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Analysis of the Experience of Dyscalculia Children in Completing Addition Operations in Upper Elementary School Classes

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ABSTRACT

Objective: This study aims to identify the forms of addition difficulties experienced by students with dyscalculia and examine the strategies used to overcome these obstacles. **Method:** A phenomenological approach was applied through semi-structured interviews, naturalistic observations, and document analysis involving high-grade students, teachers, and parents selected purposively. Data analysis was conducted through data reduction, open coding, theme categorization, and member checking to ensure credibility. **Results** The results showed that addition difficulties arise in several aspects, including poor memory for arithmetic facts, misconceptions of place value, reliance on manipulatives, use of inefficient compensatory strategies, and high cognitive load on tiered problems. Emotional and social factors such as math anxiety and inconsistent family support also exacerbate children's obstacles. **Novelty:** These findings confirm that the experience of dyscalculia is multidimensional, so interventions need to include basic numerical reinforcement, cognitive load management, anxiety reduction, and ongoing collaboration between teachers and parents

INTRODUCTION

Dyscalculia is a specific learning disability in mathematics that stems from impaired neurocognitive function. This condition directly impacts a child's ability to understand numbers and symbols, and perform basic arithmetic procedures (A. Rahmawati & Witono, 2023). Students with dyscalculia generally experience difficulties processing numerical information, understanding place value concepts, and applying arithmetic operations consistently and sequentially (Rastgar-Farajzadeh et al., 2025). Neuropsychological studies have shown that dyscalculia is associated with impairments in number sense and quantitative representation in the intraparietal sulcus, making it difficult for children to recognize number patterns, choose counting strategies, and remember arithmetic facts (Lievore et al., 2025). Therefore, this disability is not caused by a lack of enthusiasm for learning or low intelligence, but rather represents a specific disorder that affects the effective acquisition of mathematical concepts.

Globally, dyscalculia is a concern due to its widespread impact on children's cognitive, emotional, and academic development. The prevalence of this disorder is estimated to be around 3–7% of the elementary school student population, and can even reach around 10% in certain contexts (Stasolla et al., 2025). The difficulties experienced not only hinder math achievement but also trigger decreased self-confidence, anxiety around numbers, and other socio-emotional problems (Ruhaida et al., 2025). Children with dyscalculia often avoid arithmetic activities, feel anxious when asked to work on math problems, and are often labeled negatively by the learning environment, which ultimately further reduces their motivation.

One of the most common difficulties faced by children with dyscalculia is addition. Addition is a fundamental skill in mathematics and serves as the foundation for

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mastering other arithmetic operations (Dewi et al., 2024). Several studies have shown that children with dyscalculia experience specific difficulties in addition, such as an inability to use the counting-on strategy, errors during the carry process, poor memory for arithmetic facts, misunderstandings of the "+" symbol, and low levels of accuracy and speed in calculation (Fadhilah & Wijiastuti, 2025). These difficulties cause children to take longer and often repeat errors even after receiving explanations and practice.

In the Indonesian context, the issue of dyscalculia is beginning to receive more serious research, particularly at the elementary school level. However, most research still focuses on learning interventions, while studies exploring children's personal experiences with arithmetic difficulties are limited. Recent studies indicate that approximately 5–6% of elementary school students have indications of dyscalculia, which affects basic arithmetic skills, including addition (Haryanti & Yasin, 2024). Furthermore, teachers' competence in identifying signs of dyscalculia is still limited, resulting in many students not receiving appropriate support, leading to ongoing difficulties.

Initial observations in upper elementary school classes indicate that some children face significant challenges in solving addition problems. These difficulties include inaccuracies in adding units and tens, confusion when carrying, an inability to explain the solution procedure, and a tendency to guess without considering the correct calculation steps. This error pattern consistently emerged, both when working with direct numerical problems and word problems. These findings align with various international studies that indicate that children with dyscalculia exhibit characteristic errors in addition and experience difficulties in processing simple numerical relationships (Darmayanti et al., 2023).

In addition to cognitive aspects, these difficulties also impact students' emotional and social well-being. Children who struggle with addition are prone to fear of making mistakes, experience math anxiety, and have low interest in mathematics (Nurvidia & Yulianto, 2024). During learning, they tend to be inactive, reluctant to engage in discussions, and feel isolated from their peers (Indriano et al., 2023). If left unaddressed, this can hinder their broader academic development.

Most previous research on dyscalculia has focused on developing learning tools, multisensory media, or intervention strategies to improve children's numeracy skills (Agostini et al., 2022; Ahuja et al., 2022; Mutlu, 2024; Ouyang et al., 2024). Meanwhile, studies that highlight children's subjective experiences in solving addition operations are still very limited. Yet, understanding children's learning experiences is crucial for understanding how they interpret the challenges they face, the strategies they use, and the types of support they need.

