Strategic Thinking in Mathematical Problem Solving among Students with Special Educational Needs: A Systematic Literature Review

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HOW TO CITE:
Agung Firmansyah, St. Budi Waluya, Isnarto (2026). Strategic Thinking in Mathematical Problem Solving among Students with Special Educational Needs: A Systematic Literature Review. International Journal of Special Education, 41(7s), 317-339.

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ABSTRACT:
Background: Strategic thinking in mathematical problem-solving is a crucial aspect of mathematics learning for students with special educational needs, as it relates to the ability to understand problems, determine strategies, and evaluate solutions. However, students with special educational needs still face difficulties in cognitive regulation and the systematic application of problem-solving strategies.
Objective: This study aims to examine the development of strategic thinking in mathematical problem-solving among students with special educational needs based on previous empirical research.
Method: This study employed a Systematic Literature Review (SLR) using the PRISMA approach, supported by bibliometric analysis using VOSviewer. The literature search was conducted via the Scopus and ScienceDirect databases using keywords related to Strategic Thinking, metacognition, Mathematical Problem Solving, and Special Educational Needs. Following a screening and eligibility process, a total of 14 articles were analysed descriptively.
Results and Discussion: Strategic Thinking in mathematics learning is closely related to metacognitive regulation, instructional strategy, as well as mathematical reasoning and problem solving. The components of self-monitoring and self-regulation are the most dominant aspects in supporting students' mathematical problem-solving processes. Furthermore, approaches such as Self-Regulated Strategy Development (SRSD), scaffolding, schema-based instruction, and discourse-based instruction have proven effective in helping students understand problems, organise information, and apply problem-solving strategies systematically. Research also indicates that the use of technology-based instruction and visual supports makes a positive contribution to the engagement and conceptual understanding of mathematics among students with special educational needs. This review identifies several research gaps, including the limited number of longitudinal studies, the lack of representation of students with ASD and ADHD, and the lack of technology-integrated approaches in developing Strategic Thinking within inclusive mathematics education.
Conclusions and Implications: Strategic Thinking in students with special educational needs can be developed through the support of metacognitive strategies and structured learning. Hence, mathematics education needs to emphasise the development of strategic thinking skills in addition to the mastery of mathematical procedures.

Keywords: Strategic Thinking, Mathematical Problem Solving, Metacognitive Regulation, Special Educational Needs, Inclusive Mathematics Education.

1. Introduction

Mathematical problem-solving skills are one of the essential competencies in 21st-century education, as they relate to students' ability to analyse problems, determine appropriate strategies, and evaluate solutions effectively. In the context of mathematics learning, strategic thinking plays a vital role in supporting students' cognitive and metacognitive processes during the resolution of mathematical problems. Previous research has shown that cognitive strategy instruction can significantly improve students' mathematical problem-solving skills and metacognitive awareness (Montague et al., 2014). Further, metacognitive regulation is also known to contribute to students' success in mathematical reasoning and strategic decision-making during the problem-solving process (Tzohar-Rozen & Mark-Zigdon, 2020).

Nevertheless, students with special educational needs (SEN) still face various obstacles in developing strategic thinking skills in mathematics. These obstacles include difficulties in representing problems, determining solution strategies, monitoring the thinking process, and evaluating the results of problem-solving. Research by Montague and Bos (1990) indicates that students with learning disabilities have difficulties in using metacognitive strategies during the process of solving mathematical problems. Similar findings have also been reported by Rosenzweig et al. (2011) which states that students with learning difficulties experience difficulties in monitoring and evaluating mathematical procedures.

Several recent studies emphasise the importance of explicit learning interventions in supporting the development of strategic thinking in students with SEN. The Solve It! model, developed by (Rosenzweig et al., 2011) integrating cognitive and metacognitive strategies through structured stages, such as visualisation, hypothesis formulation, calculation processes, and checking answers. Furthermore, the use of visual approaches and technology-assisted learning has also been reported to improve mathematical understanding, independent learning, and problem-solving skills in students with autism spectrum disorder or learning disabilities (Barnett & Cleary, 2019). Research by Shin and Park (2024) It also shows that the integration of technology into mathematics learning can help improve the visualisation and retention of mathematical skills among students with special educational needs.

However, studies on strategic thinking in mathematical problem-solving among students with special educational needs still reveal several limitations. Most research focuses on the outcomes of short-term interventions, whilst longitudinal studies on the sustainability of strategic thinking skills remain limited. Furthermore, research examining the use of authentic and open-ended mathematical problems with SEN students is also still scarce (Shin & Park, 2024). On the other hand, the development of adaptive and dynamic assessment tools capable of identifying students' strategic thinking processes in real time still requires further validation in order to be effectively applied in inclusive education (Ebenbeck & Gebhardt, 2024).

In addition to cognitive and instructional aspects, affective factors also influence the strategic thinking abilities of students with SEN in solving mathematical problems. Research by Lievore et al. (2024) indicates that maths anxiety can hinder students' ability to select and apply problem-solving strategies optimally. Low motivation to learn and a fear of failure also influence students' engagement in the mathematical thinking process. Therefore, the development of strategic thinking in students with special educational needs requires a learning approach that is not only focused on cognitive abilities but also takes into account the students' emotional and motivational aspects.

Based on the above, research on Strategic Thinking in Mathematics Problem Solving among Students with Special Educational Needs is important to identify the characteristics of SEN students' strategic thinking abilities in mathematical problem-solving, effective learning strategies, and various factors influencing its development. This research is expected to contribute to the development of more adaptive, evidence-based, and needs-appropriate inclusive mathematics learning for students with special educational needs.

1. RQ1: What types of students with special educational needs (SEN) have been studied in research on strategic thinking in mathematical problem-solving?
2. RQ2: Which mathematical domains, problem-solving skills, and metacognitive components have been examined in research on strategic thinking in mathematics learning for students with special educational needs?
3. RQ3: At which levels of education has research on Strategic Thinking in mathematical problem-solving among students with special educational needs been conducted?
4. RQ4: What learning strategies and instructional approaches have been implemented to support Strategic Thinking and mathematical problem-solving among students with special educational needs?

2. Methodology

This study employed a Systematic Literature Review (SLR) method, adhering to the PRISMA guidelines to ensure that the processes of identifying, selecting and synthesising articles were conducted systematically and transparently. The literature search was conducted using two international databases, namely Scopus and ScienceDirect. The search terms used were: ('Strategic Thinking' OR 'problem-solving strategies' OR metacognition OR 'mathematical reasoning') AND ('mathematics problem solving' OR 'Mathematical Problem Solving' OR 'mathematics education') AND ('Special Educational Needs' OR SEN OR 'students with disabilities' OR 'learning disabilities' OR 'special needs students').

The inclusion criteria for this study were as follows: (1) the article discussed Strategic Thinking, metacognition, or problem-solving strategies in mathematics learning; (2) the research focused on mathematics problem solving or mathematics education; (3) the research subjects were students with Special Educational Needs; (4) the article was available in English; and (5) the article was fully accessible (open access). Meanwhile, articles that were not relevant to the research focus, did not discuss students with special educational needs, or had an inappropriate methodology were excluded from the review process.

