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Specific Learning Disorder in Elementary School Students: A Systematic Review

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ABSTRACT

Specific Learning Disorder (SLD) is a neurocognitive disorder affecting 5–15% of elementary students, with dyslexia being the most prevalent form, particularly in boys. This systematic review, following PRISMA guidelines, synthesized 22 articles from PubMed and Scopus to examine SLD prevalence, influencing factors, comorbidities, and effective interventions. Key findings indicate SLD stems from deficits in executive function, working memory, genetic factors, and maladaptive learning environments. Children with SLD face high risks of comorbidities like anxiety (21%), depression (28%), ADHD (28%), and behavioral disorders (22%). Effective interventions identified include cognitive rehabilitation, multisensory teaching methods, and specific technological approaches: eye-tracking applications for early dyslexia screening (e.g., tablet-based tools achieving 84,62% accuracy), the Lexia® Core5® reading edtech program improving academic outcomes, and NAO robots showing efficacy comparable to standard human tutoring. The review concludes that early screening, holistic interventions combining cognitive and technological strategies, and robust family-teacher collaboration are vital for optimizing the academic and psychological well-being of children with SLD. This synthesis provides an evidence-based foundation for policymakers, educators, and researchers designing targeted support systems.

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1. INTRODUCTION

Specific Learning Disorder (SLD) is a neurodevelopmental condition that significantly impacts academic skills such as reading, writing, and arithmetic, despite normal intelligence. A critical challenge in understanding SLD lies in the inconsistency of prevalence data reported across sources. For instance, global estimates range from 5–10% (Stepanovic & Ilic, 2025), while (UNESCO, 2020) cites a higher figure of 10–15%. To resolve this discrepancy, it is essential to anchor the global estimate on a primary source such as the latest meta-analysis by (Sotelo-Dynega, 2022). While contextualizing regional variations through supplementary data. This approach not only clarifies statistical differences but also highlights how

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socioeconomic, educational, and diagnostic factors influence prevalence rates across contexts (Bandla et al., 2023).

Beyond academic difficulties, SLD ex profound psychological consequences on children. Research indicates that students with SLD are at heightened risk for comorbid conditions such as anxiety, depression, and behavioral disorders (Li, 2025; Visser et al., 2020). These issues are not merely secondary effects but are intrinsically linked to academic struggles, as repeated failures erode self-esteem and increase emotional distress. For example, (Fishstrom et al., 2024). Found that anxiety and reading difficulties are bidirectionally reinforcing, creating a cycle that exacerbates both academic and psychological challenges. This underscores that SLD is not solely an educational issue but a holistic concern affecting children's well-being (Stein, 2023).

Previous research on SLD has often examined the disorder in isolation focusing either on cognitive deficits, environmental factors, or interventions without integrating these dimensions cohesively. For instance, while studies like (Azizi et al., 2020) and (Papadopoulou et al., 2022) highlight effective interventions, they seldom address how these strategies interact with psychological or familial contexts. Similarly, research on comorbidities (Visser et al., 2020) may not explore how environmental support moderates outcomes. This fragmented approach limits the development of truly holistic interventions. Therefore, a comprehensive, integrated framework is needed one that simultaneously considers neurocognitive, psychological, and environmental factors to inform more effective support systems (Sağir & Içer, 2023). By addressing these gaps, this systematic review aims to synthesize evidence on SLD in elementary students, emphasizing the interconnectedness of academic, psychological, and environmental dimensions. Such a synthesis is crucial for designing early detection strategies, evidence-based interventions, and collaborative support mechanisms that promote both academic success and emotional well-being (Mitchell et al., 2026).

