University of Hormozgan

Iranian Journal of Educational Research

Print ISSN: 1735 - 563X Online ISSN: 2980 - 874X

Homepage: http://ijer.hormozgan.ac.ir

Educational and Behavioral Research Center

The Effectiveness of Technology-Based Cognitive Interventions on Improving Executive Functions and Reading Skills of Dyslexic Students: A Systematic Review of Iranian Research

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Article Info

Article type:

Research Article

Article history:

Received 12 Jul. 2025

Received in revised form 14 Aug. 2025

Accepted 06 Sep. 2025

Published online 01 Dec. 2025

Keywords:

Cognitive interventions,
Dyslexia,
Executive functions,
Reading skills,
Technology-based

ABSTRACT

Objective: The aim of the present study was to investigate the effectiveness of technology-based cognitive interventions on improving the executive functions and reading skills of dyslexic students.

Methods: The research method was a systematic review. Persian studies conducted in the last 5 years in the SID, Magiran, Google Scholar, Ensani, and Civilica databases were reviewed. After applying the inclusion and exclusion criteria according to the PRISMA model, 41 valid articles were reviewed from 189 searched studies.

Results: The research findings were categorized into five categories: "computer-based software," "neurofeedback intervention," "Transcranial Direct Current Stimulation (tDCS)," "mobile phone-based interventions," and "augmented reality intervention." The most interventions conducted were related to computer-based software (29 studies), followed by neurofeedback intervention with 8 studies, Transcranial Direct Current Stimulation (tDCS) with 4 studies, mobile phone-based interventions with 2 studies, and augmented reality interventions with 1 study.

Conclusions: The results of the study, while explaining the functions of each of the above effective interventions, emphasize the importance of combining these interventions and determining their effectiveness simultaneously in the form of a single intervention program.

Cite this article: Nikbin, N., Ghasemi, S. A., Asgharinekah, S. M. & Malakooti, F. (2025). The effectiveness of technology-based cognitive interventions on improving executive functions and reading skills of dyslexic students: a systematic review of Iranian research. *Iranian Journal of Educational Research*, 4 (4), 1-35.
. DOI: https://doi.org/10.22034/4.4.1

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Publisher: University of Hormozgan.
DOI: https://doi.org/10.22034/4.4.1

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[DOI: 10.22034/ijer.4.4.16]

Introduction

The Specific learning disorders represent one of the most prevalent challenges in childhood education, often affecting students' abilities in reading, writing, mathematics, listening, verbal expression, and sometimes motor skills (Marchese et al., 2022). Dyslexia, also known as "reading disability," is the most common specific learning disorder (Scaria et al., 2022) characterized by difficulties in accurate or fluent word recognition, poor decoding, and weak spelling abilities (Pedemonte et al., 2024). These difficulties are not caused by hearing or vision problems, socio-economic factors, cultural or linguistic differences, lack of motivation, or inadequate instruction (Muktamath et al., 2021).

Experts identify the most significant characteristic of dyslexia as a reading skill disorder (Hoseinzadeh et al., 2024), which causes affected individuals to have weak reading and even writing abilities, despite the fact that this issue is unrelated to their intelligence quotient (Alqahtani et al., 2023). Reading is a complex process involving visual, phonological, and decoding skills, with cognitive-linguistic abilities and executive functions playing a central role (Zoghi Paydar et al., 2024; Ruan et al., 2024). The challenges faced by children with dyslexia are not limited to reading (Shamshiri et al., 2024), as this issue is closely linked to executive functions (Vismeh et al., 2023). Children with dyslexia exhibit increased inattention and impulsivity, along with reduced active memory, all of which reflect dysfunction in their executive functions (Chutko et al., 2022). Executive functions refer to a broad concept and a set of cognitive processes that enable individuals to control their attention and regulate their behavior (Frischen et al., 2022). These functions include working memory, problem-solving, inhibitory control, planning, cognitive flexibility, and emotional regulation (Sonbol et al., 2024; Ramos-Galarza et al., 2023).

Epidemiological and longitudinal studies indicate that dyslexia is a highly prevalent neurodevelopmental disorder, affecting approximately 20% of children worldwide and impacting boys and girls equally (Shaywitz et al., 2021). In Iran, recent prevalence estimates vary, with studies reporting rates of 5.8% (Echarshavi et al., 2020), 9.9% (Yavari et al., 2020), and up to 23.8% (Dashtipour et al., 2024), reflecting differences in assessment methods and populations studied. Dyslexia often co-occurs with other learning disorders, with overlap rates between 20% and 70% (Pedemonte et al., 2024). This comorbidity underscores the complex and interrelated nature of neurodevelopmental difficulties in children with dyslexia and highlights the critical need

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for timely, evidence-based, and comprehensive interventions to address both core symptoms and associated challenges.

Given these considerations, dyslexia is a treatable disorder that can be significantly improved through early and timely intervention (Farghaly et al., 2022). Various interventions have been designed to reduce reading difficulties and improve the executive functions of children with dyslexia. Among these, technology-based cognitive interventions have gained prominence due to their distinct advantages. Advancements in cognitive sciences have led to the emergence of technology-based cognitive interventions as a promising approach for students with dyslexia. These interventions focus on the language, memory, and executive functions of individuals and are based on the principles of neuroplasticity and self-repairing of the brain (Shamshiri et al., 2024). Due to the widespread use of computers, these interventions are designed and implemented in a computerized format (Seif et al., 2021) and offer several advantages, including high accuracy in information processing, a variety of adaptable programs, and the flexibility to be used in diverse settings—often without the need for continuous specialist supervision (Ranjbar et al., 2019). Such features underscore the growing importance and effectiveness of technology-based interventions in addressing the complex challenges faced by children with dyslexia.

Numerous findings highlight the effectiveness of such interventions on the reading skills and executive functions of children with dyslexia. In a study, Shamshiri et al. (2024) examined the efficacy of a computer-based cognitive rehabilitation program called " Captain’s Log." The results indicated that this intervention could significantly sustain its impact over time and take a significant step toward improving the executive functions and reading performance of students with dyslexia. Farghaly et al. (2022) designed a technology-based program, which, upon implementation, led to a significant increase in the average reading scores of children with dyslexia. Basharpoor et al. (2024) implemented the computer-based executive function training on children with dyslexia, and the results showed that their intervention improved the reading performance of dyslexic children by enhancing their cognitive abilities, such as working memory, inhibitory control, and cognitive flexibility—abilities essential for normal reading proficiency. Additionally, Salehi et al. (2023) in investigating the effect of computer-assisted cognitive rehabilitation based on working memory concluded that this program, by creating a unique

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learning experience, had a significant effect on the core components of working memory in children with dyslexia.