Based on these considerations, this study is urgently needed to obtain a more in-depth understanding of the learning experiences of children with dyscalculia in completing addition operations in the upper grades of elementary school. This study aims to: (1) identify the forms of addition difficulties experienced by children with indications of dyscalculia, and (2) analyze the strategies they use to overcome these obstacles. The results of this study are expected to enrich theoretical studies on dyscalculia while providing practical guidance for teachers and parents in providing appropriate interventions according to the child's needs.

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RESEARCH METHOD

This study uses a qualitative approach with a phenomenological design to reveal the meaning of the experiences of students who experience difficulties in addition operations in the upper grades of elementary school.Data collection was conducted through three main procedures: semi-structured interviews, direct observation in the learning context, and review of documents related to the student learning process. Participant selection used the techniquepurposive samplingby considering their direct involvement in the phenomenon under study. Participants consisted of a student who showed indications of dyscalculia in addition operations, the class teacher who accompanied the student during learning activities, and a parent who was familiar with the child's learning patterns at home. Interviews were conducted repeatedly until the information obtained was saturated. All conversations were recorded, transcribed in full, and anonymized. Observations were conducted in routine learning situations to identify types of errors, chosen solution steps, and students' emotional reactions when faced with numerical tasks. Document analysis included examining student work results, academic progress records, and school archives relevant to numeracy.

Data processing was carried out using a phenomenological analysis approach in three main stages. The first stage,data reduction, starting with rereading the entire transcription, annotating it, and performingopen codingto find important parts that describe cognitive barriers and student strategies in solving addition. The second stage is the compilation and presentation of data, namely grouping codes into broader themes and compiling descriptions that can describe the student's experience as a whole, including cognitive, adaptive, and emotional aspects. The third stage is the process of deriving meaning and re-checking findings through comparisons between sources (interviews, observations, and documents) andmember checkingto participants. This series of procedures provides an in-depth and consistent picture of students' experiences in facing addition obstacles in the context of elementary school learning.

Data validity was ensured by meeting four trustworthiness indicators: credibility, transferability, dependability, and confirmability. Credibility was strengthened by combining various sources of information from students, classroom teachers, and parents, as well as various data collection techniques such as in-depth interviews, naturalistic observation, and analysis of students' academic documents. Member checking was conducted to ensure that the researcher's interpretations aligned with the participants' factual experiences. Transferability was achieved by presenting detailed descriptions of the school context and participant profiles so that readers could assess their relevance to other contexts. Dependability was maintained through systematic procedural recording from the instrument design stage to data analysis. Meanwhile, confirmability was achieved through the use of reflective journals and peer discussions to minimize potential researcher bias.

This research has obtained ethical approval from Universitas Muhammadiyah Purwokerto Number A12-11/019-S.Re/LPPM/I/2026. All participants provided informed consent, with a guarantee of anonymity.

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RESULTS AND DISCUSSION

Results

Difficulty with addition in dyscalculic children

The results of the study indicate that addition difficulties in students with dyscalculia appear consistently across various basic numerical components. This finding is in line with the study abstract, which identified that the main obstacles lie in weak memory of arithmetic facts, misconceptions of place value, reliance on manipulatives, the use of inefficient compensatory strategies, and high cognitive load when dealing with tiered problems. Classroom observations, analysis of student work results, and interviews with students, teachers, and parents indicate that these five aspects are interrelated, forming a multidimensional difficulty that affects students' addition performance. The following learning activities at school:

Figure 1. Learning observation

In terms of arithmetic fact memory, students appear unable to access simple addition results such as 5 + 3 or 6 + 7 without having to recalculate using their fingers. This difficulty is clearly evident when students say, "I forgot the result, sir... if I don't use my fingers, I'll make a mistake." This condition results in longer processing times and makes students lose concentration mid-process. In some situations, students even say, "I already calculated it, but then forgot to start from the beginning," indicating instability of numerical working memory. This instability significantly impacts their ability to complete more complex operations, especially when problems involve two- or three-digit addition that require rapid integration between arithmetic facts and place value structures. This is also evident in students' work when they write down the results of addition inconsistently, then say, "The numbers are confusing, sir... where do I put this one?" These findings provide a basis for understanding the characteristics of addition difficulties in students with indications of dyscalculia and provide an initial overview of patterns that are then analyzed further in the next section. The following are the results of the students' work.

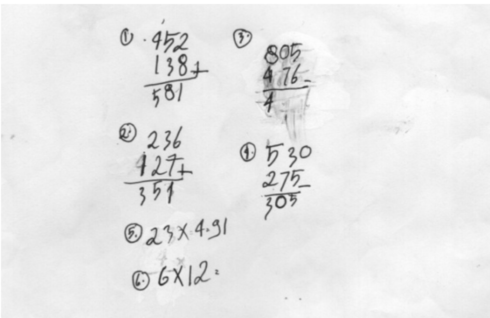

Figure 2. Example of student A's work results

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Obstacles become more apparent when students encounter misconceptions about place value, which manifest themselves in the form of incorrect placement of the units, tens, and hundreds digits. Student work shows that they frequently add digits horizontally without considering column placement, resulting in incorrect carrying over. For example, in the problem 452 + 138, students write results such as 620 or 581, demonstrating a lack of understanding of how the units digit should be added first before moving on to the tens and hundreds digits. This error pattern is also evident in three-digit addition, where students incorrectly multiply or shift digits due to a lack of understanding of the relationship between digit positions in the decimal system.

