

Developmental Dyslexia in Children: A Narrative Review of Evidence-Based Interventions, Parenting Approaches, and Assistive Technologies

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ABSTRACT

Background: Developmental dyslexia is a neurobiological learning disorder that significantly affects reading, spelling, and academic achievement. It is often misunderstood and underdiagnosed, which may result in long-term educational and emotional consequences.

Materials And Methods: This narrative literature review synthesized 19 key references, including peer-reviewed studies and foundational sources relevant to dyslexia. Foundational references published before 2000 were included only to support definitions and theoretical background. Databases searched included PubMed, ProQuest, Academia.edu, and Google Scholar. The review focused on academic interventions, parenting approaches, and assistive technologies for school-aged children with dyslexia.

Results: Phonological awareness training, structured literacy programmes, and multisensory methods were identified as effective academic interventions. Parenting approaches characterized by emotional responsiveness and structured routines were associated with better academic engagement and psychological well-being. Assistive technologies, including text-to-speech and speech-to-text software, were found to improve accessibility, promote independence, and enhance learning participation.

Conclusion: A comprehensive and multidisciplinary approach that integrates evidence-based educational strategies, family involvement, and technological support is essential to support children with dyslexia. Further research is needed to refine and contextualize these interventions across diverse educational settings.

Keywords: Dyslexia; Learning Disorders; Educational Technology; Parent–Child Relations; Teaching; Assistive Technology

INTRODUCTION

Developmental dyslexia is a specific learning disorder characterized by persistent difficulties in learning to read, which cannot be explained by low intelligence, visual or auditory impairments, or inadequate educational instruction ⁽¹⁾. It is the most common form of learning disability, accounting for approximately 80% of all identified cases ⁽²⁾, and affects an estimated 5% to 17.5% of school-aged children worldwide ⁽³⁾. Children with dyslexia frequently experience challenges in both academic and social domains. These difficulties often result

in heightened anxiety related to reading tasks, reduced self-esteem, and the development of negative attitudes toward learning.

In recent years, there has been a growing emphasis on inclusive education and early intervention strategies aimed at supporting children with learning disabilities such as dyslexia. Educators and parents play a pivotal role in this process by adopting effective teaching methods and supportive parenting approaches. Moreover, the advancement of assistive technologies has expanded access to educational resources, offering dyslexic learners alternative means to engage with academic content and communicate effectively.

Despite these advancements, many students with dyslexia continue to face significant barriers due to limited awareness, insufficient support systems, and the lack of individualized interventions. Educational frameworks must also reflect cultural sensitivity and emphasize empathy, the pursuit of knowledge, and respect for individual differences.

Although numerous studies have examined dyslexia interventions, fewer reviews have integrated academic interventions, parenting approaches, and assistive technologies within one inclusive educational framework. Therefore, this narrative review aims to: (1) identify evidence-based academic interventions for children with dyslexia; (2) examine the role of parenting approaches in supporting academic and emotional development; and (3) evaluate assistive technologies that support accessibility, independence, and learning participation among dyslexic learners.

MATERIALS AND METHODS

This narrative literature review was conducted to explore effective academic interventions for children with dyslexia, investigate the influence of parenting styles, and evaluate the role of assistive technologies in supporting learning. A comprehensive search strategy was employed across multiple electronic databases, including PubMed, ProQuest, Academia.edu, and Google Scholar. The search utilized Boolean operators to combine relevant terms such as “dyslexia,” “learning disability,” “assistive tool,” and “intervention for students with reading disabilities,” to ensure broad coverage of pertinent literature.

Inclusion and Exclusion Criteria

The selection of articles was guided by clearly defined inclusion and exclusion criteria to ensure that the reviewed literature was relevant to the objectives of this narrative review. The criteria focused on publication year, language, study population, article type, and relevance to dyslexia interventions, parenting approaches, and assistive technologies.

Table 1. Inclusion and exclusion criteria for article selection

Criteria	Inclusion Criteria	Exclusion Criteria
Publication year	Articles published between 2000 and 2025 were included in the main thematic synthesis.	Articles published before 2000 were excluded from the main synthesis, except for foundational references used to support definitions or theoretical background.
Language	Articles written in English were included.	Articles written in languages other than English were excluded.
Type of publication	Peer-reviewed journal articles, empirical studies, review articles, and scholarly publications relevant to dyslexia were included.	Non-peer-reviewed sources, opinion pieces, blogs, magazines, and non-academic websites were excluded.
Study population	Studies involving school-aged children, particularly those aged between 5 and 17 years, were included.	Studies focusing mainly on adults, university students, or non-school populations were excluded.

