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Developing Functional Numeracy Literacy among Students with Intellectual and Developmental Disabilities: A Systematic Review and Narrative Synthesis of Arithmetic Interventions

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ABSTRACT

Numeracy literacy constitutes a fundamental component of functional literacy and is essential for independent functioning, adaptive behavior, and participation in everyday life. However, children and adolescents with intellectual and developmental disabilities often experience substantial difficulties in acquiring foundational arithmetic skills due to challenges in numerical reasoning, working memory, abstraction, and problem solving. The present study aimed to systematically synthesize empirical and review evidence on instructional approaches designed to support the development of functional numeracy literacy through arithmetic interventions among these learners. The review was conducted in accordance with the PRISMA 2020 framework. Relevant literature was identified through systematic searches of Scopus, Web of Science, ERIC, and Google Scholar using predefined search terms and eligibility criteria. Following screening and full-text assessment, 36 studies were included in the qualitative synthesis. Of the 36 included studies, 22 were empirical intervention studies, 6 were systematic reviews or evidence-based practice reviews, 2 were meta-analyses, 1 was a correlational study, and 5 employed other research designs, including content analyses, intervention syntheses, and classroom-based investigations. Narrative synthesis was conducted following the framework proposed by Popay et al. (2006), involving study coding, thematic grouping, and cross-study comparison. Six recurring instructional themes emerged across the reviewed literature: explicit instruction, the Concrete-Representational-Abstract (CRA) approach, schema-based instruction, structured practice interventions, technology-supported instruction, and cooperative or inclusive instructional strategies. Across studies, effective interventions consistently incorporated structured guidance, visual representations, scaffolded learning opportunities, repeated practice, and active learner engagement. Beyond improving arithmetic performance, these approaches appeared to support learners' ability to interpret, understand, and apply numerical information in meaningful contexts. Overall, the findings suggest that effective mathematics instruction contributes not only to mathematical achievement but also to the development of functional numeracy literacy among students with intellectual and developmental disabilities. Further research employing more rigorous designs, larger samples, and longer follow-up periods is needed to strengthen the evidence base and examine long-term functional outcomes.

Key words: Numeracy Literacy, Functional Literacy, Intellectual Disability, Developmental Disabilities, Arithmetic Interventions, Special Education

INTRODUCTION

Mathematical competence constitutes a fundamental component of academic achievement, adaptive functioning, and independent participation in everyday life. Basic arithmetic skills such as counting, addition, subtraction, multiplication, and problem solving are essential for managing practical daily activities, including financial transactions, time management, and decision making. However, students with intellectual disability frequently experience substantial difficulties in acquiring mathematical competencies due to limitations in intellectual functioning, working memory, abstract reasoning, and information processing (Schalock et al., 2021). These challenges often affect the development of number sense, procedural fluency, and mathematical problem-solving abilities, resulting in persistent difficulties in mathematics achievement across educational settings. In response to these challenges, a growing body of research has examined instructional approaches designed to improve mathematical

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learning outcomes among students with intellectual disability and related disability populations. Evidence-based instructional strategies such as explicit instruction, schema-based instruction, the Concrete-Representational-Abstract (CRA) instructional model, and structured practice interventions have demonstrated promising results in supporting the development of foundational arithmetic competencies (Alhwaiti, 2022; Burns et al., 2015; Jung et al., 2022; Long et al., 2021). Earlier meta-analytic and review studies have also emphasized the effectiveness of structured mathematics instruction for students with learning difficulties and special educational needs (Gersten et al., 2009; Kroesbergen& Van Luit, 2003). At the same time, recent advances in educational technology have created new opportunities for interactive, visually supported, and individualized mathematics instruction through the use of virtual manipulatives, video modeling, and digital learning environments.Contemporary literacy scholarship increasingly recognizes numeracy as a core dimension of functional literacy. Functional literacy extends beyond reading and writing and includes the ability to interpret, understand, and apply symbolic information in everyday contexts. From this perspective, arithmetic can be understood as a form of symbolic language through which individuals interpret quantities, relationships, and real-world information (UNESCO, 2006). For students with intellectual disability, difficulties in understanding numerical symbols may therefore be conceptualized not only as mathematical challenges but also as barriers to functional literacy, social participation, and autonomy.

Despite the increasing number of studies examining mathematics interventions for students with intellectual disability, the available evidence remains dispersed across diverse research designs, disability populations, instructional models, and educational contexts. Furthermore, intervention research specifically targeting intellectual disability remains comparatively limited, resulting in the inclusion of broader disability-related populations in many instructional investigations. Consequently, there is a need for a systematic synthesis of the existing literature in order to identify the instructional approaches that appear most effective for supporting arithmetic learning among students with intellectual disability and related disability populations. The purpose of the present study was therefore to systematically review empirical and review evidence examining mathematics intervention programs designed to teach basic arithmetic and related mathematical skills to children and adolescents with intellectual disability and related disability populations. The review aimed to identify the principal instructional approaches reported in the literature, examine their reported educational outcomes, and synthesize current evidence regarding effective practices in mathematics instruction within disability-focused educational settings.

THEORETICAL BACKGROUND

Mathematical learning involves the interaction of cognitive, instructional, and environmental factors. For students with intellectual disability, mathematical learning may be influenced by limitations in intellectual functioning, working memory capacity, and adaptive behavior skills (Schalock et al., 2021). These limitations can affect the development of number sense, numerical reasoning, and the ability to perform arithmetic operations. Working memory plays a particularly important role in mathematical problem solving because it enables learners to store and manipulate numerical information during calculation processes (Nelwan et al., 2021). When working-memory capacity is limited, students may experience difficulty maintaining intermediate steps during arithmetic procedures or organizing information within multistep mathematical problems. Research has also highlighted the role of numerical representation and number sense in mathematical development, with impairments in these processes contributing to difficulties in arithmetic learning (Decarli et al., 2022).Several theoretical perspectives contribute to understanding how mathematics instruction can be effectively designed for students with intellectual disability. Behaviorist learning theory emphasizes observable learning behaviors and the role of reinforcement, prompting, and repeated practice in supporting skill acquisition. Instructional strategies derived from behaviorist principles often involve structured teaching sequences, guided practice, and systematic reinforcement procedures designed to strengthen correct responses (Cihon et al., 2020). Cognitivist learning theory, in contrast, focuses on internal mental processes such as information processing, memory organization, and problem-solving strategies. From a cognitivist perspective, effective mathematics instruction should support students in constructing meaningful mental representations of mathematical concepts and organizing knowledge structures that facilitate retrieval and application.

Constructivist learning theory emphasizes the active role of learners in constructing knowledge through interaction with their environment and through engagement with meaningful learning experiences. Constructivist approaches encourage inquiry, collaboration, and exploration of mathematical relationships (Almulla, 2023). Social constructivist perspectives further emphasize the importance of guided participation and instructional scaffolding within the learner's zone of proximal development. Recent research has also emphasized the importance of inclusive and cooperative learning environments in supporting mathematical learning among students with intellectual disability and related disability populations. Cooperative learning strategies encourage peer interaction and collaborative problem solving, which may support conceptual understanding and social participation (Bornaa et al., 2023). At the same time, advances in educational technology have introduced new instructional possibilities, including digital learning environments, virtual manipulatives, and adaptive learning systems that provide individualized feedback and interactive representations of mathematical concepts (Gupta et al., 2022). Together, these theoretical perspectives suggest that effective mathematics interventions for students with intellectual disability should combine structured instruction, scaffolded learning, visual supports, and opportunities for active engagement.