2. METHODS

The search strategy was systematically implemented across PubMed and Scopus databases in strict adherence to PRISMA guidelines, employing a combination of Boolean operators and keyword variations to ensure comprehensive coverage. For PubMed, the initial search utilized the phrase: ("Specific Learning Disorder" OR "SLD") AND ("Elementary School" OR "Primary School" OR "School Child") AND ("Child" OR "Children" OR "Student" OR "Students"), yielding 229 articles. Filters were then applied: publication date (last 5 years, 2018–2023), free full-text availability, and age criterion (elementary school children, 6–12 years), reducing the pool to 10 articles. In Scopus, the search was refined using TITLE-ABS-KEY syntax with terms like "Specific Learning Disorder," "Elementary School," and "Child," limited to English-language publications, resulting in 36 articles, which were further narrowed to 15 after applying open access criteria. Inclusion criteria explicitly focused on empirical or review studies addressing SLD in elementary students (6–12 years), published in English within the last 5 years, and available in

full text. Exclusion criteria encompassed studies outside the specified age range, non-English publications, and theoretical works without empirical data. The restriction to open access sources was justified to minimize publication bias and ensure equitable inclusion, particularly for researchers in low-resource settings. The screening process involved two independent reviewers: the first assessed titles and abstracts for relevance, removing duplicates and off-topic studies, while the second evaluated full texts against predefined inclusion/exclusion criteria. Disagreements were resolved through consensus or consultation with a third reviewer. After deduplication, 22 articles were selected for final analysis, with the screening detailed in Figure 1.

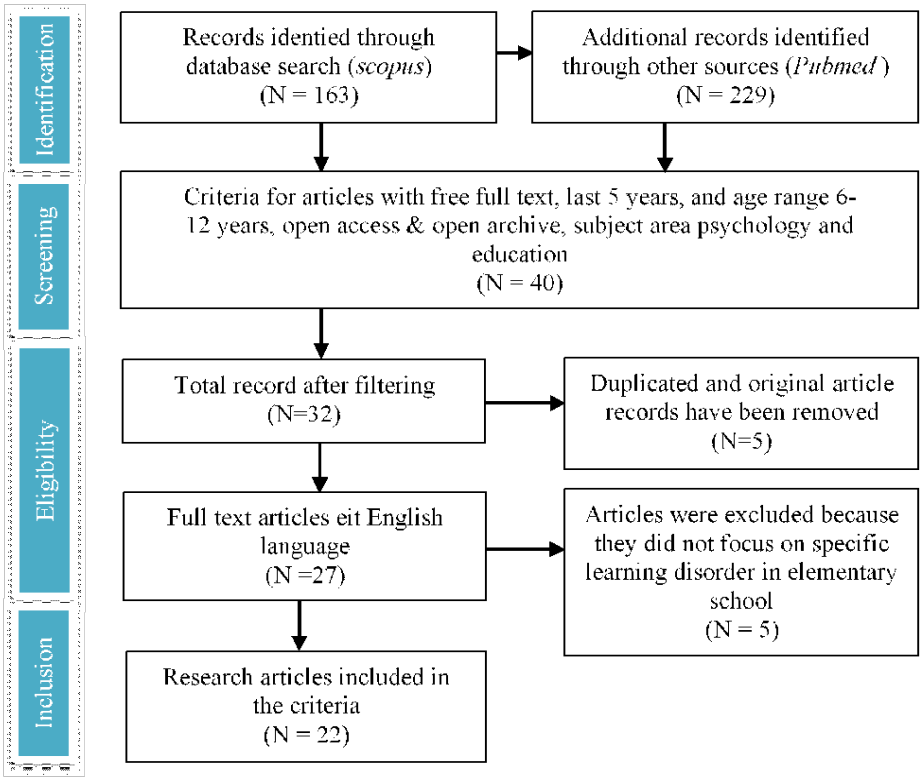


Figure 1. Article Search and Screening Procedure

3. RESULT AND DISCUSSION

Table 1 synthesizes key findings from 22 studies on Specific Learning Disorder (SLD) in elementary students, highlighting prevalence profiles, cognitive and environmental factors, comorbidities, and effective interventions. This overview provides a concise evidence base for understanding the multifaceted nature of SLD and its implications for academic and psychological support.

