



Implementation of Manipulative Media to Improve the Numeracy Skills of Students with Special Needs in an Inclusive School

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Article Info	Abstract
Article history: Received: March 18, 2026 Accepted: June 7, 2026 Published: July 29, 2026 Keywords: Inclusive education Manipulative learning media Numeracy skills Students with special needs Inclusive elementary school This article is licensed under a Creative Commons Attribution- ShareAlike 4.0 International License. © 2026 Journal of Mathematics, Science, and Computer Education	This study aims to analyze the implementation of manipulative media in improving the numeracy skills of special needs students in an inclusive elementary school. Mathematics learning often presents challenges for special needs students because mathematical concepts are generally abstract and symbolic. Therefore, the use of concrete learning media is needed to help students understand basic numeracy concepts more effectively. This research employed a qualitative approach using a case study method to explore the implementation of manipulative media in mathematics learning within an inclusive classroom context. The study was conducted at SD Muhammadiyah 2 Gresik and involved classroom teachers, special education teachers, and special needs students as research participants. Data were collected through classroom observations, interviews, and documentation. The data were analyzed using the qualitative data analysis model of Miles, Huberman, and Saldaña, which includes data reduction, data display, and conclusion drawing. The findings show that the use of manipulative media such as number cards, counting beads, number trees, and simple concrete objects can help special needs students understand basic arithmetic concepts more easily. The implementation of manipulative media also increased students' engagement, attention, and participation during the learning process. Students who previously experienced difficulties in understanding addition and subtraction were able to perform simple counting operations more confidently after using manipulative media. In addition, the use of concrete media supported positive social interaction between special needs students and their peers in inclusive classrooms. In conclusion, manipulative media play an important role in supporting more adaptive and meaningful mathematics learning for special needs students. The findings suggest that teachers should integrate manipulative media into inclusive mathematics instruction to create more interactive and accessible learning environments.
To cite this article: Tasari, E. M., Syahri, M., & Syaifuddin, M. (2026). Implementation of manipulative media to improve the numeracy skills of students with special needs in an inclusive school. <i>Journal of Mathematics, Science, and Computer Education</i>, 6(1), 456-476.	

INTRODUCTION

Inclusive education is one of the important paradigms in the modern education system that emphasizes equal access to education for all learners without discrimination, including learners with special needs (Isyattirradhiyah et al., 2025; Makeleni & Ndu, 2024). The principle of inclusive education emphasizes that every child owns equal rights to get quality education in the same environment and study with friends and peers (Novrizal & Manaf, 2024). This approach puts diverse learners as a strength in the learning process and not as an obstacle (Murtini et al., 2025). A total of 240 million children in the world have disabilities, and some big ones still face limitations in access to inclusive and quality education (Haniyah, 2025; KamiBijak.com, 2025). The conditions push various countries to develop inclusive education policies as an effort to ensure every child gets a chance at equal learning.

In Indonesia, the implementation of inclusive education has a strong legal runway law through various regulations, including Law Number 20 of 2003 concerning the National Education System, Law Number 8 of 2016 concerning persons with disabilities. Disability, as well as Regulation of the Minister of National Education Number 70 of 2009 concerning Inclusive Education. The policy confirms that learners with special needs are entitled to get service-customized education with characteristics and study needs (Clever et al., 2025). As the most inclusive school in Indonesia, the main challenge faced is how to provide capable learning strategies to accommodate the diverse abilities of learners in the same class.

One of the basic competencies that must be mastered by learners at the elementary school level is the ability to count or numeracy (Syaepudin et al., 2025). Ability to count, cover, and understand draft numbers and introductory quantities, as well as the ability to do basic arithmetic operations like addition and subtraction. This ability is not only important for a successful academic learner but also plays a role in supporting daily life activities like managing money, measuring time, and finishing simple problems. However, thus, for learners with special needs, learning mathematics often becomes a challenge because of the abstract and symbolic nature of mathematics in nature (Zis et al., 2021). Learners with intellectual obstacles, attention disorders, as well as specific learning difficulties often experience difficulty in understanding the connection between symbols, numbers, and real quantities (Damopoli et al., 2024; Ginting et al., 2019).

In the context of learning mathematics inclusively, the use of concrete learning media becomes one of the effective strategies for helping learners understand abstract concepts. One of many media used in learning mathematics is manipulative media. Manipulative media are concrete objects that can be touched, moved, and manipulated in a way directly by learners to help them understand mathematics through real experience (Desrinelti et al., 2021). Use of manipulative media allows learners to build understanding and learn actively through exploration, activity, and interaction with objects. This approach is in line with the theory of constructivism, which states that knowledge is built through direct experience and interaction with the learning environment (Pramana et al., 2024).

A number of studies previously showed that the use of manipulative media has its own positive influence on learning mathematics. Research conducted by (Sulistiyawati et al., 2021) shows that the media is manipulative and capable of increasing understanding of mathematics concepts in elementary students. Other studies also found that the use of manipulative media can increase involvement of learners in the learning process as well as help reduce anxiety to a lesser extent in mathematics (Taslima, 2021). In addition, research by (Harahap & Surya, 2017) shows that the use of manipulative media is effective in increasing participation and results for learners in need of special help in learning mathematics.

Although various studies have proven the effectiveness of manipulative media in learning mathematics, a large-scale study is still focused on improving study results or is done in the context of special education schools and individual learning. Research on the special study implementation of manipulative media in learning mathematics in a heterogeneous inclusive class is still relatively limited. Even though in an inclusive school, teachers face more complex challenges because they must manage learning for learners with diverse abilities in the same learning environment. In addition, practicing learning in several inclusive schools still dominated by less conventional methods gives concrete study experience for learners in need, specifically (Nurjanah et al., 2021)

The condition shows an existing research gap (research gap) on how manipulative media are implemented in a real way in learning counting for learners in need, specifically in an inclusive class. Research has previously placed more emphasis on aspects of media effectiveness on learning outcomes, but not yet many are studying in-depth the processes of implementing manipulative media and the learning interactions that occur, as well as the challenges faced by teachers in their implementation.

Based on the gap identified, this research aims to analyze the implementation of manipulative media in increasing counting ability in learners in need, specifically at inclusive schools. This research novelty lies in its focus on studies that not only evaluate the improvement in counting ability and counting learners but also study the comprehensive implementation process of manipulative media in inclusive learning, including learning activities, interaction between teachers and learners, and obstacles faced in inclusive classroom learning practice. To identify the research gap and establish the novelty of the study, a comparison between previous studies and the current research is presented in Table 1.