Numeracy literacy has increasingly been conceptualized as a social practice rather than merely a set of computational

skills. Street's (1984, 2003) ideological model of literacy argues that literacy practices are embedded within social and cultural contexts and cannot be reduced to technical competencies alone. Applied to numeracy, this perspective suggests that mathematical understanding emerges through participation in socially meaningful activities involving numbers, measurement, money, time, and problem solving. Similarly, Vygotsky's sociocultural theory emphasizes the importance of scaffolding, guided participation, and social interaction in cognitive development. Mathematical symbols can be viewed as cultural tools that mediate thinking and communication. For students with intellectual disability, instructional supports such as visual representations, manipulatives, peer-assisted learning, and teacher scaffolding may facilitate access to these symbolic systems and strengthen functional numeracy literacy. Consequently, effective numeracy instruction should be understood not only as the teaching of arithmetic procedures but also as the development of learners' capacity to interpret, communicate, and apply numerical information in everyday life.

METHOD

Study Design

The present study employed a systematic literature review design in order to synthesize research examining mathematics intervention approaches aimed at improving basic arithmetic skills among children and adolescents with intellectual disability and related disability populations. The review focused on studies addressing foundational mathematical competencies, including number sense, addition, subtraction, multiplication, division, fractions, and mathematical problem solving. Because the available literature in this area includes both primary empirical intervention studies and intervention-focused evidence syntheses, the review adopted a broader evidence-mapping approach in order to capture the range of instructional practices reported in the field. The review process was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (Page et al., 2021a; Page et al., 2021b).

Search Strategy

A comprehensive literature search was conducted in March 2026 across four major academic databases: Scopus, Web of Science, ERIC, and Google Scholar. These databases were selected because they provide extensive coverage of research in education, psychology, special education, and developmental disabilities. The search targeted studies published between January 2000 and February 2026 in order to capture contemporary developments in mathematics instruction as well as recent advances in educational technology and intervention design. The search strategy combined terms related to the target populations, the academic domain, and the instructional focus. Population-related terms included intellectual disability, developmental disability, students with intellectual and developmental disabilities, significant cognitive disabilities, and special educational needs associated with intellectual functioning. Additional searches involving learning disabilities and learning difficulties were conducted only when the intervention findings were considered potentially relevant to numeracy literacy development among students with significant support needs.These were combined with mathematics-related terms such as mathematics intervention, mathematics instruction, arithmetic instruction, numeracy, numeracy literacy, addition, subtraction, multiplication, division, fractions, and mathematical problem solving. Boolean operators such as AND and OR were used to refine the searches and improve retrieval precision. In addition to the electronic database search, the reference lists of relevant studies and review articles were manually examined in order to identify additional relevant publications.

Eligibility Criteria

Studies were considered eligible for inclusion if they examined mathematics instruction or mathematics intervention approaches relevant to the development of foundational arithmetic skills among children or adolescents with intellectual disability or developmental disabilities.The primary target population of the review consisted of students with intellectual disability (ID) and developmental disabilities (DD). Studies involving students with learning disabilities (LD) or learning difficulties were included only when the instructional approaches addressed numeracy literacy skills that could reasonably be transferred to learners with significant cognitive support needs. Such studies were identified separately during data extraction and considered with caution during narrative synthesis in order to avoid conflating distinct disability categories.Eligible sources included both primary empirical intervention studies and intervention-focused secondary syntheses, such as systematic reviews and meta-analyses, provided that they addressed mathematics instruction and reported findings relevant to instructional effectiveness.Studies were included when they focused on foundational mathematical skills such as number sense, arithmetic operations, fractions, or mathematical problem solving. Particular attention was given to studies examining the development of functional numeracy literacy, defined as the ability to interpret, understand, and apply numerical information in everyday contexts.Only peer-reviewed journal articles published in English were considered. The review excluded editorials, conceptual papers, conference abstracts, dissertations, and publications unrelated to mathematics intervention or unrelated to disability-focused educational contexts.

Study Selection Process

The study selection process followed the stages recommended by the PRISMA 2020 framework. The initial database search identified 212 records across the four databases. After removal of duplicate records, 165 articles remained for title and abstract screening. During this stage, 79 records were excluded because they did not focus on mathematics

interventions, did not involve relevant disability-related populations, or did not align with the instructional scope of the review. The remaining 86 articles were assessed in full text for eligibility.During the full-text review stage, 50 studies were excluded because they did not address mathematics instruction in a sufficiently relevant way, did not focus on foundational arithmetic or related mathematical skills, or did not provide findings applicable to the aims of the review. Following this process, 36 studies met the eligibility criteria and were included in the final qualitative synthesis. These studies comprised a combination of primary empirical intervention research and intervention-focused evidence syntheses. The complete selection process is illustrated in Figure 1.

Data Extraction

Data from the included studies were systematically extracted in order to ensure consistency across the synthesis process. In addition to bibliographic and methodological characteristics, data extraction included information regarding participant disability category (ID, DD, LD, or mixed populations), instructional mechanisms, use of visual supports, numeracy literacy outcomes, and reported functional learning outcomes. The extracted information included the authors and year of publication, country of study, participant characteristics or target population, type of mathematics intervention or instructional approach, target mathematical domain, research design or review type, and principal findings. The extracted data were organized and summarized in Table 1.

Quality Appraisal

The methodological quality of the included studies was evaluated using the Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018). The MMAT was selected because the review included a heterogeneous body of evidence comprising experimental studies, single-case intervention designs, correlational studies, systematic reviews, and evidence-based practice syntheses. Each study was assessed according to the criteria relevant to its methodological design. The appraisal focused on the clarity of research questions, adequacy of sampling procedures, appropriateness of data collection methods, quality of outcome measures, and coherence between study design and conclusions. Based on MMAT criteria, studies were categorized as high, moderate, or low methodological quality. The quality appraisal

