Systematic Literature Review of Mathematics Learning Strategies for Children with Special Educational Needs

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Abstract
Learning mathematics for children with special needs requires an approach that is tailored to the type and needs of each student. This literature review aims to find out about mathematics learning strategies for children with special needs. This literature study presents a literature review of mathematics learning strategies and how they are implemented, including the types of children with special needs, the topics discussed and the level of education of the children with special needs. The literature study method used was SLR (Systematic Literature Review) with the process of selecting articles for SLR referring to the PRISMA flow chart for the period 2020-2024, considering that the literature on learning strategies for children with special needs continues to grow. Data were collected from Web of Science and Scopus databases, and 10 relevant articles from 2020 to 2024 were selected and analysed. The results revealed that from the 10 literatures, it was found that learning strategies must be adapted to the type of special needs that students have. The strategies vary from video modelling, virtual manipulatives, to STEAM and inquiry-based learning, all of which aim to help children with disabilities master mathematical concepts that were previously considered difficult.
Keywords: Children with Special Needs, Learning Strategy, Mathematics Education.

Introduction

Education is an essential element in educating the nation and is a basic need for every human being to develop abilities, personality, and create a dignified national civilisation (Sujana, 2019). Likewise, education for children with special needs is part of the world of education and aims for every child to receive equal education to learn and develop. Education for children with disabilities in Indonesia has a long history that dates back to the Dutch colonial period, when the education system for children with disabilities was introduced through the establishment of special education institutions (Hasmyati et al., 2022). Since post-independence, education for children with disabilities has continued to develop, as reflected in Article 31 of the 1945 Constitution, which states that every Indonesian citizen has the same right to obtain a proper education. This is further reinforced by Government Regulation No. 72 of 1991 concerning Special Education, which is a guideline for the implementation of special education, this confirms that every child has the right to receive education according to the type of disability they have.

Education for children with disabilities in Indonesia is divided into three types of services, namely: segregation, integration and inclusion (Sapitri et al., 2024). Segregated

education is an education service that separates children with special needs from normal children, for example special schools. Integrated education is an education service that brings together children with special needs and normal children in one class or even one school, for example special classes (Sapitri et al., 2024). Inclusive education is an educational service that is carried out in a sustainable and directed manner to develop the potential of children with special needs so that they can adapt to the surrounding environment, for example regular classes (Akbar et al., 2024). According to Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System Article 5 Paragraphs 2, 3, and 4 defines children with special needs as (1) children who have physical, emotional, (2) children who have the potential for special intelligence and talent; and (3) children in remote or underdeveloped areas and remote indigenous communities so that they are all entitled to special service education. In addition to this scope, the concept of children with special needs can be categorised into two categories: temporary children with special needs and permanent children with special needs. Temporary children with disabilities are children who experience learning and developmental barriers caused by external factors. Children with disabilities that are permanent are children who experience learning and developmental barriers that are internal and a direct result of the condition of disability, including: children who lose the function of vision, hearing, and intellectual development disorders (Suharsiwi, 2017). So, it can be concluded that children with special needs are children who have specialities and needs that are different from other normal children.

The characteristics of children with special needs include physical, mental, intellectual, social or emotional impairments. Therefore, they need educational services that are in accordance with the learning needs of each child. The classification of children with special needs based on (Hasmyati et al., 2022) includes: learning disabilities, ADHD, emotional and behavioural disorders, communication disorders, hearing impairments, visual impairments, autism and multiple disabilities, and gifted children. In line with current developments in education, education services for children with disabilities are also growing. In Indonesia, based on the data recorded, only about 25.92% of children with special needs are taking formal education (Oktaviani & Setiyono, 2023). This highlights a significant gap in accessibility, especially considering Indonesia's commitment to inclusive education. One of the main factors is the lack of understanding of parents and teachers,

who are important components in child development, about the needs of children with special needs (Fardila, 2018).

Mathematics is one of the mandatory materials that need to be given to students to equip them with the ability to think logically, analytically, systematically, critically, and creatively as well as the ability to cooperate (Apriza, 2019). The National Council of Teachers of Mathematics (NCTM, 2000) states that the standard learning process in mathematics includes communication, reasoning, problem-solving, connections, and representation. Problem solving in mathematics learning emphasizes the use of methods, procedures and strategies (Faidah, 2024). On the other hand, mathematics learning refers to abstract concepts such as numbers, counting operations, and geometry (Fahrurrozi & Hamdi, 2017). In classroom practice, students with special needs often face various challenges in understanding mathematics material. Research by (Sabaruddin et al., 2020) indicates that supporting factors such as parental motivation to encourage students to study and behave appropriately, as well as the use of well-designed learning packages, have not been fully implemented. On the other hand, limited learning media and school facilities, as well as the unavailability of special assistant teachers for students with autism, are significant obstacles in the learning process of mathematics. One of the other main obstacles is the students' difficulty in concentrating, which causes teachers to often have to retell material outside the lesson plan, especially basic concepts (Sabaruddin et al., 2020). A study by (Ediyanto et al., 2023) also emphasizes that the available mathematics learning strategies should facilitate instruction for students with special needs by providing explicit guidance and appropriate instructional media. Therefore, collaboration between special education teachers and mathematics teachers is essential in designing effective mathematics instruction by considering each student's academic development level, strengths, and areas for improvement.

