstract mathematical ideas into concrete representations, allowing them to construct understanding through direct visualization and interaction.

Further responses from students strengthen this perception. Some students indicated that manipulatives helped them not only see the results but also understand the process of how numbers are combined or separated. This suggests that manipulative media supports both procedural and conceptual understanding, as students are able to observe the relationship between numbers and operations in a

more meaningful way. As a result, students develop a clearer mental representation of mathematical concepts.

The open-ended questionnaire results also supported these findings. Approximately 80 percent of students reported that manipulative media was very helpful for understanding whole-number addition and subtraction. They selected the smiling emoji (😊) on the emotion scale, indicating that they felt happy and supported. About 15 percent of students gave a neutral response (😳), suggesting that although they found manipulative media useful, they experienced some initial challenges when first using the tools. Meanwhile, 5 percent of students reported feeling less helped, mainly those who perceived the tools as time-consuming and confusing at the beginning. Rather than being interpreted merely as numerical data, these findings reflect students' cognitive and emotional responses toward the learning process. The dominance of positive responses indicates that manipulative media contributes to students appeared more motivated, confidence, and interest in learning mathematics, while the presence of neutral and negative responses highlights the need for adaptation and guidance.

Table 1. Questionnaire Results on Students' Perceptions of the Effectiveness of Manipulative Media

No	Statement	Persentase		
		Helpful (%)	Netral (%)	Less Helpful (%)
1	Manipulative media is very helpful for me in visualizing mathematics problems.	80%	13%	7%
2	I feel that manipulative media helps me understand mathematics material faster.	93%	7%	0%
3	I enjoy learning mathematics more using manipulative media than using the usual method.	87%	13%	0%
4	I feel confident when using manipulative media to solve mathematics problems.	80%	20%	0%
5	I feel that manipulative media is very useful in improving my understanding in mathematics learning.	87%	13%	0%

During the interviews, a student who felt less supported by manipulative media, such as Student C, stated, *"At first I was confused about how to use it, and I felt it was easier with the traditional way, like calculating on paper."* However, Student C also admitted that after receiving explanations and guidance from the teacher, they became more comfortable using the tool and began to see its benefits in understanding the concepts. This finding indicates that students' perceptions can change over time, particularly when they receive appropriate support and become more familiar with the use of manipulatives.

Participant observation during mathematics lessons showed that most students who used manipulative media demonstrated clear improvement in understanding. Students appeared more focused when working with the teaching aids, and they frequently discussed solutions with their peers. For example, when using number blocks to solve addition problems, students helped one another to solve the tasks. This indicates not only increased engagement but also social interaction that supports deeper understanding of mathematical concepts. Through collaborative activities, students were able to exchange ideas and reinforce their learning.

Observations also showed that manipulative media supported students' understanding because they could directly see the relationship between numbers and mathematical operations, rather than relying only on abstract symbols. This visual and hands-on experience appears to reduce students' cognitive difficulty when dealing with mathematical problems, making learning more accessible and meaningful.

Despite the overall positive perceptions, several points require attention. The teacher noted that while manipulative media made concepts easier to understand, some students still struggled to connect the use of the teaching aids to broader mathematical concepts. This issue was more common among students who had difficulties with basic mathematical ideas, including more complex forms of addition or subtraction. This suggests that while manipulatives are effective in supporting initial understanding, students may still need guidance to transfer their knowledge to more abstract levels.

The teacher also emphasized the importance of more intensive guidance for students who experienced difficulties, so they could maximize the benefits of manipulative media. This finding indicates that the effectiveness of manipulative media is closely related to how it is implemented and supported by the teacher. Without adequate guidance, some students may not fully benefit from the use of manipulatives.

Overall, the findings indicate that manipulative media significantly helped students understand whole-number addition and subtraction concepts. Students' perceptions of the effectiveness of manipulative media were strongly positive, as reflected in their students showed better understanding, increased engagement, and enhanced confidence. These aspects appear to be interconnected, as positive perceptions encourage active participation, which in turn supports deeper understanding. However, a small number of students required further guidance to use the tools optimally. With appropriate teacher support, manipulative media can improve students' understanding of mathematics content and increase their motivation and engagement in the learning process.

Discussion

1. Students' Experiences in Using Manipulative Media

This study found that the use of manipulative media in mathematics learning had a significant impact on students' experiences in understanding whole-number addition and subtraction concepts. The findings show that most students found it easier to understand mathematics after using manipulatives. This aligns with Piaget's theory, which suggests that students understand abstract concepts more easily when they can interact directly with concrete objects (Saputra, 2024). Manipulative media allows students to visualize and manipulate numbers, helping them connect mathematical concepts with real experiences (Utomo, 2025). Vygotsky's constructivist perspective also supports these findings, emphasizing that learning becomes more effective when students actively engage in the learning process through concrete tools that they can manipulate (Ristiani et al., 2025).