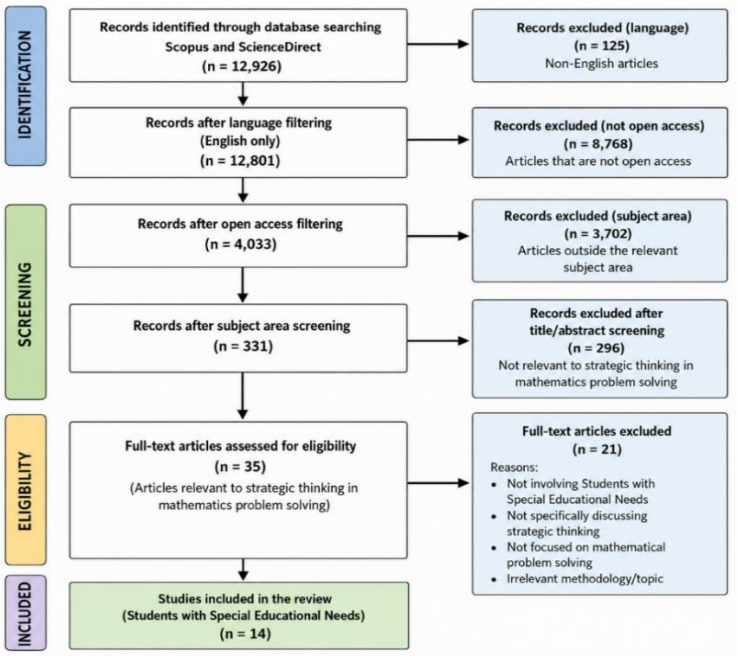

Figure 1. PRISMA Flow Diagram of the Article Selection Process for the Systematic Literature Review

The search process began by identifying 12,926 articles from the ScienceDirect database. These were then screened based on language criteria, resulting in 12,801 English-language articles. In the next stage, an open-access filter was applied, yielding 4,033 articles. Following screening based on subject area relevance, the number of articles was reduced to 331. Further screening through a review of titles and abstracts yielded 35 articles relevant to the topic of Strategic Thinking in mathematics problem solving. A full-text review was then conducted based on research inclusion criteria, specifically focusing on articles discussing learners with Special Educational Needs (SEN). The final results showed that only 14 articles met all the criteria and were used in this study.

The data obtained were then analysed descriptively to identify the characteristics of the studies, the approaches used, and the main findings regarding Strategic Thinking in mathematical problem-solving among students with Special Educational Needs (SEN). In addition to the PRISMA-based systematic review process, a bibliometric analysis using VOSviewer was also conducted to identify research trends, author collaboration networks, the co-occurrence of keywords, and the development of themes within the selected studies.

3. Results

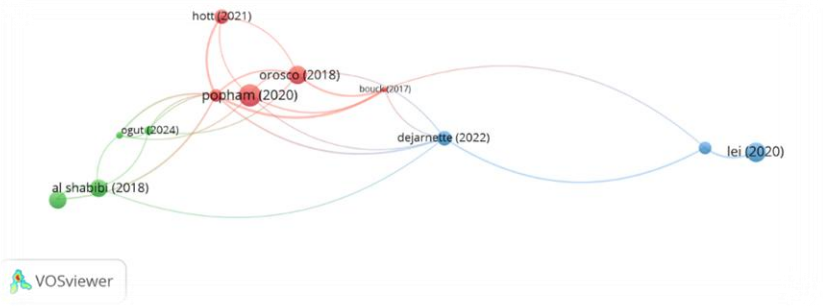

Figure 1. Bibliographic Coupling Document

Network visualisation using VOSviewer shows that research on strategic thinking in mathematical problem-solving among students with special educational needs is divided into three main, interrelated clusters. The red cluster is the most dominant group, comprising Orosco and Ibrahim (2018), Hott et al. (2021), and Bouck (2015) with Popham (1995) having the largest node, indicating the highest level of connectivity within the research network. The green cluster includes Al Shabibi and Alkharusi (2018) and Ogut et al. (2024), which are connected to the red cluster, indicating continuity in research themes regarding mathematics learning strategies for students with special needs. Meanwhile, the blue cluster consists of DeJarnette and Hord (2022) and Lei et al. (2020) acting as a link between clusters, thus playing a key role in integrating various research approaches. Lei et al. (2020) is situated in the most isolated position within the network visualization, indicating a more specific research focus compared to other studies, although it remains connected to the same overarching theme. Overall, this bibliometric map illuminates that research in this field is still developing within a relatively small network but maintains sufficiently strong connections between studies.

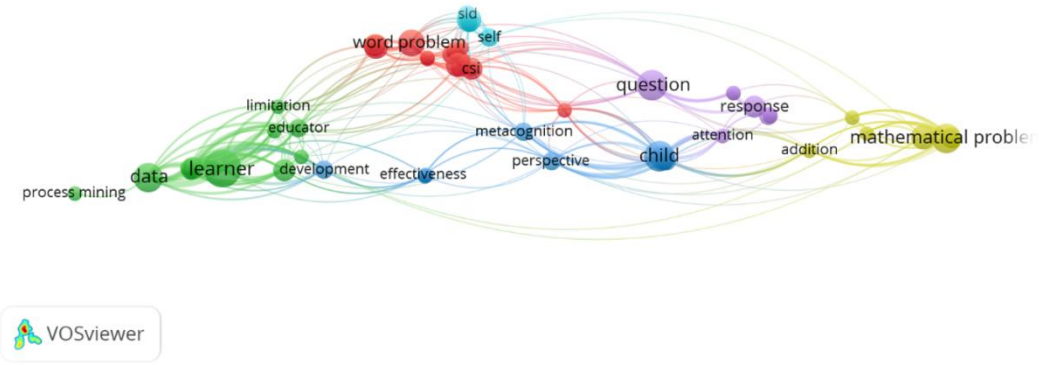

Figure 2. Title and Abstract

The interrelationships between key terms in research on strategic thinking in mathematical problem-solving among students with special educational needs. This network visualization is divided into several interconnected clusters. The green cluster focuses on terms such as 'learner', 'data', 'educator' and 'development', indicating the research's focus on learner characteristics, the learning process, and the development of educational strategies. The red cluster features the terms 'word problem' and 'CSI', which relate to story-based mathematical problem-solving strategies. The blue cluster contains the words 'child', 'metacognition', and 'perspective', indicating the research's focus on thinking skills, cognitive processes, and students' perspectives in solving mathematical problems. Furthermore, the purple and yellow clusters include the terms 'question', 'response', 'addition', and 'mathematical problem', which describe aspects of student responses and mathematical operations in the context of problem-solving. Overall, this map indicates that research in this field is dominated by themes of problem-solving strategies, metacognition, and the development of mathematics learning oriented towards the needs of students with special needs.

Figure 3. Co-authorship

The authors' collaboration patterns in research on strategic thinking in mathematical problem-solving among students with special educational needs are divided into two main clusters. The red cluster comprises Park, Joo Young; Yan, Xuan; Ma, Xiaojun; and Chiu, Ming Ming, indicating a fairly strong collaborative relationship among the authors in producing research in this field. Meanwhile, the green cluster includes Xin, Yan Ping; Tzur, Ron; Morita-Mullaney, Trish; and Lei, Qingli, who also share close research ties. Xin, Yan Ping appears to be the central figure in the green cluster due to her connections with several other authors, whilst Yan, Xuan acts as a link between the red and green clusters. This indicates academic collaboration across research groups in developing studies related to thinking strategies and mathematical problem-solving for students with special needs. Overall, this network illustrates that research in this field is developing through interconnected author collaboration, although it remains within a relatively limited network scope.