Table 1 Comparison of previous studies and the current study

Authors	Research Focus	Main Findings	Limitations	Position of the Current Study
Sulistyawati et al. (2021)	Effectiveness of manipulative media in mathematics learning	Manipulative media improved students' understanding of mathematical concepts and learning outcomes.	Focused primarily on learning achievement and did not examine inclusive classroom contexts.	Examines how manipulative media are implemented in inclusive classrooms for students with special needs.
Harahap & Surya (2017)	Mathematics instruction for students with special needs using concrete learning materials	Concrete learning materials increased student participation and conceptual understanding.	Focused on instructional outcomes rather than implementation processes and classroom interactions.	Explores implementation processes, teacher strategies, and student interactions in inclusive settings.
Carbonneau et al. (2013)	Role of manipulatives in mathematics education	Manipulative media positively affected mathematical achievement and conceptual learning.	Provided general evidence but did not specifically address inclusive education contexts.	Investigates the use of manipulative media within inclusive elementary school classrooms.

Authors	Research Focus	Main Findings	Limitations	Position of the Current Study
Bouck & Sprick (2019)	Mathematics learning supports for students with disabilities	Learning supports improved engagement and academic performance of students with disabilities.	Limited discussion of challenges and adaptations during classroom implementation.	Identifies implementation challenges and adaptive strategies used by teachers in inclusive classrooms.
Current Study	Implementation of manipulative media to improve numeracy skills of students with special needs in inclusive schools	Examines implementation processes, student responses, classroom interactions, challenges, and adaptive strategies in inclusive mathematics learning.	—	Provides a qualitative understanding of how manipulative media support numeracy development and participation among students with special needs in inclusive classrooms.

As shown in Table 1, previous studies have mainly focused on the effectiveness of manipulative media in improving mathematics achievement and conceptual understanding. However, limited attention has been given to how manipulative media are implemented in inclusive classrooms, particularly regarding classroom interactions, adaptive teaching strategies, and implementation challenges. Therefore, the present study addresses this gap by exploring the implementation process and its contribution to the numeracy development of students with special needs in an inclusive elementary school setting.

This study uses a qualitative case study approach to get a greater, deeper understanding of the practical use of manipulative media in learning mathematics in an inclusive class. Through this approach, research is expected to contribute to the development of inclusive mathematics learning strategies as well as become a reference for teachers in utilizing manipulative media to increase the counting ability of learners in need of special education.

METHODS

This study uses a qualitative approach with a case study method. A qualitative approach was chosen because this study aims to understand the in-depth processes of implementing manipulative media in learning counting for learners in need, specifically in an inclusive class. The case study method is used to dig into the phenomenon of learning in a way that is contextual and comprehensive in a real situation in the school environment (Malahati et al., 2023; Sugiyono, 2020). Through this approach, researchers can get an in-depth overview of practical learning, interaction between teachers and learners, and factors that influence the use of manipulative media in learning mathematics.

This study focuses on the implementation of manipulative media as a learning strategy to increase the counting ability of learners with special needs in the context of an inclusive class in elementary school. The subject in this study consists of 17 participants, including nine learners, four assistant teachers, four homeroom teachers, and one principal. The students represent the primary participants, while the teachers and principal serve as supporting

informants to provide additional perspectives related to the learning or research process. Learners with special needs who become subjects of study have their own characteristics and obstacles to learning, such as learning difficulties and intellectual light obstacles. The selection of subjects for study was done using a purposive sampling technique, namely the selection of informants, based on consideration of certain things that are considered capable of giving relevant information with objective research (Sugiyono, 2020). The study instrument is a tool used by researchers to collect research data. In qualitative research, the researcher is the main instrument (human instrument) that plays a role directly in the process of data collection and analysis (Creswell, 2010).

Table 2 Description of research/learning subjects

No	Category	Code	Total per Category
1	Students	AH	9 students
		FR	
		IN	
		MF	
		MR	
		NS	
		RK	
		RR	
		TA	
2	Assistant Teachers	AM	4 teachers
		DA	
		EN	
		MA	
3	Homeroom Teachers	ER	4 teachers
		BA	
		NK	
		SA	
4	Principal	LS	1 person

Manipulative media used in this study are in the form of concrete objects that can be manipulated by learners, such as beam numbers, card numbers, bead counting, and simple mathematics tools and props to help learners understand the concept of counting in a concrete way.

To support the data collection process, this research uses a number of instruments, namely observation sheets, interview guidelines, and documentation. Observation sheets are used for observing the direct learning process, counting in an inclusive class, in particular related to the use of manipulative media by teachers and the responses of learners during learning. Guidelines for interviews are used to get more in-depth information from class teachers and assistant teachers, especially about their experience in applying manipulative media in learning mathematics. Meanwhile, documentation techniques are used to collect data in the form of photo activity learning and device learning, as well as note results. Study participants related to education and counting ability.

The data obtained were then analyzed using the qualitative data analysis model of Miles, Huberman, and Saldaña (2014), which includes three stages, namely data reduction, data presentation, and drawing conclusions and verification. Data reduction is carried out by selecting and focusing on relevant data with objective research, and then the data is presented in the form of a description, narrative, or table to make it easier to understand emerging patterns. The end stage is drawing conclusions continuously with the verification process during the ongoing study. To ensure data validity, this research also uses triangulation technique sources and triangulation techniques to compare the data obtained through observation, interviews, and documentation (Miles et al., 2014).

RESULTS AND DISCUSSION

Implementation of Manipulative Media in Learning Counting in an Inclusive Class

This study started with activity coordination and management permission research conducted on August 4, 2025, at Muhammadiyah 2 Gresik Elementary School. At the beginning stage, researchers conveyed a plan for activity research that includes observation of classroom learning inclusion and interviews with teachers, as well as data collection through studies and documentation in accordance with the research timetable that has been compiled. Furthermore, on August 15, 2025, an interview was carried out with a special companion teacher (GPK) to get information about the characteristics of learners in need of special conditions for learning counting in an inclusive class, as well as the readiness of facilities and infrastructure that support the learning process of mathematics. Based on results, interviews, and documentation, it is known that the accompanying special teacher has compiled a document identifying needs for special learners as well as a *planning matrix* for learning counting at the beginning of the 2025/2026 academic year, namely, July 1, 2025, which is used as guidelines in giving service learning during one year of teaching. In its implementation, learning mathematics in an inclusive class utilizes manipulative media like card numbers, block numbers, bead counting, and various concrete objects that can be touched and moved by learners so that it helps the teacher explain draft numbers as well as simple operation counts like addition and subtraction in a way that is more concrete and easier to understand for learners in need of special attention. The observation results class is shown in Figure 1.