Table 1. Summary of Specific Learning Disorder in Elementary School Students

Authors and Year	Method and Research Design	Research Aim	Research Findings
(Hachmann et al., 2020)	Quantitative Experimental method	To examine the relationship between reading development in elementary school children and the ability to retain sequential information.	The chronological age (CA) group showed implicit sequential facilitation for item memory, whereas this implicit recruitment of sequential ability in reading was completely absent in children with Developmental Dyslexia (DD).
(Aldakhil et al., 2023)	Mixed methods with a survey-based design	To determine the prevalence of dyslexia among Saudi Arabian students in grades 3–6.	Dyslexia was found in 5.86% of the total sample. Its prevalence was twice as high in male students compared to female students (6.54% and 3.83%, respectively).
(Lee et al., 2024)	Qualitative Exploratory case study	To investigate the relationship between mental health and reading difficulties in elementary school children in China.	The findings indicated that Chinese children with RD (Reading Difficulties) experienced more depression but not more anxiety compared to their typically developing peers across all three grade levels.
(Visser et al., 2020)	Quantitative with a correlational descriptive (non-experimental) method	To determine the likelihood of children with specific learning disorder in reading, spelling, and/or arithmetic experiencing anxiety disorders, depression, ADHD, and/or behavioral disorders.	The results showed a high level of comorbidity in children with SLD: • Anxiety disorders: 21% • Depression: 28% • ADHD: 28% • Behavioral disorders: 22%
(Azizi et al., 2020)	Quantitative with an experimental method	To compare the effect of Cognitive Rehabilitation on Sustained Attention in elementary school students with SLD.	The results showed a significant difference in the CPT variable between the research groups ($P<0.05$). Furthermore, the CPT score of the CR group was higher than the NFB group ($P<0.001$).

Authors and Year	Method and Research Design	Research Aim	Research Findings
(Papadopoulou et al., 2022)	Experimental study with a randomized controlled design	To determine the effectiveness of the NAO robot in a human-supported intervention for elementary school students with specific learning disorder.	The NAO robot was proven effective as a tutor in a human-supported intervention when compared to the best-standard intervention for elementary school students with specific learning disorder (SpLD).
(Lomurno et al., 2023)	Experimental quantitative	To develop and test an early detection model for dysgraphia using deep learning technology.	The resulting final dysgraphia classifier was able to identify "at-risk" children with 84.62% accuracy and 100% precision, more than two years earlier than current diagnostic techniques.
(Elhakeem et al., 2023)	Experimental quantitative research	To determine and test the effectiveness of rehabilitating Egyptian children with learning disorders through the "Executive Functions Training-Elementary" and "Promoting Executive Function in the Classroom" programs.	There was a significant increase in the scores of the Arabic version of the Barkley Deficits in Executive Functioning Scale, Children and Adolescents long-form (BDEFS-CA) for executive function evaluation, with the mean executive function score decreasing from 228.63 to 213.77 ($p < 0.001$). A significant increase was also found in the Arabic Dyslexia Assessment Test (ADAT) scores for dyslexia evaluation, from 1.89 to 1.33 ($p < 0.001$).
(Connors et al., 2025)	Longitudinal quantitative	To analyze the longitudinal developmental patterns in mathematics and reading skills in children with and without learning difficulties.	The developmental patterns of mathematics and reading skills in children with learning difficulties were consistent with those of children without learning difficulties.

