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Dyscalculia and dyslexia in school-aged children: comorbidity, support, and future prospects

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The comorbidity of dyscalculia and dyslexia represents a significant challenge in education, affecting a considerable number of school-aged children globally. This Mini Review synthesizes literature from the last decade (2015–2024) to provide an updated perspective on the prevalence, etiology, and educational implications of these co-occurring learning differences. Despite recent advancements in screening, diagnostic, and intervention tools, significant gaps remain in addressing the unique needs of children facing both dyscalculia and dyslexia. This review highlights the limitations of current research, particularly the scarcity of studies focused on culturally and linguistically diverse (CALD) populations and socio-economic disparities and explores the urgent need for more comprehensive, integrated approaches. Future directions include leveraging technological innovations, fostering interdisciplinary collaborations, and adopting neurodiversity-based educational models to support affected learners effectively. Addressing these gaps can foster an inclusive learning environment and improve outcomes for children navigating the complexities of both dyscalculia and dyslexia.

KEYWORDS

dyscalculia, dyslexia, learning differences, educational intervention, screening and diagnosis, culturally and linguistically diverse populations, inclusive education

1 Introduction

The comorbidity of dyscalculia and dyslexia presents significant challenges for school-aged children, with a high prevalence of co-occurrence complicating diagnosis, intervention, and overall academic achievement. Dyscalculia affects numerical processing, while dyslexia impairs literacy skills, and their combined impact places affected children at a higher risk of educational underachievement and emotional stress. Despite the considerable prevalence, comprehensive research addressing this dual diagnosis remains limited.

The literature review synthesizes peer-reviewed articles published between 2015 and 2024. Articles were identified through searches using combinations of key terms such as "dyscalculia," "dyslexia," "comorbidity," "screening," "educational support," "intervention," and "neurodevelopmental disorders" across major databases, including PubMed, Scopus, and Google Scholar. The inclusion criteria focused on articles that addressed dyscalculia, dyslexia, or their comorbidity, particularly those offering insights into screening, diagnosis, intervention, and support strategies within educational settings. The review prioritized studies related to educational psychology, special educational needs, and recent advancements

in technology and neuroscience. Articles not meeting these criteria, such as those lacking peer review or those unrelated to the targeted areas, were excluded to maintain relevance and rigor. The selected literature aimed to provide a broad but concise overview of key developments in understanding and addressing the comorbidity of dyscalculia and dyslexia in school-aged children.

2 Current understanding of dyscalculia and dyslexia in school-aged children

2.1 Definitions, characteristics and etiology

Dyslexia and dyscalculia are distinct but overlapping learning differences, each evolving in definition over time. Developmental dyslexia and dyscalculia manifest during childhood, impacting literacy and numerical processing from early stages. Acquired forms, however, result from brain injuries or neurological conditions later in life, affecting previously developed skills. This review focuses primarily on developmental forms, given the educational context addressed. Dyscalculia is an impairment in mathematical abilities, involving difficulties with numerical concepts, arithmetic operations, and recalling mathematical facts (Andersson and Abdelmalek, 2021; Wilson et al., 2015). It is often linked to deficits in numerical cognition and issues in developing a mental number representation, which impairs numerical reasoning and processing. Dyslexia is typically characterized by difficulties in reading, phonological processing, and decoding written language. Core symptoms include problems with letter-sound mapping, word recognition, and retrieving verbal information from memory, leading to impaired reading fluency and comprehension (Moreau et al., 2018; Reisman and Severino, 2021). While dyscalculia and dyslexia are primarily associated with deficits in numerical and linguistic domains, respectively, they often share domain-general impairments, such as working memory difficulties, contributing to a high rate of comorbidity (Peters et al., 2018).

The causes of dyscalculia and dyslexia are multifaceted, and likely involve genetic and neurobiological factors. For example, dyscalculia may be linked to structural differences in the left fusiform gyrus and angular gyrus, affecting number processing (Ulfarsson et al., 2017), while dyslexia could be associated with hypoactivation in brain regions responsible for language processing, including the temporoparietal and occipital areas (Mingozzi et al., 2024; Moreau et al., 2018). Both conditions share risk factors, such as impairments in phonological processing and working memory, suggesting common underlying mechanisms, yet their primary deficits—numerical representation in dyscalculia and phonological decoding in dyslexia—remain distinct (Mingozzi et al., 2024; Ulfarsson et al., 2017). However, the evidence remains complex and further research is needed to fully elucidate these mechanisms.