Figure 1 Observation results class

Based on Figure 1, it shows the teacher starting learning by introducing the draft number through the use of concrete objects. Learners requested a count of available objects. Then, they grouped the objects in accordance with the numbers mentioned by the teacher. Approach: This allows learners to understand the connection between the symbol number and the number of objects in a real way. In addition, learners are seen to be more active in following the learning process. Because they are involved in a way directly in manipulating activity objects. Observation results: the beginning is also strengthened through an interview with four accompanying teachers (specifically GPK), namely Mr. AM, Mrs. MA, Mrs. DA, and Mrs. EN. Mr. AM accompanied him, three participant students in the second grade, namely MF, who is indicated as deaf and experienced *speech delay*, as well as IN and MR, who experience disturbance, concentration, or *attention deficit hyperactivity disorder* (ADHD). Ms. MA accompanied two participants. Educate those named RK and RR, who are also indicated to have experienced disturbance, concentration, or ADHD. Meanwhile, Mrs. DA accompanied a learner with the condition *Down syndrome* named FR. Meanwhile, Mrs. EN accompanied three participant students, namely TA, AH, and NS, who are indicated to have experienced *speech delay* as well as intellectual disturbance or *slow learning*. Information shows that classroom learning inclusion involving learners with

various characteristics needs special attention so that the use of manipulative media becomes one of the learning strategies that helps them understand draft counting in a way that is more concrete and gradual.

Interview results show that learning counting at Muhammadiyah 2 Gresik Elementary School was carried out in a classical way in an inclusive class; however, for learners in need, special adjustments were made to learning based on results, identification of needs, and a *planning matrix* that has been prepared by the teacher. Adjustments include learning strategies, materials, and the use of adapted learning media based on the abilities of each learner in need of special attention. The teacher conveys that part of the learner still experiences difficulty in understanding basic operation counting, especially with the concepts of addition and subtraction. This is influenced by the continued use of learning media dominated by symbolic media, such as numbers written and pictorial, so draft counting becomes more abstract for learners in need of special attention. Thus, teachers occasionally utilize manipulative media like ice cream sticks, buttons, small balls, and straws. To help learners understand draft counting in a more concrete way.

Findings: This is also supported by the statement of several accompanying special (GPK) teachers that conveys that learners in need of special attention tend not to be focused enough and easily feel bored when learning counting delivered in an abstract way. However, there are learners with Down syndrome who persist in feeling comfortable following classroom learning inclusion. Because he can study together with his friends. This shows that an inclusive learning environment gives positive social experiences for learners in need of special support, although abilities may differ academically from those of other learners. As delivered by the teacher in the results interview following.

A learner with *Down syndrome* feels comfortable studying together with friends regularly in his class. She doesn't show signs of being bored during the following classroom learning. Although the academic ability is, of course, not yet capable of following the same material as his friends.” (DA/G/15082025)

Other assistant teachers also give statements.

“Students with ADHD tend to be more focused when they are allowed to manipulate concrete objects rather than only looking at numbers on worksheets.” (AM/G/15082025)

These statements indicate that manipulative media function as concrete representations that facilitate students’ conceptual understanding and attention regulation during mathematics learning.

In addition, the results of the interview also showed that a large part of the teachers had not yet received special training related to learning strategies in mathematics for learners with special needs. Condition: This is one of the challenges in implementing learning inclusion because teachers need more pedagogical-specific competence. For designing adaptive learning. Needs to be delivered by the teacher in the following quote interview.

“Teachers need special training related to learning mathematics for learners in need of special training. It is necessary for teachers to be able to design more learning in accordance with the needs of participants to learn. In addition, participants' education also requires additional mentoring of learning resources as well as the use of concrete learning media like pictures, buttons, and straws. (AM/G/15082025)

Some teachers have made an effort to increase their competence in a way that is independent through professional activity development. One of the teachers said that he once attended a webinar discussing learning strategies catering to learners in need of special

attention. In addition, the school also provides a timetable and special classroom learning resources as an additional service for participating students who need more intensive mentoring. This is delivered in the quote interview following.

"The school provides a timetable and special classroom learning resources for learners in need of special activities. This is done to help learners train and understand material that has not been mastered in regular class. Through the classroom learning resources, teachers can give more intensive assistance in accordance with the learner's needs." (MA/G/15082025)

On the other hand, facility learning, results observation, and interviews show that Muhammadiyah 2 Gresik Elementary School has adequate facilities and infrastructure. To support this, the school implements inclusive classroom learning. Available facilities include tables and chairs for learning, a board to write on, an LCD projector, and a digital interactive board that can be utilized in the learning process. Schools also provide various concrete learning media for mathematics as well as give teachers a chance to develop learning media in an independent way, such as card pictures, small balls, ice cream sticks, buttons, and straws. In addition, the presence of a special teacher companion (GPK) in each inclusive class becomes an important supporting factor in accompanying learners with special needs during the ongoing learning process.

Support for implementing learning inclusion also comes from parents who participate and play an active role in accompanying the learning process of children at home. Parents not only help learners in exercising counting but also include children in service therapy in accordance with individual needs. In general, schools show an attitude open to development methods of learning as well as the use of new learning media in support of the implementation of inclusive education. This shows the existence and commitment from the school. Keep going to increase the quality of learning mathematics for learners with special needs through more innovative learning strategies and adaptive media.

The use of manipulative media also helps learners in understanding the concept of counting operations. The teacher gives an example of addition using bead counting, where learners are requested to add the number of beads in accordance with the questions given. Through the activity, learners can see in a direct way how the addition process happens so that previous abstract mathematical notions become easier to understand.

Observation results show that a big part of learners in need of special attention shows improvement in involvement during learning going on. They look more focused, active, and believe in themselves when finishing question counting when using manipulative media compared to learning that only uses the lecture method.

Results of Observations of the Learning Process at Muhammadiyah 2 Gresik Elementary School

Observation learning was held on August 22, 25, 26, and 27, 2025, in several inclusive classes at Muhammadiyah 2 Gresik Elementary School to see a direct implementation of manipulative media in learning counting for learners in need of special attention. Observation results show that the use of manipulative media has been implemented by the accompanying special teacher as a customized learning strategy with abilities and characteristics of the learner. The media used include tree counting, tree numbers, *stick intelligence*, as well as various concrete objects that help learners understand the concept of counting in a more real way.

In an observation on August 22, 2025, in grades V and VI, it was found that learning mathematics in an inclusive class still follows the applicable curriculum for regular learners, but learners in need of special education get adjusted materials and learning methods. In

grade V, the material studied by the learners regularly is prime factorization for determining the KPK and FPB, while learners in need of special education named FR, who are indicated as having *Down syndrome*, are still at the stage of operating with numbers 1–20. The teacher companion specially prepares manipulative media in the form of tree counting as well as sheet-customized work with the Individual Learning Program (PPI). Although FR is more interested in following activity studies together with a friend in class, the use of manipulative media is still done as a form of adaptive learning in accordance with the learner's abilities.