Main focus	Studies addressing developmental dyslexia, reading difficulties, academic interventions, parenting approaches, or assistive technologies were included.	Studies focusing on unrelated learning disabilities, general academic difficulties, or conditions not specifically related to dyslexia were excluded.
Intervention relevance	Studies discussing evidence-based educational interventions, structured literacy, phonological awareness training, multisensory approaches, or reading support strategies were included.	Studies focusing only on medical treatment, non-academic therapy, or interventions unrelated to reading and learning support were excluded.
Parenting relevance	Studies examining parental involvement, parenting styles, home learning support, emotional support, or parent-child relationships in the context of dyslexia or learning disabilities were included.	Studies discussing general parenting without relevance to dyslexia, learning disabilities, or educational outcomes were excluded.
Technology relevance	Studies discussing assistive technologies such as text-to-speech, speech-to-text, word prediction software, digital learning tools, or other educational technologies for dyslexic learners were included.	Studies discussing general technology use without specific application to dyslexia or learning support were excluded.
Relevance to review objectives	Articles that contributed directly to at least one of the three main themes of this review—academic interventions, parenting approaches, or assistive technologies—were included.	Articles that did not contribute directly to the objectives or thematic focus of the review were excluded.

These criteria were applied during the title, abstract, and full-text screening stages to ensure that only relevant and academically credible sources were included in the review. Although this study was designed as a narrative review rather than a systematic review, the use of predefined criteria helped to improve the transparency and consistency of the article selection process.

Screening and Data Extraction

An initial pool of sixty-one articles was identified through database searches. Following a screening process based on title and abstract review, thirty-eight articles were excluded for not meeting the established criteria. The remaining twenty-three articles were selected for full-text analysis and inclusion in the review. As this was a narrative review, no formal risk-of-bias assessment was conducted; however, studies were selected based on relevance, peer-reviewed status and methodological clarity. Data extracted from these articles were synthesized thematically and organized into four central areas of focus: definition and symptoms of dyslexia, academic interventions, parenting approaches, and the application of assistive technologies. This thematic approach enabled a nuanced understanding of interdisciplinary strategies for supporting children with dyslexia.

LITERATURE REVIEW

The findings are presented according to four major themes: definition and symptoms of dyslexia, educational interventions, parenting approaches, and assistive technologies.

Definition of Dyslexia

The term “dyslexia” is derived from the Greek words *dys*, meaning “difficulty,” and *lexia*, meaning “words” or “language,” reflecting a fundamental difficulty with word recognition and reading ⁽⁴⁾. Developmental dyslexia is widely acknowledged as a neurobiological learning disorder that selectively affects language-based processing skills, particularly reading fluency, decoding, and spelling, despite adequate intelligence, socio-economic opportunity, and educational exposure ^(1,5).

Unlike general cognitive impairments or delays due to environmental factors, dyslexia involves specific deficits, particularly in phonological processing—the ability to identify and manipulate the sound structures of language. This deficit interferes with the accurate translation of written text into spoken language and is considered a core feature of dyslexia ⁽⁶⁾. Neuroimaging studies have consistently demonstrated that individuals with dyslexia exhibit atypical neural activation patterns and disrupted connectivity across several regions of the brain associated with language processing, including the temporoparietal junction, the insula, and the inferior frontal gyrus ⁽⁷⁾. Reduced activity in these areas is associated with difficulties in phonological decoding, verbal working memory, and speech planning, all of which are central to reading development.

Importantly, dyslexia is not indicative of low intellectual potential or global cognitive deficits. Instead, it reflects a selective weakness in the neural architecture that supports reading and language processing, while other areas of cognitive function often remain intact ^(4,8). Understanding dyslexia as a neurodevelopmental disorder with distinct cognitive and neurological underpinnings is essential for fostering early identification, developing effective interventions, and promoting inclusive educational practices. This definition is important for educators because dyslexia requires instructional adaptation rather than assumptions of low ability.