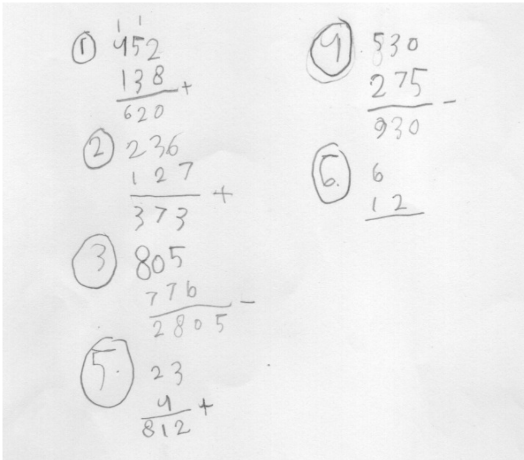

Figure 3. Example of Student B's work results

Students' work on addition tasks showed a consistent pattern of difficulty, particularly related to understanding place value and carrying procedures. In some problems, such as three-digit addition, students often misplaced the units and tens digits, resulting in answers that were far from correct, for example, adding 452 + 138 to 620 or 581. This difficulty was evident when students said, "I forgot the result, sir... if I don't use my fingers, I'll get it wrong." This condition resulted in longer work times and caused students to lose concentration midway through the process. In some situations, students even stated, "I already calculated it, but then forgot to start from the beginning," indicating instability in numerical working memory. This instability significantly impacted their ability to complete more complex operations, especially when problems involved two- or three-digit addition that required rapid integration of arithmetic facts and place value structures. This is also seen in the student's work when he writes down the addition results inconsistently, then says, "The numbers are confusing, sir... where should I put this one?", confirming that the weakness of factual memory is intertwined with misconceptions of place value.

These errors not only reflect a weak mastery of basic arithmetic facts but also indicate confusion in applying sequential steps when performing vertical addition. Furthermore, there are indications that students try to overcome obstacles with inappropriate compensatory strategies, such as copying numbers directly without calculating or combining numbers based on estimates. These findings indicate that the main obstacle lies in the inability to integrate place value concepts with addition procedures, thus supporting indications of dyscalculia in this aspect of basic operation processing.

When faced with difficulties, students often use inefficient compensatory strategies, such as counting on their fingers, guessing answers, copying friends' work, or adding

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numbers based on estimates without clear calculations. These strategies emerge as students' spontaneous adaptations to cognitive demands that exceed their processing capacity. However, instead of helping, these strategies actually produce inaccurate answers and hinder mastery of correct addition procedures.

Figure 4. Copying a friend's work

Another very important finding was the high cognitive load when students worked on multi-level problems. In problems requiring more than one calculation step, students quickly lost the sequence of steps, forgot the numbers they had just calculated, or stopped mid-task, displaying signs of confusion. This was evident when one student said, “Sir, how do I calculate again? I forgot… where do I start?”. As cognitive load increased, students were often seen stopping completely, looking down, or saying, “I have a headache, Sir… there are a lot of numbers,” indicating mental fatigue that hindered their ability to complete the task. The teacher also confirmed this phenomenon by saying, “If there is more than one step, he immediately goes blank. He stays silent, and then ends up not continuing.” This observation supports the statement in the abstract that the experience of dyscalculia is multidimensional, encompassing the interaction between basic numerical aspects, working memory capacity, and emotional factors. Overall, these findings indicate that addition difficulties in students with dyscalculia do not exist in isolation, but are a combination of obstacles at the conceptual (place value), computational (arithmetic facts), procedural (how to calculate), strategic (strategy choice), and cognitive (mental load) levels. These five aspects are the foundation for the following discussion, which is supported by observation data, student work analysis, and in-depth interviews.

Observation findings of addition learning

Field observations revealed how students with dyscalculia process addition within the context of classroom activities. Through images of their work and recordings of their activities during the lesson, researchers found that students exhibited recurring error patterns, even on relatively simple problems. These observations aimed to directly identify how students' cognitive processes operate when faced with basic addition operations.

During class activities, students are often seen stopping mid-process, checking numbers repeatedly, or losing focus after performing a simple operation. When the teacher provides step-by-step instructions, students may follow along but still exhibit signs of hesitation, such as recalculating or asking again about instructions given only seconds earlier. This suggests that their short-term working memory capacity is limited, especially in the context of math tasks that require maintaining information quickly.