Observations conducted on August 27, 2025, in the resource class show that the use of manipulative media, tree counting, helps increase focus and engagement of learners in finishing operations of addition and subtraction. Learners see that it is easier to understand draft counting when using manipulative media compared to the method of arithmetic. This shows that the use of concrete media can help learners in need, especially, understand abstract mathematical concepts. Assistant Teacher DA stated,

"The number tree and counting beads help students visualize addition and subtraction processes more clearly, especially for my Down syndrome student."
(DA/G/27082025)

Findings are also reinforced through results interviews with a companion teacher specifically explaining the condition of the learner during learning taking place. The teacher conveys that learners with conditions like *Down syndrome* often show desire. He studies together with his friends in class regularly. Learners try to follow the same study activities as their friends and classmates, although their academic abilities are still limited to counting operations. Therefore, teachers usually give guidance in addition to classroom learning or special room sources so learners can still understand material in accordance with their abilities.

FR often wants to learn and do activities together with his friends in class regularly. In addition, the assistant teacher highlighted the learning characteristics of a student with Down syndrome and explained how manipulative media supported both academic learning and classroom participation.

"She wants to see the same ability with her friend, although he actually still is at the stage of counting 1–20. Therefore, usually I give mentoring additions to class specifically so that he can study in accordance with his abilities."
(DA/GPK/22082025)

Observations in class VI on August 22, 2025, also showed use of manipulative media, tree numbers, and *stick intelligence*. For helping learners in need, specifically those indicated with ADHD, namely RK and RR. At the time of learning mathematics, the class teacher conveys material about fractions to the learner regularly, whereas the learner in need is given special exercises on the operations of addition and subtraction in accordance with their ability level. The companion teacher, especially, formerly explained the function and method of use of manipulative media before the learner did sheet work. Observation results show that learners show enough enthusiasm to use manipulative media. Although thus, participants' RK's education still needs intensive mentoring to guard focus during the counting process. On the other hand, participant RR's education is visibly more capable of using manipulative media in an independent way and demonstrates greater understanding. Good at finishing questions, addition, and subtraction.

In addition, positive social interaction is also seen during the learning process in inclusive classes. Some learners regularly help learners in need, especially in using manipulative media and solving questions given by the teacher. Conditions: This shows that learning

inclusion not only gives a chance for learners in need to study together but also builds positive social interaction between learners with different backgrounds and abilities.

Observations made on August 25, 2025, in class II also showed similar results. In class, there are three learners with special characteristics: disturbance, concentration, and deafness to light. The companion teacher used special manipulative media, such as tree numbers made from a closed bottle, to help learners understand draft addition and subtraction. Observation results show that learners experience difficulty when using the arithmetic method; however, after using manipulative media, they seem more interested and capable of understanding draft counting with more accuracy. Even one of the learners is capable of finishing a number of questions in a way that is independent after using the media.

Furthermore, on August 26, 2025, researchers conducted observations in class III, consisting of one regular learner and learners with special needs with characteristics of *speech delay* and intellectual disorders. The companion teacher specially introduced manipulative media in the form of *stick intelligence* and tree counting to help learners finish questions on addition and subtraction. Observation results show that the learner looks enthusiastic using manipulative media because the shapes are colorful and easy to play with. In addition, learners also regularly show interest in the media, which created a more learning-interactive and fun atmosphere in an inclusive class.

For stronger results of the observation, researchers also conducted an interview with the head of the school on September 2, 2025, related to school policy in support of the use of manipulative media in inclusive learning. The head of the school conveyed that the school has special programs that support inclusive education for learners with special needs, including the use of helpful learning media to increase understanding of concepts. The school also provides learning facilities as well as room resources that can be used to give mentoring and additional support for learners with special needs. In addition, the school gives support to the teacher to develop various appropriate learning media for the needs of learners in inclusive classes.

“The school has a Happy Sunshine program that supports system learning for learners in need of special help. This program also encourages using various learning media to help understanding and develop skills. Therefore, the use of manipulative media is strongly supported by schools. Good from the side facility and learning in the classroom source.” (LS/KS/02092025)

However, the head of the school also conveyed that teachers and accompanying teachers are not yet special. Once they get special training formally regarding the use of manipulative media in learning for learners in need of special assistance. Knowledge about the use of manipulative media is part of what is acquired by teachers through other sources, such as sharing good practices and learning videos. In addition, the head of the school evaluates the use of manipulative media as effective enough in helping the learning process, even though it requires more study to measure its effectiveness in a more structured way. “He gets knowledge through various study sources, like sharing good practices and learning videos. The school also provides freedom and support facilities for teachers who want to develop learning media manipulatives.” (LS/KS/02092025)

In a way overall, the results of observation and interviews show that the use of manipulative media in learning counting in an inclusive class has a positive impact on the learning process. Manipulative media are capable of increasing attention and involvement of learners in activities and learning, helping learners understand abstract mathematics gradually, from concrete to symbolic, as well as increasing interaction between teachers and learners during the learning process. In addition, the use of manipulative media also

encourages positive social interaction between learners in need of special support and regular learners so that it creates an inclusive and collaborative learning environment.

Change Numeracy Skills of Students with Special Needs

Interview results with the class teacher and assistant teacher especially show that the use of manipulative media has a positive impact on learning mathematics in an inclusive class. The teacher stated that learners are in need of a more easily understood draft of counting when they can see, touch, and manipulate objects in a direct way. Through using concrete objects, learners are capable of connecting the symbol number with the amount of the actual object so that the draft number becomes more easily understood. In addition, the approach of visual and kinesthetic learning also improves study motivation as well as learner involvement during the learning process. As stated by one assistant teacher:

“Students with special needs understand mathematical concepts more easily when they can directly manipulate objects. They become more focused and actively participate in learning activities compared to lessons that only use worksheets or verbal explanations.” (MA/G/22082025)

Thus, the teacher also expressed the existence of a number of constraints in the implementation of manipulative media, such as limitations of learning time and the number of media available, as well as the need for more intensive assistance for learners with special needs.

Based on results, observations, and interviews, it was found that counting ability changed qualitatively in learners in need of special education after the use of manipulative media in learning. Participants' previous education experience had difficulty with sorting numbers and solving operation counts; simple shows development in understanding draft numbers as well as doing addition and subtraction. For example, participants previously educated in FR often experience difficulty remembering order numbers or moments of use. The method of arithmetic shows improved ability after using manipulative media. Likewise, during the observation conducted on August 22, 2025, participant RK's experience with concentration disturbance looks more focused and capable of finishing operations of addition and subtraction simply with manipulative media assistance. As stated by one special assistant teacher:

“Students are more able to understand addition when they can directly move and count objects rather than only looking at numbers on paper.” (MA/G/22082025)

One student also expressed a positive response to the use of manipulative media:

“I like learning mathematics with counting beads and number cards because I can see and count the objects directly.” (RK/S/22082025)

In general, the use of manipulative media helps change abstract mathematics drafts to become more concrete, improving learner involvement and reducing errors in the process of counting.