Despite the promising outcomes of technology-based cognitive interventions, the current body of research in Iran remains fragmented, lacking an integrated perspective on their implementation, effectiveness, and contextual challenges. There is a pressing need to consolidate existing evidence to better understand the role and limitations of such interventions in improving the executive and reading-related outcomes of children with dyslexia within the national educational context. Accordingly, the present study seeks to conduct a systematic review of domestic research on technology-based cognitive interventions for dyslexia. By synthesizing findings, identifying methodological gaps, and organizing existing data into meaningful categories, this review aims to propose a conceptual framework to inform future research and practice. The central purpose of this article is to critically analyze and categorize Iranian studies on technology-based cognitive interventions for children with dyslexia, highlight existing research gaps, and offer structured recommendations to guide future academic inquiry and intervention design.

Material and Methods

Study Design

This study employed a systematic review approach to examine the effectiveness of technology-based cognitive interventions on improving executive functions and reading skills among students with dyslexia. The review focused on empirical studies published between April 2020 and 2024, with the aim of identifying patterns, strengths, and gaps in the existing domestic literature.

Search Strategy

To locate relevant studies, a comprehensive search was conducted using a combination of keywords, including effectiveness, impact, intervention, computer, computerized, technology, cognitive, cognitive-technology, neurofeedback, software, electrical stimulation, executive functions, reading skills, reading ability, dyslexic students, and dyslexia. These terms were applied in both Persian and English, depending on the database's language settings. The databases included in the search were SID, Magiran, Google Scholar, Ensani, and Civilica. These databases were selected for their coverage of peer-reviewed Persian-language publications in psychology, education, and related fields.

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Study Selection and Screening

All retrieved articles underwent an initial screening process based on their titles and abstracts. Studies were excluded if they were deemed irrelevant, duplicated, low in methodological quality, or focused on populations other than students with dyslexia (e.g., adults). Other exclusion criteria included being case reports, letters to the editor, symposium or conference presentations, or articles published in non-peer-reviewed journals. Furthermore, studies that solely employed regression analyses, structural equation modeling, or path analysis without evaluating intervention outcomes were also excluded. After this preliminary screening, the full texts of the remaining articles were examined in depth to assess their methodological rigor and relevance to the research objectives.

Inclusion and Exclusion Criteria

To ensure consistency and relevance in the final selection, specific inclusion and exclusion criteria were applied. Included studies had to be published in Persian, peer-reviewed, and directly examine technology-based cognitive interventions targeting students with dyslexia. Moreover, the interventions needed to address either executive functions, reading skills, or both. Studies were excluded if they targeted non-dyslexic populations, lacked an intervention component, relied solely on theoretical or descriptive analyses, or used traditional (non-technological) methods.

Data Extraction and Analysis

Once the final set of eligible articles was identified, relevant information was systematically extracted, including study design, sample characteristics, type and duration of the intervention, tools used for assessment, and key findings. This information was used to compare methodological approaches and intervention outcomes across studies, and to synthesize the evidence regarding the effectiveness of various technology-based cognitive strategies. Moreover, Flowchart 1 illustrates the study selection process following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (O'Dea et al., 2021). The research methodology, applied tools, and key findings of all selected studies have been systematically documented.

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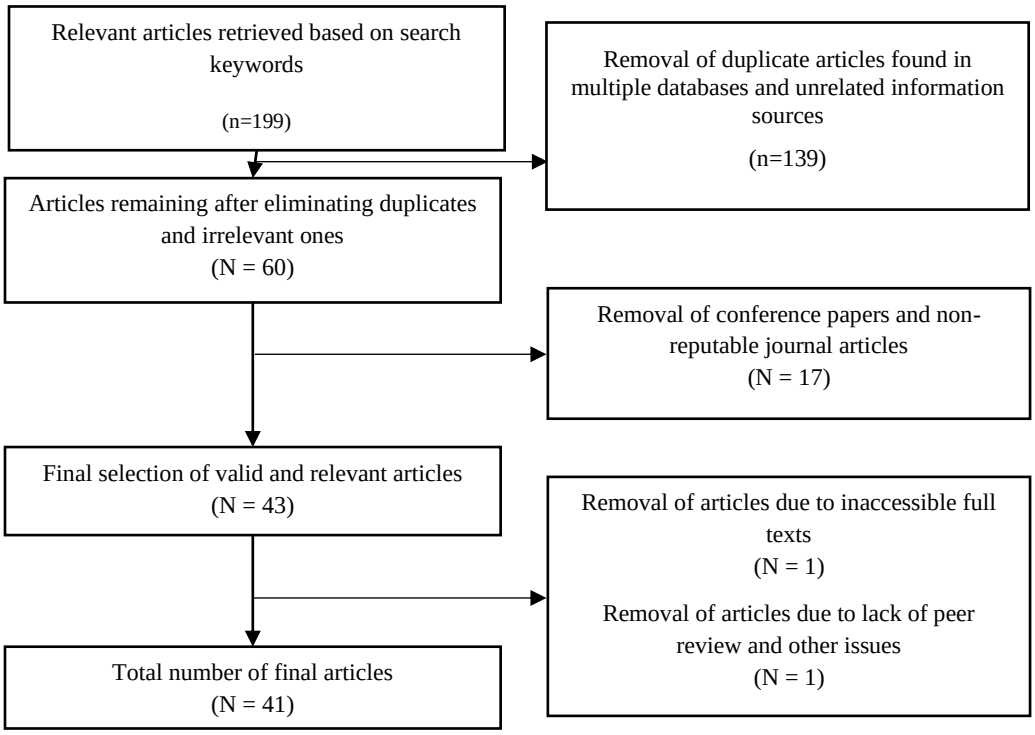


Figure 1. The Step-by-Step Process of Reviewing and Selecting Articles for Systematic Review

Results

After searching, collecting, and categorizing various articles according to the criteria outlined in the methodology section, a total of 41 Persian articles were gathered. Upon reviewing and analyzing the collected articles, Table 1, presents the research findings on the effectiveness of technology-based cognitive interventions in enhancing executive functions and reading skills of students with dyslexia.

Table 1. Findings Examined in the Studie

Author & Year	Title	Sample	Intervention & Number of Sessions	Results
Tikdari & Kafi (2020)	The effectiveness of working memory enhancement in improving reading performance and increasing working memory capacity in children with reading disorders	30 third- to fifth-grade dyslexic students	Computer-based working memory training program, 25 sessions (45 minutes each)	The program improved word reading, nonword reading, fluency, and text comprehension. Additionally, it increased working memory capacity.
Khatari et al. (2020)	The impact of augmented reality technology on learning in second-grade dyslexic students	20 second-grade dyslexic students	*HP Reveal* augmented reality software, 3 sessions	This technology captured students' attention, and with 95% confidence, it can be stated that augmented