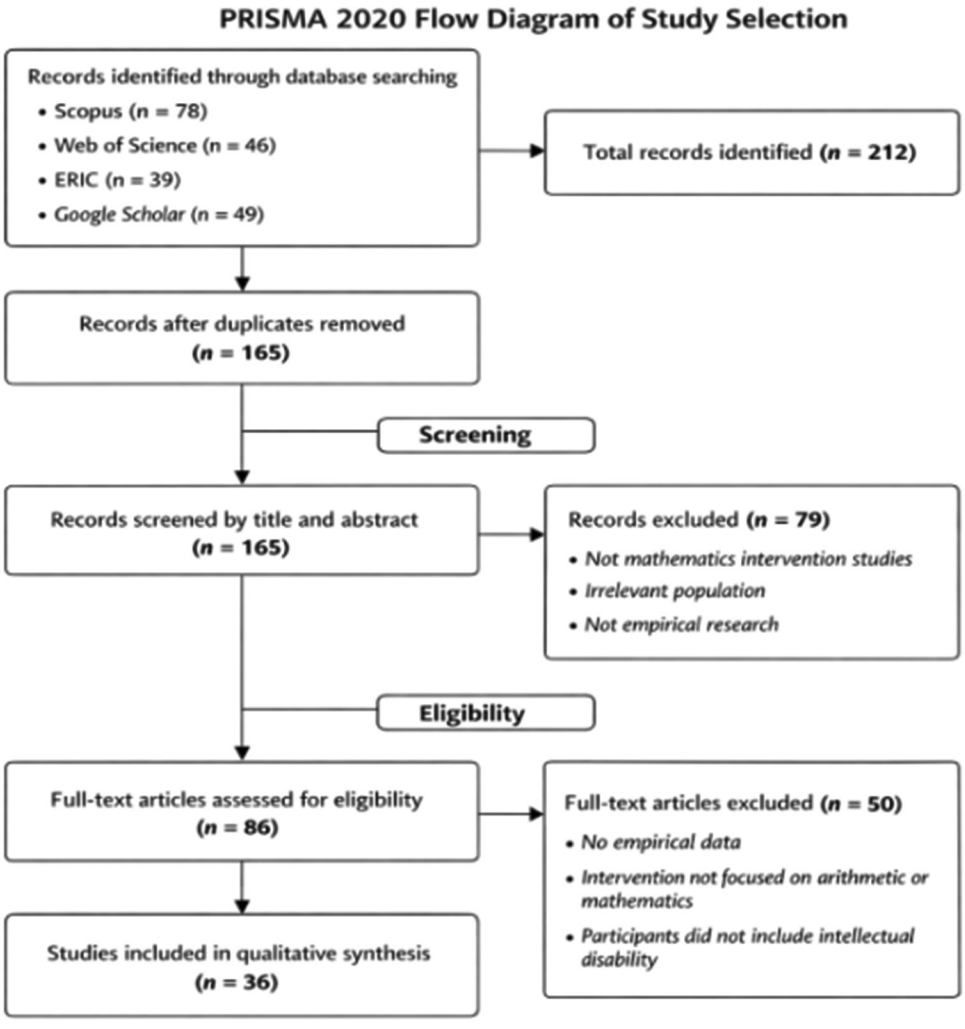

Figure 1. Prisma Diagram

Table 1. Representative studies included in the narrative synthesis and their contributions to functional numeracy literacy

Study	Participants	Instructional Approach	Mathematical Focus	Study Type	Main Findings	Contribution to Functional Numeracy Literacy
Browder et al. (2008)	Significant cognitive disabilities	Systematic mathematics instruction	Numeracy and arithmetic	Meta-analysis	Positive effects across studies	Supported acquisition and application of foundational numeracy skills
Butler et al. (2003)	Mild disabilities	Problem-solving instruction	Word problems	Experimental	Improved problem-solving performance	Enhanced interpretation of quantitative information
Xin & Jitendra (1999)	Learning disabilities	Schema-based instruction	Word problems	Experimental	Improved strategy use	Facilitated understanding and organization of numerical information
Browder et al. (2012)	Moderate intellectual disability	Grade-aligned mathematics instruction	Arithmetic concepts	Experimental	Improved mathematics performance	Strengthened access to functional numeracy skills
Fuchs et al. (2014)	Learning disabilities	Explicit instruction	Mathematics achievement	Experimental	Improved achievement	Supported interpretation and application of numerical symbols
Park et al. (2016)	Students with disabilities	CRA approach	Fractions	Experimental	Improved conceptual understanding	Linked concrete experiences with symbolic representations
Kleinert et al. (2017)	Students with disabilities	Taped problems intervention	Math facts	Experimental	Increased fluency	Improved automatic processing of numerical information
Root et al. (2017)	Moderate intellectual disability	Technology-supported instruction	Problem solving	Experimental	Improved engagement and performance	Enhanced access to mathematical representations
Bouck et al. (2019)	Learning disabilities	CRA approach	Arithmetic concepts	Evidence synthesis	Positive outcomes	Supported movement from concrete to symbolic understanding
Spooner et al. (2019)	Moderate and severe DD	Systematic instruction	Mathematics skills	Evidence-based review	Positive effects	Supported development of functional numeracy competencies
Bouck et al. (2020)	Students with disabilities	Virtual manipulatives	Fractions	Experimental	Improved conceptual understanding	Facilitated visual interpretation of mathematical relationships
Park et al. (2020)	Intellectual disability	Maintenance interventions	Arithmetic skills	Systematic review	Importance of repeated practice	Strengthened retention and use of numerical knowledge
Long et al. (2021)	Intellectual disability	Explicit instruction	Mathematics learning	Intervention synthesis	Consistent learning gains	Supported understanding and use of mathematical symbols
Schnepel&Aunio (2021)	Intellectual disability	Mathematics interventions	Foundational arithmetic	Systematic review	Positive outcomes	Supported development of everyday numeracy skills
Morris et al. (2022)	Students with disabilities	Video modeling & AR	Mathematics concepts	Intervention study	Improved engagement	Enhanced comprehension through multimodal representations
Jung et al. (2022)	Students with disabilities	Schema-based instruction	Problem solving	Systematic review	Improved performance	Supported interpretation and organization of numerical information
Satsangi& Raines (2022)	Students with disabilities	Virtual manipulatives	Mathematics concepts	Review	Positive effects	Increased accessibility of numerical representations

(*Contd...*)

Table 1. (*Continued*)

Study	Participants	Instructional Approach	Mathematical Focus	Study Type	Main Findings	Contribution to Functional Numeracy Literacy
Yıldırım&Yıkmış (2022)	Learning disabilities	CRA approach	Fractions	Experimental	Improved fraction learning	Supported symbolic understanding of quantitative relationships
Bornaa et al. (2023)	School students	Cooperative learning	Mathematics achievement	Experimental	Improved achievement	Promoted communication and collaborative construction of numerical meaning
Hord (2023)	Mild intellectual disability	Structured instruction	Arithmetic skills	Classroom study	Positive outcomes	Strengthened functional numeracy performance
Gilley et al. (2023)	Intellectual disability	Modified schema-based instruction	Word problems	Experimental	Improved problem solving	Supported interpretation and communication of quantitative relationships
David et al. (2025)	Children with intellectual disabilities	Digital-based mathematics intervention	Numerical and arithmetic skills	Preliminary intervention study	Improvements in mathematics performance	Enhanced access to numerical concepts through structured digital activities
Shin et al. (2023)	Students with disabilities	Technology-supported mathematics instruction	Mathematics learning	Content analysis	Enhanced accessibility	Increased opportunities for engagement with numerical information

Studies involving learning disabilities were included only when the instructional mechanisms were considered transferable to the development of functional numeracy literacy among students with intellectual and developmental disabilities.

findings were used to inform interpretation of the evidence during narrative synthesis rather than as exclusion criteria. Overall, the methodological quality of the included literature was considered moderate. Although most studies reported positive findings regarding mathematics interventions, many of the primary studies relied on small samples or single-case designs, while some of the secondary syntheses combined studies of differing methodological strength. These considerations were taken into account in interpreting the findings of the review.