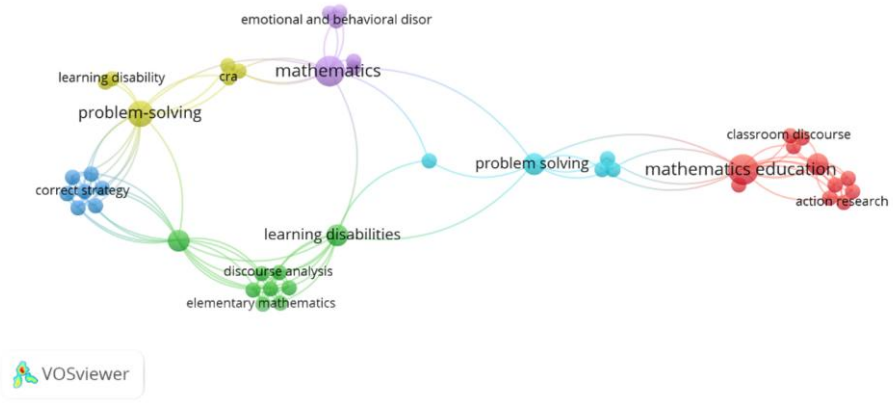

Figure 4. Co-occurrence

Corelation between keywords in research on strategic thinking and mathematical problem-solving among students with special educational needs. This Co-occurrence network visualization is divided into several interconnected clusters. The red cluster centres on the terms 'mathematics education', 'classroom discourse' and 'action research', indicating a research focus on mathematics learning and classroom interactions. The green cluster contains keywords such as 'learning disabilities', 'elementary mathematics' and 'discourse analysis', illustrating the research's attention to students with learning difficulties in the context of basic mathematics. The yellow and blue clusters feature the terms 'problem-solving', 'learning disability' and 'correct strategy', relating to strategies for solving mathematical problems. Meanwhile, the purple cluster includes the terms 'mathematics' and

'emotional and behavioural disorders', indicating a link between mathematical ability and the behavioural or emotional conditions of students with special needs. Further, the term 'problem-solving' acts as a link between clusters, signifying that the theme of problem-solving is a central focus across various studies in this field. Overall, this map indicates that research is developing around the themes of mathematics learning, problem-solving strategies, and support for students with special needs and learning difficulties.

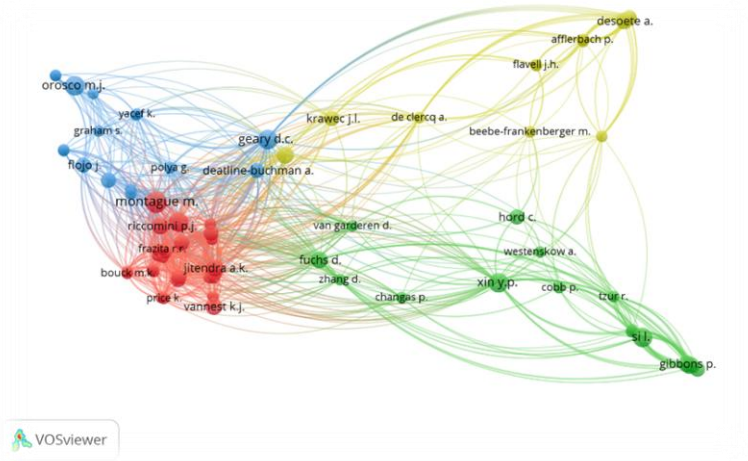

Figure 5. Co-Citation Cited Authors

A visualization of authors frequently cited together in research, mapped using VOSviewer. Several clusters of authors can be seen interconnected based on common research themes, particularly in the fields of mathematics education, problem-solving, and learning disabilities. Authors such as "Montague M.", "Jitendra A.K.", "Xin Y.P.", and "Beebe-Frankenberger M." have larger nodes, indicating a high level of citations and academic influence. The connections between authors suggest that their works serve as primary references and possess strong theoretical and methodological links in the development of research related to mathematics learning for students with learning difficulties.

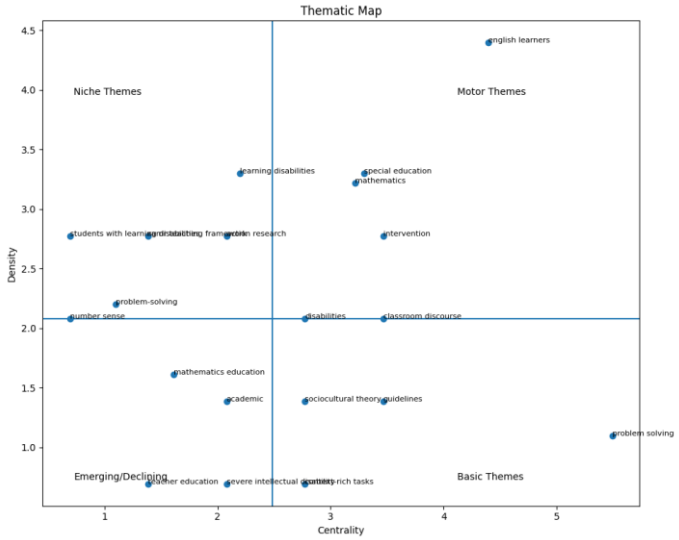

Figure 6. Thematic Map Analysis

Based on the results of the thematic map from the bibliometric analysis, the development of research on the analysed dataset reveals several thematic clusters with varying levels of importance and interconnectedness. The thematic mapping is divided into four main quadrants: motor themes,

niche themes, basic themes, and emerging/declining themes, which are determined based on centrality and density values. In the motor themes quadrant, themes with high centrality and density values are found; these can be categorised as core themes that have developed strongly and serve as the main drivers of literature development. Meanwhile, niche themes indicate topics that have developed in depth but have low connectivity with other themes, thus tending to be specific in nature. In the basic themes quadrant, themes exhibit high connectivity but their internal development remains low, thereby serving as the foundation for research and opening opportunities for further study. Emerging/declining themes, on the other hand, show themes with low centrality and density values, indicating either new themes that are beginning to emerge or older themes where the intensity of research is starting to decline. Overall, the results of the thematic map demonstrate that the analysed research field is developing dynamically, with dominant and potential themes that can serve as a basis for identifying research gaps, determining novelty, and formulating the direction of future research.

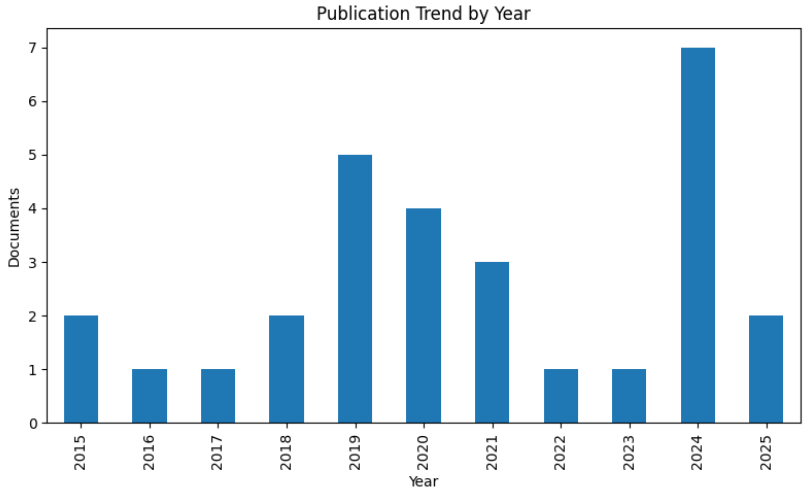

Figure 7. Publication Trend

The publication trend results show that the number of publications in the research field analysed has been on an upward trend year on year. This increase indicates that the research topic is attracting growing attention and remains relevant for study. In the early period, the number of publications was still relatively low, but subsequently increased gradually until reaching a peak in recent years, signalling that the research is in an active phase of development. Although there have been fluctuations in certain years due to changes in research trends, publication policies, or other factors, the overall publication trend continues to show a positive direction. These findings suggest that the research field has good prospects for further development and opens up opportunities to identify research gaps and determine the direction of future research.