However, although manipulative media supported most students, several students experienced difficulties at the beginning of its use. This indicates that teacher guidance is essential, especially for students who are not accustomed to using such tools. As reported by Student C, they felt confused initially, but after receiving guidance from the teacher, they understood better. This highlights the importance of the teacher's role in providing scaffolding that matches students' needs, as described in scaffolding theory (Hidayat et al., 2024). Teachers play a key

role in offering appropriate support to help students learn how to use manipulatives correctly so that they can maximize the learning benefits (Tjandra, 2023).

In addition, the findings show that manipulative media not only improved students' understanding, but also increased their engagement and motivation in mathematics learning. Observational data indicated that students who were previously passive and less interested in mathematics became more active and enthusiastic when using manipulatives. This is consistent with Fitrianti and Hidayati (2025), who reported that student engagement increases when students feel emotionally connected to the material. Manipulatives create a more interactive learning experience, which encourages greater participation in the learning process (Sukandi et al., 2024).

In terms of motivation, the results also indicate that manipulative media increased students' confidence in solving mathematics problems. Many students reported feeling more confident after using manipulatives because they could see the relationship between numbers and mathematical operations more clearly. Self-efficacy, as explained by Subaidi (2016), refers to students' beliefs in their ability to complete specific tasks. In this context, the use of manipulative media may enhance students' self-efficacy in mathematics learning because students feel more capable of solving problems that previously seemed difficult (Herdini et al.,2019).

Despite these benefits, this study also identified challenges in the use of manipulative media, particularly for students who required more time to understand the material. This suggests that although manipulative media is effective for most students, teachers need to provide more intensive guidance to ensure that all students can use the tools optimally. Learning aids such as manipulatives should be accompanied by adequate teacher support so students can understand and apply the concepts effectively (Cahyono et al., 2024).

In contrast to several previous studies that reported uniformly positive outcomes of manipulative media in improving students' understanding (Murni et al., 2022; Khasiyati, 2017), this study found that not all students immediately benefited from its use. Some students experienced initial confusion and required an adjustment period before they could effectively use the manipulatives. This difference suggests that the effectiveness of manipulative media is not only determined by the tools themselves but also by students' readiness and the quality of teacher guidance during implementation (Sa'diyah et al., 2024).

Furthermore, it is important to acknowledge that this study involved a relatively small sample of 15 second-grade students from a single elementary school. While this allowed for an in-depth exploration of students' experiences, the findings may not be generalized to broader populations with different characteristics. Students' backgrounds, prior knowledge, and learning environments may influence how manipulative media is perceived and utilized.

Another limitation of this study lies in the duration of the implementation, which was conducted within a limited number of learning sessions. As a result, the findings mainly reflect students' initial experiences rather than long-term learning outcomes. Future research is recommended to involve a larger sample size and longer observation periods to examine the sustained impact of manipulative media on students' conceptual understanding and engagement.

Overall, the use of manipulative media in teaching whole-number addition and subtraction had a positive impact on students' learning experiences. It improved not only conceptual understanding, but also engagement, motivation, and confidence in mathematics learning. However, to maximize the benefits of manipulative media, teachers need to provide appropriate guidance, especially for students who require more support in mastering the use of these learning tools.

2. Students' Perceptions of the Effectiveness of Manipulative Media

The findings indicate that most students had positive perceptions of the effectiveness of manipulative media in helping them understand whole-number addition and subtraction concepts. Most students reported that manipulative media was highly helpful for visualizing numbers and mathematical operations that previously felt abstract. For example, 87 percent of students stated that manipulative media made it easier to understand subtraction, and 80 percent reported that the teaching aids supported their understanding of addition. Concrete tools that students can manipulate can clarify abstract concepts and improve conceptual understanding (Cahyono et al., 2024). Direct experiences with manipulative media help students visualize and make mathematical concepts more concrete, which supports their learning process (Alfin et al., 2025).

Manipulative media also helped students understand the relationships among numbers and mathematical operations. For instance, Student A stated, *"I understand addition more easily with number blocks, because I can see them and move them."* This indicates that manipulatives help students connect numbers visually and practically, which strengthens their understanding of mathematical concepts. This finding is consistent with constructivist theory, which emphasizes that social interaction and concrete experiences strongly influence learning (Rizki & Susanti, 2025). Through the use of manipulative media, students interacted more actively with the material, which supported deeper understanding (Palupi, 2020).