Authors and Year	Method and Research Design	Research Aim	Research Findings
(Ahmadi et al., 2025)	Semi-experimental quantitative	To evaluate the effectiveness of self-monitoring of attention in improving concentration and cognitive flexibility in children with SLD.	There was a statistically significant difference in concentration and cognitive flexibility scores between the experimental and control groups in students with specific learning difficulties ($p \leq 0.01$).
(Hurwitz & Vanacore, 2023)	Quantitative. Experimental	To evaluate the effectiveness of the Lexia® Core5® Reading (Core5) edtech program on easyCBM-based Measures of Academic Progress® (MAP) Growth Reading™ outcomes in students with reading difficulties or language-based disorders in grades K-5.	Students in the treatment group obtained better outcomes than the control group on the MAP test (B = 3.85, CI = 0.57–7.13, p = .022, d = .24), however, there was no significant difference in oral reading ability. Educational technology (edtech) can effectively supplement reading instruction for students with language-based disabilities or reading difficulties.
(Park et al., 2024)	Quantitative. Experimental	Early detection and intervention for dyslexia are crucial to prevent educational gaps.	Excellent reliability was found for gaze fixation frequency (ICC = 0.83), mean gaze fixation duration (ICC = 0.82), and gaze-based reading speed (ICC = 0.76); as well as good reliability for regression ratio (ICC = 0.75) and saccade length (ICC = 0.72). The tablet-based dyslexia screening application was able to reliably measure eye movements in subjects with dyslexia.
(Tarjiah et al., 2023)	Qualitative explanatory case study	To explore the successful experiences of teachers in improving the reading ability of children with dyslexia.	Four key factors for success in improving reading ability in students with dyslexia were identified: remedial teaching, the application of multisensory methods, the use of reading

Authors and Year	Method and Research Design	Research Aim	Research Findings
			media, and parental support. Teachers act as facilitators, serving as a bridge to enhance the reading skills of students with dyslexia.
(Grossman et al., 2022)	Quantitative Correlational survey (non-experimental)	To determine if current psychological distress can be predicted by learning-experience-based PTSD levels at each developmental stage.	Individuals with SLD reported higher levels of learning-experience-based PTSD compared to individuals without SLD. The relationship between SLD and PTSD remained significant even after accounting for symptoms of adjustment disorder.
(Lerthattasilp et al., 2022)	Quantitative Correlational descriptive (epidemiological analytical)	To investigate students with reading problems and at risk of dyslexia.	Of the 1,018 students tested, 161 were at risk for dyslexia, with a prevalence of 15.81% (95% CI, 13.63–18.20%). The main risk factors associated with reading problems in children were: male gender, having a developmental or hereditary disease, a father with a low education level, and the type of school attended
(Miciak et al., 2022)	Quantitative method with a comparative longitudinal design	To investigate the reading skill profiles of English Learner (EL) students in grades 3 and 4.	The class with reading difficulties consistently scored lower than the typical class, in both code-based (decoding) and meaning-based (comprehension) domains. During one academic year, the typically developing class showed a significantly higher reading comprehension growth pattern ($\chi^2(1) = 206.21$, $p < 0.001$). Class membership was relatively stable, with 97% of participants remaining in their initial group.

Authors and Year	Method and Research Design	Research Aim	Research Findings
(Bassôa et al., 2021)	Correlational–validation quantitative	To examine the relationship between screening scores and objective reading and writing test results in detecting dyslexia risk.	Showed evidence of validity and reliability for the scale developed for the purpose of developmental dyslexia screening. The percentage of children identified as at risk for developmental dyslexia by this scale was around 9%, which is consistent with the international literature on dyslexia prevalence.
(Franchi et al., 2023)	Quantitative descriptive–correlational	To evaluate reading and retelling abilities in children with reading difficulties, and to correlate decoding and comprehension issues with changes observed in auditory and visual perception tests.	Tasks such as picture naming, backward digit span, figure copying, syllable synthesis, phonemic synthesis, rhyming, and phonemic manipulation collectively contribute to the multidisciplinary diagnosis and intervention process.
(Grills et al., 2023)	Experimental longitudinal quantitative	To compare children with reading difficulties and typical reading ability.	There were very small between-group differences at the beginning of the year, but many differences emerged by the end of the year, where students with persistent reading difficulties reported significantly higher levels of psychological distress.
(Lindström-Sandahl et al., 2023)	Experimental quantitative with a pre-test design	To evaluate the effectiveness of a phonics program in improving the reading skills and comprehension of children with SLD.	It showed that an additional phonics program delivered with high intensity can significantly improve word reading skills and reading comprehension in second-grade students with early reading difficulties.
(Endlich et al., 2024)	Non-experimental quantitative	To investigate differences in task-switching costs using	Children with mathematical difficulties required more time and worked with lower overall accuracy.