Table 1. Synthesis of Strategic Thinking Components in Mathematics Problem Solving among Students with Special Educational Needs

Citation	Special Educational Needs	Mathematics Learning Focus	Educational Level	Metacognitive Regulation	Instructional Strategy	Mathematical Reasoning / Problem Solving
(Deaño, 2015)	Students with low intelligence and learning difficulties	Arithmetic and Mathematical Problem Solving	Primary education	✓	✓	✓

Citation	Special Educational Needs	Mathematics Learning Focus	Educational Level	Metacognitive Regulation	Instructional Strategy	Mathematical Reasoning / Problem Solving
(Al Shabibi & Alkharusi, 2018)	Learning Disabilities (LD)	Mathematical problem-solving skills	Primary education	✓		✓
(Orosco & Abdulrahim, 2018)	English learners at risk of Mathematics Learning Difficulties (MLD)	Word-problem solving	Primary education	✓	✓	✓
(Baten & Desoete, 2019)	Mathematical Learning Disabilities (MLD)	Mathematical accuracy and calculation speed	Elementary education	✓		
(Darragh, 2019)	Students with Special Educational Needs (SEN)	Collaborative problem-solving mathematics	Primary education		✓	✓
(Zakirova, 2019)	General school students	Problems with parameters and graphic methods	School education		✓	✓
(Lee, 2020)	Mathematically gifted and talented students	Mathematics-related affect	Secondary education	✓		✓
(Lei et al., 2020)	English Learners (ELs) with Learning Disabilities	Multiplicative reasoning and mathematical discourse	Elementary education		✓	✓
(Xin et al., 2020)	Learning Disabilities (LD)	Multiplicative reasoning and mathematical discourse	Elementary education	✓	✓	✓
(Hott et al., 2021)	Emotional and Behavioral Disorders (EBD)	Schema-based Mathematical Problem Solving	Primary education	✓	✓	✓
(DeJarnette & Hord, 2022)	Learning Disabilities (LD)	Algebra tutoring and mathematical discourse	Secondary education		✓	✓
(da Silva Soares Jr et al., 2023)	Mathematics difficulties and Learning Disabilities	Mathematical thinking and problem solving	School education	✓	✓	✓

Citation	Special Educational Needs	Mathematics Learning Focus	Educational Level	Metacognitive Regulation	Instructional Strategy	Mathematical Reasoning / Problem Solving
(Kivirähk, 2024)	Mild Intellectual Disability (MID)	Mathematical attainment and cognitive skills	Middle school education	✓	✓	✓
(Mulcahy et al., 2024)	Learning Disabilities (LD)	Algebraic word-problem solving	Secondary education	✓	✓	✓

Based on Table 1, research on strategic thinking in mathematical problem-solving among students with special educational needs is dominated by three main components: metacognitive regulation, instructional strategy, and mathematical reasoning/problem-solving. The components of mathematical reasoning and problem-solving are the most frequently cited aspects, indicating that strategic thinking skills are closely linked to students' ability to understand, plan, and solve mathematical problems systematically. Furthermore, the majority of studies also emphasise the importance of metacognitive regulation, particularly in helping students monitor and evaluate their thinking processes during problem-solving.

In terms of student characteristics, research has largely focused on students with Learning Disabilities (LD), Mathematical Learning Disabilities (MLD), and other mathematical learning difficulties. Meanwhile, instructional strategies are implemented through various approaches such as schema-based instruction, collaborative problem-solving, and mathematical discourse to support students' strategic thinking skills. Based on educational levels, the majority of studies have been conducted at the primary and elementary education levels, indicating that the development of strategic thinking in mathematics is primarily focused on the early stages of education.

Table 2. Characteristics of Included Studies

Author(s)	Country	Research Design	Participants	Educational Level
(DeJarnette & Hord, 2022)	United States	Cross-disciplinary study	Pre-service special education teachers and students with LD	Secondary education
(da Silva Soares Jr et al., 2023)	Brazil	Perspective / Review article	Students with mathematics difficulties and LD	School education
(Mulcahy et al., 2024)	United States	Instructional practice article	Secondary students with LD	Secondary education
(Lei et al., 2020)	United States	Exploratory case study	English Learners (ELs) with LD	Elementary education
(Al Shabibi & Alkharusi, 2018)	Oman	Descriptive study	Fifth-grade students including students with learning disabilities	Primary education
(Orosco & Abdulrahim, 2018)	United States	Experimental study	English learners at risk of mathematics learning difficulties	Primary education

Author(s)	Country	Research Design	Participants	Educational Level
(Baten & Desoete, 2019)	Belgium	Comparative study	Children with and without mathematical learning disabilities	Elementary education
(Xin et al., 2020)	United States	Exploratory teaching experiment	Students with learning disabilities	Elementary education
(Hott et al., 2021)	United States	Single-case study	Student with emotional and behavioral disorders (EBD)	Primary education
(Zakirova, 2019)	Russia	Methodological research	School students	School education
(Lee, 2020)	South Korea	Mixed-method study	Mathematically gifted and talented students	Secondary education
(Kivirähk, 2024)	Estonia	Comparative study	Students with mild intellectual disability	Middle school education
(Deaño, 2015)	Spain	Experimental intervention study	Students with low intelligence and learning difficulties	Primary education
(Darragh, 2019)	Chile	Qualitative discourse study	Primary school teachers	Primary education
(Haigler, 2021)	United States	Research article / conceptual analysis	Educators, employers, workforce stakeholders	Postsecondary / workforce education
(Calleros, 2019)	Mexico / Spain	Edited research and development book	Educational technology researchers and students	School and higher education

Research on strategic thinking in mathematics education for students with special educational needs shows that the distribution of studies is dominated by the United States, with additional contributions from other countries such as Oman, Belgium, Brazil, Russia, South Korea, Estonia, Spain, Chile and Mexico. This geographical variation indicates that the issue of Strategic Thinking in mathematics education has become a focus across various international education systems. From a methodological perspective, the research employs a variety of approaches, ranging from experimental studies, comparative studies, exploratory case studies, mixed-methods, qualitative discourse studies, to reviews and conceptual analyses, indicating the development of research both empirically and conceptually.

The characteristics of research participants are predominantly students with Learning Disabilities (LD), Mathematical Learning Disabilities (MLD), and difficulties in learning mathematics, although some studies also involve English Learners (ELs), students with Emotional and Behavioural Disorders (EBD), and those with Mild Intellectual Disability (MID). In addition to students, some studies also involve teachers, trainee special education teachers, and education stakeholders. Based on educational levels, the majority of studies focus on primary and elementary education, whilst research on secondary, middle school, and postsecondary education remains relatively limited. This suggests that the development of Strategic Thinking in mathematics is prioritised more at the primary education stage as a foundation for problem-solving skills and mathematical reasoning.

Table 3. Main Mapping of Studies

Citation	Special Educational Needs	Mathematics Learning Focus	Educational Level	Metacognitive Regulation	Instructional Strategy	Mathematical Reasoning / Problem Solving
(DeJarnette & Hord, 2022)	Learning Disabilities (LD)	Algebra tutoring and mathematical discourse	Secondary education		✓	✓
(da Silva Soares Jr et al., 2023)	Mathematics difficulties and Learning Disabilities	Mathematical thinking and problem solving	School education	✓	✓	✓
(Mulcahy et al., 2024)	Learning Disabilities (LD)	Algebraic word-problem solving	Secondary education	✓	✓	✓
(Lei et al., 2020)	English Learners (ELs) with Learning Disabilities	Multiplicative reasoning and mathematical discourse	Elementary education		✓	✓
(Al Shabibi & Alkharusi, 2018)	Learning Disabilities (LD)	Mathematical problem-solving skills	Primary education	✓		✓
(Orosco & Abdulrahim, 2018)	English learners at risk of Mathematics Learning Difficulties (MLD)	Word-problem solving	Primary education	✓	✓	✓
(Baten & Desoete, 2019)	Mathematical Learning Disabilities (MLD)	Mathematical accuracy and speed	Elementary education	✓		
(Xin et al., 2020)	Learning Disabilities (LD)	Multiplicative reasoning and mathematical discourse	Elementary education	✓	✓	✓
(Hott et al., 2021)	Emotional and Behavioral	Schema-based word-problem solving	Primary education	✓	✓	✓