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Observational images show that students are still in the concrete stage, characterized by the need to move physical objects one by one before being able to determine the total. When asked to solve problems without concrete objects, they appear confused and even provide answers unrelated to calculations. This observational finding is consistent with the abstract finding that reliance on manipulatives is a key characteristic of students with dyscalculia.

Analysis of student work results

Analysis of the work of students A, B, and C showed that the obstacles that emerged were systematic and consistent in several core aspects of addition. Observable error patterns included weak mastery of basic arithmetic facts, for example when students answered 6 + 5 = 10 or 7 + 8 = 12, indicating low retention of simple addition facts. Furthermore, misconceptions about place value emerged, such as when students added tens digits as units or wrote results randomly without following the positional value structure. Misordered work procedures were also apparent, for example, students added tens digits before units digits, or added horizontally even though the problem was presented vertically. Another error was seen in writing numbers that were not aligned, indicating that students did not yet understand column representation in addition. Some students even combined numbers based on estimates, especially when adding large numbers without calculating in detail. The most striking error occurred in three-digit addition; In problem 452 + 138, students gave answers such as 620 or 581. These answers indicate that they understand some elements of the arithmetic process, but are unable to integrate the steps completely, resulting in an inaccurate final result. This finding confirms that students' difficulties lie not only in their weak arithmetic facts, but also in their understanding of place value and the overall integration of addition procedures.

Student interview findings

Interviews were conducted to identify how students interpret the addition difficulties they experience, the strategies they use when facing these obstacles, and the roles of teachers and parents in the support process. These data are important because they provide affective, cognitive, and pedagogical context not explicitly visible on the worksheets, allowing researchers to understand addition difficulties not only as cognitive phenomena but also as learning experiences influenced by interactions, emotions, and environmental support. The following table presents a summary of the interview findings based on the coding categories established in the analytical framework.

Table 2. Experiences of Children with Dyscalculia in Addition

Brief Definition	Indicator (What Is Observed)	Example Quote (Paraphrased from Findings)
Inability to recall basic addition facts	Incorrect answers to simple +/- facts; needs to recount	"I forgot where I was, so I had to count using my fingers."
Incorrect placement of tens and ones in addition	Errors in carrying/positioning; numbers not aligned	"I thought the 3 was in the tens place, so I calculated it wrong."
Understanding emerges only with concrete tools	Can solve using sticks/counters; fails without manipulatives	"If I use small stones I can do it, but with numbers alone I get confused."
Alternative strategies used when facing difficulty	Finger counting, guessing, copying peers	"When I'm confused, I look at my friend's work or just guess."
Multi-step problems trigger cognitive fatigue	Takes a long time; loses sequence of steps	"If there are many numbers, my head hurts and I stop."

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Brief Definition	Indicator (What Is Observed)	Example Quote (Paraphrased from Findings)
Negative affective response during problem solving	Anxiety, fear of mistakes, task avoidance	"When I'm asked to calculate quickly, I'm afraid of being wrong."
Need for teacher scaffolding to complete tasks	Can answer when guided step by step	"If the teacher guides me, I can follow."
Helpful pedagogical actions	Use of manipulatives, repetition, remedial sessions	"I repeat the lesson using objects until the student understands."
Home support: positive or counterproductive	Practice at home; harsh reprimands; external tutoring	"At home they help, but sometimes I get scolded when I'm wrong."
Narrative of 'I can't do math'	Giving up; avoiding math tasks	"I've never been able to do math since I wa

The table above shows that students with dyscalculia experience indications in addition operations not only related to directly visible cognitive limitations but also influenced by latent dynamics that shape how they understand and respond to mathematical tasks. The data shows that students experience many basic obstacles such as forgetting arithmetic facts, confusion about place value, and a tendency to use compensatory strategies such as counting on their fingers, guessing, or copying friends. Errors in these aspects indicate that the representation of numbers and the relationships between operations have not been stably internalized. Furthermore, reliance on teacher guidance and the use of manipulatives in learning indicate that mathematical understanding is still at a concrete stage, requiring students to extend their sensorimotor skills to solve problems. This phenomenon demonstrates that cognitive obstacles in children with dyscalculia are multilevel, ranging from difficulty processing simple facts to an inability to map more abstract operational structures.

The table above also shows that emotional and social aspects exacerbate the academic difficulties students face. Math anxiety, cognitive load leading to loss of focus, and decreased self-confidence form a negative cycle that leads students to increasingly avoid math tasks and perceive themselves as incompetent. This suggests that the challenges faced by children with dyscalculia are not only cognitive but also rooted in self-perception and emotional experiences accumulated through repeated failures. Teacher support through the use of concrete objects, repetition, and remedial approaches can alleviate some of this stress. Thus, students with dyscalculia's experience with addition is seen as a complex interaction between cognitive difficulties, affective responses, and the social ecology that shapes their subjective meaning of mathematics.

