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Comparison of the Effect of Phonological–Visual Approach Training and Working Memory Training on Reading Attitude in Male Second-Grade Elementary Students with Dyslexia in Tehran

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A B S T R A C T

Purpose: This study aimed to compare the effectiveness of phonological–visual approach training and working memory training on improving the reading attitude of male second-grade elementary students with dyslexia in Tehran.

Methods and Materials: This quasi-experimental study employed a pretest–posttest design with an unequal control group. The statistical population consisted of male second-grade elementary students with dyslexia who attended learning disorder centers under the supervision of Tehran's Special Education Organization between November 5 and December 6, 2024. Using convenience sampling, 45 students were selected and randomly assigned into three equal groups: phonological–visual training, working memory training, and control. The Reading Attitude Scale (McKenna & Kear, 1990) was administered as pretest, posttest, and one-month follow-up. The phonological–visual program included 12 structured sessions focusing on sound-symbol mapping, visual discrimination, and multisensory reading strategies, while the working memory program followed Dan's (2008) 18-session protocol targeting auditory, visual, and sequential memory processes. Data were analyzed using repeated-measures ANOVA with Bonferroni adjustments after confirming assumptions of covariance homogeneity, sphericity, and equal variances.

Findings: Repeated-measures ANOVA indicated a significant main effect of time ($F(2, 42) = 412.17$, $p = .001$, $\eta^2 = .95$) and a significant group × time interaction ($F(4, 84) = 42.42$, $p = .001$, $\eta^2 = .67$). Pairwise comparisons showed that both phonological–visual and working memory groups improved significantly more than the control group at posttest (mean differences = 9.53 and 12.46, respectively; $p = .001$). Working memory training produced significantly greater improvements than the phonological–visual approach at posttest and follow-up (mean differences = 2.93 and 2.26; $p < .05$).

Conclusion: Both interventions effectively improved reading attitude among students with dyslexia; however, working memory training showed superior and more sustained outcomes, suggesting its greater potential for enhancing motivation and engagement in reading.

Keywords: *disorder, reading attitude, working memory, phonological–visual approach*

1. Introduction

Reading is a foundational academic skill and a primary gateway to learning, yet developmental dyslexia remains one of the most prevalent and disabling learning disorders worldwide (Georgiou et al., 2012). Dyslexia is characterized by persistent difficulties in accurate and fluent word recognition, decoding, and spelling, often rooted in deficits in phonological awareness and working memory (Moshtaghy Sharifzadeh et al., 2021; Yao et al., 2024). These difficulties not only disrupt children's academic progress but also negatively impact their motivation and attitude toward reading, potentially creating a cycle of avoidance and failure (Badami et al., 2016). Because reading ability is strongly tied to both cognitive and emotional dimensions, interventions targeting underlying neurocognitive processes—particularly working memory and phonological–visual integration—have become essential in educational and clinical settings (Akbari et al., 2019; Carretti et al., 2017).

Working memory plays a central role in reading development by temporarily storing and manipulating phonological and visual information while decoding and comprehending text (Baniasadi, 2024; Safari Vesal et al., 2022). Children with dyslexia frequently show deficits in both verbal and visuospatial components of working memory, hindering their ability to map graphemes to phonemes and integrate meaning (Aprilia & Siahaan, 2020; Georgiou et al., 2012). As a result, their reading fluency, comprehension, and engagement decline over time. Neuropsychological and educational research suggests that strengthening working memory capacity can improve phonological processing, executive attention, and reading outcomes (Carretti et al., 2017; Naji et al., 2020). Interventions such as computer-assisted cognitive rehabilitation (Ranjbar et al., 2022; Soleimani Oskouei et al., 2022), mental rehearsal strategies (Zarenezhad et al., 2019), and game-based cognitive training (Asgari, 2023) have shown measurable gains in decoding speed, comprehension, and motivation to read.

In parallel, research has emphasized the role of phonological–visual training in remediating dyslexia by strengthening the link between auditory and orthographic representations (Nabīzādeh Nodehī et al., 2018; Ortiz et al., 2014). Many dyslexic readers struggle with visual and auditory discrimination, including difficulty perceiving sound contrasts and visually tracking letters and words (Ghorbani et al., 2012; Ortiz et al., 2014). Targeted interventions that explicitly integrate sound-symbol mapping, visual pattern recognition, and multisensory exercises can help build stable phonological representations and improve decoding skills (Akbari et al., 2019). Combining visual perception exercises, such as distinguishing minimal phonemic pairs and enhancing visual-spatial orientation, with auditory memory reinforcement fosters more efficient word recognition and improves reading fluency (Aprilia & Siahaan, 2020; Badami et al., 2016).