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				reality training significantly improved learning in dyslexic students.
Zare Nejad et al. (2020)	The effectiveness of neurofeedback on cognitive deficits and visuomotor perception in students with dyslexia	40 dyslexic students (ages 8–11)	Neurofeedback therapy, 20 sessions (45 minutes each)	Neurofeedback had a positive effect on visuomotor perception in dyslexic children and improved their cognitive deficits. This method, based on operant conditioning and brainwave modulation, facilitated improvement in brain function.
Abbasi Feshmi et al. (2020)	A comparison of the effectiveness of cognitive rehabilitation and neurofeedback in improving executive functions in children with dyslexia	36 dyslexic students (ages 8–12)	Neurofeedback intervention (30 sessions), computer-based working memory training program (11 sessions, 60 minutes each)	Both cognitive rehabilitation and neurofeedback improved cognitive abilities and self-regulation in dyslexic children, showing similar positive effects on executive functions.
Alidousti et al. (2020)	Improvement of executive functions and reading performance in dyslexic children through computer-based cognitive tasks	20 dyslexic students (ages 7–9)	*Yarsina* computer-based cognitive rehabilitation program, 10 sessions (45 minutes each)	Computer-based cognitive training improved executive functions, such as working memory, planning, reasoning, and inhibition, which positively impacted reading performance.
Moslemi Bakhtiar et al. (2020)	The effectiveness of transcranial direct current stimulation (tDCS) on visual-auditory attention and working memory in children with dyslexia	24 dyslexic students (ages 8–10)	Transcranial direct current stimulation (tDCS), 15 sessions (20 minutes each)	There was a significant difference between the intervention and control groups in improving visual working memory and attention. Anodal stimulation contributed to these improvements and helped mitigate dyslexia-related difficulties.
Mo'taghadi Fard et al. (2020)	Designing a computer-based cognitive rehabilitation program (*Nakhti Server*) and evaluating its impact on spelling efficiency and visuophonological processing in dyslexic students with writing difficulties	20 dyslexic students with writing difficulties (third grade)	*Nakhti Server* cognitive rehabilitation software, 20 sessions (60 minutes each)	Cognitive rehabilitation through spelling exercises and color-based training in the *Nakhti Server* program reduced spelling errors and improved visuophonological processing in the experimental group.
Seif et al. (2021)	The effectiveness of executive function-based	40 fourth- and fifth-	Executive function-based rehabilitation	Simultaneous training of sensory-visual and auditory

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	cognitive rehabilitation in improving cognitive deficits in children with dyslexia	grade dyslexic students	software, 12 sessions (60 minutes each)	components across four games improved coordination and cognitive deficits such as distractibility and poor concentration in dyslexic children.
Fadaei et al. (2021)	The impact of the computer-based "sequential letter presentation" method on rapid naming, phonological awareness, fluency, and reading accuracy in elementary dyslexic students	6 third-grade dyslexic students	Custom-designed PowerPoint and Captivate software, 16 sessions	The computer-based method enhanced word reading accuracy and fluency while positively influencing phonological awareness and processing speed.
Abbasi Feshmi et al. (2021)	The effectiveness of biofeedback in improving reading performance and visuomotor perception in children with dyslexia	24 dyslexic students (ages 8–12)	Neurofeedback intervention, 30 sessions (45 minutes each)	Neurofeedback improved reading performance and reduced errors in shape recognition, composition, rotation, and continuity in dyslexic children. This method also enhanced visuomotor perception by strengthening self-regulation skills and modulating brainwave activity.
Norouzbakhsh Hajikandi et al. (2021)	The effectiveness of cognitive rehabilitation on working memory capacity in third-grade elementary students with specific learning disabilities (reading), with gender as a moderating factor	60 dyslexic students (ages 10–12)	Sound Smart software, 9 sessions (30–40 minutes each)	Cognitive rehabilitation significantly increased working memory capacity in students with reading disabilities, with greater effects observed in female students.
Nosrati et al. (2021)	The impact of an online blended learning model on improving reading fluency in students with reading learning disabilities	3 second-grade dyslexic boys	Blended learning model (direct instruction and phonological awareness training) with video calls via messaging apps, 30 sessions (35 minutes each)	Mobile-based interventions, by providing real-time feedback and task supervision, increased learners' motivation and cognitive mastery. Dyslexia interventions via video calls improved reading skills derived from direct instruction, phonological awareness training, and online learning.
Zamani Behabahani et al. (2021)	A comparison of the effectiveness of Fernald multisensory instruction	45 first- and second-grade	Fernald multisensory method, 8 sessions	Both Fernald multisensory training and computer-based dyslexia games were

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	and computer-based dyslexia games in elementary students with learning disabilities	dyslexic students	(45 minutes each) vs. computer-based cognitive rehabilitation program, 8 sessions (45 minutes each)	effective in reducing learning disabilities in elementary students, but the Fernald multisensory instruction was more successful in alleviating dyslexia symptoms.
Norouzbakhsh et al. (2021)	The effectiveness of cognitive rehabilitation on different types of attention in third-grade students with specific learning disabilities (reading), considering gender as a moderating factor	60 dyslexic students (ages 10–12)	Sound Smart software, 9 sessions (30–40 minutes each)	Cognitive rehabilitation improved focused, sustained, and divided attention, as well as reaction time in students with specific learning disabilities, with gender not playing a significant role.
Soleimani Eskouei et al. (2022)	The effectiveness of computer-based cognitive rehabilitation on executive brain functions (attention, working memory, response inhibition) in students with reading disabilities	20 dyslexic students (ages 7–12)	Computer-based intervention (My Brain Cognitive Games Collection), 12 sessions (45–60 minutes each)	The computer-based cognitive rehabilitation package notably enhanced executive functions, particularly attention, working memory, and response inhibition in dyslexic children.
Hojjati Nasab et al. (2022)	A comparison of the effectiveness of cognitive games on executive functions in students with dysgraphia and dyslexia	100 students with dyslexia and dysgraphia (ages 8–12)	Sound Smart cognitive software, 30 sessions (30–45 minutes each)	The software also improved executive functions like time self-management, self-organization, self-control, self-motivation, and emotional self-regulation in students with dyslexia and dysgraphia, although there was no significant difference in improvement between intervention groups.
Amiri et al. (2022)	The impact of neurofeedback on brainwave modulation and core executive functions in children (ages 8–12) with specific learning disabilities	20 dyslexic or dysgraphic students (ages 8–12)	Neurofeedback intervention, 20 sessions (40 minutes each)	The neurofeedback protocol decreased the theta-to-alpha wave ratio and enhanced executive functions such as attention, response inhibition, and working memory, likely through facilitating synaptic connectivity and brainwave modulation.
Bakhshipour et al. (2022)	Examining the effectiveness of frequency synchronization correction through neurofeedback on reading	4 dyslexic children (ages 8–12)	Neurofeedback intervention, 20 sessions (40 minutes each)	Post-treatment, reading scores increased and EEG analysis displayed heightened frequency synchronization across various brain regions,