Obstacles and Solutions in The Use of Manipulative Media In Learning Counting for Learners in Need, Specifically in Inclusive Elementary Schools

Research results show that learners give positive responses to the use of manipulative media in learning mathematics. Learners are seen to be more enthusiastic, follow learning, and be more active in finishing counting questions. Learners who need special previous experience

and have difficulty understanding draft addition and subtraction show improved ability after using manipulative media. They are capable of counting the number of objects with more appropriateness as well as finishing counting questions more simply with more self-belief. In addition, the use of manipulative media also encourages the occurrence of more socially positive interactions in an inclusive class because learners often work together to finish assignments given by the teacher, thus creating a more collaborative learning atmosphere.

Thus, the results of the interview with a companion teacher and special learning observation show the existence of a number of constraints in the implementation of manipulative media. Colorful and attractive media sometimes divert the attention of learners in need of special care, causing behavioral play. Teachers need to give clear directions as well as arrange time for the use of media to remain in accordance with the objective of learning. In addition, the conditions, emotions, participants, and fluctuating education, as well as the interest of regular learners in the media used, can also influence the atmosphere of the class. To overcome this matter, the teacher applies a personal approach, organizes the use of media in turns, and develops manipulative media variations using simple and easy-to-obtain material so that learning is still effective and appropriate to the learner's needs.

To strengthen the analytical presentation of the findings, the results of observations, interviews, and documentation were reduced and categorized into several major themes, namely: (1) adaptive implementation of manipulative media in inclusive mathematics learning, (2) improvement of students' numeracy engagement and understanding, (3) social interaction and inclusive classroom participation, and (4) challenges and adaptive strategies in the use of manipulative media.

Table 2 Thematic categories of research findings

Main Themes	Findings	Sources of Data
Adaptive implementation of manipulative media	Teachers used number cards, counting beads, bottle-cap number trees, sticks, and concrete objects adapted to students' characteristics and individual learning programs (PPI).	Observation, interview, documentation
Improvement of numeracy understanding	Students showed better understanding of addition and subtraction concepts through direct object manipulation.	Observation, interview
Increased engagement and participation	Students became more focused, active, and confident during mathematics learning activities.	Observation
Social interaction in inclusive classrooms	Students with special needs interacted positively with peers and participated collaboratively in classroom activities.	Observation, interview
Challenges in implementation	Teachers experienced limitations in training, instructional time, classroom management, and media availability.	Interview
Adaptive solutions	Teachers applied personal approaches, classroom assistance, media variation, and additional learning support.	Interview, documentation

Adaptive Implementation of Manipulative Media in Inclusive Mathematics Learning

The findings indicate that manipulative media were implemented adaptively according to students' individual learning needs and characteristics. The learning process did not merely focus on delivering mathematical content but also on adjusting instructional strategies for students with special needs. Teachers and special assistant teachers collaboratively prepared

learning modifications through Individual Learning Programs (PPI), allowing students to learn according to their cognitive readiness and developmental stages.

The use of concrete objects such as counting beads, number trees, sticks, and bottle caps functioned as mediational tools that bridged abstract mathematical concepts into concrete learning experiences. This finding demonstrates that manipulative media were not only instructional aids but also pedagogical strategies to support conceptual understanding among students with diverse learning barriers.

The interview data further revealed that students with ADHD, speech delay, intellectual disabilities, and Down syndrome showed different responses toward manipulative media. For example, students with concentration difficulties became more engaged when using concrete objects because the learning process involved physical interaction and visual stimulation. This finding reflects the constructivist principle that knowledge is constructed through direct experience and active engagement with learning materials.

Improvement of Numeracy Engagement and Conceptual Understanding

The findings showed that manipulative media significantly increased students' participation and understanding of basic arithmetic operations. Observation results indicated that students who previously struggled to understand symbolic representations of numbers became more capable of connecting numerical symbols with actual quantities after interacting with concrete media.

For example, the participant coded FR, who previously experienced difficulty recognizing number order and simple arithmetic operations, demonstrated improved ability after using counting tree media and bead manipulation activities. Similarly, participant RK, who showed attention difficulties, became more focused and able to complete addition tasks when guided through manipulative learning activities.

These findings suggest that manipulative media support multisensory learning processes by integrating visual, tactile, and kinesthetic experiences. Such processes helped students gradually move from concrete operational thinking toward symbolic mathematical understanding. Therefore, the improvement was not merely procedural but also conceptual because students could understand how arithmetic operations occur through direct manipulation.

Social Interaction and Participation in Inclusive Classrooms

Another important finding is that manipulative media contributed to the development of positive social interaction in inclusive classrooms. Observation data showed that regular students often assisted students with special needs during learning activities involving concrete objects and group participation.

This condition indicates that manipulative learning activities created collaborative learning opportunities and reduced social barriers between students with different abilities. Students with special needs appeared more comfortable participating in classroom activities because the learning process was designed interactively rather than individually isolated.

The interview with special assistant teachers also revealed that students with Down syndrome demonstrated strong motivation to participate alongside their peers despite having different academic levels. This finding implies that inclusive learning environments not only support academic development but also strengthen students' emotional comfort and social belonging within the classroom community.

Challenges and Adaptive Strategies in the Use of Manipulative Media

Although manipulative media showed positive impacts, the findings also identified several implementation challenges. Teachers reported limitations in pedagogical training related to

inclusive mathematics instruction, insufficient instructional time, and limited availability of learning media. In addition, colorful and attractive media occasionally distracted students' attention and caused off-task behavior during classroom activities.

However, teachers attempted to overcome these challenges through adaptive strategies such as applying individualized approaches, providing additional classroom assistance, rotating media use, and developing low-cost manipulative media from simple surrounding materials. These adaptive efforts demonstrate that successful implementation of manipulative media depends not only on media availability but also on teachers' pedagogical creativity and classroom management skills.

Analytically, these findings indicate that manipulative media function effectively when integrated with adaptive instructional support and inclusive classroom collaboration. The results also strengthen constructivist and inclusive learning perspectives, emphasizing that meaningful mathematics learning occurs when students actively interact with concrete experiences within supportive social environments.