Through a review of research on learning strategies for children with special needs, it was found that there are several strategies according to the type of need. In addition, technology-based learning media and the use of teaching aids also play a role in these strategies. Given the importance of learning mathematics for children with special needs, teachers are expected to apply one of these strategies in their learning. Therefore, this study aims to answer some questions related to the following key questions:

RQ1: What types of children with special needs have been studied in the context of learning mathematics?

RQ2: What mathematics topics and skills have been investigated in the context of learning mathematics?

RQ3: At what level of education has research in the context of learning mathematics for children with disabilities been conducted?

RQ4: What mathematics learning strategies are used and how are they implemented in the context of learning for children with disabilities?

Through this research, it is hoped that new insights can be found about appropriate learning strategies to improve mathematics learning for children with special needs according to their needs. It is also hoped that this research will provide guidance for teachers and education personnel in selecting and implementing effective strategies to support the development of children with disabilities' mathematics skills.

Method

This research was conducted using the Systematic Literature Review (SLR) method. The purpose of conducting SLR is to identify all empirical evidence that meets the established article selection criteria in answering a particular research question or hypothesis (Tarsilla, 2010). In this research, SLR is used to systematically identify and analyse effective mathematics learning strategies for children with special needs, especially in the 2020-2024 timeframe, in order to provide a thorough and up-to-date understanding according to the latest research developments. This is because SLR requires the use of explicit and systematic methods when searching for and reviewing evidence and thus enables the analysis of information.

In this study, the four stages of article selection based on the PRISMA flow chart (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) is a standardized protocol that outlines the four main steps in systematic article selection: identification, screening, eligibility, and inclusion. It ensures transparency and reproducibility in the article selection process (Mengist et al., 2020). Therefore, this SLR study covered five main aspects for the articles obtained: search strategy, selection criteria, selection process, data collection, and data analysis. Data was obtained from two databases, Web of Science and Scopus because both provide articles with high academic quality that have gone through the peer review process. This database selection was done to maintain the quality and validity of the systematic review results. Then a search process was carried out for SLR using two keywords “Special Needs Education”, “Mathematics Learning Strategy”.

The two keywords were combined by using the conjunction "AND" in the article search process. These keywords were selected based on their frequency of use in relevant, high-impact publications and their alignment with the research objectives. During the trial searches, the combination of these keywords yielded a substantial number of articles that directly addressed the intersection of special education and mathematics instruction, indicating their appropriateness and relevance. For articles searched in Scopus, it is searched using the publish and perish application, while for web of science it directly uses the journal's own web.

This study used six set selection criteria to accept or reject articles including year of publication, language, type of reference material, and field of study of the journal article, as shown in Table 1.

Table 1. Formatting ruler

No	Inclusion Criteria	Eksclusion Criteria
1	Research related to mathematics learning strategies for children with special needs	Research not related to mathematics learning strategies for children with special needs
2	Research in the form of qualitative, quantitative, mixed research, and development research	Research that uses methods other than qualitative, quantitative, mixed research, and development research
3	Research published in 2020-2024	Research published under 2020-2024
4	Research in the form of published journal articles, proceedings, and book chapter	Research other than in the form of published journal articles proceedings, and book chapter
5	Available in full text in online	Not available in full text in online
6	Articles written in English	Articles in languages other than English

From the first criterion, the selection of articles to straighten out the topics that will indeed be discussed, limiting the methods of these studies without including SLR research, Meta-analysis, and literature studies to avoid bias and become a novelty in this study. In terms of publication year criteria, only articles published in the last five years, namely 2020 to 2024, were accepted. The selection of articles limited to the last five years can be considered as a period of searching for topics that are still hotly discussed and cover various current events or issues. Then, the articles used are only articles from journals and proceedings that have been published and are available in full in English.