Data Synthesis

Because the included studies varied considerably in population characteristics, research designs, intervention procedures, and outcome measures, a quantitative meta-analysis was not considered appropriate. Instead, the findings were synthesized using a qualitative narrative synthesis approach. The narrative synthesis followed the framework proposed by Popay et al. (2006). First, descriptive characteristics of the included studies were extracted and coded. Second, studies were grouped according to shared instructional mechanisms and pedagogical features. Third, recurring themes were identified through iterative comparison across studies. Finally, relationships among intervention categories were examined to generate higher-order explanatory themes regarding the development of numeracy literacy among students with intellectual and developmental disabilities. This approach enabled the identification of recurring instructional patterns and the organization of the literature according to major instructional categories, including explicit instruction, the Concrete-Representational-Abstract (CRA) instructional model, schema-based instruction, structured practice interventions, technology-supported mathematics instruction, and cooperative or inclusive instructional strategies. Special attention was given to identifying how instructional approaches supported learners' interpretation, understanding, and application of numerical symbols and mathematical representations as components of functional numeracy literacy. The narrative synthesis also allowed the integration of findings drawn from both empirical intervention studies and broader intervention-focused evidence syntheses. This approach was considered appropriate given the heterogeneity of the included literature and the aim of identifying the main instructional tendencies associated with improved mathematical learning outcomes in disability-focused educational settings.

RESULTS

Students with intellectual disability and related disability populations often require structured and individualized instructional approaches in order to develop mathematical skills. Traditional instructional methods may not sufficiently address the diverse learning needs of these students, particularly when mathematical tasks involve abstract reasoning or multiple problem-solving steps. Consequently, a wide range of mathematics intervention programs have been developed to support learners with disabilities in acquiring arithmetic

skills and improving mathematical performance. Research suggests that effective mathematics interventions typically combine structured instruction, visual representations, scaffolded learning, and repeated practice opportunities (Alhwaiti, 2022; Burns et al., 2015). The studies included in this review comprised both primary empirical intervention research and intervention-focused evidence syntheses. Across the reviewed literature, several instructional approaches consistently emerged as effective in supporting mathematical learning outcomes, including explicit instruction, the Concrete-Representational-Abstract instructional model, schema-based instruction, structured practice interventions, technology-supported mathematics instruction, and cooperative or inclusive instructional practices.

Characteristics of Included Studies

The final sample comprised 36 studies that met the eligibility criteria and were included in the narrative synthesis. The included studies represented a diverse body of evidence, including experimental intervention studies, single-case research designs, correlational investigations, systematic reviews, evidence-based practice reviews, and meta-analyses. Collectively, these studies examined a broad range of instructional approaches designed to improve arithmetic performance, mathematical problem solving, and functional numeracy literacy among students with intellectual and developmental disabilities and related disability populations.As presented in Table 2, the majority of studies focused on students with learning disabilities or learning difficulties, followed by studies involving students with intellectual disabilities, developmental disabilities, and mixed disability populations. Because the primary objective of the review was to identify instructional practices relevant to learners with significant support needs, studies involving learning disabilities were retained only when their findings were considered transferable to numeracy literacy development among students with intellectual and developmental disabilities.

As shown in Table 3, across the reviewed literature, six recurring instructional themes emerged through the narrative synthesis process: explicit instruction, Concrete-Representational-Abstract (CRA) instruction, schema-based instruction, structured practice interventions, technology-supported instruction, and cooperative or inclusive instructional approaches. These themes were identified through iterative coding and comparison of intervention characteristics, instructional mechanisms, and reported learning outcomes.

Table 2. Distribution of studies by participant population

Participant Population	Number of Studies (n)	Percentage (%)
Intellectual Disability (ID)	9	25.0
Developmental Disabilities (DD)	3	8.3
Learning Disabilities (LD)	15	41.7
Mixed Disability Samples	7	19.4
General Disability Populations	2	5.6
Total	36	100.0

The quality appraisal indicated that the methodological quality of the included studies was generally satisfactory. While several investigations employed small samples or single-case intervention designs, most studies demonstrated adequate methodological rigor and provided sufficient detail regarding intervention procedures and outcomes. The quality assessment findings were considered during interpretation of the evidence and are summarized in Table 4.

The included literature suggests that effective numeracy interventions share several common characteristics, including structured instruction, visual and representational supports, scaffolded learning opportunities, repeated practice, and active learner engagement. These recurring features formed the basis for the thematic synthesis presented in the following sections (Table 4).

Although the primary focus of the review was students with intellectual and developmental disabilities, a substantial proportion of the included studies examined students with learning disabilities or broader disability populations. These studies were retained when the instructional mechanisms were considered relevant to the development of functional numeracy literacy and potentially transferable to learners with significant cognitive support needs.

Explicit Instruction

Across the included studies, explicit instruction emerged as the most frequently reported and consistently effective instructional approach for supporting numeracy literacy among students with intellectual and developmental disabilities. Studies employing explicit instruction consistently reported improvements in arithmetic accuracy, procedural fluency, and mathematical problem-solving performance (Long et al., 2021; Hord, 2023; Fuchs et al., 2014).A recurring pattern across the literature was the use of systematic teacher guidance, modeling, guided practice, and corrective feedback. These instructional elements appeared to support learners' interpretation of numerical symbols and mathematical language by reducing cognitive demands and increasing instructional clarity. Beyond improving computational performance, explicit instruction functioned as a scaffold that facilitated students' access to numerical information and strengthened their ability to engage with numeracy as a functional literacy practice.The findings suggest that explicit instruction contributes not only to mathematical achievement but also to the development of numeracy literacy by helping students understand, interpret, and apply symbolic numerical information in meaningful contexts.

Concrete-Representational-Abstract Instruction

The Concrete-Representational-Abstract (CRA) approach emerged as one of the most frequently reported instructional frameworks across the reviewed studies. Evidence consistently suggested that CRA instruction supported students' conceptual understanding of numerical relationships by facilitating movement from concrete experiences toward increasingly abstract symbolic representations (Bouck et al.,

Table 3. Narrative synthesis coding framework and emergent themes

Theme	Number of Studies	Representative Studies	Numeracy Literacy Function
Explicit Instruction	6	Long et al. (2021); Fuchs et al. (2014); Hord (2023)	Supports interpretation and application of numerical symbols and procedures
CRA Instruction	5	Bouck et al. (2019); Park et al. (2016); Yıldırım&Yıkmış (2022)	Connects concrete experiences with abstract mathematical representations
Schema-Based Instruction	5	Xin & Jitendra (1999); Jung et al. (2022); Gilley et al. (2023)	Facilitates organization and decoding of mathematical information
Structured Practice Interventions	4	Kleinert et al. (2017); Park et al. (2020)	Develops fluency and automaticity in numerical processing
Technology-Supported Instruction	8	Root et al. (2017); Morris et al. (2022); Shin et al. (2023)	Enhances access to numerical concepts through multimodal representations
Cooperative and Inclusive Approaches	3	Bornaa et al. (2023); Browder et al. (2012)	Promotes collaborative construction of numerical meaning
Total	31*	—	—