Strategies for Teachers and Parents in Dealing with Dyscalculia in Children

Teachers emphasize individualized, concrete, and repetitive learning approaches to help students overcome their addition difficulties. Strategies include providing after-school remedial classes to provide a calmer learning environment and allow students to review material as needed. Personal mentoring is also provided so teachers can directly observe students' difficulties and adjust the support provided. Furthermore, teachers reinforce basic concepts by providing problems appropriate to students' initial abilities and using manipulatives such as popsicle sticks, small stones, or other concrete objects as visual aids. Step-by-step mentoring is implemented to reduce cognitive load, while consistent praise and motivation are provided to reduce math anxiety. Teachers also implement peer tutoring as a form of social support among students. All of these

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strategies support the findings in the abstract that effective learning interventions need to involve basic numerical reinforcement, cognitive load management, and anxiety reduction.

Discussion

Types of Addition Difficulties Experienced by Students with Dyscalculia Indications

Weak memory of arithmetic facts and number sense

The findings of this study indicate that students with dyscalculia experience significant difficulty in accessing basic arithmetic facts, as evidenced by their tendency to forget simple calculations and repeat the process from the beginning. This pattern aligns with Wachidah & Putikadyanto (2024); Widiawati et al., (2024) who stated that dyscalculia is characterized by deficits in arithmetic fact retrieval due to weak numerical working memory. This condition makes students unable to automate basic facts, resulting in a high reliance on manual strategies such as counting on their fingers. Research by Suzana & Maulida (2019; Varenchi et al., (2025) also found that children with dyscalculia more frequently use inefficient strategies and experience longer processing times, as reflected in the students in this study who required step-by-step guidance when completing vertical addition.

Difficulties in number sense, particularly understanding place value and number structure, were also strong characteristics of the students in this study. Misplacement of tens and ones digits and misunderstanding of digit magnitude reflect deficits in mental number representation, a core characteristic of dyscalculia according to the number module deficit theory (Suhendar & Yanto, 2023; Umam & Sa'diyah, 2025). Errors such as adding 452 + 138 to 620 indicate that students are unable to associate arithmetic operations with correct numerical relations. This is in line with the findings of (Stasolla et al., 2025), who stated that children with dyscalculia tend to fail to map the concept of digit position in the decimal system. This study also confirms that number sense difficulties are systemic, appearing not only in abstract problems but also in concrete activities, such as when students need manipulatives to reduce confusion when processing number structures.

The interaction between poor arithmetic fact memory and poor number sense in this study resulted in a high cognitive load, causing students to frequently lose sequences of steps or stop mid-process. The consistency of this finding with research by Ruhaida et al., (2025; Sholihah et al., (2025) which reported that dyscalculic children frequently exhibit working memory overload when performing multi-step operations, clarifies that students' errors are not simply inaccuracies, but manifestations of fundamental numerical disorders. Thus, this study confirms that addition difficulties in students with dyscalculia are the result of a multidimensional interaction between number representation deficits, poor arithmetic working memory, and repeated procedural errors, as also demonstrated by various previous studies.

Place value misconceptions as a conceptual barrier

The results of this study indicate that students with dyscalculia experience strong conceptual barriers in understanding place value, as evidenced by repeated errors in

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placing the units, tens, and hundreds digits when performing addition. Errors such as writing the sum of three digits out of alignment or interpreting the number "3" as a tens digit when it is actually a units digit reflect fundamental misconceptions about the structure of the decimal system. This finding is consistent with the theory of place value systems as the foundation of numerical representation (Musyarofah et al., 2025; Mutiani & Suyadi, 2020), which states that understanding digit position is not simply a procedural rule, but a hierarchical concept that requires integration between numerical quantities and mathematical symbols. In the students in this study, these misconceptions appeared to hinder their ability to maintain logical consistency in addition operations.

The misconceptions of place value that emerged in this study are in line with Mahmudah & Fikroh, (2021); Monalisa et al., (2023) who explained that children with dyscalculia often fail to map the relationship between digit positions and their numerical values. Research Latifah, (2021); Nandilah et al., (2024) also reported that children at risk of dyscalculia tend to treat digits as separate symbols, not part of a single number unit, so that errors such as "452 + 138 = 620" occur not because of miscalculation, but because of a failure to understand the structure of numbers. A similar phenomenon was seen in students in this study, who several times expressed confusion such as "The numbers are confusing, sir… where do you put this one?", asserting that their difficulties stem from conceptual deficits, not simply procedural errors or lack of due diligence.