The article selection process for SLR was carried out since October 2024. Figure 1 shows the flowchart of the article selection process adapted from the PRISMA flowchart:

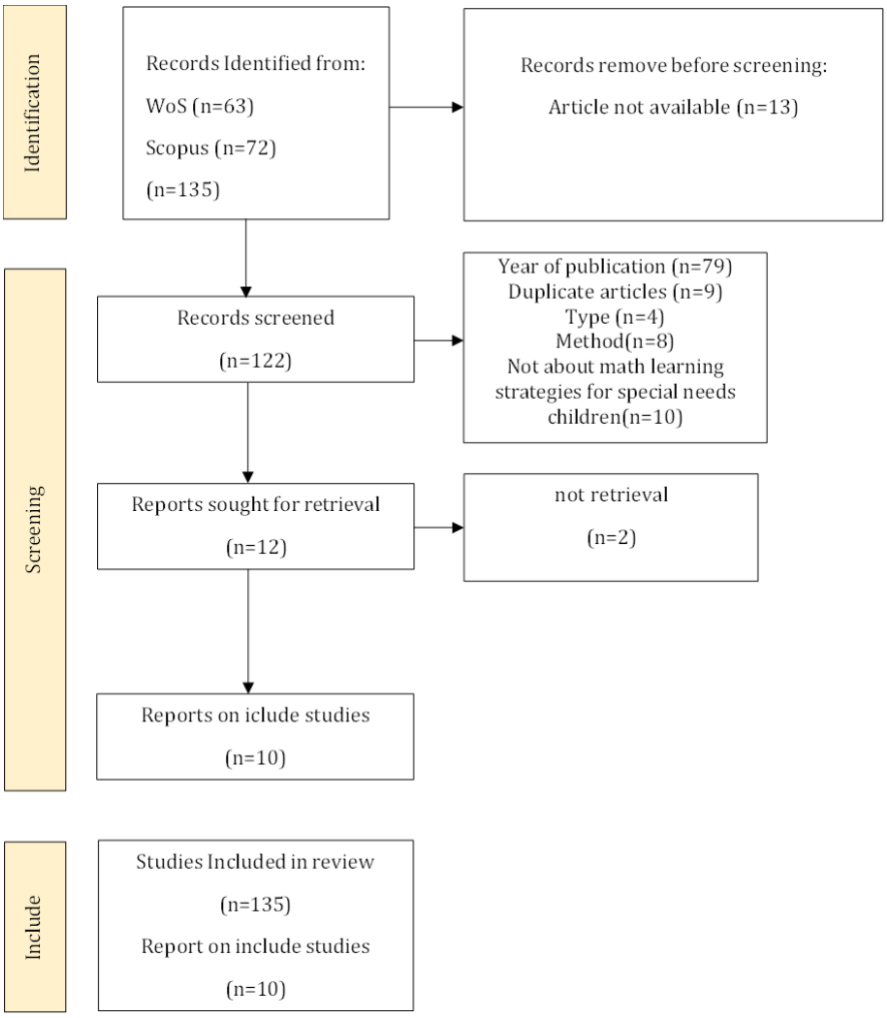

Figure 1. PRISMA flowchart

As shown in the figure above, this research covers 3 main stages in the article selection process. In the identification stage, 135 articles were obtained from two databases. The next step involves filtering the articles using the acceptance criteria inclusion in the previous table and then entering the eligibility stage, which is whether the articles match the expected results.

Results and Discussion

This SLR article reveals that there are several learning strategies used in teaching mathematics to children with special needs according to the needs of these children.

RQ1: Types of children with special needs

Based on the analysis of 10 articles, 8 types of children with special needs were found, such as Autism Spectrum Disorder (ASD), hearing impairment, intellectual disabilities, high intellectual abilities, slow learners, blindness, and low achievers. Here is the distribution in a diagram:

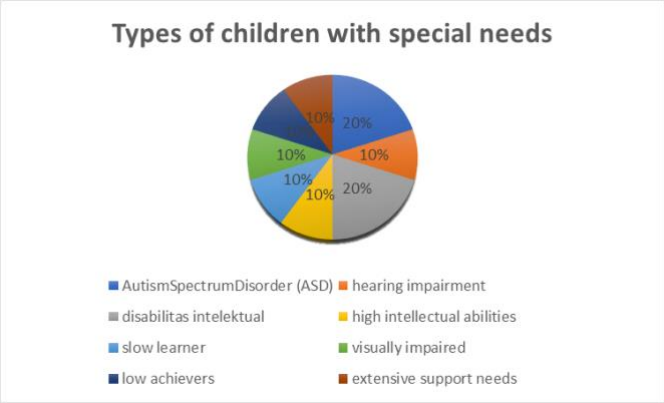

Figure 2. Diagram Types of children with special needs

RQ2: Math Topics And Skills Have Been Investigated in Research

In the 10 studies that have been examined, there are actually several studies that do not discuss what mathematics topics the research is carried out on, but the research is more focused on improving students' mathematical abilities such as concept understanding and problem-solving skills. So, here will be divided into two categories, namely for the category, namely for the category of material and skills developed.