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	improvement in children with dyslexia			suggesting that neurofeedback can boost academic abilities in children with learning disabilities.
Khanjani et al. (2022)	The effectiveness of phonological awareness training via mobile applications on behavioral regulation skills, metacognition, and reading improvement in children with dyslexia	3 dyslexic children (ages 8–10)	Mobile-based phonological awareness software, 10 sessions	Training with mobile applications notably raised executive function scores and metacognitive skills while reducing dyslexia symptoms in female students with specific learning disabilities.
Darabi et al. (2022)	A comparison of the effectiveness of the central nervous system reorganization method (Doman-Delacato) and neurofeedback on reading improvement in dyslexic children	45 dyslexic students (grades 1–5)	Neurofeedback intervention, 16 sessions (30 minutes each) vs. Doman-Delacato intervention, 86 sessions	The neurofeedback group exhibited greater improvements in reading skills, word chains, and rhyming abilities compared to the Doman-Delacato method, although there was no significant difference in text comprehension scores. Both methods significantly enhanced reading performance.
Derikvand et al. (2022)	A comparison of the impact of "computer-based cognitive rehabilitation games for attention and memory" and "practical attention games" on sustained attention, response inhibition, reading speed, and accuracy in students with learning disabilities and dyslexia symptoms	60 dyslexic students (grades 2–5)	Aram cognitive rehabilitation software and practical attention games, 11 sessions (45 minutes each)	Computer-based rehabilitation games significantly improved sustained attention, response inhibition, reading speed, and accuracy in dyslexic students. These interventions were more effective than practical attention games.
Ranjbar et al. (2022)	The effectiveness of computer-based working memory rehabilitation on improving planning and organizational skills in children with reading disorders (using Memory Club software)	30 dyslexic students (grades 3–5)	Memory Club software, 14 sessions (40–45 minutes each)	Furthermore, computer-based rehabilitation games notably improved sustained attention, response inhibition, reading speed, and accuracy in dyslexic students, proving to be more effective than practical attention games.
Suri et al. (2022)	Comparative analysis of the effectiveness of play therapy and cognitive rehabilitation on intolerance of uncertainty, reading difficulties, and reading	45 fourth-grade dyslexic students	Aram cognitive rehabilitation package (10 sessions, 45 minutes each) vs. play therapy sessions (18	Both cognitive rehabilitation and play therapy improved reading performance and reduced reading difficulties. However, cognitive rehabilitation was more

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	performance in students with learning disabilities		sessions, 45 minutes each)	effective in improving reading performance, while play therapy had a greater impact on reducing reading difficulties and intolerance of uncertainty.
Safari et al. (2022)	The effectiveness of cognitive computer-based games in enhancing reading performance in dyslexic students	40 elementary dyslexic students	Cognitive working memory computer training (8 sessions, 60 minutes each)	Training with cognitive computer-based games significantly reduced reading disorder scores in the experimental group. The effect size indicated a positive impact on improving reading difficulties.
Vasimeh et al. (2022)	Comparison of the effectiveness of executive function training via computer games and sensory integration exercises on word reading symptoms and text comprehension in dyslexic students	30 dyslexic students (ages 8–11)	Cognitive rehabilitation working memory software (20 sessions, 30 minutes each)	No significant difference was observed in word reading scores between the computer and sensory integration groups. However, text comprehension scores were significantly different. Both interventions were effective, but the sensory integration method showed longer-lasting effects after a four-month follow-up.
Chegini et al. (2022)	Comparing the impact of cognitive rehabilitation and neurofeedback on attention, working memory, processing speed, and anxiety in dyslexic students	30 dyslexic students (ages 7–10)	Non-computerized cognitive rehabilitation and neurofeedback (16 sessions)	The neurofeedback group demonstrated greater improvements in attention, working memory, and processing speed, while also showing a more significant reduction in anxiety levels compared to the cognitive rehabilitation group.
Bahrami et al. (2023)	Examining the effectiveness of working memory enhancement on improving reading skills in dyslexic students	30 dyslexic students (grades 2–3)	Sina working memory enhancement software (10 sessions, 30 minutes each) and paper-pencil tasks (10 sessions, 25 minutes each)	Significant differences were observed in post-test scores for digit span, Corsi blocks, nonword reading, and phonological awareness between the experimental and control groups. Working memory training improved phonological awareness and reading skills in dyslexic students
Roohollamini et al. (2023)	The effectiveness of transcranial direct current stimulation (tDCS) on	20 elementary	tDCS intervention program (10	tDCS enhanced working memory and reading levels in students with specific

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	working memory and reading level in students with specific reading disabilities	dyslexic students	sessions, 20 minutes each)	reading disabilities. The intervention increased cortical excitability in executive function networks, playing a crucial role in cognitive processes.
Derikvand et al. (2023)	Comparing the effectiveness of computer-based cognitive rehabilitation games (Aram) and practical attention games on working memory, response inhibition, and reading comprehension in dyslexic students	60 dyslexic students (grades 2–5)	Aram cognitive rehabilitation software (11 sessions, 45 minutes each) vs. practical attention games (11 sessions, 45 minutes each)	Both computer-based and practical cognitive rehabilitation games improved working memory, response inhibition, and reading comprehension in dyslexic students. Bonferroni analysis indicated greater effectiveness of computer-based interventions over practical attention games.
Derikvand et al. (2023)	The effectiveness of *Aram* cognitive rehabilitation game on improving executive functions and reading skills in dyslexic students	40 dyslexic students (grades 2–5)	*Aram* computer-based cognitive rehabilitation package, 11 sessions (45 minutes each)	The Aram cognitive rehabilitation game significantly improved executive functions, including sustained attention and response inhibition, as well as reading skills (speed, accuracy, and comprehension) in the experimental group. Overall, computer-based cognitive rehabilitation was more effective than practical rehabilitation.
Sarhangpour et al. (2023)	The effectiveness of combined transcranial direct current stimulation and cognitive rehabilitation on working memory and reading efficiency in dyslexic students	22 dyslexic students (ages 8–12)	tDCS (12 sessions, 15 minutes each) + Aram computer-based cognitive rehabilitation (12 sessions, 45 minutes each)	The real tDCS intervention combined with the Aram package was more effective in increasing working memory scores and reading efficiency compared to the sham tDCS plus cognitive rehabilitation package.
Soltani et al. (2023)	The effectiveness of non-motor cognitive rehabilitation on working memory and cognitive flexibility in children with reading disabilities	37 dyslexic students (grades 2–4)	Aram computer-based cognitive rehabilitation (12 sessions, 45 minutes each)	Non-motor cognitive rehabilitation had a significant impact on working memory and cognitive flexibility in children with reading disabilities. This method can be an effective approach for improving cognitive functions in these children.