Citation	Special Educational Needs	Mathematics Learning Focus	Educational Level	Metacognitive Regulation	Instructional Strategy	Mathematical Reasoning / Problem Solving
	Disorders (EBD)					
(Zakirova, 2019)	General school students	Graphic methods for problems with parameters	School education		✓	✓
(Lee, 2020)	Mathematically gifted and talented students	Mathematics-related affect	Secondary education	✓		✓
(Kivirähk, 2024)	Mild Intellectual Disability (MID)	Mathematical attainment and cognitive processing	Middle school education	✓	✓	✓
(Deaño, 2015)	Learning difficulties and low intelligence	Arithmetic and problem solving	Primary education	✓	✓	✓
(Darragh, 2019)	Students with SEN	Collaborative problem-solving mathematics	Primary education		✓	✓
(Haigler, 2021)	Workforce learners / adult learners	Transfer of learning, workplace competencies, and mathematics application	Postsecondary / workforce education	✓	✓	✓
(Calleros, 2019)	General students / learners	Technology-supported mathematics learning and educational technology	School and higher education		✓	✓

Most research focuses on students with Learning Disabilities (LD) and Mathematical Learning Disabilities (MLD), suggesting that this group has a significant need for learning approaches capable of supporting mathematical thinking processes in a more systematic manner. The focus of learning is dominated by problem-solving activities, word-problem solving, multiplicative reasoning, and

mathematical discourse, such that strategic thinking is understood as a cognitive process involving problem identification, strategy selection, monitoring of solution steps, and reflective evaluation of results. In this context, reasoning and problem-solving abilities emerge as key indicators of success in mathematics learning for SEN students, as both represent the students' ability to meaningfully connect mathematical concepts, strategies, and applications.

On the other hand, metacognitive regulation and learning strategies appear to be dominant components in almost all of the studies analysed. Various approaches, such as schema-based instruction, mathematical discourse, collaborative learning, graphical methods, and technology integration, are used to provide scaffolding that helps students gradually build mathematical thinking patterns. The research trend, which is concentrated at the primary education level, indicates that the development of Strategic Thinking is considered important from the early stages of numeracy and reasoning skills formation. However, the limited research at the secondary and postsecondary levels highlights the need for broader studies regarding the sustainability of Strategic Thinking skills among SEN students. Overall, these findings confirm that the effectiveness of mathematics learning for SEN students is determined not only by mastery of the subject matter but also by students' ability to regulate their thinking processes and use problem-solving strategies adaptively.

Table 4. Metacognitive Components Analysis

Citation	Self-Monitoring	Self-Regulation	Self-Talk	Goal Setting	Reflection
(DeJarnette & Hord, 2022)					✓
(da Silva Soares Jr et al., 2023)	✓	✓			✓
(Mulcahy et al., 2024)	✓	✓	✓	✓	✓
(Lei et al., 2020)					
(Al Shabibi & Alkharusi, 2018)	✓	✓	✓	✓	✓
(Orosco & Abdulrahim, 2018)	✓	✓		✓	
(Baten & Desoete, 2019)	✓		✓		✓
(Xin et al., 2020)	✓	✓		✓	✓
(Hott et al., 2021)	✓	✓		✓	
(Zakirova, 2019)					
(Lee, 2020)		✓			✓
(Kivirähk, 2024)			✓		
(Deaño, 2015)	✓	✓	✓	✓	
(Darragh, 2019)					✓
(Haigler, 2021)			✓	✓	
(Calleros, 2019)	✓	✓	✓	✓	✓

Self-monitoring and self-regulation are the most prominent aspects in research on mathematics learning for students with special educational needs. These two components appear consistently across various studies, such as those by Soares et al. (2023), Mulcahy et al. (2024), Al Shabibi and Alkharusi (2018), Xin et al. (2019), and Calleros et al. (2019). This prevalence indicates that students' ability to monitor their thought processes, control problem-solving strategies, and independently adjust their

learning steps is viewed as a key foundation for the development of mathematical skills. In the context of mathematics learning, self-monitoring plays a crucial role in helping students identify errors, evaluate the effectiveness of strategies, and maintain consistency in problem-solving processes. Meanwhile, self-regulation enables students to manage the learning process more adaptively, particularly when facing complex mathematical tasks that require step-by-step reasoning.

On the other hand, components such as self-talk, goal setting, and reflection appear with varying degrees of intensity, yet still demonstrate a significant contribution to the development of Strategic Thinking. Studies by Mulcahy et al. (2024), Al Shabibi and Alkharusi (2018), and Calleros et al. (2019) demonstrate the comprehensive integration of these five metacognitive components, indicating a more comprehensive approach to mathematics learning. The presence of self-talk reflects the importance of internal dialogue in helping students maintain focus and direct their thinking strategies during the problem-solving process. Meanwhile, goal setting serves to build a focused learning orientation, whilst reflection helps students evaluate their learning experiences and the effectiveness of the strategies used. Interestingly, some studies, such as those by Lei et al. (2020) and Zakirova et al. (2019), do not explicitly demonstrate the presence of metacognitive components, indicating that not all mathematics learning interventions directly integrate metacognitive dimensions. Finally, these findings confirm that strengthening metacognitive components plays a central role in supporting strategic thinking and mathematical problem-solving skills in SEN students.

Table 5. Mathematics Domain Analysis

Citation	Algebra	Geometry	Arithmetic	Word Problems	Multiplicative Reasoning
(DeJarnette & Hord, 2022)	✓				
(da Silva Soares Jr et al., 2023)		✓	✓	✓	
(Mulcahy et al., 2024)	✓			✓	
(Lei et al., 2020)					✓
(Al Shabibi & Alkharusi, 2018)	✓	✓	✓		✓
(Orosco & Abdulrahim, 2018)		✓	✓		✓
(Baten & Desoete, 2019)	✓				
(Xin et al., 2020)		✓	✓	✓	✓
(Hott et al., 2021)	✓	✓			✓
(Zakirova, 2019)		✓			✓
(Lee, 2020)					✓
(Kivirähk, 2024)		✓	✓		✓
(Deaño, 2015)			✓	✓	✓
(Darragh, 2019)					✓

Multiplicative reasoning and word problems emerge as the most frequently studied domains, as seen in the research by Lei et al. (2020), Xin et al. (2019), Deaño and Das (2015), and Darragh and Valoyes-Chávez (2019). The dominance of these two domains indicates that the ability to understand quantitative relationships, interpret contextual information, and apply problem-solving strategies are key aspects in the development of mathematical skills among SEN students. In this context,

mathematics learning is not only directed towards mastering procedures, but also towards students' ability to construct problem representations, connect concepts, and use thinking strategies flexibly. This confirms that Strategic Thinking develops through mathematical activities that require interpretation, analysis, and decision-making in a step-by-step manner.

Furthermore, the domains of algebra, geometry, and arithmetic also show significant involvement in various studies, albeit with a more varied distribution. Algebra is frequently associated with generalisation skills and symbolic problem-solving, as seen in the studies by DeJarnette and Hord (2022) and Mulcahy et al. (2024). Meanwhile, geometry and arithmetic are often used as a medium to develop visualisation, spatial reasoning, and mathematical calculation accuracy in SEN students. Interestingly, some studies integrate more than one mathematical domain simultaneously, such as those by Al Shabibi and Alkharusi (2018) and Xin et al. (2019), indicating a trend towards a multi-domain approach in inclusive mathematics education. The integration of these various domains indicates that Strategic Thinking skills do not develop in isolation within a specific mathematical topic, but rather through the interconnection of mathematical concepts, which enables students to develop more adaptive and comprehensive reasoning.