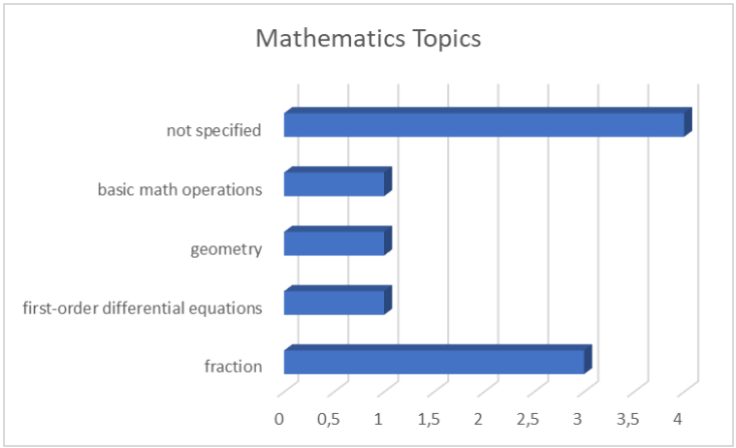

Figure 3. Diagram mathematics topics

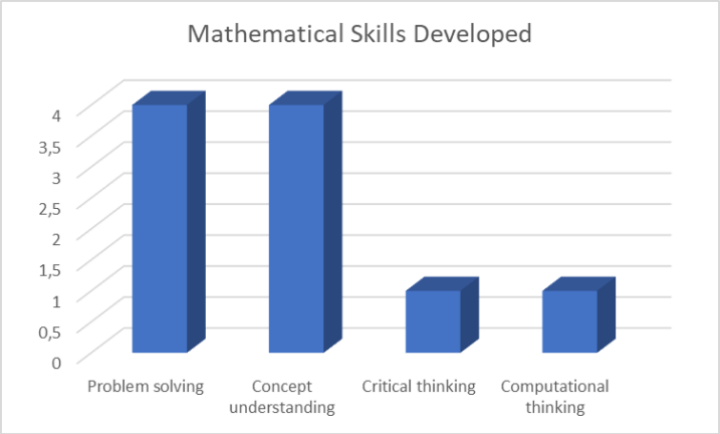

Figure 4. Diagram Mathematical Skills Developed

On the topic of learning mathematics, there were 4 studies that did not have a specific topic, followed by fraction material which appeared the second most with a total of three, then basic mathematical operations, geometry, and first-order differential equations which had the same frequency of occurrence. For the mathematical skills developed, there are two skills that have the most appearances, namely concept understanding and problem solving, followed by critical thinking and computational thinking.

RQ3: Criteria For Education Level

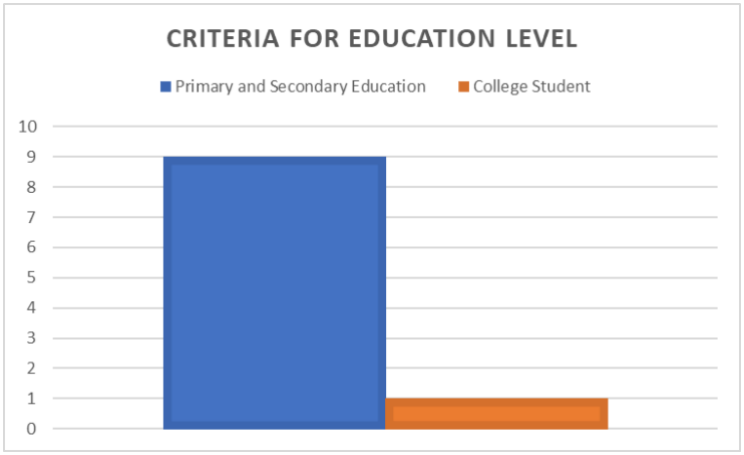

Figure 5. Diagram Criteria for Education Level

Based on the diagram above, the largest proportion, 9 studies or 90%, shows the dominance of respondents from primary to secondary education levels. This indicates that the research has a focus on the non-higher education group. This result illustrates that the majority of research conducted so far involves respondents from primary to secondary education, in line with the research objectives which may be related to the development or evaluation of learning at these levels.