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Shamshiri et al. (2023)	Comparing the effectiveness of computer-based cognitive rehabilitation and cognitive-behavioral play therapy on reading performance in elementary dyslexic students	45 dyslexic students (ages 8–12)	Captain Log computer-based package (10 sessions) vs. cognitive-behavioral play therapy (10 sessions, 60 minutes each)	Both interventions improved reading performance, with effects persisting after a one-month follow-up. There was no significant difference in effectiveness between the two methods.
Salehi et al. (2023)	The impact of Cognmed computer-based cognitive rehabilitation on improving working memory in students with specific learning disabilities	15 dyslexic students (ages 8–10)	Cognmed cognitive rehabilitation package (8 sessions, 60 minutes each)	The computer-based working memory rehabilitation method provided a structured learning experience, significantly improving working memory in dyslexic children.
Fazel & Rostamoghli (2023)	The effectiveness of transcranial direct current stimulation (tDCS) on attention and working memory in dyslexic students	40 elementary dyslexic students	tDCS (20 sessions, 20 minutes each)	tDCS was found to be an effective, neurobiological, low-cost, and long-term intervention for enhancing attention and working memory in children and adolescents with dyslexia.
Vasimeh et al. (2023)	A comparison of the effectiveness of executive function training through computer games and sensory integration exercises on dyslexia symptoms in students	30 dyslexic students (ages 8–11)	Working memory rehabilitation (20 sessions, 30 minutes each) vs. sensory-motor integration rehabilitation (20 sessions, 30 minutes each)	Both interventions significantly reduced dyslexia symptoms, but sensory integration exercises showed more lasting effects.
Kalani et al. (2023)	The effectiveness of computer-based language games on phonological and semantic awareness in dyslexic students	20 second-grade dyslexic students	CBLG (Computer-Based Language Games) software (10 sessions, 45 minutes each)	The educational software-based language games package was more effective than traditional methods in improving semantic and phonological awareness in dyslexic students.
Sarafarazi & Mirmohammadi (2024)	A comparison of the effectiveness of two cognitive enhancement approaches on improving reading skills in dyslexic students	36 dyslexic students (grades 3–4)	Amin cognitive rehabilitation software (12 sessions, 45 minutes each) vs. SAM attention and memory enhancement program (12 sessions, 45 minutes each)	Phonological awareness training significantly improved reading accuracy, text comprehension, and phonological awareness, while cognitive empowerment training enhanced reading speed, accuracy, comprehension, and phonological awareness.

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Shamshiri et al. (2024)	The effectiveness of Captain Log cognitive rehabilitation software on improving reading performance and executive functions in elementary dyslexic students	30 dyslexic students (ages 8–12)	Captain Log computer-based cognitive rehabilitation package (10 sessions, 45 minutes each)	Computer-based cognitive rehabilitation using Captain Log effectively enhanced reading performance and executive functions in dyslexic students.
Dashtipour et al. (2024)	Comparison of the efficiency of cognitive rehabilitation, Barkley model-based intervention, and neurofeedback in improving executive functions, reading performance, and reading attitude in children with dyslexia	60 dyslexic students (ages 8–12)	Computer-based working memory rehabilitation (11 sessions, 60 minutes each), Barkley model-based intervention (10 sessions, 60 minutes each), Neurofeedback (30 sessions, 45 minutes each)	All interventions significantly improved executive functions, reading performance, and reading attitude. However, the Barkley model-based intervention produced the best results in improving reading performance and reading attitude, while neurofeedback had the least overall impact.
Dashtipour et al. (2024)	The effectiveness of cognitive rehabilitation on improving executive functions, reading performance, and reading attitude in children with dyslexia	30 dyslexic students (ages 8–12)	Computer-based working memory rehabilitation (11 sessions, 60 minutes each)	Cognitive rehabilitation training significantly improved executive functions, reading performance, and reading attitude in dyslexic children.

Discussion

Dyslexia, one of the most common specific learning disorders, is typically associated with deficits in executive functions and cognitive aspects (American Psychiatric Association, 2013). Research indicates that children with dyslexia experience impairments in executive functions such as attention, working memory, emotional control, cognitive flexibility, and planning, all of which affect their reading skills (Dadgar et al., 2022; Khan & Lal, 2023). In recent years, technology-based cognitive interventions for children with dyslexia have attracted the attention of researchers and specialists (Alqahtani et al., 2020). This systematic review examines the effectiveness of technology-based cognitive interventions on executive functions and reading skills in dyslexic students by analyzing 41 studies conducted between 2020 and 2024.

in summary, based on our study results, cognitive rehabilitation interventions, especially computer-based programs like Aram and Sound Smart, significantly improve executive functions, working memory, and reading skills in children with dyslexia. Neurofeedback and tDCS also showed promising effects on attention and brain function modulation. These findings provide a

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solid foundation for understanding the effectiveness of diverse interventions before further interpretation.

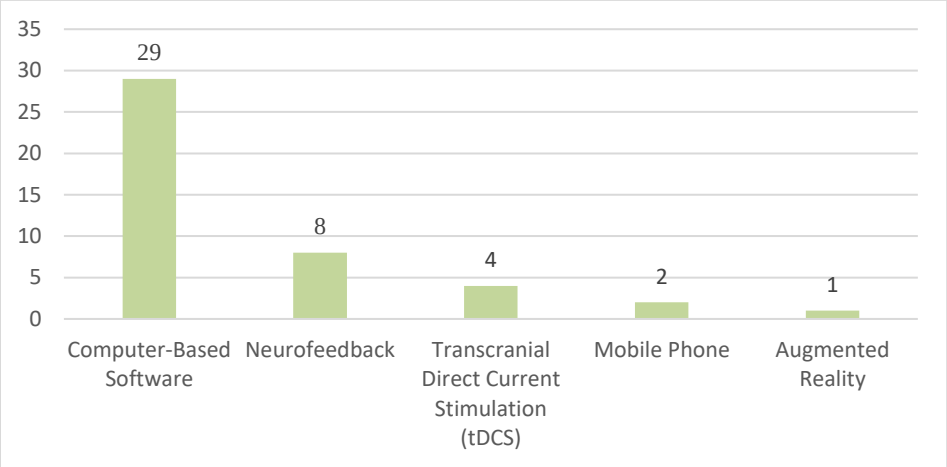


Figure 2. The Number of Technology-Based Studies by Type of Interventions

Computer-based software

According to the findings, the most widely used technology-based intervention is computer-based software or cognitive rehabilitation programs. These interventions utilize training methods based on gamification techniques, cognitive science findings, and the principle of neuroplasticity to enhance cognitive functions such as attention, memory, language, and executive functions (Hong & Song, 2024). Computer games, with their diverse colors and attractive designs, help individuals with dyslexia improve their attention and concentration by fostering interaction and competition (Jaramillo Alcázar et al., 2021; Brennan et al., 2022). Furthermore, time constraints and the need for rapid responses in these games can strengthen individuals' ability to cope with dyslexia-related challenges. This approach not only enhances cognitive abilities but also boosts self-confidence and motivation for learning (Derikvand et al., 2023).

Based on the findings of this study, computer-based programs have been designed to target various cognitive and reading-related skills, each focusing on specific features and domains. For instance, working memory rehabilitation software helps improve executive functions and cognitive flexibility. This program can restore brain functions in the frontal and prefrontal areas that have been impaired, ultimately enhancing mental and cognitive abilities (Abbasi Feshmi et al., 2020). The use of this software also increases active memory capacity (Tikdari & Kafi, 2020).

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Additionally, this program contributes to the improvement of reading components such as word reading, nonword reading, reading fluency, and text comprehension (Tikdari & Kafi, 2020; Safari et al., 2022). By using this program and strengthening their self-regulation skills, individuals can improve their reading abilities and achieve better performance in this domain (Abbasi Feshmi et al., 2020). In this regard, working memory cognitive rehabilitation software has demonstrated significant results in enhancing executive functions and attitudes toward reading, particularly in children with dyslexia (Dashtipour et al., 2024).