Symptoms of Dyslexia and How It Affects Learning Ability

Dyslexia manifests through a broad spectrum of cognitive and behavioural symptoms, most notably affecting reading, writing, and language-related tasks. One of the hallmark features of dyslexia is a deficit in phonological processing, which refers to the difficulty in recognizing and manipulating the sound structures of language. This includes impaired phonemic awareness, which limits the ability to identify, segment, and blend sounds in words, thereby compromising reading fluency and decoding accuracy ^(4,6).

To provide a clearer overview of how dyslexia affects learning, the common symptoms can be organized according to the specific area of difficulty and their educational implications, as shown in Table 2.

Table 2. Common symptoms of dyslexia and their educational implications.

Area Affected	Common Symptoms	Educational Implication
Phonological processing	Difficulty identifying, segmenting, blending, and manipulating sounds in words. Children may struggle to connect letters with their corresponding sounds.	Affects decoding, word recognition, spelling accuracy, and early reading development.
Reading accuracy	Frequent misreading of words, omission of words, substitution of similar-looking or similar-sounding words, and difficulty recognizing familiar words automatically.	Leads to slow reading progress and difficulty reading at grade level.
Reading fluency	Slow, hesitant, and effortful reading. Students may pause frequently, reread lines, or lose their place while reading.	Reduces reading speed and makes reading tasks tiring, which may affect comprehension and classroom participation.
Reading comprehension	Difficulty understanding the meaning of a text, especially when significant effort is used for decoding individual words.	Limits the ability to extract key ideas, answer comprehension questions, and engage with academic texts.
Spelling and writing	Inconsistent spelling errors, difficulty remembering spelling patterns, letter reversals, and problems organizing written ideas.	Affects written assignments, note-taking, examination answers, and overall academic performance.
Auditory processing	Difficulty distinguishing similar sounds, following multi-step oral instructions, or remembering verbal information in sequence.	May affect listening comprehension, classroom instruction, and language-based learning activities.
Visual and orthographic processing	Difficulty recognizing word patterns, confusing visually similar letters, and problems tracking text across a page.	May interfere with word recognition, reading continuity, and copying from books or the board.

Working memory and sequencing	Difficulty remembering sequences such as days of the week, instructions, spelling patterns, or steps in a task.	Affects task completion, organization, problem-solving, and independent learning.
Executive functioning and organization	Problems with time management, planning, organizing school materials, and completing assignments within the given time.	May result in incomplete work, poor study habits, and increased dependence on teachers or parents.
Emotional and behavioural responses	Frustration, avoidance of reading tasks, low self-esteem, anxiety, embarrassment, or reluctance to participate in oral reading.	May reduce motivation, classroom engagement, confidence, and long-term academic resilience.
Second-language learning	Difficulty learning new vocabulary, pronunciation, spelling, and grammar patterns in an additional language.	May make foreign-language learning more challenging and require additional instructional support.

These symptoms show that dyslexia does not only affect reading accuracy, but also influences broader aspects of learning, including comprehension, writing, classroom participation, emotional well-being, and independent study skills. Although letter and number reversals, such as confusing “b” with “d” or “6” with “9”, may occur among some children, these features alone should not be considered definitive indicators of dyslexia without broader reading and phonological assessment.

The severity and combination of symptoms may vary widely among individuals and may present differently according to age, educational environment, language background, and available support systems. Therefore, early identification and individualized support are essential to reduce academic frustration, prevent negative self-perception, and promote more inclusive learning experiences for children with dyslexia.

Interventions for Dyslexic Children

Interventions for children with dyslexia should be evidence-based, structured, and responsive to the specific learning difficulties experienced by the child. Since dyslexia primarily affects phonological processing, decoding, reading fluency, spelling, and comprehension, the most effective interventions are those that directly address these core areas. In addition, supportive interventions that focus on emotional well-being and classroom engagement are also important to promote confidence and long-term academic resilience.

Phonological Awareness Training

Phonological awareness training is one of the most widely supported interventions for children with dyslexia. It focuses on improving the child’s ability to recognize, segment, blend, and manipulate the sounds of language. These skills are essential for learning to decode words and develop accurate reading. Children with dyslexia often experience difficulties in connecting sounds with letters, and therefore systematic training in phonemic awareness can strengthen early reading development.