RQ4: Implementing Learning Strategies in The Context of Learning Mathematics for Children with Disabilities

Based on the articles that have been analysed, the strategies and their implementation will be described in the following table:

Table 2. Implementation Strategies in The Context of Learning Mathematics

No	Strategy Used	How these strategies work in learning maths for children with special needs
1	Video modelling instruction package	The application of this strategy in mathematics learning is as follows: • Video modelling (VM): This video shows the steps to solve a fraction problem from a first-person perspective, so students can see how to solve the problem clearly. The video teaches how to add and subtract fractions using systematic and explicit instructions, which is important for ASD students who need clear visual guidance. • Concrete manipulatives: Students use fraction tiles as physical manipulatives to understand fraction concepts visually and directly. These manipulatives support students in building conceptual understanding and help them move from concrete to abstract understanding in solving fraction problems. • Self-monitoring checklist: This checklist helps students to follow each step in solving fraction problems independently without depending on direct instructions. It aims to increase the independence and ability of ASD students to remember the steps that need to be done. • Comprehension Check: After watching the video, students are given the opportunity to practice their comprehension with the instructor, who also provides additional help if needed. This strategy helps students overcome barriers and ensure that they understand the problem-solving steps appropriately. After the application of this strategy, two out of three ASD students were able to generalise their skills to other fraction problems (Yakubova et al., 2020).
2	Applications such as Learning Apps	Key aspects of this strategy and its implementation: • Use of interactive media: Applications such as LearningApps are used to create interactive exercises, so that SEN students can learn in a visual and kinesthetic way. These exercises help them understand the concepts of statistics, probability and geometry gradually, allowing for a more engaging and accessible learning process. • GeoGebra application for Geometry visualisation: using this application, students can directly observe the results of simulations or visualisations of complex geometric shapes through their respective mobile phones or computers. • STEM-based education projects: This approach provides an integrative and practical learning experience, which promotes critical thinking, cooperation and socialisation skills that are indispensable for SEN students to adapt in social life. • Application of inclusive learning principles: This strategy uses the principle of adapting teaching materials and methods based on the individual needs of SEN students, such as preparing additional visual materials, slowing down the pace

No	Strategy Used	How these strategies work in learning maths for children with special needs
		of teaching, and allowing extra time for tasks or answers. This ICT-based method shows that there is an increase in students' scores and understanding in diagnostic tests and evaluations. In addition, the ICT method also improves the motivation, social skills and learning independence of SEN students (Kramarenko et al., 2021).
3	Virtual Manipulative	In its application, it consists of: • Virtual manipulatives: Teachers use virtual manipulative apps, such as 'Fraction Tiles,' which allow students to interact with fractions in a visual format on iPads. At this stage, teachers help students understand the concept of equivalent fractions through direct interaction with digital fraction blocks, which are designed to clarify their understanding of the relationship between numerators and denominators. • Abstract approach: Once students are familiar with the virtual manipulatives, they are guided to solve equivalent fraction problems without the help of visuals and manipulatives, using numerical strategies as stages of abstraction. The teacher models by think-aloud and gives step-by-step instructions. • Self-monitoring: This strategy was added to help students maintain their skills after the intervention was over. With the self-monitoring checklist, students can verify the steps needed to find equivalent fractions, so that the acquired skills can be maintained. This VA strategy proved to be effective in improving students' accuracy in solving equivalent fractions. Two out of three students experienced improvement in their accuracy and were able to maintain their skills with additional self-monitoring sessions (Park & Bouck, 2022).
4	Curricular Enrichment and Flexible Promotion	Strategy Implementation 1. Curricular Enrichment: • Incorporating more advanced or unusual subject matter beyond the standard curriculum. • Accelerates learning for students who have faster learning abilities. • Providing specialised activities, such as research or art, designed to add variety and depth to student learning. 2. Flexible Promotion: • This strategy is only applied when curriculum enrichment does not adequately meet student needs. • Tailor educational promotion to the intellectual abilities of the students, while still considering the social-emotional aspects to prevent excessive pressure. Application of strategies in the field of mathematics: 1. Mathematical Olympiad of Paraguay (OMAPA) Identifies mathematical talent through a series of competitions from local to international levels. Gives gifted students the opportunity to learn from more complex problems, improving problem-solving skills, creativity and logic. 2. Use of local language (Guarani) Integrating problem-based approaches in mathematics with the local language, so that students from different backgrounds feel more connected to