*Several studies contributed to more than one thematic category

Table 4. Methodological quality of included studies (MMAT classification)

Quality Level	Number of Studies	Percentage (%)
High Quality	18	50.0
Moderate Quality	14	38.9
Low Quality	4	11.1
Total	36	100.0

2019; Park et al., 2016;Yıldırım&Yıkmış, 2022).A cross studies, CRA was particularly effective in teaching fractions, arithmetic operations, and mathematical reasoning. A common feature of successful CRA interventions was the use of multiple representations that enabled students to connect physical experiences with mathematical symbols. From a numeracy literacy perspective, these representations appeared to function as semiotic tools that helped learners interpret and construct meaning from numerical information. The reviewed studies therefore suggest that CRA instruction supports numeracy literacy development by strengthening students' ability to navigate between concrete experiences and symbolic mathematical language.

Schema-Based Instruction

Schema-based instruction emerged across several studies as an effective approach for improving mathematical problem solving among students with disabilities (Jung et al., 2022; Gilley et al., 2023). Rather than focusing solely on computational procedures, these interventions emphasized the recognition of underlying problem structures and the interpretation of mathematical information. A consistent finding across studies was that schema-based approaches helped learners organize numerical information, identify relationships among quantities, and select appropriate solution strategies. Visual diagrams and graphic organizers frequently served as mediational tools that supported comprehension of mathematical "texts" and facilitated the translation of symbolic information into meaningful representations. These findings indicate that schema-based instruction may support numeracy literacy by helping students decode, organize, and communicate numerical meaning.

Structured Practice Interventions

Structured practice interventions were consistently associated with improvements in arithmetic fluency and retrieval of mathematical facts. Across the reviewed studies, repeated opportunities for practice combined with immediate feedback appeared to strengthen students' automaticity and confidence when engaging with numerical tasks (Kleinert et al., 2017). The findings suggest that repeated exposure to numerical symbols and operations contributed to increased fluency, allowing learners to allocate greater cognitive resources to interpretation and problem solving. Consequently, structured practice interventions appear to support foundational components of numeracy literacy by improving learners' efficiency in processing numerical information. Systematic instruction, prompting procedures, task analysis, and repeated practice have been identified as evidence-based approaches for teaching mathematics to students with significant cognitive disabilities (Hudson et al., 2018).

Technology-Supported Instruction

Technology-supported interventions represented an emerging but promising category within the reviewed literature. Across studies, digital learning environments, virtual manipulatives, video modeling, and augmented reality applications were associated with improvements in engagement, conceptual understanding, and participation in mathematical activities (Morris et al., 2022; Satsangi& Raines, 2022). A common feature of these interventions was the provision of interactive visual representations that supported students' interpretation of numerical concepts. Digital tools frequently enabled learners to manipulate mathematical representations, receive immediate feedback, and engage with numerical information through multiple modalities. These

characteristics appeared particularly beneficial for students with intellectual and developmental disabilities, as they reduced cognitive demands while increasing opportunities for active participation and individualized learning. Across the reviewed studies, technology-supported approaches were most effective when integrated with explicit instructional guidance rather than functioning as stand-alone instructional tools. The evidence suggests that technology served primarily as a mediational support that enhanced access to mathematical concepts through visualization, interaction, and immediate feedback. From a numeracy literacy perspective, technology-supported interventions appeared to facilitate access to mathematical meaning by making abstract concepts more visible, interactive, and comprehensible. Consequently, digital instructional tools may support learners' ability to interpret, understand, and apply numerical information in educational and everyday contexts. Recent evidence further indicates that digital mathematics interventions can improve numerical and arithmetic performance among children with intellectual disabilities by providing structured, interactive, and individualized learning opportunities (David et al., 2025).

Cooperative and Inclusive Instructional Strategies

Cooperative and inclusive instructional approaches appeared less frequently than explicit instruction or CRA interventions but nevertheless demonstrated positive educational outcomes. Across the reviewed studies, collaborative learning opportunities supported both mathematical performance and student engagement (Bornaa et al., 2023). Peer interaction, collaborative problem solving, and guided discussion appeared to facilitate learners' understanding of numerical concepts and mathematical language. These findings align with sociocultural perspectives that conceptualize learning as a socially mediated process. The reviewed evidence suggests that cooperative instructional environments may contribute to numeracy literacy development by providing opportunities for students to communicate, negotiate, and construct numerical meaning through interaction with others.

Summary of Intervention Approaches

Across the 36 included studies, several recurring instructional characteristics emerged irrespective of intervention type. Effective interventions typically incorporated structured teaching procedures, visual representations, scaffolded learning opportunities, repeated practice, and opportunities for active engagement. Importantly, the reviewed evidence suggests that successful interventions did not merely improve arithmetic accuracy. Rather, they functioned as mediational supports that enabled students to access, interpret, and apply numerical information more effectively. Explicit instruction, CRA approaches, schema-based interventions, technology-supported learning, and cooperative practices all appeared to facilitate learners' engagement with numerical symbols and mathematical representations. Taken together, these findings support the view that effective mathematics interventions contribute to the development of functional numeracy literacy by strengthening students' ability to understand, communicate, and use numerical information in meaningful educational and everyday contexts.

DISCUSSION

A central finding of this review is that effective mathematics interventions did not merely improve computational performance but also appeared to support the development of functional numeracy literacy. Across the reviewed studies, successful interventions provided learners with structured opportunities to interpret, understand, and apply numerical symbols in meaningful contexts. From a literacy perspective, arithmetic can be conceptualized as a symbolic language through which individuals communicate quantitative information. Consequently, interventions such as explicit instruction, CRA approaches, and schema-based teaching may be understood as mechanisms that facilitate access to numerical meaning rather than solely improving arithmetic accuracy. The present systematic review sought to synthesize research on mathematics intervention programs designed to support the development of basic arithmetic and related mathematical skills among students with intellectual disability and related disability populations. Overall, the findings indicate that structured, evidence-based instructional approaches are consistently associated with improved mathematical learning outcomes across disability-focused educational contexts. Among the instructional strategies most frequently identified in the reviewed literature were explicit instruction, the Concrete-Representational-Abstract instructional model, schema-based instruction, and structured practice interventions. These approaches have been widely recognized in previous research as effective practices for improving mathematical learning among students with disabilities (Alhwaiti, 2022; Jung et al., 2022; Long et al., 2021).The results of the review also support earlier meta-analytic and systematic research identifying structured mathematics instruction as a critical component of effective intervention for students with learning difficulties and disabilities (Gersten et al., 2009; Kroesbergen& Van Luit, 2003). Explicit and systematic instructional procedures appear particularly beneficial for learners with intellectual disability because they reduce cognitive load, provide clear instructional guidance, and support the gradual development of mathematical reasoning skills. These findings are consistent with broader research in special education, which emphasizes the importance of structured instruction, repeated practice, and scaffolded learning environments in supporting skill acquisition and retention.