2.2 Overlapping cognitive profiles and shared educational challenges

Despite their differences, dyscalculia and dyslexia often co-occur, indicating shared etiological factors. Individuals with both conditions frequently experience working memory, visual perception, and spatial difficulties (Cheng et al., 2018; Layes, 2022). Neuroimaging studies reveal that both disorders involve overlapping neural networks, particularly those linked to magnitude processing and phonological tasks, though each condition also shows distinct patterns of brain activation related to their specific deficits (Peters et al., 2018). This overlap suggests that comorbid cases may require interventions that concurrently target both literacy and numerical skills, emphasizing the need for integrated approaches.

The prevalence of neuromyths among educators further complicates effective support for students with dyscalculia and dyslexia. Misconceptions—such as dyslexia being synonymous with letter reversals or dyscalculia simply indicating poor math skills—negatively impact the implementation of evidence-based interventions (Van Herwegen et al., 2024). In addition to neuromyths, other challenges include limited specialized training for educators, variability in diagnostic criteria across educational systems, and socioeconomic disparities that hinder access to early intervention and specialized resources.

2.3 Screening, diagnosis, and technology-enhanced interventions

Screening tools such as the Dyslexia Screening Test (Fawcett and Nicolson, 2004) and Number Sense Screener (Jordan et al., 2008) are commonly used in the early identification of dyslexia and dyscalculia. These tools provide structured assessment methods to identify learning difficulties in young children, enabling timely interventions. Strengths include early identification and structured frameworks for intervention, while weaknesses involve limited cultural adaptability and potential biases that may lead to false positives or missed diagnoses. Morsanyi et al. (2018) highlighted the high prevalence of specific learning differences, including dyscalculia, and their comorbidity with other developmental conditions. This study underscores the need for comprehensive screening approaches that consider multiple neurodevelopmental factors, thus supporting the argument for integrated assessments for comorbid dyscalculia and dyslexia. Recent advances in screening have also leveraged technology, enhancing the accuracy and accessibility of assessments. Machine learning and AI-based approaches have shown promise in improving the early identification of learning differences, allowing for more nuanced diagnoses. For instance, Lachmann et al. (2022) proposed a multilevel diagnostic framework that incorporates neurobiological, cognitive, and behavioral indicators, providing a comprehensive assessment model. Mobile applications using deep learning—such as those developed by Kariyawasam et al. (2019a,b)—offer interactive screening for multiple learning differences, using gamified tasks to engage young learners and adapt interventions to their specific needs. These applications have shown high accuracy, making them particularly useful in early education and in under-resourced areas where traditional screening tools may be inaccessible.

2.4 Educational modifications

Inclusive education is a dynamic and contested concept, characterized by varying interpretations and practices across cultural, educational, and policy contexts. While its overarching goal is to ensure equitable access to quality education for all learners, the pathways to achieving inclusion differ significantly (Allan and Slee, 2019; Paseka and Schwab, 2020). Some definitions emphasize the full integration of students with diverse needs into mainstream classrooms, advocating for shared learning environments as a fundamental right. Others argue for tailored approaches, including hybrid models or specialized settings, to address specific needs effectively (Almusaed et al., 2023), such as those presented by students with dyscalculia and dyslexia.

Cultural and systemic factors further shape these interpretations. In Japan, for example, inclusion often emphasizes structured integration within mainstream settings, while Finland prioritizes equity-driven practices that integrate all learners into a unified system (Moberg et al., 2020). Such varied understandings highlight the importance of adapting inclusive strategies to address both dyscalculia and dyslexia in ways that respect local contexts and resource capacities.

The Universal Design for Learning (UDL) framework offers a practical approach to supporting students with dyscalculia and dyslexia in inclusive classrooms. UDL promotes flexible curriculum design by incorporating multiple means of representation, engagement, and expression to accommodate diverse learning needs (Korsgaard et al., 2020). For students with dyslexia, this may include providing multimodal materials, such as audio and visual resources, to strengthen reading comprehension. For students with dyscalculia, strategies might involve manipulatives, visual supports, and technology tools to scaffold mathematical understanding. However, research underscores that successful implementation of UDL requires robust teacher training and adequate resources, particularly in under-resourced educational systems (Florian, 2019).

The socio-political dimension of inclusion extends beyond addressing disabilities alone. Broader issues such as cultural and linguistic diversity, as well as socioeconomic disparities, must be accounted for to create meaningful inclusion. The Salamanca Statement (UNESCO, 1994) and Sustainable Development Goal 4 reaffirm the global commitment to equitable education, underscoring the need for systemic shifts to ensure that students with dyscalculia and dyslexia are not excluded or marginalized (Florian, 2019; Paseka and Schwab, 2020). Parents' and teachers' attitudes toward inclusive education further highlight the practical challenges in its implementation, including concerns about resource allocation and professional training (Paseka and Schwab, 2020; Korsgaard et al., 2020).