No	Strategy Used	How these strategies work in learning maths for children with special needs
		the material being taught. 3. STEM (science, technology, engineering, mathematics) programme Engaging talented students in maths for robotics, programming and technology projects that integrate maths as a foundation (Vuyk et al., 2024).
5	Problem-Solving Strategies to Increase Learning Motivation	1. Focus on Conceptual Understanding: • Teachers use real contexts, such as stories or everyday situations, to help students understand the concept of fractions. For example, the teacher gives a story-based problem about cake division to explain the addition of fractions with the same denominator. 2. Use of Visual and Manipulative Representations: • The teacher uses number lines and manipulatives, such as circular or square pieces of paper, to demonstrate division and fraction operations. 3. Discussion and Verbalisation: • The teacher asks the students to explain their thinking in front of the class. The teacher also provides opportunities for students to discuss different strategies in solving the problem. 4. Extra Time and Individual Support: • Fraction materials are taught in long units, giving students time to overcome difficulties and strengthen their skills. Teachers also provide extra time after class to help students who need further guidance. 5. Reward for Progress: • The teacher appreciates students' efforts through positive feedback, such as praising the strategies used or asking students to share their thoughts with classmates (Newton et al., 2024).
6	Rigorous Mathematics Computational Thinking (RMcT)	RMcT Implementation • Students are directed through stages such as problem identification, model formulation, solution strategies, solution interpretation, and validation of results. An example is how students are asked to determine variables in differential equations and relate the results to real-life contexts. • The teacher provides critical questions that help students recall previous concepts, connect new concepts to their experiences, and explore patterns or relationships in the data. • Students are invited to discuss in small groups, share ideas, and provide feedback to peers. The teacher acts as a mediator who helps students navigate difficult concepts. • The teacher pays special attention to students who are having difficulty, such as providing additional explanations or analogies to reinforce understanding (Setyawan et al., 2021).
7	ROBOSTEAM	Implementation in mathematics learning: • Teacher Training: Teachers are trained to use the robotics tools and understand how to integrate technology into maths learning. • Robotics tool customisation: Robots are programmed to perform tasks related to mathematical concepts, such as calculating distance, time or angles. Then, the robotics can be adapted to turn abstract mathematical concepts, such as

No	Strategy Used	How these strategies work in learning maths for children with special needs
		geometry or algebra, into concrete tasks. For example: Using the robot to draw a circle or rectangle and programming the robot to calculate distance based on certain parameters. • Teacher initiates learning, then can explore concepts, group discussion • Assessment and feedback • Reflection and evaluation (Conde et al., 2024)
8	Learning Through Playing	Strategy Implementation 1. Direct Instruction: • The teacher teaches students one-on-one if they have difficulty focusing in a large group. • The teacher repeats maths concepts such as addition or subtraction until the students understand. 2. Play-Based Learning: • The teacher provides game-based tasks, such as using blocks to build geometric shapes or playing number puzzles. 3. CRA Approach: • Students are invited to understand concepts with real objects, such as counting physical objects. • After that, they look at visual representations such as pictures or graphs, before moving on to mathematical symbols. 4. Role-Playing: • In a shopping simulation, students use play money to buy items. This helps them understand the value of currency and the transaction process. 5. Technology: • Songs or videos are played after learning sessions as a form of reward, or used during learning to explain the concept of time of day or day of the week. (Jalil et al., 2020)
9	Technology-based Inclusive Math Learning Strategies and Tactile Approach	Strategy Implementation 1. Direct Instruction: • The teacher teaches students one-on-one if they have difficulty focusing in a large group. • The teacher repeats maths concepts such as addition or subtraction until the students understand. 2. Play-Based Learning: • The teacher provides game-based tasks, such as using blocks to build geometric shapes or playing number puzzles. 3. CRA Approach: • Students are invited to understand concepts with real objects, such as counting physical objects.

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10	An inquiry-based learning approach with an open-ended approach	Strategy Implementation 1. Competence-Oriented Diagnosis: • Identifying students' abilities through competency-based assessment, which focuses not only on mistakes but also on their strengths and potential. • Teachers can administer context-based tests used to understand how students think and solve problems. 2. Students' Own Productions: • Asking students to create their own problems or solutions based on the given numbers or context. • This strategy aims to encourage students' creativity and build understanding of concepts through hands-on experience. 3. Open Problems: • Providing problems without predetermined answers, so that students can choose a solution strategy that suits their abilities. • This strategy aims to reduce pressure on students and allow them to explore mathematical concepts in their own way. 4. Making Connections: • Helps students discover relationships between mathematical concepts, such as the relationship between multiplication and division or patterns in geometry. • This strategy aims to improve students' conceptual understanding and critical thinking skills. (Scherer, 2020)