This research result shows that the use of manipulative media in learning mathematics in an inclusive class is capable of having a positive impact on the improvement of the counting ability of learners in need of special education. Findings: This shows that an approach to learning that utilizes concrete objects can help learners understand abstract previous mathematics that is difficult to understand. The results are in line with research conducted by

A number of studies, including the latest, show similar tendencies. [Rahmawati & Indarini \(2024\)](#) found that the use of concrete media like objects daily is capable of increasing understanding of draft mathematics for school-based learners because the learning process becomes more contextual and easier to understand. Research emphasizes direct interaction with objects. A study gives learners a chance to build meaning and draft mathematics through real experience.

In addition to improving understanding of concepts, the use of manipulative media is also proven to increase learner involvement during the learning process. [Rahmadhani et al. \(2023\)](#) explained that activities involving movement, physical exploration, and objects make learners more active participants in learning mathematics. Conditions are influential in improving motivation in studies as well as helping learners maintain attention for a longer time.

Another study conducted by [Ariani & Mahrus \(2025\)](#) also showed that using tool props manipulatively in learning mathematics can increase the ability to solve problems and understanding of the draught number of learners on a school basis. In the research, they explained that the media is manipulative, functioning as a bridge between abstract symbols and concrete experience so that learners not only memorize procedures for counting but also understand the process in a conceptual way.

In the context of inclusive education, the use of manipulative media becomes an important learning strategy because it is capable of accommodating different study abilities and learners. ([Tjandra, 2023](#)) stated that learning mathematics for learners in need requires a special needs approach that is multisensory, involving various senses, such as sight, touch, and movement. Manipulative media enable the learning process to be ongoing through diverse sensory experiences, which helps learners understand the draft in a more effective way.

Findings: A similar statement was also put forward by [Foulkes et al. \(2023\)](#), who showed that the use of concrete media in learning mathematics is capable of increasing interaction between teachers and learners as well as strengthening social participation in class. This shows that the media is manipulative. Not only does it function as a tool to help learning but

also as supporting facilities to create an environment to learn more inclusively and collaboratively.

Istiandaru et al. (2018) research added that using manipulative objects in learning mathematics helps learners develop logical and systematic thinking abilities. Through activity, moving, grouping, and counting objects in a direct way, learners can understand connections between numbers as well as develop operational mathematics more clearly.

For a learner in need, a special approach-based experience that is concrete is also proven capable of reducing anxiety about mathematics. Taslima (2021) explain that the use of manipulative media can help learners understand draft numbers in a gradual way so that psychological pressure is reduced when facing mathematical questions. Thus, learning becomes more fun and does not cause fear of mathematics.

In addition to providing a positive impact on understanding concepts, manipulative media is also proven to increase ability on a counting basis. Research by Nurjanah et al. (2021) shows that using tool props like beam numbers and concrete objects can help learners in need of special understanding operate addition and subtraction in a more systematic way. Through manipulating objects, learners can see in a way the direct change process and the amount that occurs.

Although this is the case, some research also identified existing challenges in the implementation of manipulative media in the classroom. Susanta & Koto (2022) found that limitations in learning facilities as well as the number of media available often become constraints for teachers in implementing learning strategies based on manipulatives. In addition, time-limited learning can also influence effective use of the media.

Teacher competency factors also become an important aspect in the successful use of manipulative media. Farhana et al. (2022) emphasized that teachers need adequate pedagogical skills to be able to design activity-appropriate manipulatives that meet learner needs. Without good planning, manipulative media potential only becomes a game tool without having a significant impact on understanding the draft.

Based on various studies previously mentioned, it can be concluded that manipulative media is an effective learning strategy in increasing the ability of learners, especially in learning mathematics in basic and inclusive classes at school. This media allows learners to understand draft mathematics through concrete experience, improving learning motivation and pushing active involvement during the learning process.

Findings of the study: This strengthens previous study results and makes an empirical contribution in the context of inclusive mathematics learning. Implementation of manipulative media carried out in a flexible way, adapting to the characteristics of learners with special needs, shows that learning mathematics can be designed to be more adaptable and meaningful. Thus, the use of manipulative media not only helps increase the ability to count but also supports creating an inclusive and needs-centered learning process for learners.

The study's recency in implementing manipulative media in learning mathematics in an inclusive class with adaptive use of simple media like ice cream sticks, buttons, lids of bottles, and tree numbers to meet the individual needs of learners in need of special education through individual learning programs. Findings from the study show that the media are manipulative and can be used in a flexible way in a heterogeneous class so that they help bridge understanding and make abstract mathematics more concrete for participants' education. Impact study: This gives a theoretical contribution in strengthening the approach of constructivism as well as a practical contribution for teachers and schools in developing learning in more mathematics that is adaptive, creative, and inclusive. For increasing the ability to count learners in need of special education.

The findings of this study demonstrate that the implementation of manipulative media in mathematics learning at SD Muhammadiyah 2 Gresik plays an important role in supporting the numeracy development of students with special needs in inclusive classrooms. The use of concrete objects such as counting beads, number trees, bottle caps, sticks, and number cards enabled students to understand mathematical concepts more easily because the learning process became more visual, tangible, and interactive. This finding is particularly important in the context of inclusive elementary education, where students with diverse learning characteristics require adaptive instructional approaches.

The improvement in students' numeracy skills occurred because manipulative media helped bridge the gap between abstract mathematical symbols and concrete experiences. Many students with special needs, particularly those with ADHD, intellectual disabilities, speech delay, and Down syndrome, experienced difficulties in understanding symbolic arithmetic instruction delivered through conventional lecture methods. Through manipulative activities, students were able to directly observe, touch, group, and count objects, which made mathematical concepts more meaningful and easier to comprehend. This finding explains why students became more focused, active, and confident during mathematics learning activities.

From a theoretical perspective, these findings strongly support Bruner's theory of cognitive representation, particularly the enactive and iconic stages of learning, in which students understand concepts more effectively through direct manipulation and visual experiences before reaching symbolic understanding. The findings also align with Piaget's theory of concrete operational development, which states that elementary school students learn more effectively through concrete and hands-on experiences. In the context of students with special needs, concrete learning experiences become even more essential because many students require repeated sensory interaction to develop conceptual understanding.

Furthermore, the findings strengthen Vygotsky's social constructivist perspective, particularly regarding the importance of social interaction and instructional scaffolding in learning. At SD Muhammadiyah 2 Gresik, manipulative media were not used individually but were integrated into collaborative classroom activities involving classroom teachers, special assistant teachers (GPK), and peer interaction. Students with special needs often received assistance from peers during mathematics activities, which helped create a more inclusive and supportive learning environment. This explains how manipulative learning not only improved numeracy understanding but also strengthened social participation and classroom inclusion.