Phonological awareness activities may include identifying beginning and ending sounds, blending sounds to form words, segmenting words into individual sounds, and manipulating sounds within words. When delivered consistently and intensively, this form of intervention has been shown to improve decoding, spelling, and word recognition skills, particularly among young learners with reading difficulties ^(6,10).

Structured Literacy

Structured literacy is another key evidence-based approach for supporting dyslexic learners. This approach emphasizes explicit, systematic, sequential, and cumulative instruction in phonology, phonics, syllable patterns, morphology, syntax, and spelling rules. Unlike general reading instruction, structured literacy provides direct teaching of how language works, which is particularly beneficial for students who do not acquire reading skills naturally through exposure alone.

Examples of structured literacy programmes include the Orton-Gillingham approach, the Wilson Reading System, and the Barton Reading and Spelling System. These programmes break reading and spelling into

smaller, manageable components and provide repeated practice until mastery is achieved. Such approaches are particularly useful for improving decoding accuracy, spelling, reading fluency, and overall word recognition among children with dyslexia ^(12,13).

Multisensory Intervention

Multisensory intervention is commonly used in dyslexia support because it engages more than one learning pathway at the same time. This approach combines visual, auditory, kinesthetic, and tactile modalities to strengthen memory and learning. For example, children may be asked to see a letter, say its sound, hear the sound, and trace the letter using their finger. This simultaneous use of multiple senses helps reinforce the connection between letters, sounds, and motor memory.

The Orton-Gillingham approach is one example of a multisensory method that has been widely applied in dyslexia intervention. Multisensory teaching is especially useful for learners who struggle with traditional text-based instruction because it allows them to process information through different channels. However, these interventions often require trained instructors, individualized attention, and consistent implementation over time to achieve meaningful outcomes ^(12,13).

Comprehension Support

Although dyslexia is often associated with decoding and word recognition difficulties, reading comprehension can also be affected. When children use too much cognitive effort to decode individual words, they may have fewer mental resources available to understand the meaning of the text. Therefore, comprehension support should be included as part of dyslexia intervention.

Effective comprehension strategies include reciprocal teaching, questioning, predicting, clarifying, summarizing, and the use of graphic organizers. These strategies help students actively engage with the text and organize information more clearly. Graphic organizers, for example, can help students identify main ideas, supporting details, sequences, and relationships between concepts. Such approaches are useful not only for reading comprehension but also for improving classroom learning and academic writing ^(14,15).

Socio-emotional Support

In addition to academic intervention, socio-emotional support is essential for children with dyslexia. Repeated reading failure may lead to frustration, low self-esteem, anxiety, avoidance of reading tasks, and reduced motivation to participate in classroom activities. Therefore, intervention should not focus only on reading skills, but also on the child's emotional adjustment and learning confidence.

Supportive strategies may include positive reinforcement, counselling, peer support, teacher encouragement, and classroom accommodations. Cognitive Behavioural Therapy may also be helpful for children who experience anxiety, negative self-beliefs, or emotional distress related to academic difficulties. However, it is important to note that socio-emotional interventions do not directly remediate decoding or spelling difficulties. Instead, they support emotional well-being, resilience, and school engagement, which can indirectly improve learning outcomes ^(6,17).

Summary of Intervention Approaches

Overall, interventions for dyslexic children should combine direct reading instruction with broader learning and emotional support. Phonological awareness training, structured literacy, and multisensory approaches can be considered core evidence-based academic interventions because they directly target reading-related difficulties. In contrast, comprehension strategies and socio-emotional support function as complementary interventions that enhance learning participation, confidence, and overall educational adjustment. A comprehensive and individualized intervention plan is therefore necessary to address the diverse academic, cognitive, and emotional needs of children with dyslexia.

Table 3. Types of interventions for children with dyslexia

Intervention Type	Main Focus	Examples	Expected Benefit
Phonological awareness training	Sound awareness and sound manipulation	Blending, segmenting, phoneme identification	Improves decoding, spelling, and early reading skills
Structured literacy	Explicit and systematic reading instruction	Orton-Gillingham, Wilson Reading System, Barton Reading and Spelling System	Improves word recognition, spelling, and reading fluency
Multisensory intervention	Learning through visual, auditory, tactile, and kinesthetic pathways	Tracing letters, saying sounds aloud, using manipulatives	Strengthens memory, engagement, and letter-sound association
Comprehension support	Understanding and organizing meaning from text	Summarizing, questioning, predicting, graphic organizers	Improves reading comprehension and academic understanding
Socio-emotional support	Emotional adjustment and learning confidence	Counselling, positive reinforcement, peer support, CBT	Reduces anxiety, improves motivation, and supports classroom engagement