Children with special needs are children who have limitations or disorders, whether physical, mental intellectual, social or emotional, which significantly affect the growth or development process compared to other children their age (Winarsih et al., 2013). Winarsih et al (2013) in the Handbook for Handling Children with Special Needs published by the Ministry of Women's Empowerment and Child Protection mention

disability in the classification of children with special needs, which is divided into twelve categories, as follows: 1) children with visual special needs, 2) children with hearing special needs, 3) children with intellectual special needs, 4) children with physical special needs, 5) children with social special needs, 6) children with concentration and hyperactivity special needs (GPPH), 7) children with autism spectrum special needs, 8) children with multiple special needs, 9) slow learning children, 10) children with learning difficulties, 11) children with communication skills special needs, 12) children with potential intelligence and/or special talents. Based on the 10 articles that have been further analysed, it was found that there are 8 types of children with special needs, namely: Autism Spectrum Disorder (ASD), hearing impairment, intellectual disability, high intellectual ability, slow learner, blind, and low achiever. the types of children with special needs can be divided into cognitive and physical aspects. this then, can be divided into 2 namely: from a cognitive point of view and from a physical point of view. the types of children with special needs based on cognitive aspects are ASD children, high and low intellectual abilities, slow learners, and low achievers. whereas, children with physical impairments are blind children and children with hearing impairments.

Based on this description, different treatments are needed for each child with different needs because they also have different categories. In analyzing 10 articles, it was found that the majority of research on learning mathematics for children with intellectual disabilities was conducted on children with intellectual disabilities. This is not too surprising due to the high contribution of students with intellectual disabilities who are one of the main focuses in mathematics learning. Research conducted by (Maryanti, 2021) also shows that most students with intellectual disabilities experience problems in aspects of mathematical ability. Students with intellectual disabilities have difficulty in understanding abstract and complex concepts. Children with intellectual disabilities often face difficulties in tasks that require high-level cognitive processing, such as mathematics involving abstraction. In addition, students with Autism Spectrum Disorder (ASD) often have barriers in social communication, which affects the understanding of mathematical concepts that require abstract reasoning and verbal interaction (Tonizzi & Usai, 2023). In a study conducted by Tonizzi & Usai (2023) also said that it is important to evaluate mathematics abilities in students with ASD and their cognitive processes by recognizing the important role of verbal intellectual functions and working memory (WM). Gathering information about individuals relative strengths and weaknesses in mathematics ability and

cognitive processes can be crucial to implementing adequate teaching and intervention strategies. Similarly, mathematics learning disabilities, high intellectual abilities, slow learners, low achievers, visually impaired and hearing impaired also require strategies in teaching mathematics to them.

Mathematics topics that are the focus of this research include fractions, geometry, basic mathematical operations, one-variable differential equations and geometry. In addition, the mathematical abilities developed are concept understanding, problem solving, critical thinking, and computational thinking. Research conducted by (Setyawan et al., 2021) showed that the Rigorous Mathematics Computational Thinking (RMcT) model can assist slow learners in developing their critical thinking skills, which are essential in solving more complex mathematical problems. Understanding fractions is one of the most frequently encountered topics due to the importance of this concept in building further maths skills. Learning about fractions is especially relevant for children with ASD who require more visual and concrete teaching, as applied in a study (Yakubova et al., 2020) that examined the effectiveness of using video modelling (VM) and concrete manipulatives to teach fraction concepts. Geometry is also a mathematics topic that requires an educational context approach that deserves deeper study. One of the alternatives to visual teaching is through applications such as Geogebra. Research (Kramarenko et al., 2021) involving the use of ICT technology shows that learning applications such as GeoGebra can help students with hearing loss and autism understand more abstract geometric concepts (Sudihartinih & Purniati, 2019). The development of these abilities also refers to the NCTM that mathematics learning should include five main process standards, namely mathematical communication, mathematical reasoning, mathematical problem solving, mathematical connections, and mathematical representation.

These primary and secondary levels of education are often the main targets of educational research, especially when it comes to learning, character or skills development (Suwartini, 2017). Research that focuses on this level of education usually aims to understand how the education system works at the most basic level, as learning at this level is the foundation for the next level of education. This is relevant to understanding learning processes, character development, or the implementation of policies such as the 2013 curriculum or Merdeka Curriculum. In society, the number of students at the primary and secondary levels is also usually greater than other levels such as university students. As primary and secondary education levels are 12 years of mandatory education, the majority

of school-age children are in these levels. Respondents from primary and secondary education levels are easier to reach, for example through schools. Schools often have a structured system for disseminating surveys or research data. If the research is related to learning, behaviour or curriculum, primary and secondary groups are the most relevant targets (Basar et al., 2021). This is because it is at this level that children and adolescents are in the formation phase of cognitive, affective and psychomotor abilities (Lidyasari et al., 2022).