The inclusive education context in this study also provides important practical insights. Although the school has implemented inclusive learning policies and provides special assistant teachers and learning resource rooms, the findings revealed that many teachers still experience limitations in specialized pedagogical training related to inclusive mathematics instruction. This condition explains why some teachers relied heavily on symbolic learning approaches before gradually integrating manipulative media into classroom practice. Therefore, the successful implementation of manipulative media was influenced not only by media availability but also by teacher creativity, adaptive instructional planning, and collaboration among teachers, schools, and parents.

Another important finding is that manipulative media functioned as adaptive learning tools rather than merely teaching aids. Teachers modified the use of media according to students' individual characteristics and Individual Learning Programs (ILPs). For example, students with ADHD required more focused guidance and shorter learning instructions, while students with Down syndrome benefited more from repetitive and concrete counting activities. This finding indicates that inclusive mathematics learning cannot apply a uniform

instructional strategy because students with special needs demonstrate different cognitive and behavioral characteristics.

This study also contributes theoretically and practically to inclusive mathematics education. Theoretically, the study strengthens constructivist and inclusive learning perspectives by demonstrating that manipulative media support conceptual understanding through multisensory and socially interactive learning experiences. Practically, the findings provide evidence that simple and low-cost manipulative media available in the surrounding environment can be effectively utilized to support numeracy learning in inclusive elementary schools. This contribution is particularly relevant for schools with limited resources because effective inclusive mathematics learning does not always require expensive educational technology.

However, this study also identified several challenges in implementing manipulative media. Attractive and colorful media occasionally distracted students' attention and caused off-task behavior, particularly among students with concentration difficulties. In addition, teachers experienced limitations related to instructional time, classroom management, and professional training. These findings indicate that manipulative media cannot function effectively without proper classroom management strategies and adequate teacher competency in inclusive instruction.

Overall, this study demonstrates that the implementation of manipulative media at SD Muhammadiyah 2 Gresik not only improves numeracy skills among students with special needs but also supports the development of more adaptive, participatory, and inclusive mathematics learning environments. The findings emphasize that successful inclusive mathematics learning requires concrete learning experiences, collaborative social interaction, and adaptive pedagogical support that accommodate the diverse needs of students in inclusive classrooms.

CONCLUSION

This study concludes that the use of manipulative media in inclusive mathematics learning at SD Muhammadiyah 2 Gresik effectively supports the development of numeracy skills among students with special needs. The findings show that concrete media such as counting beads, number trees, sticks, and bottle caps help students understand addition and subtraction concepts more meaningfully by connecting abstract mathematical symbols with direct learning experiences. The use of manipulative media also increased students' focus, participation, confidence, and social interaction during classroom learning activities.

The novelty of this study lies in its exploration of how manipulative media are adaptively implemented in inclusive elementary classrooms through collaboration between classroom teachers and special assistant teachers based on students' individual learning characteristics and Individual Learning Programs (PPI). This study also highlights that manipulative media function not only as instructional tools but also as adaptive pedagogical strategies that support multisensory and socially interactive learning experiences for students with diverse special needs.

The study contributes theoretically by strengthening constructivist and inclusive learning perspectives, particularly regarding the importance of concrete and collaborative learning experiences in developing numeracy understanding among students with special needs. Practically, the findings provide evidence that low-cost and easily accessible manipulative media can be effectively utilized in inclusive schools to support adaptive mathematics instruction.

Based on the findings, schools are recommended to provide more structured professional training related to inclusive mathematics learning and the development of adaptive manipulative media. Teachers are also encouraged to integrate manipulative learning

gradually from concrete to symbolic stages according to students' cognitive characteristics and learning readiness. In addition, future studies are recommended to examine the effectiveness of manipulative media through mixed-method or quantitative approaches involving broader participant characteristics and different inclusive educational settings.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS STATEMENT

Conceptualization, EMT, MS, and M.Sy.; methodology, EMT and MS; formal analysis, EMT; investigation, EMT; data curation, EMT; writing original draft preparation, EMT; writing review and editing, MS and M.Sy.; supervision, MS and M.Sy.; validation, MS and M.Sy. All authors have read and agreed to the published version of the manuscript.

AI DISCLOSURE STATEMENT

The authors used DeepL, Mendeley, and Turnitin during the preparation of this work for language checking, reference management, citation formatting, bibliography organization, and similarity screening. After using these tools, the authors thoroughly reviewed, edited, and verified the manuscript as needed and take full responsibility for the content of the publication. The authors declare that no generative artificial intelligence (AI) tool was used to create, analyze, interpret, or write the scientific content of this research.

ACKNOWLEDGMENTS

The authors would like to express their sincere gratitude to the school principal, teachers, and students of SD Muhammadiyah 2 Gresik who participated in this research for their cooperation and support during the data collection process. Appreciation is also extended to colleagues and academic supervisors who provided valuable suggestions and guidance in the completion of this study. Their support and contributions have greatly assisted the authors in conducting and completing this research.

REFERENCES

- Ariani, R., & Mahrus, M. (2025). Efektivitas media manipulatif dalam meningkatkan pemahaman operasi bilangan pecahan peserta didik kelas iv sekolah dasar. *Alacrity : Journal Of Education*, 5(1), 681–692.
- Bouck, E. C., & Sprick, J. (2019). The virtual-representational-abstract framework to support students with disabilities in mathematics. *Intervention in School and Clinic*, 54(3), 173. <https://doi.org/https://doi.org/10.1177/1053451218767911>
- Carbonneau, K. J., Marley, S. C., & Selig, J. P. (2013). A meta-analysis of the efficacy of teaching mathematics with concrete manipulatives. *Journal of Educational Psychology*, 105(2), 38. <https://doi.org/https://doi.org/10.1037/a0031084>
- Clever, D., Krist, F., Shinta, E., Br, B., Yolanda, J., Gaol, L., Hutagalung, M. G., Agatha, N., Jawak, P., Simorangkir, D., Munthe, T. S. V. M., & Tansliova, L. (2025). Tantangan dan solusi pendidikan inklusi di sumatera utara : mewujudkan kesetaraan pendidikan untuk semua anak. *Morfologi: Jurnal Ilmu Pendidikan, Bahasa, Sastra Dan Budaya*, 3(April). <https://doi.org/doi.org/10.61132/morfologi.v3i2.1543> Available
- Creswell, J. W. (2010). *Research design: pendekatan kualitatif, kuantitatif, dan mixed*. PT Pustaka Pelajar.
- Damopoli, T., Amalia, R., & Dione, F. (2024). Implementation of the electronic-based government system (SPBE) in the north Sulawesi provincial government. *Jurnal Scientia*, 13(01), 117–131.