Moreover, the "Nakhti Server" software specifically focuses on reducing spelling errors and enhancing visuophonological processing, directly improving reading skills (Mo'taghadi Fard et al., 2020). The "Memory Club" software suite employs engaging, gamified approaches to strengthen memory, attention, and problem-solving by facilitating subprocesses related to planning and organizational functions, thereby indirectly contributing to the improvement of reading skills (Ranjbar et al., 2022). The "Aram" software is effective in improving executive functions, including sustained attention, working memory, response inhibition, cognitive flexibility, and intolerance of uncertainty. Indirectly, it facilitates reading skills such as word reading, word chaining, rhyme recognition, picture identification and naming, word comprehension, text comprehension, nonword reading, sign reading, reading speed, and reading accuracy by enhancing cognitive control (Soltani et al., 2023; Souri et al., 2022; Sarhangpour, 2024; Derikvand et al., 2023; Derikvand et al., 2022). The "Captain Log" program primarily enhances core executive functions such as working memory, cognitive flexibility, and attention, indirectly improving reading performance (Shamshiri et al., 2023; Shamshiri et al., 2024). Additionally, the computer-based intervention "My Brain Cognitive Games Collection" improves executive functions, including attention, working memory, and response inhibition, in dyslexic students (Soleimani Eskouei et al., 2022).

The "Sound Smart" software significantly enhances executive and cognitive functions, including time self-management, self-organization, self-control, self-motivation, and emotional self-regulation in students with dysgraphia and dyslexia (Hojjati Nasab et al., 2022). The Sound Smart cognitive rehabilitation program has a meaningful impact on focused attention, divided attention, and reaction time in students with specific learning disabilities, with no gender differences observed in these effects (Norouzbakhsh et al., 2021). This program not only improves attention

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in both male and female students but also increases working memory capacity in individuals with specific learning disabilities, particularly in reading (Norouzbakhsh Hajikandi et al., 2020). The "Computer-Based Language Games" (CBLG) software is designed to enhance learning in students with dyslexia by providing interactive communication, personalized learning opportunities, and immediate feedback to strengthen phonological and semantic awareness. Findings indicate that CBLG can boost students' motivation and improve cognitive functions such as short-term memory, working memory, auditory processing, and attention, making it an effective tool in special education (Kalani et al., 2023).

The "Yarsina Computer-Based Cognitive Rehabilitation Program" enhances several executive functions, such as working memory, planning, reasoning, and inhibition in dyslexic children, positively impacting both executive functions and reading performance (AliDousti et al., 2020). Similarly, the "Executive Function-Based Rehabilitation Software" helps dyslexic children improve coordination by engaging the sensory-visual and auditory aspects of words in four different games simultaneously. This computer-based rehabilitation tool addresses cognitive deficits like distractibility, weak concentration, attention instability, and impulsivity in dyslexic children (Seif et al., 2021). The "Sina Active Memory Enhancement Software" offers exercises in three areas - auditory memory, visuospatial memory, and consolidation - using numbers, shapes, and letters to enhance the retention of verbal and visuospatial information. This software effectively improves phonological awareness and reading ability in dyslexic students (Bahrami et al., 2023). Additionally, the "Cogmed Cognitive Rehabilitation" Program provides a structured learning experience that significantly enhances all major components of working memory examined, including the number of correct responses and response time, in children with dyslexia (Salehi et al., 2023).

The "SAM Attention and Memory Enhancement Program" consists of four assessment tests and six training modules, each with ten speed levels and ten difficulty stages. It effectively improves reading accuracy, speed, text comprehension, and phonological awareness. Similarly, the "Amin Cognitive Rehabilitation Program" aims to enhance phonological awareness through ten specialized tasks and has been proven to be effective in improving phonological awareness, reading accuracy, and comprehension (Sarafarazi & Mirmohammadi, 2024). Fadaei et al. (2021) developed software using "Microsoft PowerPoint" and "Adobe Captivate" to display words letter

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by letter, syllable by syllable, and then in their complete form, along with their pronunciation. This computer-based sequential presentation method enhances word-reading accuracy and overall reading fluency, enabling students to read with fewer errors and in less time. The intervention, created using free "PowerPoint software," has shown significant effectiveness in improving reading skills, phonological awareness, and information processing speed in dyslexic children. Table 2 displays the impact of computer-based software on reading skills and executive functions in dyslexic students.

Table 2. The Impact of Computer-Based Software on Reading Skills and Executive Functions

Software/Program Name	Reading Skills	Executive Functions
Memory Rehabilitation Software, Sina Memory Enhancement, Cogmed	Improved reading fluency, word and nonword reading, text comprehension, and phonological awareness	Enhanced working memory, planning, reasoning, inhibition, cognitive flexibility, and attention
Nakhti Server, Amin Cognitive Rehabilitation, SAM Program	Improved spelling accuracy, reading accuracy, reading speed, text comprehension, and phonological awareness	Strengthened attention, memory, and visuospatial-auditory coordination
Memory Club, Captain Log, My Brain Games Collection	Indirect improvement of reading skills through enhanced attention, memory, and cognitive processes	Strengthened problem-solving, working memory, and concentration
Aram Software, Sound Smart	Facilitated text comprehension, reading fluency, word reading, rhyme recognition, and reading accuracy	Improved emotional regulation, time management, and uncertainty tolerance
Sina Cognitive Rehabilitation, Executive Function-Based Tools, Computer-Based Language Games (CBLG)	Improved reading skills through phonological and semantic awareness enhancement	Reduced impulsivity and distractibility, strengthened focus, executive functions, and visuospatial-auditory coordination
PowerPoint and Adobe Captivate Software	Increased word reading accuracy, reading fluency, and text comprehension through gradual letter and sound presentation	Accelerated information processing and reduced errors by step-by-step letter and syllable display

The reviewed software programs exhibit unique features and strengths while demonstrating similarities in their ability to address cognitive and reading challenges, particularly for individuals with dyslexia. For instance, cognitive rehabilitation programs such as "Sina" focus on enhancing

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working memory, executive functions, and phonological awareness, directly contributing to improving reading skills. Similarly, "Sound Smart" emphasizes emotional regulation, self-management, and increasing working memory capacity, indirectly enhancing reading fluency. Additionally, programs like "Amin" and "SAM" enhance phonological awareness and improve reading accuracy and comprehension through structured exercises. Moreover, cognitive training games like "Captain Log" and "My Brain" target executive functions such as working memory and cognitive flexibility. In comparison, interventions like PowerPoint-based programs, by breaking words into smaller units, specifically enhance reading accuracy and speed, while "Captain Log" comprehensively strengthens core components of working memory. Furthermore, "Computer-Based Language Games" (CBLG) provide interactive experiences, personalized learning, and immediate feedback, enhancing phonological and semantic awareness, increasing students' motivation, and improving cognitive functions. These tools complement each other; some, such as "Amin" and PowerPoint interventions, directly target reading-related skills, while others, like "Captain Log", provide multidimensional learning support through cognitive and interactive skill enhancement.