Parenting Approaches in Supporting Children with Dyslexia

Parenting plays a pivotal role in shaping both the academic outcomes and emotional well-being of children with dyslexia. While formal educational support is critical, the influence of the home environment and parental behavior is equally significant in facilitating learning, fostering resilience, and supporting psychological adjustment. Dyslexia presents ongoing challenges that extend beyond school settings, and parenting approaches can either buffer or exacerbate the impact of these difficulties.

A supportive and emotionally responsive parenting style is widely associated with positive developmental outcomes for children with learning disabilities. This approach emphasizes effort over outcomes, provides consistent encouragement, and nurtures a growth mindset. By creating a safe and affirming space at home, parents can help children manage frustration and anxiety often associated with academic underachievement⁽⁶⁾. Emotional validation and positive reinforcement enhance self-concept and motivation, particularly in children who face persistent difficulties with reading and writing.

A structured home environment also contributes significantly to learning stability. Consistency in daily routines, clearly defined expectations, and organized schedules can mitigate the executive functioning deficits common among dyslexic learners, such as difficulties with time management, sequencing, and attention regulation⁽¹⁰⁾. Parents who establish dedicated study periods, reading practice sessions, and predictable routines provide children with the scaffolding necessary to develop effective learning habits and reduce academic stress.

Parental involvement in the child's educational journey is another essential dimension. Collaborative engagement with teachers, specialists, and the child in developing individualized learning strategies enhances academic outcomes and fosters a sense of agency in the learner. Responsive parents who recognize their child's strengths and challenges are better equipped to tailor support and adjust expectations, which contributes to improved academic engagement and reduced behavioral problems⁽¹⁸⁾.

Equally important is the promotion of emotional regulation and psychological resilience through nurturing parenting. Children with dyslexia often experience repeated academic failures that can lead to avoidance behaviors, low self-worth, and school-related anxiety. A protective and patient parenting approach can act as a buffer against these negative outcomes, helping children persevere despite setbacks⁽⁶⁾. Parents who encourage independence while maintaining emotional availability support the development of autonomy and confidence.

In contrast, authoritarian or overly critical parenting styles, which emphasize high performance without adequate attention to emotional needs, may contribute to increased stress and reduce a child's motivation to engage in

learning. Unrealistic expectations and punitive responses to academic struggles may lead to increased resistance, withdrawal, or internalized distress, thereby undermining academic and emotional development ⁽¹⁸⁾.

In sum, the most effective parenting strategies for children with dyslexia are those that combine emotional warmth, structured routines, collaborative decision-making, and patient guidance. When integrated with appropriate educational and therapeutic interventions, such parenting styles serve as a protective factor, reinforcing academic achievement, emotional stability, and long-term well-being. As dyslexia is a lifelong condition, parental involvement remains essential throughout the child's development to promote adaptive coping and continuous growth.

Role of Technology and Assistive Tools in Supporting Dyslexic Students

Technological innovations have significantly transformed the landscape of special education, offering dyslexic students greater access to learning resources, improved communication, and enhanced academic performance. Assistive technologies, in particular, are instrumental in helping learners bypass the challenges of decoding, encoding, and organizing written information. These tools provide personalized support that addresses the specific cognitive and processing deficits associated with dyslexia.

One of the most widely used forms of support is Text-to-Speech (TTS) software, which allows students to listen to written content being read aloud. This technology is especially beneficial for students who struggle with decoding and reading fluency. TTS tools such as Kurzweil 3000 and Natural Reader enhance reading comprehension by engaging the auditory channel while enabling visual tracking of text. These programs also offer digital highlighting and note-taking features that further support understanding and retention ^(16,19). Audiobook services such as Bookshare and Learning Ally provide dyslexic students with access to grade-level reading materials in audio format, thereby reducing cognitive load and fostering a more positive reading experience.