Table 6. Instructional Strategy Analysis

Citation	Tutoring	Scaffolding	SRSD	Technology-Based	Discourse-Based Instruction
(DeJarnette & Hord, 2022)	✓				✓
(da Silva Soares Jr et al., 2023)				✓	
(Mulcahy et al., 2024)		✓	✓		
(Lei et al., 2020)		✓			✓
(Al Shabibi & Alkharusi, 2018)			✓		
(Orosco & Abdulrahim, 2018)	✓		✓		✓
(Baten & Desoete, 2019)					
(Xin et al., 2020)			✓	✓	✓
(Hott et al., 2021)		✓	✓		
(Zakirova, 2019)				✓	
(Lee, 2020)					
(Kivirähk, 2024)		✓			
(Deaño, 2015)	✓		✓		
(Darragh, 2019)		✓			✓
(DeJarnette & Hord, 2022)				✓	
(da Silva Soares Jr et al., 2023)				✓	

Teaching approaches in mathematics for students with special educational needs are dominated by the use of Self-Regulated Strategy Development (SRSD), scaffolding, and mathematical discourse-

based approaches. The presence of SRSD in various studies, such as those by Mulcahy et al. (2024), Al Shabibi and Alkharusi (2018), Orosco and Abdulrahim (2018), Xin et al. (2020), Hott et al. (2021), and Deaño (2015), indicates that this strategy is considered effective in helping students develop self-regulation skills during the process of solving mathematical problems. SRSD not only emphasises the mastery of cognitive strategies but also encourages students to plan, monitor, and evaluate their thinking processes independently. In the context of SEN students, this approach is particularly important as it provides a systematic framework for thinking whilst helping students develop confidence in tackling complex mathematical tasks.

Furthermore, the use of scaffolding and discourse-based instruction demonstrates a tendency towards supportive and collaborative learning. Scaffolding strategies, as seen in Mulcahy et al. (2024), Lei et al. (2020), Hott et al. (2021), Kivirähk (2024), and Darragh (2019), are used to provide gradual support so that students can build mathematical understanding more independently. Meanwhile, the mathematical discourse-based approach places interaction, communication, and argumentation as key components in the development of students' mathematical reasoning. On the other hand, the integration of technology-based instruction in several studies indicates efforts to utilise technology to enhance engagement and accessibility in mathematics learning for SEN students. Interestingly, there are several studies that do not explicitly indicate the use of specific instructional strategies, suggesting a variety of approaches within the analysed literature. Overall, these findings confirm that the development of Strategic Thinking in mathematics is significantly shaped by instructional designs capable of combining cognitive support, self-regulation, social interaction, and the adaptive use of technology.

4. Discussion

Learners with special educational needs are individuals who have certain difficulties or characteristics whether cognitive, behavioural, social or academic and therefore require more adapted educational provision than the general student population. In the context of mathematics learning, students with special needs often experience difficulties in understanding abstract concepts, using problem-solving strategies, and regulating their thought processes whilst completing mathematical tasks. Therefore, Strategic Thinking is an important aspect that needs to be developed as it relates to students' ability to plan, monitor, and evaluate problem-solving steps systematically.

Based on an analysis of the reviewed articles, it was found that research on Strategic Thinking in mathematical problem-solving is dominated by students with Learning Disabilities (LD) and Mathematical Learning Disabilities (MLD) (Al Shabibi & Alkharusi, 2018; Baten & Desoete, 2019; Xin et al., 2020). This group is the primary focus because students with LD and MLD generally face difficulties in understanding mathematical relationships, employing appropriate strategies, and organising problem-solving steps logically. Research by Montague and Bos (1990) also explains that students with learning disabilities tend to have weaknesses in the use of metacognitive strategies during the mathematical problem-solving process.

Furthermore, several studies have also involved students with Emotional and Behavioural Disorders (EBD), Mild Intellectual Disabilities (MID), English Learners (ELs) with learning disabilities, and students with special educational needs in general (Hott et al., 2021; Kivirähk, 2024; Lei et al., 2020). The diversity of these students' characteristics indicates that Strategic Thinking is not solely related to academic ability, but is also influenced by factors such as language, behaviour, emotional regulation, and students' cognitive abilities. Students with EBD, for example, often struggle to maintain focus and control their behaviour during the process of solving mathematical problems, whilst students with MID require more concrete and step-by-step support in understanding mathematical concepts.

Research findings also indicate that the majority of studies still focus on specific groups with special needs, particularly LD and MLD, whilst research on groups such as Autism Spectrum Disorder (ASD), ADHD, and sensory impairments remains relatively

limited. However, each category of special educational needs has distinct learning characteristics, thus requiring different Strategic Thinking approaches. Consequently, future research should broaden the scope of its subjects to ensure that the development of inclusive mathematics education is more representative of the diversity of learners' needs.

The findings indicate that research on Strategic Thinking in mathematical problem-solving is dominated by students with Learning Disabilities (LD) and Mathematical Learning Disabilities (MLD) (Al Shabibi & Alkharusi, 2018; Baten & Desoete, 2019; Xin et al., 2020). The dominance of this group indicates that students with difficulties in learning mathematics are the primary focus in the development of metacognitive and problem-solving-based learning strategies. Students with LD and MLD generally face barriers in understanding abstract concepts, organising problem-solving steps, and monitoring their mathematical thinking processes. Therefore, Strategic Thinking is regarded as a crucial ability that can help students develop a more systematic and focused approach to problem-solving.

In addition to LD and MLD, several studies have also involved learners with Emotional and Behavioural Disorders (EBD), Mild Intellectual Disability (MID), English Learners (ELs) with learning disabilities, and students with special educational needs in general (Hott et al., 2021; Kivirähk, 2024; Lei et al., 2020). The variation in these students' characteristics indicates that Strategic Thinking is relevant not only for students with academic difficulties but also for those with behavioural, language, or cognitive impairments. These findings demonstrate that the development of strategic thinking skills in mathematics is multidimensional, as it is influenced by cognitive, affective, social, and communicative aspects.

On the other hand, the limited research on specific groups with special needs, such as autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and sensory impairments, indicates a research gap in the analysed literature. In fact, the cognitive and behavioural characteristics of each group may require a different Strategic Thinking approach. Therefore, future research needs to broaden the scope of the research subjects so that the development of inclusive mathematics learning can better reflect the diversity of learners' needs.

Mathematical problem-solving is a key skill in mathematics education as it involves the ability to understand problems, select strategies, engage in reasoning, and evaluate the solutions obtained. Within the context of Strategic Thinking, the problem-solving process emphasises not only the final outcome but also how students consciously and reflectively employ thinking strategies whilst solving mathematical problems (Unaenah et al., 2022).

Based on the analysis, the most frequently studied mathematical domains include multiplicative reasoning, word problems, arithmetic, algebra, and geometry (Deaño, 2015; Lei et al., 2020; Xin et al., 2020). The dominance of research on multiplicative reasoning and word problems indicates that the ability to understand quantitative relationships and interpret contextual information is a key focus in the development of Strategic Thinking in SEN students. Mathematical word problems require students to understand the context of the problem, connect available information, determine a solution strategy, and evaluate answers logically. Therefore, Strategic Thinking skills develop through mathematical activities that require interpretation, analysis, and decision-making.

Beyond the mathematical domain, research has also highlighted mathematical reasoning and problem-solving as key indicators of Strategic Thinking ability. Mathematical reasoning helps students build connections between mathematical concepts, whilst problem-solving relates to students' ability to employ flexible strategies when facing non-routine problems (Gamaliel et al., 2024). These findings suggest that Strategic Thinking in mathematics learning is not only related to the mastery of mathematical procedures but also to students' ability to understand the meaning of concepts and select appropriate strategies.

From a metacognitive perspective, self-monitoring and self-regulation are the most dominant

components in various studies (Mulcahy et al., 2024; Al Shabibi & Alkharusi, 2018; Calleros, 2019). Self-monitoring helps students identify errors and evaluate the effectiveness of the strategies used during the problem-solving process, whilst self-regulation enables students to control their thinking and learning processes more independently. Several studies also highlight the importance of self-talk, goal setting, and reflection in supporting Strategic Thinking. The presence of these components indicates that the success of SEN students in mathematics learning is influenced not only by cognitive abilities but also by their awareness in managing their own thinking processes.