The interaction between place value misconceptions and limited numerical working memory exacerbates students' conceptual barriers to understanding addition. Symbolic operations such as vertical addition require coordination between verbal, quantitative, and digit position representations; when positional representations are disrupted, students cannot maintain the correct step structure (Juniawan, 2021; Khasanah & Abduh, 2023; Muflichah & Ulum, 2022). The high cognitive load resulting from these misconceptions is evident when students lose the order of operations, forget interim results, or have to start calculations over. A study Heryanto et al., (2022) showed that weaknesses in place value understanding exacerbate multi-step errors, especially in two- to three-digit addition. The findings of this study reinforce this view by demonstrating that conceptual barriers in place value are at the root of subsequent errors in addition operations, and not simply due to poor calculation accuracy. Thus, place value misconceptions in students with dyscalculia are not simply procedural irregularities, but core conceptual barriers that affect number representation, calculation strategies, and step integration in arithmetic operations.

Manipulative dependency and limitations of mental representation

The findings of this study indicate that students with dyscalculia have a high dependence on manipulatives such as small stones, popsicle sticks, or fingers to complete basic addition calculations. While manipulatives can help visualize numbers, in the case of dyscalculic students, this dependence is not a temporary strategy but rather the only way for them to process numbers. When manipulatives are unavailable, students immediately show confusion, panic, or stop working, indicating that their mental representations of numbers have not yet been stably formed. This is in line with the findings of Hazima et al., (2022), who explained that children who are unable to transfer concrete experiences to abstract representations will remain at the sensorimotor stage in understanding numbers. Similar symptoms emerged in the study of Iftayani & Ratnaningsih (2018), who found that children with dyscalculia tend to fail to build an

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internal number line, resulting in them relying heavily on concrete tools to maintain calculation accuracy.

This reliance on manipulatives stems from the limitations in mental representation of numbers, a core characteristic of dyscalculia. Batubara et al., (2024) stated that children with dyscalculia experience deficits in their innate ability to recognize quantities, so that number representations in long-term memory do not form automatically. The findings of this study support this view, as seen in students' inability to connect numerical symbols with numerical quantities without the aid of concrete objects. When faced with two- or three-digit addition, limitations in mental representation prevent students from understanding number structure and forgetting previous calculations, requiring manipulatives to be used for each small step. Anshori's (2025) research shows that children with weaknesses in symbolic representation tend to experience procedural errors due to their inability to maintain the stability of digit values in working memory.

The interaction between reliance on manipulatives and weak mental representations results in a high cognitive load on students, especially on step-by-step problems. The use of manipulatives, which should facilitate learning, actually becomes a hindrance as the number of steps increases, as students must repeatedly move, recount, or verify concrete objects. This is consistent with the findings of Firdaus et al., (2021) that manipulatives are only effective if children have a strong enough mental representation to connect concrete objects with numerical symbols; without this competence, manipulatives actually increase the workload on working memory. In this study, this condition was clearly evident when students lost the sequence of steps, forgot the numbers they had just calculated, or asked to start over because they were "confused about the numbers." Thus, limited mental representation not only explains the reliance on manipulatives but also underlies the inefficiency of counting strategies and repeated errors in addition operations.

Inefficient compensatory strategies and emotional impact

The results of this study indicate that students with dyscalculia tend to use various inefficient compensatory strategies when faced with addition difficulties, such as counting on their fingers, guessing answers, copying friends' work, or relying excessively on concrete objects. These strategies emerge as a spontaneous response to overcome limited memory of arithmetic facts and misconceptions about place value that have hampered cognitive processes from the outset. However, this pattern aligns with (Eteng-uket (2023) suggestion that children with dyscalculia tend to use immature strategies, not due to lack of practice, but because their numerical representations are not strong enough to support more efficient strategies. Research Räsänen et al., (2021) also found that children with dyscalculia often rely on manual strategies due to their inability to automate procedures, resulting in slow, unstable, and error-prone math work.

This reliance on inefficient compensatory strategies interacts closely with the emergence of affective distress, particularly math anxiety. In this study, students repeatedly showed signs of nervousness, fear of making mistakes, loss of concentration, and even stopping work on problems while saying they were "dizzy" or "afraid of making mistakes." This phenomenon aligns with the findings of Salisa & Meiliasar (2023), who explained that math anxiety reduces working memory capacity, making problem-solving more difficult. This impact forms a negative cycle: inability to understand concepts leads to anxiety, anxiety inhibits cognitive processing, and then repeated failure reinforces

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negative beliefs such as "I can't do math." Research by Roulstone et al., (2024) also shows that children with numerical difficulties are more susceptible to these emotional reactions due to repeated experiences of failure in the classroom.

Emotional impacts not only affect academic performance but also overall learning behavior. When cognitive load increased, students in this study often exhibited shutdown behaviors such as stopping work, looking down, or asking to start over, demonstrating an interaction between cognitive inhibition and emotional regulation. Negative emotions can disrupt the executive processes required to complete multi-step operations. Another study by Dewi et al., (2024) also showed that children with dyscalculia have more intense emotional responses to numerical tasks because their difficulties are fundamental, not simply due to lack of practice. Thus, inefficient compensatory strategies and the accompanying emotional impact are two mutually reinforcing aspects, forming a complex barrier to the mathematics learning process for students with dyscalculia.