- Desrinelti, D., Afifah, M., & Gistituati, N. (2021). Kebijakan publik: konsep pelaksanaan. *JRTI (Jurnal Riset Tindakan Indonesia)*, 6(1), 83.
- Farhana, S., Amaliyah, A., Safitri, A., & Anggraeni, R. (2022). Analisis persiapan guru dalam pembelajaran media manipulatif matematika di sekolah dasar. *Educenter : Jurnal Ilmiah Pendidikan*, 1(5), 507–511. <https://jurnal.arkainstitute.co.id/index.php/educenter/index>
- Foulkes, M., Sella, F., Wege, T. E., & Gilmore, C. (2023). The effects of concreteness on mathematical manipulative choice. *Mind, Brain, and Education*, 17(3), 185–196. <https://doi.org/https://doi.org/10.1111/mbe.12374>
- Ginting, L. A. U. B., Mulyani, R. W. P., & Muta'ali, L. (2019). Mapping of the elderly in indonesia based on their socioeconomic characteristics and health profile. *Sosio Informa*, 5(01), 51–53.
- Haniyah, A. P. (2025). *Pendidikan Masih jadi Tantangan Besar Bagi Penyandang Disabilitas*. <https://berita.rri.co.id/nasional/1906042/pendidikan-masih-jadi-tantangan-besar-bagi-penyandang-disabilitas>
- Harahap, L. W., & Surya, E. (2017). Development of learning media in mathematics for students with special needs. *International Journal of Sciences: Basic and Applied Research*, 33(3), 1–1.
- Istiandaru, A., Istihapsari, V., Prahmana, R. C. I., Setyawan, F., & Hendroanto, A. (2018). Characteristics of manipulative in mathematics laboratory. *Journal of Physics: Conference Series*, 943(1). <https://doi.org/10.1088/1742-6596/943/1/012023>
- Isyattirradhiyah, I., Afandi, A., Marlina, R., & Agustina, L. K. (2025). Strategies, approaches, and best practices of inclusive education in regular schools: Systematic literature review. *Research and Development in Education (RaDEn)*, 5(1), 243–258. <https://doi.org/10.22219/raden.v5i1.38046>
- KamiBijak.com. (2025). *Unicef: Mayoritas Anak Disabilitas Dunia 2025 Berasal dari Asia Selatan*. <https://kamibijak.merahputih.com/v/unicef-mayoritas-anak-disabilitas-dunia-2025-berasal-dari-asia-selatan>
- Makeleni, S., & Ndu, O. G. (2024). Assessing significance of inclusive education as a remedy of addressing the challenges of disabled children. *International Journal of Inclusive Education*, 9(2), 1–15. <http://dx.doi.org/10.17977/um005v9i22025p442-458>
- Malahati, F., B, A. U., Jannati, P., Qathrunnada, Q., & Shaleh, S. (2023). Kualitatif: Memahami karakteristik penelitian sebagai metodologi. *Jurnal Pendidikan Dasar*, 11(2), 341–348. <https://doi.org/10.46368/jpd.v11i2.902>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: a methods sourcebook* (Third edit). SAGE Publications, Inc.
- Murtini, M., Suhardhono, D. W., Damayanti, E., & Susandi, D. G. (2025). Inovasi pembelajaran inklusif berbasis kewirausahaan: studi fenomenologis pada smk di wilayah kabupaten sukabumi. *Journal Of Economic Research*, 1(2), 124–129. <https://doi.org/10.56799/joer.v1i2.24>
- Novrizal, N., & Manaf, S. (2024). The policy of inclusive education in indonesia. *Multicultural Islamic Education Review*, 2(1), 37–44. <https://doi.org/10.23917/mier.v2i1.4297>
- Nurjanah, N., Rohayati, A., & Riza, L. (2021). A learning media based on hands-on activity in mathematics for students special school. *IJDS: Indonesian Journal of Disability Studies*, 8(02), 317–329. <https://doi.org/10.21776/ub.ijds.2021.008.02.02>
- Pramana, P. M. A., Suarni, N. K., & Margunayasa, I. G. (2024). Relevansi teori belajar konstruktivisme dengan model inkuiri terbimbing terhadap hasil belajar siswa. *Ideguru: Jurnal Karya Ilmiah Guru*, 9(2), 487–493. <https://doi.org/10.51169/ideguru.v9i2.875>
- Rahmadhani, A. P., Aprilia, I., Santi, L. A., Yunita, N. W., Tanjung, S. M., & Mayangsari,

- Y. D. (2023). Penggunaan media manipulatif dalam pembelajaran bangun ruang sisi datar. *Jurnal MIPA Dan Pembelajarannya*, 3(9), 1–5. <https://doi.org/10.17977/um067.v3.i9.2023.3>
- Rahmawati, A. A., & Indarini, E. (2024). Application of polya strategy assisted by concrete media to improve numeracy and learning outcomes in elementary school students mathematics is one of the subjects that plays an important role in the development counting but also trains students to solve. *Edunesia : Jurnal Ilmiah Pendidikan*, 5(1), 263–277.
- Sugiyono. (2020). *Metode penelitian kuantitatif kualitatif dan R&D*. Alfabeta.
- Sulistiyawati, E., Puspitasari, D., Saidah, Z. N., & Rofiqoh, I. (2021). Manipulative learning media based on stem (science, technology, engineering, and mathematics) to improve student learning outcomes. *MaPan*, 9(1), 1. <https://doi.org/10.24252/mapan.2021v9n1a1>
- Susanta, A., & Koto, I. (2022). Workshop penggunaan media manipulatif matematika materi pecahan bagi guru sekolah dasar bengkulu selatan. *Dharma Raflesia : Jurnal Ilmiah Pengembangan Dan Penerapan IPTEKS*, 20(1), 146–158. <https://doi.org/10.33369/dr.v20i1.20974>
- Syaepudin, M., Nopianti, R., Afifah, S. S., & Arifin, M. Z. (2025). Problematika pembelajaran komponen literasi numerasi di sekolah dasar. *Cokroaminoto Journal of Primary Education*, 8(4), 1573–1584. <https://doi.org/10.30605/cjpe.8.4.2025.6516>
- Taslina, I. (2021). The effect of use of manipulative media on increasing understanding of mathematics learning concepts for students in class v sd. *SHEs: Conference*, 4(6), 437–445. <https://doi.org/e-ISSN 2620-9292>
- Tjandra, C. (2023). Effectiveness of using manipulatives in mathematics teaching in inclusive education programs in an elementary school. *Dharmas Education Journal (DE_Journal)*, 4, 168–178. <https://doi.org/10.56667/dejournal.v4i1.944>
- Zis, S. F., Effendi, N., & Roem, E. R. (2021). Perubahan perilaku komunikasi generasi milenial dan generasi z di era digital. *Satwika : Kajian Ilmu Budaya Dan Perubahan Sosial*, 5(1), 69–87. <https://doi.org/10.22219/satwika.v5i1.15550>

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