Based on the results of this analysis, there are two main categories viz: technology-based, and manipulation-based. Technology-based strategies include the use of ICT, which was used in several studies. Geogebra and learning apps allow students to interact with abstract mathematical concepts in a more visualized way (Dockendorff & Solar, 2018). Technology also enables children with disabilities to visually represent mathematical problems and have a better and more enjoyable learning experience. Research conducted by (Iyamuremye et al., 2023) found that technology provides a lot of help in Math and Science education and has a significant positive impact on student motivation, attitudes and academic performance. Even positive learning outcomes depend on how digital technology is used, especially on the capabilities of each unique technology implementation. In a study (Kramarenko et al., 2021) also found that the use of ICT-based teaching aids, such as in teaching planimetry and stochastics, can improve their understanding of the material. In addition, distance learning was also found to be effective in helping students with special needs to better represent themselves and actively participate in learning (Sukisworo et al., 2021).

Manipulative-based strategies include virtual manipulatives such as Fraction Tiles that help students understand mathematical concepts in a more direct and tangible way (Yakubova et al., 2020), which is particularly important for children with intellectual disabilities. These manipulatives give students the opportunity to explore and represent a concept that allows them to see an abstract mathematical idea as an integrated whole, not just a fact to be memorized (Larbi & Mavis, 2016). Research conducted by Larbi & Mavis (2016) also found that students whose learning used teaching aids had much better achievement than students who were taught without using teaching materials. Research conducted by (Park & Bouck, 2022) also found that virtual manipulative-based mathematics learning provided by special education teachers was effective in helping students with extensive support needs (ESN) learn the concept of equivalent fractions.

Research conducted by (Yakubova et al., 2020) found that all three students improved in solving simple fraction problems after receiving an intervention consisting of video modelling, use of concrete aids, and self-monitoring strategies. Two students were also able to apply these skills to more complex fraction problems, suggesting that this intervention could be adapted for wider learning (Yakubova et al., 2020).

Mathematics learning strategies for children with special needs need to consider the specific needs of each category of children and the appropriate learning topics need of each category of children and the appropriate learning topics (Ediyanto et al., 2023). Analysis of various articles and literature sources shows that ethe use technology and manipulative approaches has significant results in improving the understanding and math skills of children with disabilities (Tjandra, 2023). Technology-based strategies, such as the use of GeoGebra software or information and communication technology (ICT)-based teaching aids, have proven effective in helping students understand abstract concepts such as geometry and stochastics (Tamam & Dasari, 2021). In addition, video modeling (VM) and virtual manipulatives have been used to improve fraction understanding in students with Autism Spectrum Disorder (ASD). Studies show that these methods allow students to visualize mathematical concepts more concretely, thus improving critical thinking and problem-solving skills. Research also indicates that technology-based distance learning can provide flexibility for students with ASD to actively participate and develop skills relevant to their needs (Musaraj & Muskaj, 2022).

Physical and virtual manipulatives are effective strategies in improving the mathematical understanding of students with special education needs. For example, the use of fraction tiles to understand the concept of simple fractions in students with intellectual disabilities, as well as video modeling-based approaches supported by concrete aids. This manipulative approach not only makes learning more interactive but also provides opportunities for students to explore mathematical ideas independently. Mathematics learning for children with disabilities needs to emphasize the five process standards developed by the National Council of Teachers of Mathematics (NCTM), namely mathematical communication, mathematical reasoning, problem solving, mathematical connections and mathematical representation. Research shows that manipulative and technology-based strategies can help students meet these standards. For example, the Rigorous Mathematics Computational Thinking (RMcT) method has shown to improve critical thinking skills in slow learners, while learning with a competency approach has

been shown to help low-achieving students better understand mathematical concepts. Overall, the research on mathematics learning strategies for children with disabilities highlights the importance of flexible, innovative and individual needs-based approaches. The integration of technology and manipulatives, supported by specialized training for educators, can be key in creating inclusive and effective learning environments for students with special needs.

Conclusion and Suggestion

The research in this journal illustrates that mathematics learning strategies for children with special needs need to be tailored to the needs and characteristics of each child. Strategies such as video modeling, Applications such as Learning Apps (GeoGebra), virtual manipulatives, as well as STEAM and inquiry-based learning are proven to help children with special needs understand mathematical concepts that were previously considered difficult. Topics often covered include fractions, geometry and basic math operations, with a primary focus on concept understanding and problem solving. The research also shows that education at the primary and secondary levels is the main focus in developing the math skills of children with special needs. The use of technology such as GeoGebra, video modeling, and virtual manipulatives has been shown to increase students' motivation, independence, and critical thinking skills. Similarly, manipulative approaches provide opportunities for students to understand abstract concepts visually and concretely. With the implementation of appropriate strategies, the learning gap between children with special needs and regular students can be minimized.

To support the success of this strategy, it is recommended that educators receive adequate training on the use of technology and manipulatives in mathematics learning. Further research is also needed to explore the effectiveness of this strategy across different educational contexts and age groups. In addition, education policy should support the widespread integration of these strategies in the school curriculum to improve inclusiveness and quality of learning.

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