High cognitive load and limited working memory

The findings of this study indicate that students with dyscalculia experience high cognitive load when working on addition problems, especially in operations involving more than one step, such as adding two- and three-digit numbers. Students often lose the sequence of steps, forget the numbers just calculated, or have to repeat calculations from the beginning. This indicates limitations in working memory, especially the phonological loop and visuospatial sketchpad, which are unable to retain numerical information for a short period of time. Cognitive fatigue is evident through behaviors such as stopping suddenly, looking down, or saying "dizzy" and "forgot where I was." This picture is in line with the findings of (Adhim) 2019; Ahmad et al., (2024) who stated that multi-step tasks will fail to be processed when working memory capacity is exceeded.

The limited working memory of students with dyscalculia in this study aligns with the findings of Anshori (2025); Arifa et al., (2025) who showed that working memory deficits are a major predictor of arithmetic difficulties. Research by Patricia & Zamzam (2019) also explains that children with numerical representation weaknesses often experience working memory overload because they must maintain and manipulate numbers without a stable mental representation. This is evident in their research data, where students must continually recalculate, forget interim results, or are unable to integrate the "storing" step in addition operations. Thus, failure occurs not only at the procedural level but is an indication that the numerical working memory system is unable to withstand the information load required to complete basic arithmetic operations.

The interaction between high cognitive load and limited working memory creates a cascade effect on students' performance and emotional regulation. When working memory capacity is insufficient, students experience increased anxiety and mental fatigue, which impairs their ability to maintain focus, leading to increased error rates. These findings align with those of Dewi et al., (2024), who explain that negative emotions such as stress and confusion can impair executive function, thus exacerbating problem-solving difficulties. Research by Jati et al., (2020) also shows that math anxiety can reduce working memory capacity by up to 20–30% on numerical tasks. A similar phenomenon was observed in this study, when students stopped working when asked to solve multilevel problems and expressed an inability to continue. Thus, high cognitive load

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and limited working memory are two mutually reinforcing components that are at the root of fundamental obstacles in solving addition problems in students with dyscalculia.

Teacher Strategies in Dealing with Dyscalculia Children

The individual, concrete, and repetitive learning strategies implemented by teachers demonstrate an appropriate response to the main characteristics of dyscalculia, namely weak number sense and difficulty processing basic quantitative relationships. According to Ouyang et al., (2024), children with dyscalculia require highly structured and remedial instruction to rebuild their numerical foundations. The teacher's after-school remedial sessions provide a calmer, less stressful learning environment, a much-needed condition for children with dyscalculia, who often experience slowed numerical information processing Salisa & Meiliasar (2023). With a slower and more repetitive learning rhythm, this teacher strategy allows students to process number concepts with a longer comprehension period.

Personal mentoring by teachers is also an important strategy for children with dyscalculia because this condition is highly heterogeneous. Each child exhibits different error patterns, such as miscalculating skip numbers, reversing the order of numbers, or using inefficient counting strategies. One-on-one mentoring allows teachers to directly identify these specific difficulties. This approach is consistent with Bruner's scaffolding and Vygotsky's zone of proximal development, where assistance is provided according to the child's actual ability level Ahuja et al., (2022). By adapting problem types based on the student's initial ability, teachers help children with dyscalculia experience success, which is crucial for maintaining motivation and preventing recurrent frustration.

The use of concrete manipulatives such as popsicle sticks, small stones, or other visual objects is a relevant strategy for children with dyscalculia, who tend to fail to form stable mental representations of numbers. Research by Latifah (2021) confirms that students with dyscalculia require visual-physical support to understand quantity concepts because they often struggle to connect number symbols to their quantitative meanings. Manipulatives help reduce cognitive load by shifting some mental processes to the physical environment Roulstone et al., (2024). This aligns with Sweller's cognitive load theory, which suggests that concrete aids can reduce the intrinsic load when students learn basic operations like addition and subtraction.

Praise, motivation, step-by-step guidance, and peer tutoring provided by teachers also play a crucial role in addressing the emotional aspects that often accompany dyscalculia Stasolla et al., (2025). Children with chronic math difficulties tend to have high math anxiety Agostini et al., (2022), which can exacerbate their working memory weaknesses. Emotional support from teachers and peer assistance not only reduce psychological distress but also increase children's opportunities to verbally explain and rehearse mathematical processes. This strategy is consistent with findings Luoni et al., (2023) that collaborative learning can strengthen procedural understanding and build self-confidence in at-risk students. Thus, all teacher strategies are not only pedagogical but also aligned with the neurocognitive and emotional needs of children with dyscalculia.