Critics of inclusion often argue that the intensive needs of students with severe learning difficulties may be diluted in mainstream classrooms. Proponents, however, emphasize that inclusion does not preclude specialized support; rather, it necessitates a flexible, responsive approach to meet individual learning profiles. Holistic frameworks that integrate general education with specialized interventions can provide targeted support for students with dyscalculia and dyslexia, improving both academic and socio-emotional outcomes (Korsgaard et al., 2020). Inclusive education, therefore, must be viewed as a continuum, requiring systemic change, flexible instructional strategies, and robust teacher preparation. Effective implementation of frameworks like UDL, along with evidence-based interventions for dyslexia and dyscalculia, holds the potential to transform inclusive classrooms into environments where all learners thrive.

2.5 Integrated support and collaborative community involvement

Effective support for children with dyscalculia and dyslexia requires an integrated approach that brings together schools, families, healthcare providers, and communities. Research highlights that holistic and integrated models of support are particularly effective in addressing the multifaceted challenges faced by children with specific learning differences (Lawson et al., 2024; Lee-St. John et al., 2018; Power et al., 2020). Such collaborative efforts ensure continuity of care, timely interventions, and shared responsibility across all stakeholders, creating a support system that meets both academic and non-academic needs.

Integrated support systems and other similar frameworks, emphasize tailoring interventions based on individual strengths and barriers to learning. These systems utilize structured collaboration among educators, mental health professionals, and family members to identify and respond to the specific needs of students with learning differences (Lawson et al., 2024). For children with dyscalculia and dyslexia, this approach ensures that cognitive, emotional, and social factors impacting their academic performance are considered comprehensively. By leveraging community resources, schools can connect students to enrichment services—such as tutoring, occupational therapy, and mental health support—that complement in-school efforts.

The implementation of shared digital platforms for storing developmental and educational records has been shown to enhance collaboration and communication among stakeholders (Choirunnisa et al., 2024). These platforms facilitate the development and monitoring of individualized education plans, providing a real-time overview of a student's progress, challenges, and goals. Such systems foster seamless coordination between teachers, families, and healthcare professionals, reducing delays in interventions and promoting targeted support for students with comorbid dyscalculia and dyslexia.

Community-based initiatives play a critical role in ensuring equitable access to support, particularly for families with limited resources or in under-resourced regions. Workshops for parents and caregivers, for instance, have been instrumental in helping families understand the nature of their child's learning challenges and implement supportive strategies at home (Asencios-Trujillo et al., 2024). Parent involvement not only bridges the gap between home and school but also strengthens the child's academic and emotional development. Studies suggest that such initiatives can mitigate the adverse effects of socioeconomic disadvantage by offering tailored interventions that are both culturally sensitive and accessible (Lawson et al., 2024).

Empirical studies have consistently demonstrated the benefits of integrated, "one-stop" support systems in addressing diverse

student needs. Power et al. (2020), for example, emphasize that cohesive student services, which combine academic, social, and health-related supports, enhance student outcomes by improving accessibility, reducing fragmentation, and fostering collaborative engagement among professionals. These services are particularly effective for historically underserved or marginalized students, including those with learning differences. For children with dyscalculia and dyslexia, such models offer an opportunity to provide coordinated interventions that simultaneously address learning, emotional resilience, and mental health needs.

The long-term impact of integrated support programs cannot be understated. Research has shown that participation in such systems significantly improves academic achievement, retention, and social outcomes for students, particularly those facing systemic barriers (Lawson et al., 2024; Lee-St. John et al., 2018). These benefits extend beyond primary and secondary education, with long-term positive effects on high school graduation rates, post-secondary enrolment, and career readiness (Kezar and Holcombe, 2018). For students with dyslexia and dyscalculia, the continuity of integrated support across developmental stages ensures that challenges are addressed proactively and consistently, minimizing disruptions to their learning trajectories.

Overall, integrated support systems offer a promising pathway for addressing the complex needs of children with dyscalculia and/or dyslexia. By fostering collaboration among schools, families, and community agencies, these systems create a unified and holistic framework that prioritizes both academic achievement and emotional wellbeing. Such approaches are particularly vital in promoting equitable access to resources and mitigating disparities caused by socioeconomic or cultural barriers. Moving forward, the development of evidence-based, scalable models of integrated support will be essential for enhancing the educational experiences and outcomes of children with specific learning differences.