Authors and Year	Method and Research Design	Research Aim	Research Findings
		tablet-based arithmetic verification.	
(Fishstrom et al., 2024)	Correlational quantitative	To test the dimensions of anxiety in relation to the accuracy and fluency of word and text reading, as well as reading comprehension.	All three measures of anxiety were significantly correlated (r = 0.51–0.56, p < .001). The relationship between anxiety and reading difficulties is complex and varies depending on the severity of the child's SLD.

The first theme concerns the prevalence and profile of specific learning disorder in elementary school children, with dyslexia being the most dominant type and having a higher prevalence in males than females (Aldakhil et al., 2023; Büber et al., 2020; Lerthattasilp et al., 2022). The second theme pertains to the cognitive and neurobiological factors causing SLD. Research indicates that children with dyslexia tend to fail in utilizing sequential information facilitation in short-term memory (Hachmann et al., 2020). Impairments in brain connectivity also contribute to lower reading and mathematics abilities (Flores-Gallegos et al., 2024). Furthermore, weak executive functions impact shifting, updating, and inhibition, thereby affecting overall academic performance (Capodieci et al., 2023; Ceruti et al., 2025). The third theme addresses the emotional, behavioral, and psychological impacts and comorbidities. Research shows that children with SLD are at high risk of experiencing anxiety disorders, depression, behavioral disorders, and ADHD (Fishstrom et al., 2024; Grills et al., 2023; Grossman et al., 2022; Li, 2025; Pade et al., 2020; Şahin et al., 2020; Visser et al., 2020; Williams & Kumar P, 2023). Additionally, children with SLD exhibit lower self-esteem, a tendency for rumination, and their parents experience parenting stress (Bonifacci et al., 2020; Matteucci et al., 2019). The fourth theme involves environmental factors and learning support. Research indicates that teacher and parental support contribute significantly to the success of interventions (Bassôa et al., 2021; Tarjiah et al., 2023; Woodcock, 2021). As emphasized by (Donolato et al., 2022), children with language and learning disorders are more vulnerable to internalizing and externalizing problems, and parenting style modulates the risk and severity of these issues in children with specific learning disorder (Prando et al., 2024). The fifth theme covers academic findings and the skill profiles of children with SLD. Studies show that children with mathematical difficulties require more time and have lower accuracy in arithmetic verification (Endlich et al., 2024). Their reading profiles indicate difficulties with phonological tasks, auditory-visual perception, and rapid naming (Franchi et al., 2023; Miciak et al., 2022; Miranda-López et al., 2025; Nora et al., 2021). The sixth theme identifies effective interventions for addressing SLD. Research findings

include: cognitive rehabilitation training that improves attention and executive functions (Azizi et al., 2020), intensive phonics programs to enhance reading skills (Basri, 2024; Lindström-Sandahl et al., 2023) tablets with music or rhythm content to improve reading ability (Descamps et al., 2025; Lewis & Kim, 2024) self-monitoring of attention to increase concentration and cognitive flexibility (Ahmadi et al., 2025) edtech interventions such as Lexia® Core5® Reading and eye-tracking-based screening applications (Hurwitz & Vanacore, 2023; Park et al., 2024) the NAO robot as an effective learning tutor equivalent to human intervention (Papadopoulou et al., 2022) game-based assessment and deep learning for early detection of dyslexia/dysgraphia (Connors et al., 2025; Elhakeem et al., 2023; Lomurno et al., 2023; Samarasinghe & Abeyasinghe, 2023) an AI model intervention based on weighted ensemble learning (Alzahrani & Algahtani, 2025) and phonological tele-rehabilitation for children with reading and mathematical difficulties (Miranda-López et al., 2025).