In the domain of writing, many students with dyslexia face difficulties with spelling, grammar, and organizing ideas. Speech-to-Text (STT) software addresses these challenges by allowing students to dictate their thoughts, which are then transcribed into written text. Tools like Dragon NaturallySpeaking and Google Voice Typing enable students to focus on the content of their ideas without being hindered by mechanical aspects of writing. This promotes fluency, reduces frustration, and encourages more authentic expression ⁽¹⁶⁾. Additionally, word prediction software such as Co:Writer and Ghotit Real Writer helps students construct sentences more efficiently by suggesting contextually appropriate vocabulary and correcting spelling and grammatical errors in real time.

Handwriting-related difficulties are also common among dyslexic learners. Mobile applications such as Snap Type allow students to take pictures of printed worksheets and type their answers directly onto the images, eliminating the need for handwriting. These applications often include customizable visual settings—such as adjustable text size, font, and background color—that can be tailored to suit individual preferences and visual processing needs.

Another critical area of support involves organizational tools. Dyslexic students frequently experience difficulties with sequencing, planning, and managing information. Digital note-taking tools like OneNote and Notability offer multiple modalities—typed, handwritten, and audio—to accommodate diverse learning styles. These tools help students organize class materials, integrate multimedia content, and revisit recorded lessons, enhancing information retention and study efficiency. For students who benefit from visual learning, mind mapping applications such as Inspiration and Mind Meister enable them to visually structure ideas, which is particularly effective for brainstorming, planning essays, or understanding complex concepts ⁽¹⁹⁾.

The increasing availability of mobile-based assistive tools further enhances accessibility and convenience. These applications are adaptable across settings—school, home, or travel—enabling students to engage with content wherever they are. The portability and customizability of mobile technology support independent learning, build confidence, and promote self-advocacy.

Despite these benefits, assistive technologies require teacher training, affordability, accessibility, and continuous support to ensure effective implementation. Not all students have equal access to digital devices, stable internet connection, or trained educators who can guide the effective use of these tools. Therefore, the successful integration of assistive technology depends not only on the availability of digital tools, but also on appropriate training, institutional support, and individualized implementation.

In conclusion, assistive technologies play an essential role in addressing the multifaceted challenges faced by students with dyslexia. By supporting reading fluency, writing skills, and executive functioning, these tools not only enhance academic achievement but also contribute to the development of self-efficacy and autonomy. The integration of technology into dyslexia support systems is not merely supplementary; it is increasingly important for inclusive, equitable, and effective education for diverse learners.

CONCLUSION

This narrative review highlights that developmental dyslexia is a complex neurodevelopmental condition that affects not only reading and spelling, but also children's emotional well-being, classroom participation, and long-term academic development. The findings of this review contribute to the literature in three main areas: evidence-based academic interventions, parenting approaches, and assistive technologies for supporting dyslexic learners.

First, this review emphasizes the importance of evidence-based academic interventions that directly address the core difficulties experienced by children with dyslexia. Phonological awareness training, structured literacy instruction, and multisensory teaching approaches remain central strategies for improving decoding, word recognition, spelling, reading fluency, and comprehension. These interventions are most effective when they are explicit, systematic, individualized, and delivered consistently over time.

Second, this review shows that parenting approaches play a significant role in supporting the academic and emotional development of children with dyslexia. Emotionally responsive parenting, structured routines, positive reinforcement, and active collaboration with teachers can help children develop confidence, motivation, and resilience. In contrast, overly critical or unrealistic expectations may increase anxiety and reduce children's engagement with learning. Therefore, parental support should be viewed as an essential component of dyslexia intervention rather than a secondary factor.

Third, this review identifies assistive technologies as important tools for promoting accessibility and independent learning among dyslexic students. Text-to-speech, speech-to-text, word prediction software, audiobooks, digital note-taking tools, and mind-mapping applications can reduce the cognitive burden associated with reading and writing tasks. These technologies do not replace direct reading intervention, but they provide meaningful support that enables students to access learning materials, express ideas, and participate more confidently in academic activities.

Overall, the effective support of children with dyslexia requires a comprehensive and multidisciplinary approach that integrates educational intervention, family involvement, and appropriate technological support. Teachers, parents, specialists, and policymakers should work collaboratively to ensure early identification, individualized support, and inclusive learning environments. Future research should further examine the effectiveness of integrated intervention models across diverse cultural, educational, and socio-economic contexts to strengthen support systems for dyslexic learners.

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Conflicts of interest

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