The findings of the review also highlight the significant role of the Concrete-Representational-Abstract (CRA) instructional model in supporting mathematical learning. CRA instruction facilitates the transition from concrete experiences to abstract symbolic reasoning by enabling students to manipulate physical objects, represent mathematical concepts visually, and eventually work with symbolic notation. This progression appears to support deeper conceptual understanding while reducing the cognitive load associated with abstract mathematical tasks. Several studies included in the review demonstrated that CRA instruction

improves performance in areas such as arithmetic operations, fractions, and algebraic reasoning (Bouck et al., 2019; Yıldırım&Yıkmış, 2022). These results align with broader research in mathematics education, which suggests that multiple representations of mathematical concepts can enhance both comprehension and long-term retention.The effectiveness of CRA instruction may also be interpreted through a sociocultural lens. Consistent with Vygotskian perspectives, the progression from concrete manipulatives to abstract symbols provides scaffolded access to increasingly complex forms of representation. The visual and concrete supports used in CRA interventions may therefore function as mediational tools that facilitate participation in numeracy practices and support the gradual internalization of mathematical concepts.

Another important finding concerns the effectiveness of schema-based instructional approaches. Schema-based instruction helps students identify structural similarities among mathematical problems and apply appropriate solution strategies. By organizing mathematical problems into recognizable categories, students can develop more efficient problem-solving strategies and reduce cognitive overload during complex tasks. This approach appears particularly beneficial for students with intellectual disability, who may struggle with transferring learned procedures to unfamiliar contexts. The reviewed studies indicate that schema-based instruction improves students' ability to solve word problems and enhances their strategic understanding of mathematical relationships (Gilley et al., 2023; Jung et al., 2022). In addition to structured instructional approaches, the findings suggest that technology-supported interventions represent a promising area of development in mathematics education for students with intellectual disability. Digital learning environments, virtual manipulatives, augmented reality applications, and video modeling strategies have demonstrated positive effects on student engagement and conceptual understanding. Technology-based instructional tools can provide individualized learning experiences, immediate feedback, and interactive visualizations of mathematical concepts. These features may help address the diverse learning needs of students with intellectual disability and support differentiated instruction within inclusive educational settings (Morris et al., 2022; Satsangi& Raines, 2022). The review also highlights the potential benefits of cooperative and inclusive learning environments. Collaborative instructional strategies allow students to engage in shared problem solving, exchange ideas, and observe peer modeling of mathematical strategies. For students with intellectual disability, such environments may promote both cognitive development and social participation. Inclusive classroom settings can provide opportunities for peer interaction and differentiated instruction, which may enhance both motivation and academic achievement (Bornaa et al., 2023). These findings support broader educational frameworks that emphasize inclusive education and the importance of providing equitable learning opportunities for students with disabilities.

From a theoretical perspective, the results of this review support the integration of multiple learning theories in the design of mathematics interventions. Behaviorist principles such as reinforcement and repeated practice appear to support skill acquisition, while cognitivist approaches emphasize the development of conceptual understanding and strategic thinking. Constructivist and social constructivist perspectives further highlight the importance of active learning, social interaction, and scaffolded instruction. Combining insights from these theoretical perspectives may help educators design comprehensive intervention programs that address both the cognitive and social aspects of mathematical learning among students with intellectual disability. Despite the promising findings identified in the review, several limitations in the existing research literature should be acknowledged. First, many intervention studies involve relatively small participant samples, which may limit the generalizability of findings. Second, the heterogeneity of research designs and intervention approaches makes direct comparisons between studies challenging. Third, many studies focus on short-term intervention outcomes, while longitudinal research examining the long-term impact of mathematics interventions remains limited. Future research should therefore aim to conduct large-scale studies that evaluate the sustained effects of mathematics interventions across different educational contexts. The findings of this systematic review suggest that effective mathematics interventions for students with intellectual disability should integrate structured instruction, multiple representations of mathematical concepts, scaffolded learning opportunities, and technology-supported instructional tools. Despite differences in instructional format, the interventions reviewed shared several common characteristics. Most successful approaches incorporated explicit guidance, visual representations, scaffolded learning experiences, and repeated opportunities for practice. These common elements may explain why instructional effectiveness was observed across otherwise diverse intervention models. Rather than functioning as independent approaches, they appear to represent complementary mechanisms that support access to numerical meaning and reduce cognitive demands for learners with intellectual and developmental disabilities. The findings suggest that numeracy literacy should not be viewed as a narrow mathematical competence but as a broader communicative and functional capability. For students with intellectual and developmental disabilities, the ability to interpret numerical symbols, understand quantitative relationships, and apply mathematical information in everyday contexts represents an essential dimension of literacy and social participation. Effective interventions therefore contribute not only to mathematics achievement but also to learners' broader capacity to engage independently with the demands of everyday life.

LIMITATIONS

Despite the valuable insights provided by this systematic review, several limitations should be acknowledged. First, the number of studies included in the review was relatively limited. Although the search was conducted across multiple major academic databases, including Scopus, Web of Science, ERIC, and Google Scholar, the final sample

consisted of thirty-six studies that met the inclusion criteria. This relatively small body of literature may reflect the limited number of empirical studies specifically examining mathematics interventions for students with intellectual disability, particularly those focusing on basic arithmetic operations.In addition, the studies included in the review varied considerably in terms of research design, participant characteristics, intervention duration, and outcome measures. This methodological heterogeneity made direct comparisons across studies difficult and limited the possibility of conducting a quantitative synthesis or meta-analysis. Differences in participant age groups, levels of intellectual disability, and educational contexts may also influence the reported effectiveness of specific intervention approaches.Another limitation concerns the methodological characteristics of many of the included studies. Several investigations employed small sample sizes or single-case experimental designs, which are commonly used in special education research. Although these designs provide valuable insights into instructional effectiveness at the individual level, they may restrict the generalizability of findings to broader educational populations. Future research would benefit from larger-scale studies that examine the effectiveness of mathematics interventions across diverse educational settings and student populations. The time frame of the included studies also represents a potential limitation. The review focused on research published between 2000 and 2025 in order to capture contemporary instructional approaches and recent technological developments in mathematics education. However, earlier research relevant to the topic may not have been included in the analysis. Furthermore, the review primarily examined studies published in English-language journals, which may have resulted in the exclusion of relevant studies published in other languages.Finally, the review focused specifically on interventions targeting basic arithmetic operations. While this focus allowed for a clearer synthesis of instructional approaches, it may have excluded studies examining broader mathematical domains such as geometry, measurement, or algebraic reasoning. Future systematic reviews could therefore expand the scope of analysis to include a wider range of mathematical competencies and intervention strategies. An important consideration concerns the inclusion of studies involving learning disabilities in addition to intellectual and developmental disabilities. Although these populations differ in important cognitive characteristics, some intervention findings were considered sufficiently transferable to justify inclusion within the broader narrative synthesis. Nevertheless, caution is warranted when generalizing findings across disability categories, and future reviews may benefit from conducting separate syntheses for different disability groups.