Parental Strategies in Dealing with Dyscalculia in Children

Research findings indicate that parental support for children with dyscalculia occurs under conditions of significant limitations, particularly related to parental education, geographic location, and access to learning services Han (2024). Most parents provide

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support through additional practice, repetition, and motivation, but without a scientific understanding of dyscalculia or appropriate pedagogical strategies. This simplistic support pattern aligns with the findings of Rastgar-Farajzadeh et al., (2025), who demonstrated that the home environment generally provides emotional support but is less able to provide the conceptual scaffolding needed by children with specific mathematics disorders. This situation confirms that parental motivation is not always accompanied by adequate pedagogical capacity.

Interview results revealed that parents' limited educational background was the primary cause of ineffective mentoring (O1, O5). Parents were only able to provide basic assistance without explaining more complex mathematical concepts. This phenomenon is consistent with the research findings of Rahmawati & Witono (2023), which found that low numeracy literacy in families was associated with minimal success of home interventions for students with numeracy difficulties. However, this study adds the important finding that limitations are not only cognitive but also structural: parents lack access to relevant training or learning resources, so even if they have the will, they lack the appropriate pedagogical direction.

Geographical factors emerged as another significant factor (O2). The lack of access to tutoring services in mountainous areas hampers external remedial efforts that could support children's numeracy skills. This finding aligns with a study by (Fadhilah & Wijiastuti, 2025), which showed that students in rural areas are more vulnerable to learning difficulties due to a lack of educational facilities. However, this study not only reaffirms geographical barriers but also demonstrates how these barriers impact the sustainability of interventions, as the lack of professional services leaves families with no alternative but to provide minimal support at home.

Some parents' attempts to provide external tutoring (O3) indicate a desire to seek professional support, but the child's inconsistency and inability to participate in additional learning make this intervention unsustainable. These results differ from the research of Desoete et al. (2020), which showed that intensive tutoring-based interventions tend to be effective for students with dyscalculia when implemented in a structured and sustainable manner. The findings of this study, however, highlight another aspect: the success of the intervention is determined not only by the method but also by the child's motivational readiness and consistent attendance at the program. Thus, this study confirms the interaction between individual factors (motivation, math anxiety) and structural factors (access to services) in determining the effectiveness of the intervention.

Family dynamics, such as involving older siblings (O4), represent a common form of social support found in Indonesian families. However, without an appropriate pedagogical approach, this strategy has not resulted in significant change. These findings reinforce the findings of a study by Rahmawati et al., (2024), which emphasized that the success of family support depends on the appropriateness of the strategy to the child's difficulty profile, not simply the intensity of support. Overall, the results of this study provide empirical evidence that the experiences of children with dyscalculia are strongly influenced by a combination of structural factors (parental education, geography, access), relational factors (family support), and individual factors (motivation and consistency), thus addressing dyscalculia requires a multisystem approach, not just school or family intervention alone.

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CONCLUSION

Fundamental Findings: This study demonstrates that children with dyscalculia encounter persistent cognitive barriers in solving addition problems, particularly weak memory for arithmetic facts, confusion regarding place value, and heavy reliance on concrete manipulatives and direct guidance. These cognitive constraints increase cognitive load, reduce sustained attention in multi step procedures, and trigger math anxiety alongside diminished self confidence. The findings further reveal that adaptive teacher strategies such as the use of manipulative media, structured repetition, step by step scaffolding, and individualized remediation aligned with students' information processing capacity significantly mitigate these barriers. Additionally, parental involvement exerts a dual influence: supportive home practice strengthens conceptual understanding, whereas pressure oriented correction heightens anxiety and hinders learning progress. Overall, students' success in mastering addition is strongly shaped by the dynamic interaction among neurocognitive characteristics of dyscalculia, pedagogical adaptation, and emotionally responsive home support. **Implications:** The results suggest that mathematics instruction for children with dyscalculia should prioritize concrete to abstract sequencing, reduced cognitive load, and systematic scaffolding. Integrating emotional support strategies within classroom practice is equally essential to address math anxiety and rebuild learners' confidence. Furthermore, structured collaboration between teachers and parents is recommended to ensure consistent academic and emotional reinforcement. Schools may also consider providing parent guidance programs to promote supportive, non pressuring home learning environments. **Limitations:** Although the study provides meaningful insights, several limitations should be acknowledged. The findings may be context bound and influenced by specific participant characteristics or instructional settings. Variations in dyscalculia severity and possible co occurring learning difficulties were not extensively differentiated. Moreover, the focus was limited to addition operations and short term learning outcomes, restricting broader generalization. **Future Research:** Future studies should employ longitudinal designs to examine the sustained impact of adaptive instructional and parental support strategies. Expanding the scope to other mathematical domains such as subtraction, multiplication, and problem solving would strengthen theoretical and practical understanding. Investigating intervention models that integrate cognitive training with emotional regulation strategies may also provide deeper insights into comprehensive support frameworks for children with dyscalculia.

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