3 Gaps in research: bridging the divide

Current research on dyscalculia and dyslexia among school-aged children reveals significant gaps, especially concerning the comorbidity of these learning differences. A key issue is the lack of focus on screening, diagnosis, and intervention strategies for individuals experiencing both conditions simultaneously. For instance, the lack of targeted interventions for comorbid dyscalculia and dyslexia is evidenced by studies like Peters et al. (2018), which highlight the compartmentalized nature of current programs that fail to address the overlap between numerical and linguistic deficits. Despite the high comorbidity rate, existing studies often treat dyscalculia and dyslexia as separate, which fails to address the compounded challenges faced by individuals with both. Also, children with both dyscalculia and dyslexia face compounded challenges that affect their learning and development, particularly due to a lack of integrated intervention approaches that simultaneously address literacy and numeracy difficulties. This gap limits the development of targeted support systems for students with intertwined deficits in numerical and language processing.

Another critical gap is the lack of research on culturally and linguistically diverse (CALD) populations. CALD populations face unique barriers in diagnosing learning differences, often due to linguistic differences that complicate accurate assessment. For instance, bilingual children may be misdiagnosed due to difficulties differentiating between language acquisition issues and dyslexia (Taha et al., 2022). The absence of comprehensive studies on these populations perpetuates inequities in access to effective interventions, leaving many without appropriate support. This lack of representation highlights a critical need for research that considers cultural and linguistic differences in assessing and addressing learning differences.

Socio-economic disparities further exacerbate the challenges children with dyscalculia and dyslexia face. Students from economically disadvantaged backgrounds often have limited access to educational resources, specialized support, and early diagnosis (Tan, 2024). These challenges are particularly severe in under-resourced regions, where access to trained professionals and assistive technology is scarce. Without research into the impact of socioeconomic factors on educational support, it is difficult to design equitable interventions that ensure all children receive appropriate assistance, regardless of their socioeconomic status.

The absence of interdisciplinary research also contributes to these gaps (Spence et al., 2024). While dyscalculia and dyslexia have cognitive, neurobiological, and environmental underpinnings, there is little collaboration between neuroscience, psychology, education, and linguistics in developing screening and intervention programs. This siloed approach limits a comprehensive understanding of their comorbidity and prevents the creation of integrated support systems that address both medical and educational needs. The interplay of family, school, and healthcare contexts also remains underexplored, further limiting a holistic approach to supporting these children.

Several factors may explain the research gaps over the past decade. Dyscalculia has received less attention compared to dyslexia, likely due to a focus on literacy's foundational role in academic success. As a result, dyscalculia has been under-researched and misunderstood. Research funding often prioritizes more widely recognized disorders, leaving studies on comorbid learning differences with limited support. Additionally, challenges such as language barriers, cultural differences, and logistical difficulties hinder research on CALD populations and socio-economically disadvantaged groups, leading researchers to focus on more accessible populations. Systemic biases have further exacerbated the underrepresentation of marginalized groups, contributing to inequities in research (e.g., Moreau et al., 2022).

Addressing these gaps is both urgent and essential. Teachers, policymakers, parents, and medical professionals require comprehensive, evidence-based information to provide appropriate support for children with learning differences. For teachers, understanding how comorbidity affects learning is crucial for designing effective classroom interventions. Policymakers need comprehensive data to create equitable policies that provide access to educational resources, screening services, and interventions. Without adequate research, policies will continue to fall short of addressing the needs of students with comorbid dyscalculia and dyslexia, especially those from CALD backgrounds or disadvantaged environments.

Parents also need more information to support their children effectively at home. Without it, families may feel helpless as they struggle to understand and advocate for their children's unique needs. Inclusive research would empower parents with tools and resources, helping them navigate educational and

healthcare systems effectively. For medical professionals, greater emphasis on research into comorbidity, cultural factors, and socioeconomic disparities is warranted for early, accurate diagnosis and effective treatment. Since early intervention is crucial in improving outcomes for children with learning differences, better screening protocols that consider language and cultural differences are essential. Enhanced research could ensure that all children receive timely, individualized support, ultimately fostering better educational and life outcomes.

4 The future of dyscalculia and dyslexia research

Future developments in dyscalculia and dyslexia research should focus on both theoretical and practical approaches that foster a more integrated and supportive learning environment. A key theoretical advancement involves adopting a holistic neurodevelopmental model that merges insights from neuroscience, psychology, and education (Berninger, 2006). This model would move away from treating dyscalculia and dyslexia in isolation and instead view them as interconnected, potentially co-occurring with other neurodevelopmental disorders like ADHD and autism. Such an approach would enable the development of more comprehensive screening tools to assess learning difficulties more broadly, offering nuanced interventions. Neuroimaging research could also help identify specific biomarkers associated with these disorders, facilitating non-invasive early screening in clinical and educational settings.