Additionally, studies comparing the effectiveness of computer-based cognitive rehabilitation games with other non-computerized interventions (such as cognitive-behavioral play therapy and practical attention games) concluded that both types of cognitive rehabilitation (computerized and non-computerized) strengthen executive functions, including working memory, response inhibition, sustained attention, and improve reading skills and comprehension in dyslexic students. However, the effectiveness of computerized rehabilitation was significantly greater (Shamshiri et al., 2023; Derikvand et al., 2023; Suri et al., 2022; Derikvand et al., 2022). Nevertheless, research by Vasimeh et al. (2023) and Zamani Behabahani et al. (2021) indicated that interventions based on sensory integration exercises (Fernald method) had more lasting effects on reducing dyslexia symptoms than computerized cognitive rehabilitation.

Based on the reviewed studies, a variety of software programs and technological interventions have been employed to improve cognitive performance and reading-related abilities in children with dyslexia, each demonstrating different levels of effectiveness across specific cognitive domains. A comparative pattern emerges when considering multiple findings: Sound Smart, used in several studies, consistently showed broad positive effects on executive functions, attention,

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working memory, and even emotional self-regulation. Its impact appeared to be more comprehensive than Nakhti Server, which primarily targeted visuo-phonological processing and spelling through color-based exercises. While Nakhti was helpful for students with writing disorders, it lacked evidence regarding broader cognitive outcomes such as response inhibition. In contrast, Aram software has shown multi-dimensional benefits—enhancing executive function, sustained attention, response inhibition, and reading speed and accuracy—particularly when used alongside tDCS. Studies comparing Aram with attention-based games and traditional approaches such as play therapy indicate superior outcomes when Aram is integrated with tDCS, suggesting a synergistic effect. Meanwhile, Captain's Log and Cogmed, though evaluated in fewer studies, have shown effectiveness in improving working memory and attention but lack broader comparative data. The emerging trend indicates that multi-component interventions, especially those combining cognitive training with neuromodulation techniques like tDCS or neurofeedback, tend to produce more robust and sustained improvements. Moreover, mobile-based interventions and virtual reality tools have recently gained attention for their engagement and adaptability. Though fewer studies are available, preliminary evidence points to their potential in enhancing motivation, cognitive flexibility, and self-regulation. However, high costs, limited access in low-resource settings, and the need for specialized equipment remain common limitations across many technology-based interventions. In sum, integrating findings across studies suggests that effectiveness depends not only on the type of software used but also on the targeted cognitive domain, session frequency, integration with neurocognitive stimulation, and the individual profile of the child. A flexible, multi-modal, and personalized approach may offer the most promise in addressing the diverse needs of students with dyslexia.

Neurofeedback intervention

Another technology-based approach identified in the research is "Neurofeedback", a brain-training intervention based on operant conditioning principles that has demonstrated substantial potential in addressing cognitive deficits in dyslexic children (Taskov & Dushanova, 2022). By targeting abnormalities in brain waves, particularly in areas related to visuomotor perception and reading processes, neurofeedback facilitates the regulation and enhancement of brain function (Albarrán-Cárdenas, 2023; Patil et al., 2022; Abbasi Feshmi et al., 2021). Zare Nejad et al. (2020) reported that children who underwent neurofeedback training improved their visual perception, indicating

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a reduction in brain abnormalities associated with cognitive deficits. Similarly, Abbasi Feshmi et al. (2021) emphasized that neurofeedback can contribute to cognitive self-regulation and improve reading performance while reducing errors in shape recognition, composition, rotation, and continuity in dyslexic children, which are critical for academic success. Likewise, Darabi et al. (2022) confirmed the positive impact of neurofeedback in comparison to alternative methods, such as the Doman-Delacato approach, in enhancing reading skills, word chains, rhyme tests, and other related components. However, findings by Dashtipour et al. (2024), which compared the effectiveness of cognitive rehabilitation, Barkley's model-based intervention, and neurofeedback, revealed that all interventions significantly improved executive functions, reading performance, and reading attitudes. Notably, Barkley's model-based intervention yielded the most substantial improvements in reading performance and attitude toward reading, whereas neurofeedback had the least impact compared to other methods.

Neurofeedback, in addition to its effects on reading skills, is also highly effective in enhancing executive functions. Amiri et al. (2022) confirmed the effectiveness of a neurofeedback protocol focusing on reducing the theta-to-alpha ratio at the Cz site, which led to improvements in attention, response inhibition, and working memory (both auditory and visual). Similarly, findings by Abbasi Feshmi et al. (2020) indicated that neurofeedback and cognitive rehabilitation had comparable effectiveness in improving cognitive flexibility and response inhibition. However, in the study conducted by Chegini et al. (2022), the group that received neurofeedback scored higher in attention, memory, and processing speed than the cognitive rehabilitation group, and they also exhibited greater reductions in anxiety levels. Additionally, Bakhshipour et al. (2022) highlighted an increase in brainwave synchronization across different brain regions following neurofeedback treatment, which contributed to enhanced executive functions related to learning. These findings confirm the effectiveness of neurofeedback as a viable intervention for simultaneously improving both reading skills and executive functions.

Augmented Reality (AR) intervention

"Augmented Reality" (AR) is a technology-based tool, defined as a set of mixed realities that integrate real-world environments with computer-generated virtual concepts (Fouzan & Koutsar, 2023). Essentially, AR superimposes virtual elements onto the real world, providing a rich and interactive user experience (Putro et al., 2023). Augmented reality can enhance various aspects of

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learning, including activating learning content in three-dimensional perspectives, offering immersive, collaborative, and contextual learning experiences (Komporos, 2024), and increasing learners' sensory and cognitive presence and engagement (Wang, 2018). In a study by Khatari et al. (2020) on the impact of AR technology in learning among second-grade dyslexic students, the researchers utilized the HP Reveal software, an external marker-based AR application. The results demonstrated that this technology, as an effective assistive learning method, captured students' attention, facilitated meaningful learning, and positioned itself as a competitive alternative to traditional educational tools. According to this study, with 95% confidence, it can be stated that integrating AR technology into the learning process of dyslexic students significantly enhances their learning outcomes.

Transcranial direct current stimulation (tDCS)

Another key finding of the systematic review concerns the effectiveness of transcranial direct current stimulation (tDCS) interventions. The review showed that tDCS significantly enhances working memory, attention, and reading skills in dyslexic students. The increased cortical excitability in brain regions linked to executive networks, particularly those involved in working memory and cognitive processing, is likely the primary mechanism behind the observed cognitive and academic improvements (Costanzo et al., 2019). This finding is supported by studies conducted by Roohollamini et al. (2023), Fazel & Rostamoghli (2023), and Sarhangpour et al. (2023), which suggest that combining tDCS with other rehabilitation approaches, such as computer-based cognitive programs, enhances the overall effectiveness of these interventions and significantly improves reading performance and attention in students. Given that tDCS is considered a low-cost, non-invasive intervention with long-lasting effects, it can be recommended as a practical and efficient tool for enhancing cognitive functions and alleviating learning difficulties in children with dyslexia (Lazzaro et al., 2021).