Overall, the research findings show that Strategic Thinking develops through the integration of mathematical reasoning, problem solving, and metacognitive regulation. Therefore, mathematics learning for SEN students needs to be designed not only to improve learning outcomes but also to help students understand how to think and use strategies effectively during the process of solving mathematical problems.

The results of the analysis indicate that the most frequently studied areas of mathematics are multiplicative reasoning, word problems, arithmetic, algebra and geometry (Deaño, 2015; Lei et al., 2020; Xin et al., 2020). The dominance of studies on multiplicative reasoning and word problems indicates that research on Strategic Thinking is largely focused on students' ability to understand quantitative relationships, interpret contextual information, and select appropriate problem-solving strategies. Word-problem-solving activities require students to integrate reading skills, understand problem situations, represent information, and determine mathematical procedures accurately. Thus, Strategic Thinking develops through a thinking process involving the interpretation, analysis, and evaluation of solution steps.

The review findings indicate that the majority of studies were conducted at the primary and elementary education levels (Orosco & Abdulrahim, 2018; Xin et al., 2020; Hott et al., 2021). These findings suggest that the development of Strategic Thinking is considered crucial from the early stages of education, as problem-solving skills and mathematical reasoning form the primary foundation of mathematics learning. At the primary education level, students are introduced to the process of understanding problems, determining strategies, and evaluating answers; consequently, Strategic Thinking interventions are considered more effective when implemented at an early stage.

The focus of research at the primary education level is also linked to the characteristics of SEN students, who often face difficulties in mastering basic numeracy and mathematical representation. Consequently, various interventions such as scaffolding, schema-based instruction, and metacognitive strategy instruction are widely applied to help students build conceptual understanding gradually. Furthermore, the application of Strategic Thinking at an early age is considered capable of helping students form habits of reflective thinking and independent learning strategies that can be utilised at subsequent educational levels.

Nevertheless, research at the secondary, middle school, and postsecondary education levels remains relatively limited. Yet, at higher levels of education, students face more complex and abstract mathematical problems, such as advanced algebra, mathematical modelling, and problem-solving based on real-world contexts. The scarcity of research at these levels highlights the need to develop longitudinal studies examining the sustainability of Strategic Thinking skills among SEN students from primary through to further education.

Furthermore, limited research has examined strategic thinking in the context of the transition from education to the workforce or everyday life. In fact, strategic thinking skills in mathematics play a crucial role in decision-making, practical problem-solving, and the development of 21st-century skills. Therefore, future research needs to broaden the scope of Strategic Thinking studies at secondary and post-secondary levels to ensure the development of inclusive mathematics learning becomes more comprehensive.

The results of the analysis indicate that the most dominant learning approaches in supporting Strategic Thinking are Self-Regulated Strategy

Development (SRSD), scaffolding, discourse-based instruction, tutoring, and technology-based instruction (Mulcahy et al., 2024; Lei et al., 2020; Orosco & Abdulrahim, 2018). The dominance of SRSD indicates that the development of Strategic Thinking in SEN students is closely linked to self-regulation skills in planning, monitoring, and evaluating the process of solving mathematical problems. The SRSD approach provides a systematic framework for thinking, thereby helping students understand the stages of problem-solving more clearly and in an organised manner.

Scaffolding strategies are also widely used to provide gradual support to students during the mathematics learning process. In the context of SEN students, scaffolding helps students understand abstract concepts through visual aids, step-by-step instructions, and guidance tailored to individual needs. As students' understanding improves, this support is gradually reduced so that students are able to solve problems more independently. This approach demonstrates that Strategic Thinking develops through an adaptive and supportive learning process.

Moreover, discourse-based instruction positions mathematical communication as a vital component in the development of strategic thinking skills. Through discussion, argumentation, and social interaction, students are encouraged to explain the rationale behind specific strategies, compare various solutions, and reflect on their thought processes. This approach helps students build mathematical reasoning whilst enhancing their metacognitive abilities in understanding problem-solving processes.

The use of technology-based instruction also represents a significant development in inclusive mathematics education (Calleros, 2019; Shin & Park, 2024; Utami et al., 2023). Technology is used to enhance the visualisation of mathematical concepts, provide immediate feedback, and increase student engagement in learning (Ridwan et al., 2025). For students with SEN, the integration of technology can help reduce cognitive barriers and improve the accessibility of mathematics learning. However, the effectiveness of technology use remains dependent on instructional design and the teacher's ability to integrate technology with appropriate learning strategies.

Overall, research findings indicate that Strategic Thinking in mathematics can develop optimally when learning is designed explicitly, in a structured manner, and with a focus on developing students' metacognitive skills. Thus, teachers need to combine various instructional strategies, such as SRSD, scaffolding, mathematical discourse, and technology, so that SEN students receive appropriate support in developing adaptive and reflective mathematical problem-solving skills.

5. Conclusion

Strategic thinking plays a vital role in supporting mathematical problem-solving skills among students with special educational needs. Strategic thinking skills develop through the interaction between metacognitive regulation, instructional support, mathematical reasoning, and students' affective factors. Components such as self-monitoring, self-regulation, self-talk, goal setting, and reflection are vital in helping students understand problems, organise information, determine solution strategies, and evaluate the answers obtained. Further, various instructional approaches such as Self-Regulated Strategy Development (SRSD), scaffolding, schema-based instruction, and discourse-based instruction have proven effective in helping students develop mathematical problem-solving skills in a more systematic and independent manner. The use of technology-based instruction and visual supports also makes a positive contribution to enhancing conceptual understanding, visualisation, and student engagement during mathematics learning.

Most studies still focus on students with learning disabilities at the primary and elementary education levels. This situation indicates that research on Strategic Thinking among students with special educational needs at the secondary, postsecondary, and workforce education levels remains relatively limited. Furthermore, the mathematical domains most frequently studied are still related to word problems and multiplicative reasoning; therefore, research development is required in other mathematical domains.

Mathematics learning for students with special educational needs should not only be oriented towards mastering mathematical procedures but should also emphasise the development of students' strategic thinking and self-regulation skills. Teachers need to implement explicit, structured, and adaptive learning by providing scaffolding, visual support, and opportunities for reflection so that students can independently control their thinking processes. Furthermore, the integration of metacognitive strategies into mathematics learning can help students enhance their self-confidence, motivation to learn, and engagement during the process of solving mathematical problems.

Based on the results of this study, several recommendations can be made. Firstly, teachers and special education practitioners need to receive training on cognitive and metacognitive strategies in mathematics learning so that they can optimally support the development of students' strategic thinking. Secondly, future research should examine Strategic Thinking at higher levels of education and across a wider range of special educational needs categories. Thirdly, future research is advised to develop and test the effectiveness of technology-based and metacognitive learning models in enhancing the Mathematical Problem Solving skills of students with special educational needs. Furthermore, longitudinal research is required to observe the continuous development of students' Strategic Thinking in mathematics learning.

References

Al Shabibi, A. A., & Alkharusi, H. (2018). Mathematical Problem-Solving and Metacognitive Skills of 5th Grade Students as a Function of Gender and Level of Academic Achievement. *Cypriot Journal of Educational Sciences*, *13*(2), 385–395. https://doi.org/10.18844/cjes.v13i2.3306

Antar, D., & Elsayed, H. (2025). Enhancing university students' Arabic language skills through social media: A case study of TikTok. Theory and Practice in Language Studies, 15(8), 2683–2692.http://dx.doi.org/10.17507/tpls.1508.266

Barnett, J. H., & Cleary, S. (2019). Visual supports to teach algebraic equations to a middle school student with autism spectrum disorder. *Preventing School Failure: Alternative Education for Children and Youth*, *63*(4), 345–351. https://doi.org/10.1080/1045988X.2019.1608897

Baten, E., & Desoete, A. (2019). Metacognition and motivation in school-aged children with and without mathematical learning disabilities in Flanders. *ZDM*, *51*(4), 679–689. https://doi.org/10.1007/s11858-018-01024-6

Bouck, E. C. (2015). *Assistive technology*. Sage Publications.