On a practical level, technological advancements will play a crucial role in enhancing dyscalculia and dyslexia support. AI and computer-based assessments, such as the ones developed by Kariyawasam et al. (2019a), have shown advantages in terms of adaptability, providing real-time adjustments based on student responses. Evidence suggests these tools offer higher scalability an d can reduce biases found in traditional assessments, leading to more personalized learning experiences (Jian, 2023). AI-powered platforms can adapt in real-time to the unique strengths and weaknesses of learners, offering targeted exercises and feedback. These platforms can also track a child's progress over time, enabling educators and parents to make informed, data-driven decisions about effective interventions (Bhardwaj et al., 2024). Such individualized systems could shift learning away from traditional "one-size-fits-all" approaches to more dynamic and responsive support for students with these learning differences.

The development of integrated support systems involving schools, families, and healthcare providers is another key advancement (e.g., Domitrovich et al., 2010). A shared digital platform for a child's educational and developmental records could facilitate seamless communication among teachers, parents, speech pathologists, and other professionals, ensuring continuity of care. Such an ecosystem would promote collaboration on IEPs and provide early intervention when challenges arise, mitigating the impact of dyscalculia and dyslexia on a child's educational journey.

The socio-emotional impact of dyscalculia and dyslexia is a crucial area for future research, as understanding how these disorders affect children's mental health, self-esteem, and social relationships can lead to interventions that foster not only academic skills but also emotional resilience (Tan, 2024). Integrating mental health professionals alongside educators would create a comprehensive support framework addressing both cognitive and emotional needs. Teacher training also plays a vital role in the future of dyscalculia and dyslexia support (Griffiths, 2020). Initial teacher education programs, therefore, should include specialized modules on these learning differences, equipping educators with the skills needed to identify and support students effectively. Professional development for current educators must also be expanded to include strategies for differentiated instruction and the effective use of assistive technologies (Al-Bukhari, 2024), thereby promoting a responsive and inclusive learning environment for all students, including those from diverse cultural and linguistic backgrounds. Additionally, policy developments are equally crucial (Hardy and Woodcock, 2024). Comprehensive policies should mandate early screening for learning differences at multiple stages, ensuring timely identification and intervention. Policymakers must prioritize funding for interventions that address the needs of students with multiple disabilities and incentivise schools to adopt inclusive practices, ensuring equitable access to quality education for marginalized communities.

Both dyslexia and dyscalculia are recognized as forms of neurodivergence, involving differences in brain structure and function that affect learning processes. Rather than viewing these conditions solely as deficits, the neurodiversity perspective acknowledges the strengths that often accompany them (Goldberg, 2023). For instance, individuals with dyslexia may excel in creative or holistic thinking. By focusing on these strengths, educational systems could shift toward an asset-based approach that encourages students to leverage their abilities while providing support for their specific challenges. This perspective could reshape how we understand and support individuals with learning differences, promoting both academic success and personal development.

Future research should also focus on the long-term outcomes of individuals with dyscalculia and dyslexia, extending beyond their school years (e.g., Menghini et al., 2010). Understanding how these learning differences affect higher education, career opportunities, and adult life is essential for creating support systems that help individuals thrive in various aspects of their lives. Addressing these long-term impacts can lead to the development of programs that support key life transitions, such as moving from school to work, ultimately ensuring that people with dyscalculia and dyslexia are empowered to succeed and contribute meaningfully to society.

5 Conclusion

The comorbidity of dyscalculia and dyslexia poses substantial educational challenges, requiring tailored approaches for effective screening, diagnosis, and intervention. Advances in technology, such as machine learning, offer potential for better detection and personalized support. However, significant gaps remain, particularly in addressing comorbid cases, diverse cultural needs, and socio-economic disparities in access to support. Future efforts must focus on integrated educational, psychological, and technological strategies. By bridging these gaps, educators, policymakers, and healthcare professionals can create a more inclusive and supportive learning environment, ultimately enhancing educational outcomes for children with these learning differences.

Limitations of this review include its focus on English-language publications, which may have led to the exclusion of relevant studies published in other languages. Additionally, the scope was restricted to recent literature, potentially omitting older but foundational research. Generalizing findings across different educational contexts should also be approached with caution, given the diversity in policies and practices globally.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The author(s) declare that no generative AI was used in the creation of this manuscript.

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