CONCLUSION

Mathematical competence represents a fundamental component of functional literacy and plays a critical role in individuals' ability to participate independently in everyday life. For students with intellectual and developmental disabilities, the development of foundational arithmetic skills extends beyond academic achievement and is closely linked to autonomy, social participation, problem solving, and access to everyday experiences involving numerical information. The findings of this systematic review highlight the effectiveness of structured and evidence-based instructional approaches in supporting the development of functional numeracy literacy among students with intellectual and developmental disabilities. Across the reviewed studies, successful interventions not only improved arithmetic performance but also enhanced learners' ability to interpret, represent, and apply numerical information in meaningful contexts. Explicit instruction, the Concrete-Representational-Abstract (CRA) approach, schema-based instruction, structured practice interventions, technology-supported learning, and cooperative instructional strategies consistently emerged as valuable approaches for promoting mathematical learning and engagement. A recurring finding across the literature was that effective interventions shared several common characteristics, including explicit guidance, visual representations, scaffolded learning opportunities, repeated practice, and active learner engagement. These instructional elements appear to function as supports that help learners access numerical meaning, navigate mathematical symbols, and participate more effectively in numeracy-related activities. Consequently, successful mathematics interventions may be understood not only as tools for improving computational accuracy but also as mechanisms that support broader literacy development. The review further suggests that numeracy literacy should be conceptualized as a multidimensional construct that encompasses the ability to understand, communicate, and use numerical information in real-life situations. From this perspective, mathematics education for students with intellectual and developmental disabilities is not solely concerned with the acquisition of arithmetic procedures but also with enabling meaningful participation in educational, social, and community contexts. The evidence synthesized in this review supports the view that numeracy literacy is an essential dimension of functional literacy for students with intellectual and developmental disabilities. By strengthening learners' ability to understand, communicate, and apply numerical information, effective interventions contribute not only to academic success but also to greater independence, inclusion, and quality of life. Future research should continue to investigate innovative instructional approaches and emerging educational technologies while further exploring the relationship between numeracy literacy, functional outcomes, and lifelong participation.

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REFERENCES

Alhwaiti, M. M. (2022). An updated evidence-based practice review on teaching mathematics to students with intellectual disabilities. *International Journal of Computer Science and Network Security, 22*(5), 255–265. https://doi.org/10.22937/IJCSNS.2022.22.5.36

Almulla, M. A. (2023). Constructivism learning theory: A paradigm for students' critical thinking, creativity, and problem solving to affect academic performance in higher education. *Cogent Education, 10*(1), 2172929. https://doi.org/10.1080/2331186X.2023.2172929

Bouck, E. C., Mathews, L. A., & Peltier, C. (2020). Virtual manipulatives: A tool to support access and achievement with middle school students with disabilities. *Journal of Special Education Technology, 35*(1), 51–59. https://doi.org/10.1177/0162643419882422

Bouck, E. C., Satsangi, R., & Park, J. (2019). The concrete-representational-abstract approach for students with learning disabilities: An evidence-based practice synthesis. *Remedial and Special Education, 40*(1), 32–42. https://doi.org/10.1177/0741932517721712

Bornaa, C., Karsli, F., &Yildiz, M. (2023). The effects of cooperative learning supported with manipulatives on students' mathematics achievement. *Education and Information Technologies, 28*, 11345–11362. https://doi.org/10.1007/s10639-022-11362-1

Browder, D. M., Jimenez, B. A., &Trela, K. (2012). Grade-aligned math instruction for secondary students with moderate intellectual disability. *Education and Training in Autism and Developmental Disabilities, 47*(3), 373–388.

Browder, D. M., Spooner, F., Ahlgrim-Delzell, L., Harris, A. A., &Wakeman, S. (2008). A meta-analysis on teaching mathematics to students with significant cognitive disabilities. *Exceptional Children, 75*(1), 33–52. https://doi.org/10.1177/001440290807500102

Burns, M. K., VanDerHeyden, A. M., &Boice, C. H. (2015). Best practices in mathematics intervention. *Journal of Applied School Psychology, 31*(2), 131–152. https://doi.org/10.1080/15377903.2015.1001731

Butler, F. M., Miller, S. P., Lee, K., & Pierce, T. (2003). Teaching mathematics problem solving to students with mild disabilities. *Exceptional Children, 69*(2), 187–202. https://doi.org/10.1177/001440290306900204

Cihon, T. M., Leaf, J. B., Ferguson, J. L., & Leaf, R. (2020). A systematic review of prompting procedures in skill acquisition for individuals with developmental disabilities. *Behavior Analysis in Practice, 13*(1), 1–16. https://doi.org/10.1007/s40617-019-00349-7

David, C. V., Costescu, C. A., &Roșan, A. M. (2025). A preliminary study of a math digital-based intervention in children with intellectual disabilities. *Research in Developmental Disabilities, 159*, 104947. https://doi.org/10.1016/j.ridd.2025.104947

Decarli, G., Sella, F., Lucangeli, D., &Zorzi, M. (2022). Neurocognitive mechanisms underlying developmental dyscalculia. *Frontiers in Psychology, 13*, 857364. https://doi.org/10.3389/fpsyg.2022.857364

Fuchs, L. S., Fuchs, D., & Powell, S. R. (2014). The effects of explicit instruction on mathematics achievement for students with learning disabilities. *Journal of Educational Psychology, 106*(4), 1120–1136. https://doi.org/10.1037/a0037146

Gersten, R., Chard, D., Jayanthi, M., Baker, S., Morphy, P., &Flojo, J. (2009). Mathematics instruction for students with learning disabilities: A meta-analysis. *Review of Educational Research, 79*(3), 1202–1242. https://doi.org/10.3102/0034654309334431

Gilley, D., Root, J. R., Saunders, A. F., & Cox, S. K. (2023). Peer-delivered modified schema-based instruction in word problem-solving for high-school students with intellectual disability. *Research and Practice for Persons with Severe Disabilities, 48*(4), 235–251. https://doi.org/10.1177/15407969231200413

Griffin, S., Case, R., & Siegler, R. S. (1994). Rightstart: Providing the central conceptual prerequisites for first formal learning of arithmetic. *Journal of Applied Developmental Psychology, 15*(4), 567–587. https://doi.org/10.1016/0193-3973(94)90015-9

Gupta, S., Sharma, A., & Kaur, P. (2022). Artificial intelligence applications in special education: Opportunities and challenges. *Education and Information Technologies, 27*, 12019–12037. https://doi.org/10.1007/s10639-022-11054-w

Hong, Q. N., Pluye, P., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., Gagnon, M. P., Griffiths, F., Nicolau, B., O'Cathain, A., Rousseau, M. C., &Vedel, I. (2018).*Mixed Methods Appraisal Tool (MMAT), version 2018: User guide*. McGill University. http://mixedmethodsappraisaltoolpublic.pbworks.com

Hord, C. (2023). Middle and high school math teaching for students with mild intellectual disabilities. Support for *Learning, 38*(2), 240–256. https://doi.org/10.1111/1467-9604.12425