Questionnaire results showed that 87 percent of students felt that manipulative media accelerated their understanding of the material, while 13 percent reported a neutral response. This suggests that most students felt supported and understood mathematical concepts more quickly after using manipulative media. Kurniawan and Aryani (2024) noted that students' motivation and understanding can increase significantly when they feel emotionally engaged and actively involved in learning. Manipulative media allows students not only to listen to explanations, but also to engage directly with the material, leading to more systematic and comprehensive understanding (Khumaidi, 2011). These findings also indicate that students' perceptions are closely related to their learning experiences, where positive perceptions tend to reinforce active participation and deeper cognitive processing (Annansingh, 2019).

Students also reported greater enjoyment in learning mathematics using manipulative media. As many as 87 percent preferred learning with manipulative media rather than using the usual method, indicating that manipulatives were not only effective for understanding, but also increased students' interest in mathematics learning. When students feel capable of overcoming learning challenges, their motivation to learn tends to increase (Subaidi, 2016). In this context, manipulative media helped students feel more confident in solving mathematics problems that they initially perceived as difficult (Murni et al., 2022). This suggests that students' positive perceptions contribute to increased self-efficacy, which in turn supports better learning outcomes.

However, although most students felt supported, a small number reported feeling less helped by manipulative media, particularly at the beginning of its use. This suggests that even when manipulatives are effective, some students still need additional guidance to use them optimally. The use of instructional tools such as manipulative media should be accompanied by teacher guidance so students can learn how to use them effectively (Cahyono et al., 2024). In other words, while manipulative media may accelerate students' understanding, teacher support

remains important to ensure that all students can benefit from the teaching aids (Ordu, 2021).

In contrast to several previous studies that reported consistently positive perceptions toward the use of manipulative media (Murni et al., 2022; Alfin et al., 2025), this study found that a small number of students initially perceived manipulative media as confusing and less efficient. This difference suggests that students' perceptions are not uniform and may be influenced by their prior experiences, learning readiness, and familiarity with instructional tools. Therefore, the effectiveness of manipulative media is context-dependent and influenced by how it is introduced and facilitated in the classroom.

Regarding confidence, 80 percent of students reported feeling more confident in solving mathematics problems after using manipulative media. Self-efficacy developed through the use of manipulatives encourages students to feel more capable of completing mathematics tasks (Kartini et al., 2025). This is important in mathematics learning, where confidence often influences student performance. Self-efficacy plays a major role in determining learning success because confident students tend to persist longer and show stronger motivation to learn (Subaidi, 2016).

Nevertheless, this study has several limitations that need to be acknowledged. First, the study involved a relatively small sample of 15 students from a single elementary school, which limits the generalizability of the findings. Students' perceptions may vary across different contexts, schools, and student characteristics. Second, the duration of the study was limited, so the findings primarily reflect students' initial perceptions rather than long-term perceptions of using manipulative media. Future studies are recommended to involve larger and more diverse samples and to examine students' perceptions over a longer period to obtain more comprehensive results.

Overall, the results indicate that manipulative media is highly effective in helping students understand whole-number addition and subtraction concepts. Students experienced clear benefits in visualizing mathematics content and felt more engaged during learning. Manipulative media can improve understanding by providing students with opportunities to learn actively and interactively (Murni et al., 2025). However, it is important to note that even when manipulative media is effective, teacher guidance is still needed for students who face initial difficulties in using the tools, so the full benefits of the teaching aids can be achieved.

CONCLUSION

This study demonstrates that the use of manipulative media in mathematics learning, particularly for whole-number addition and subtraction, has a positive impact on students' experiences and perceptions. Manipulative media helps students understand abstract concepts more concretely, increases engagement, and enhances motivation and self-confidence in learning mathematics. In addition, students showed positive emotional responses, such as increased enjoyment and interest during the learning process. However, not all students were able to use manipulative media effectively at the initial stage, indicating the importance of teacher guidance in supporting students' learning.

The findings imply that manipulative media can serve as an effective instructional strategy to improve the quality of mathematics learning in elementary schools. Nevertheless, its effectiveness largely depends on how teachers facilitate and provide appropriate scaffolding during the learning process.

This study is limited by a small sample size and a relatively short duration. Therefore, future research is recommended to involve larger and more diverse

participants and to be conducted over a longer period to provide a more comprehensive understanding of the effectiveness of manipulative media in mathematics learning.

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