The effectiveness of tDCS can be explained by its underlying neurobiological mechanisms. By applying low-intensity electrical currents to specific brain regions, tDCS increases neuronal excitability, thereby improving the functionality of neural networks involved in executive functions. In the case of dyslexia, these targeted regions primarily include the prefrontal cortex, which plays a crucial role in working memory, sustained attention, and cognitive control. Increased activity in this area facilitates information processing and learning, enabling dyslexic students to

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focus more effectively on cognitive tasks (Battisti et al., 2022; Moslemi et al., 2020; Fazel & Rostamoghli, 2023).

Mobile phone-based interventions

The latest research findings highlight the effectiveness of mobile-based interventions in improving reading fluency and behavioral processes in dyslexic students. The impact of these interventions on reading skills and executive functions can be explained through several key mechanisms. One significant aspect of these interventions is the phonological awareness training provided via mobile applications, which has shown meaningful improvements in students' metacognition and behavioral regulation. Zhong et al. (2023) demonstrated that these interventions, by utilizing user-friendly interfaces and continuous interactions, create a more engaging learning environment that enhances linguistic and cognitive skills. Consistent with this, studies by Nosrati et al. (2021) and Khanjani et al. (2022) confirm that mobile technology, by offering immediate feedback and enabling repetitive practice, stimulates neural networks associated with reading and executive functions. This personalized and goal-oriented approach effectively reduces functional deficits.

Additionally, findings from Eroglu et al. (2022) indicate that incorporating video calls via messaging apps into blended learning sessions has enhanced the effects of traditional interventions. The integration of direct instruction with phonological awareness techniques and online tools enables interactive learning and instant error correction. Such real-time interactions not only improve learners' cognitive mastery and self-efficacy but also enhance motivation by ensuring structured monitoring of tasks and progress tracking. Supporting this, Guler & Arikan (2023) found that these processes strengthen executive functions such as working memory and attention, which directly contribute to improving reading fluency and reducing dyslexia symptoms. These findings suggest that mobile technology can serve as an effective tool for enhancing both cognitive and reading skills in dyslexic children.

Comparing Interventions: What Works Best and Under What Circumstances

Although numerous interventions have shown promise in supporting students with dyslexia, their relative effectiveness often depends on contextual factors such as age, severity of learning disorder, availability of resources, and implementation settings. For instance, software-based interventions like SoundSmart or Nakhti Server provide structured phonological training, but their success relies heavily on user engagement and teacher guidance. Similarly, Cogmed software is praised for

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improving working memory but may not address phonological deficits directly, limiting its standalone use. In contrast, mobile-based interventions offer flexibility and accessibility, especially in low-resource settings, but they often lack the depth and individualization of therapist-led programs. Neurofeedback, while offering a neurocognitive approach to improving attention and self-regulation, demands expensive equipment and trained professionals, limiting its widespread adoption. Likewise, tDCS has shown early promise in modulating neural plasticity, but ethical concerns and individual variability in response remain critical barriers. VR-based interventions provide immersive, multi-sensory environments that can enhance learning motivation and engagement, yet they also raise challenges related to cost, technical support, and accessibility in schools. Therefore, while each intervention offers unique advantages, their optimal effectiveness depends on aligning the tool with learner characteristics, training quality, and systemic supports. A balanced perspective that considers these trade-offs is essential for educators and clinicians to make informed decisions about the best course of action for individual learners.

Finally, this systematic review synthesized recent Iranian research to evaluate the effectiveness of technology-based cognitive interventions on improving executive functions and reading skills in dyslexic students. The findings indicate that while individual interventions—such as cognitive training applications, neurofeedback, tDCS, and mobile-based programs—have shown promise in targeting specific cognitive areas, greater benefits may be achieved through integrated intervention models that combine multiple approaches. In doing so, this review not only consolidates existing evidence but also identifies notable gaps in the literature, particularly the limited use of multi-modal interventions and the lack of comparative analyses across different technologies. These contributions provide a valuable basis for future research to explore the synergistic potential of combined methods and inform the development of more comprehensive, technology-enhanced intervention programs. Ultimately, the review advances understanding of how diverse technological tools can be strategically implemented to address the complex learning needs of dyslexic students and contributes to both national practice and the broader global conversation on educational technology in special education. Like any study, this systematic review has certain limitations that must be acknowledged. The most significant limitation lies in its exclusive focus on domestic (Iranian) research. This focus restricts the generalizability of the findings, as educational systems, access to technology, cultural attitudes toward learning difficulties, and

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intervention implementation methods vary widely across countries. Without considering international studies, it becomes difficult to determine whether the effectiveness of technology-based cognitive interventions observed in Iran can be replicated in other contexts with different infrastructures and pedagogical approaches. Another limitation is the relatively narrow time frame of the included studies (2020–2024). Limiting the review to recent studies may have excluded earlier foundational or long-term research that could provide valuable insights into how these interventions have evolved over time. A broader timeframe, such as the past ten years, could offer a more comprehensive picture of intervention development, longitudinal outcomes, and shifting trends in the use of educational technologies for dyslexic students. Future systematic reviews are encouraged to address these limitations by including a more diverse range of international studies and extending the review period. Such an approach would allow researchers to compare different types of interventions across cultural and technological contexts, examine long-term trends, and evaluate the sustainability of outcomes. Based on the findings, the following practical and applicable recommendations are suggested to improve reading skills and executive functions in dyslexic students: Using cognitive rehabilitation applications such as Memory Club and Captain Log, which utilize interactive games to enhance working memory and attention, ultimately leading to better reading fluency and comprehension. Integrating mobile applications with traditional interventions, such as phonological awareness training through mobile apps that provide repetitive exercises and immediate feedback, thereby strengthening metacognition and behavioral regulation. Incorporating online blended learning sessions with video calls as part of intervention programs to enable real-time error correction and increased student motivation. Developing multimedia-based programs that emphasize repetition and response speed, incorporating game-like features to boost reading speed and attention. Combining neurofeedback and tDCS technologies with computer- and mobile-based programs to stimulate specific brain regions, ultimately enhancing reading skills and executive functions in dyslexic students. Future studies should employ larger and more diverse samples across different regions of Iran to enhance generalizability. Longitudinal designs are recommended to assess the long-term effects of technology-based interventions on dyslexia. Additionally, comparing combined approaches—such as integrating neurofeedback with cognitive rehabilitation software—could clarify synergistic benefits. Investigating variables like socioeconomic status, access to technology, and

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cultural factors would further deepen understanding and optimize intervention effectiveness in Iranian contexts. The findings underscore the potential of technology-based cognitive rehabilitation programs, such as computer software and neurofeedback, to improve reading and executive functions in children with dyslexia in Iran. Implementing these evidence-based, culturally adapted technological interventions in Iranian educational settings can enhance learning outcomes and help address the lack of specialized resources. This approach supports more effective, accessible, and modernized educational practices tailored to the needs of Iranian students with learning difficulties.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the ethics committee of University of Birjand. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors contributed to the study conception and design, material preparation, data collection, and analysis. All authors contributed to the article and approved the submitted version.

Funding

The authors did (not) receive support from any organization for the submitted work.

Conflict of interest

The authors declare 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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