The synthesis of 22 articles underscores that Specific Learning Disorder (SLD) is a complex neurocognitive condition with far-reaching implications beyond academic challenges. The prevalence data, showing dyslexia as the most common subtype and a higher incidence in males, aligns with prior neurocognitive research, yet the review's strength lies in its integration of cognitive, psychological, and environmental dimensions. For instance, deficits in executive functions and working memory evidenced in studies by (Azizi et al., 2020; Hachmann et al., 2020) not only disrupt learning processes but also perpetuate a cycle of academic frustration, which may exacerbate psychological vulnerabilities (Parhoon et al., 2024).

A critical insight is the high comorbidity of SLD with mental health disorders, such as anxiety (21%), depression (28%), and ADHD (28%), as reported by (Megari, 2023; Visser et al., 2020). This comorbidity is not incidental; it reflects the profound psychological toll of SLD, where children often internalize academic struggles, leading to diminished self-esteem and increased stress (Bonifacci et al., 2020; Grossman et al., 2022). (Fishstrom et al., 2024) further note that anxiety and reading difficulties are mutually reinforcing, creating a bidirectional relationship that complicates intervention efforts. These findings highlight that SLD is not merely an educational issue but a public health concern requiring holistic, integrated support systems.

The role of environmental factors particularly teacher and family support emerges as a pivotal moderator of outcomes. Studies like (Tarjiah et al., 2023) emphasize that multisensory teaching methods, when combined with parental involvement, significantly improve reading skills (Basri, 2024). Conversely, maladaptive learning environments, such as those lacking structured phonics instruction or early screening, can amplify risks (Lerthattasilp et al., 2022). This underscores the need for policy reforms that prioritize teacher training in evidence-based strategies and foster collaborative home-school partnerships.

Technological interventions represent a transformative frontier. Eye-tracking applications (Park et al., 2024) and AI-driven tools like Lexia® Core5® (Hurwitz & Vanacore, 2023) demonstrate remarkable efficacy in early detection and

personalized support, offering scalable solutions for resource-limited settings. The NAO robot's equivalence to human tutoring (Papadopoulou et al., 2022) further illustrates how technology can democratize access to quality intervention. However, ethical considerations such as ensuring equitable access and avoiding over-reliance on digital tools must guide implementation. Longitudinal data e.g., (Connors et al., 2025) reveal that without timely intervention, children with SLD often experience persistent academic gaps, which correlate with lifelong socioeconomic disadvantages. Conversely, intensive phonics programs (Lindström-Sandahl et al., 2023) and cognitive rehabilitation (Ahmadi et al., 2025) can yield significant improvements, particularly when initiated early. This reinforces the urgency of universal screening and tiered support systems in schools.

4. CONCLUSION

Specific Learning Disorder (SLD) demands urgent, multi-dimensional intervention to prevent profound academic and psychological consequences for elementary students. This synthesis underscores that SLD is not merely an academic hurdle but a neurocognitive condition with cascading impacts, including heightened risks of comorbid anxiety, depression, and behavioral disorders. Critically, the integration of technology such as AI-driven eye-tracking for early detection and robotic-assisted tutoring transforms traditional support paradigms, offering scalable, precise solutions. The efficacy of these innovations hinges on robust collaboration among educators, families, and policymakers to ensure equitable access and implementation. By prioritizing proactive screening, holistic cognitive-environmental interventions, and cross-sector partnerships, we can mitigate long-term educational inequities and foster inclusive learning ecosystems. This evidence-based framework provides a vital roadmap for transforming SLD management from reactive remediation to proactive empowerment, ultimately reshaping outcomes for millions of children worldwide.

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