Hudson, M. E., Rivera, C. J., & Grady, M. M. (2018). Research on mathematics instruction with students with significant cognitive disabilities: Has anything changed? *Research and Practice for Persons with Severe Disabilities, 43*(1), 38–53. https://doi.org/10.1177/1540796918756601 Jung, P. G., Powell, S. R., & Fuchs, L. S. (2022). Schema-based instruction in mathematics problem solving: A systematic review. *Exceptional Children, 88*(3), 297–315. https://doi.org/10.1177/00144029211037756

Kleinert, H., Browder, D. M., & Towles-Reeves, E. (2017). Effects of the taped problems intervention on math fact fluency for students with disabilities. *Journal of Special Education Technology, 32*(3), 141–151. https://doi.org/10.1177/0162643416689321

Knight, V. F., McKissick, B. R., & Saunders, A. F. (2013). A review of technology-based interventions to teach academic skills to students with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 43*, 2628–2648. https://doi.org/10.1007/s10803-013-1814-y

Kroesbergen, E. H., & Van Luit, J. E. H. (2003). Mathematics interventions for children with special educational needs: A meta-analysis. *Remedial and Special Education, 24*(2), 97–114. https://doi.org/10.1177/07419325030240020501

Long, J., Browder, D. M., & Jimenez, B. A. (2021). Explicit instruction in mathematics for students with intellectual disability. *The Journal of Special Education, 55*(2), 91–102. https://doi.org/10.1177/0022466920953053

Miller, S. P., & Hudson, P. J. (2007). Using evidence-based practices to build mathematics competence related to conceptual, procedural, and declarative knowledge. *Learning Disabilities Research & Practice, 22*(1), 47–57. https://doi.org/10.1111/j.1540-5826.2007.00230.x

Montague, M. (2007). Self-regulation and mathematics instruction. *Learning Disabilities Research & Practice, 22*(1), 75–83. https://doi.org/10.1111/j.1540-5826.2007.00232.x

Morris, J. R., Root, J. R., Wood, L., &Brosh, C. R. (2022). Using video modeling, explicit instruction, and augmented reality to teach mathematics to students with disabilities. *Learning Disability Quarterly, 45*(4), 306–319. https://doi.org/10.1177/07319487211040470

Nelwan, M., Veldkamp, B. P., &Kroesbergen, E. H. (2021). What is the role of working memory in mathematics? A meta-analysis. *Educational Psychology Review, 33*, 165–188. https://doi.org/10.1007/s10648-020-09590-4

Ok, M. W., & Rao, K. (2019). Digital tools for the inclusive classroom: Google Chrome as assistive and instructional technology. *Journal of Special Education Technology, 34*(3), 204–211. https://doi.org/10.1177/0162643419841546

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021a). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, n71. https://doi.org/10.1136/bmj.n71

Page, M. J., Moher, D., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021b). PRISMA 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews. *BMJ, 372*, n160. https://doi.org/10.1136/bmj.n160

Park, J., Bouck, E. C., & Duenas, A. (2016). The effect of concrete-representational-abstract sequence instruction on fractions for students with disabilities. *Remedial and Special Education, 37*(2), 101–112. https://doi.org/10.1177/0741932515595999

Park, J., Bouck, E. C., & Fisher, M. H. (2020). Maintenance in mathematics for individuals with intellectual disability: A systematic review of literature. *Research in Developmental Disabilities, 105*, 103751. https://doi.org/10.1016/j.ridd.2020.103751

Patel, D. R., Greydanus, D. E., & Pratt, H. D. (2020). Intellectual disability: Definition, classification, causes, and characteristics. *Disease-a-Month, 66*(4), 100868. https://doi.org/10.1016/j.disamonth.2019.100868

Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., Britten, N., Roen, K., & Duffy, S. (2006). *Guidance on the conduct of narrative synthesis in systematic reviews: A product from the ESRC Methods Programme*. Lancaster University. https://www.lancaster.ac.uk/media/lancaster-university/content-assets/documents/fhm/dhr/chir/NSsynthesisguidanceVersion1-April2006.pdf

Powell, S. R., Fuchs, L. S., & Fuchs, D. (2015). Intensive intervention in mathematics. *Learning Disabilities Research & Practice, 30*(4), 182–192. https://doi.org/10.1111/ldrp.12087

Prosser, S. K., & Bismarck, S. F. (2023). Effectiveness of the concrete-representational-abstract instructional sequence in mathematics learning. *Education Sciences, 13*(10), 1061. https://doi.org/10.3390/educsci13101061

Root, J. R., Browder, D. M., Saunders, A. F., & Lo, Y. Y. (2017). Schema-based instruction with concrete and virtual manipulatives to teach problem solving to students with autism. *Remedial and Special Education, 38*(1), 42–52. https://doi.org/10.1177/0741932516643592

Satsangi, R., & Raines, T. C. (2022). Virtual manipulatives for mathematics instruction of students with disabilities. *Journal of Special Education Technology, 37*(2), 91–103. https://doi.org/10.1177/01626434211004448

Schalock, R. L., Luckasson, R., &Tassé, M. J. (2021). *Intellectual disability: Definition, diagnosis, classification, and systems of supports* (12th ed.). American Association on Intellectual and Developmental Disabilities.

Schnepel, S., &Aunio, P. (2021). A systematic review of mathematics interventions for primary school students with intellectual disabilities. *European Journal of Special Needs Education, 36*(5), 728–747. https://doi.org/10.1080/08856257.2021.1943268

Shin, M., Bryant, D. P., Bryant, B. R., McKenna, J. W., Hou, F., & Ok, M. W. (2023). A content analysis of research on technology use for teaching mathematics to students with disabilities. *Learning Disabilities Research & Practice, 38*(2), 93–106. https://doi.org/10.1111/ldrp.12301

Spooner, F., Root, J. R., Saunders, A. F., & Browder, D. M. (2019). An updated evidence-based practice review on teaching mathematics to students with moderate and severe developmental disabilities. *Remedial and Special Education, 40*(3), 150–165. https://doi.org/10.1177/0741932517751059

Street, B. V. (1984). *Literacy in Theory and Practice*. Cambridge University Press.

Street, B. V. (2003). What's "new" in New Literacy Studies? Critical approaches to literacy in theory and practice. *Current Issues in Comparative Education, 5*(2), 77–91.

UNESCO. (2006). *Education for All Global Monitoring Report 2006: Literacy for Life. Paris*: UNESCO Publishing.

Urton, K., Wilbert, J., &Hennemann, T. (2022). The effects of touch-point mathematics instruction for students with learning difficulties. *Learning Disabilities Research & Practice, 37*(1), 42–53. https://doi.org/10.1111/ldrp.12258

Xin, Y. P., & Jitendra, A. K. (1999). The effects of schema-based instruction on mathematical word problem solving performance of students with learning disabilities. *The Journal of Special Education, 33*(4), 207–218. https://doi.org/10.1177/002246699903300403

Yıldırım, A., &Yıkmış, A. (2022). Teaching fractions to students with learning disabilities using the concrete-representational-abstract approach. International Journal of *Special Education, 37*(2), 18–31.