Calleros, C. B. G. (2019). A serious game for solving mathematical problems for children with ADHD. *Campus Virtuales*, *8*(2), 121–140. https://doi.org/10.29375/25392115.3896

da Silva Soares Jr, R., Barreto, C., & Sato, J. R. (2023). Perspectives in eye-tracking technology for applications in education. *South African Journal of Childhood Education*, *13*(1), 1204. https://doi.org/10.4102/sajce.v13i1.1204

Darragh, L. (2019). Blurred lines: producing the mathematics student through discourses of special educational needs in the context of reform mathematics in Chile. *Educational Studies in Mathematics*, *101*(3), 425–439. https://doi.org/10.1007/s10649-018-9875-7

Deaño, M. (2015). Program of arithmetic improvement by means of cognitive enhancement: An intervention in children with special educational needs. *Research in Developmental Disabilities*, *38*, 352–361. https://doi.org/10.1016/j.ridd.2014.12.032

DeJarnette, A. F., & Hord, C. (2022). Mathematics questioning practices of pre-service special education teachers providing algebra tutoring for students with learning disabilities. *Teacher Education and Special Education*, *45*(4), 309–330. https://doi.org/10.1177/08884064211073573

Ebenbeck, N., & Gebhardt, M. (2024). Differential performance of computerized adaptive testing in students with and without disabilities–A simulation study. *Journal of Special Education Technology*, *39*(4), 481–490.

https://doi.org/10.1177/01626434241232117

Gamaliel, A., Rarasati, I. P., & Anindia, D. (2024). Pengembangan Media Lembar Kerja Siswa (LKS) Untuk Pembelajaran Matematika Kelas IV SD. *JURNAL RISET PENDIDIKAN DAN PENGAJARAN*, *3*(2), 147–160. https://doi.org/10.55047/jrpp.v3i2.747

Haigler, K. (2021). The Role of Occupational Research in Complex Assessments: Aligning Educational Practices with Workplace Requirements. *Journal of Writing Analytics*, *5*, 259–291. https://doi.org/10.37514/JWA-J.2021.5.1.08

Hott, B. L., Peltier, C., Heiniger, S., Palacios, M., Le, M. T., & Chen, M. (2021). Using Schema-Based Instruction to Improve the Mathematical Problem Solving Skills of a Rural Student with EBD. *Learning Disabilities: A Contemporary Journal*, *19*(2), 127–142. https://eric.ed.gov/?id=EJ1314840

Kivirähk, T. (2024). Cognitive factors and educational placement affecting mathematical attainment in middle school students with mild intellectual disability. *International Journal of Developmental Disabilities*, *70*(3), 493–506. https://doi.org/10.1080/20473869.2022.2106534

Lee, K. H. (2020). Risks of aiming to kill two birds with one stone: the affect of mathematically gifted and talented students in the dual realities of special schooling. *Mathematical Thinking and Learning*, 1–20. https://doi.org/10.1080/10986065.2020.1784696

Lei, Q., Xin, Y. P., Morita-Mullaney, T., & Tzur, R. (2020). Instructional Scaffolds in Mathematics Instruction for English Learners With Learning Disabilities: An Exploratory Case Study. *Learning Disabilities: A Contemporary Journal*, *18*(1), 123–144. https://eric.ed.gov/?id=EJ1264271

Lievore, R., Caviola, S., & Mammarella, I. C. (2024). How trait and state mathematics anxiety could affect performance: Evidence from children with and without Specific Learning Disorders. *Learning and Individual Differences*, *112*, 102459. https://doi.org/10.1016/j.lindif.2024.102459

Montague, M., & Bos, C. S. (1990). Cognitive and metacognitive characteristics of eighth grade students' mathematical problem solving. *Learning and Individual Differences*, *2*(3), 371–388. https://doi.org/10.1016/1041-6080(90)90012-6

Montague, M., Krawec, J., Enders, C., & Dietz, S. (2014). The effects of cognitive strategy instruction on math problem solving of middle-school students of varying ability. *Journal of Educational Psychology*, *106*(2), 469. https://doi.org/10.1037/a0035176

Mulcahy, C. A., Gagnon, J. C., Atkinson, V. S., & Miller, J. A. (2024). Self-regulated strategy development for algebra problem solving. *Teaching Exceptional Children*, *57*(2), 104–114. https://doi.org/10.1177/00400599231167816

Ogut, A., Turanlioglu, B., Metiner, D. C., Levi, A., Yilmaz, C., Çetin, O., & Uluagac, S. (2024). Dissecting Privacy Perspectives of Websites Around the World: "Aceptar Todo, Alle Akzeptieren, Accept All..." *33rd USENIX Security Symposium (USENIX Security 24)*, 2849–2863. https://www.usenix.org/conference/usenixsecurity24/presentation/ogut

Orosco, M. J., & Abdulrahim, N. A. (2018). Examining comprehension strategy instruction with English learners' problem solving: Study findings and educator preparation implications. *Teacher Education and Special Education*, *41*(3), 215–228. https://doi.org/10.1177/0888406418770787

Popham, W. J. (1995). *Classroom assessment*. Allyn and Bacon Boston.

Ridwan, M., Inabah, L., & Hayati, D. N. (2025). The Effect of PBL Learning Model Visual Mapping Method Based on Analysis on Learning Outcomes of Labor Material in Class XI at SMA Negeri 1 Pasuruan. *International Journal of Pedagogical, Humanities and Social Studies*, *1*(2), 69–75. https://doi.org/10.66324/ijphss.v1i2.57

Rosenzweig, C., Krawec, J., & Montague, M. (2011). Metacognitive strategy use of eighth-grade students with and without learning disabilities during mathematical problem solving: A think-aloud analysis. *Journal of Learning Disabilities*, *44*(6), 508–520. https://doi.org/10.1177/0022219410378445

Shin, M., & Park, J. (2024). Technology-assisted instruction with teacher prompts on fraction multiplication word problems: A single-case design with visual analysis and Bayesian multilevel modeling. *Assistive Technology*, 1–11. https://doi.org/10.1080/10400435.2024.2415366

Tzohar-Rozen, M., & Mark-Zigdon, N. (2020). *A Dynamic Meta-Cognitive Self-Regulation Model in Mathematical*

Problem Solving for Students with Special Needs. Nova Science Publishers, Inc.

Unaenah, E., Wulandari, C., Nurzahro, Y., & Aulya, Z. (2022). Factor Analysis of Learning Difficulties in Mathematics for Grade 5 Fraction Calculation Material. *TRANSPUBLIKA INTERNATIONAL RESEARCH IN EXACT SCIENCES*, *1*(3), 16–24. https://doi.org/10.55047/tires.v1i3.757

Utami, A. S., Rarasati, I. P., & Putriani, I. (2023). Application of the Teams Games Tournament (TGT) Model in Grade V Mathematics Learning. *REVIEW OF MULTIDISCIPLINARY EDUCATION, CULTURE AND PEDAGOGY*, *2*(1), 47–53. https://doi.org/10.55047/romeo.v2i1.598

Xin, Y. P., Chiu, M. M., Tzur, R., Ma, X., Park, J. Y., & Yang, X. (2020). Linking teacher–learner discourse with mathematical reasoning of students with learning disabilities: An exploratory study. *Learning Disability Quarterly*, *43*(1), 43–56. https://doi.org/10.1177/0731948719858707

Zakirova, V. G. (2019). Methodology of teaching graphic methods for solving problems with parameters as a means to achieve high mathematics learning outcomes at school. *Eurasia Journal of Mathematics Science and Technology Education*, *15*(9). https://doi.org/10.29333/ejmste/108451