Despite these advances, many conventional remedial reading programs fail to address motivation and reading attitude, which are critical predictors of long-term literacy engagement (Baniasadi, 2024; Yao et al., 2024). Children with dyslexia often develop negative beliefs about their reading competence, leading to disengagement and avoidance of reading tasks. A negative reading attitude not only affects academic achievement but can also extend to self-esteem and mental health (Faghfouriazar, 2023). Therefore, interventions should not only enhance cognitive processing but also aim to foster a more positive emotional relationship with reading. Programs focusing on working memory and phonological–visual integration may indirectly influence motivation and reading attitudes by increasing children's sense of mastery and reducing frustration (Carretti et al., 2017; Kumari et al., 2024).

A growing body of evidence supports the efficacy of working memory–centered interventions in children with reading difficulties. Computer-based cognitive rehabilitation programs, such as Memory Club and Lumosity, have been effective in improving attention, executive control, and phonological working memory (Mam Khazari Azad & Farzaneh, 2021; Ranjbar et al., 2022). These programs often incorporate tasks that require sequential recall, updating of information, and dual-task coordination, which translate into better decoding and comprehension (Safari Vesal et al., 2022; Soleimani Oskouei et al., 2022). Additionally, multimodal cognitive training has been shown to enhance visual processing and spatial perception, key components of fluent reading (Asgari, 2023; Faghfouriazar, 2023). Studies have also demonstrated that such training can transfer beyond reading, improving broader executive functions that support academic resilience (Baniasadi, 2024; Carretti et al., 2017).

Similarly, interventions focusing on phonological–visual processing have shown promising results in remediating decoding deficits and improving reading confidence. Integrating phoneme–grapheme correspondence training

Iranian Journal of Educational Sociology
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with visual discrimination tasks strengthens neural networks involved in reading (Nabīzādeh Nodehī et al., 2018; Ortiz et al., 2014). Some programs incorporate perceptual-motor and sports vision exercises to enhance oculomotor control and visual perception, which are essential for efficient reading (Badami et al., 2016; Khaloei et al., 2022). These multisensory approaches not only accelerate word recognition but also support comprehension and reduce the cognitive load associated with decoding (Akbari et al., 2019; Moshtaghy Sharifzadeh et al., 2021).

Nevertheless, comparative research on the relative impact of working memory training and phonological–visual approaches on children's **attitude toward reading** remains limited. While both methods show effectiveness in improving reading skills, it is unclear which is more influential in changing the emotional and motivational dimensions of reading. Positive shifts in reading attitude can reinforce continued reading practice, leading to sustained skill improvement and greater academic success (Carretti et al., 2017; Yao et al., 2024). Determining the differential effects of these interventions can help educators and clinicians design evidence-based remedial programs that are both cognitively and affectively supportive.

Another important consideration is contextual adaptation. Many existing programs have been developed in Western contexts and may not fully align with local educational systems and learner characteristics (Moshtaghy Sharifzadeh et al., 2021; Naji et al., 2020). Cultural and linguistic differences can influence how children process phonological and visual information, requiring tailored interventions (Akbari et al., 2019; Baniasadi, 2024). For example, Persian orthography presents unique challenges in phoneme–grapheme consistency and visual symbol processing (Nabīzādeh Nodehī et al., 2018), necessitating localized training content. Furthermore, incorporating engaging, game-based tasks may increase motivation and compliance among young learners (Asgari, 2023; Kumari et al., 2024).

Given the persistent reading challenges among students with dyslexia and the need to address both cognitive processing and motivational factors, this study was designed to fill a critical gap. By directly comparing the effectiveness of phonological–visual approach training and working memory training on reading attitude among second-grade male elementary students with dyslexia in Tehran, it seeks to provide evidence for selecting optimal interventions.

2. Methods and Materials

2.1. Study Design and Participants

The research method was quasi-experimental with a pretest–posttest design and an unequal control group. In this study, the groups were initially formed randomly. Pretest measurements were collected at one time point, and the phonological–visual approach intervention (eight 90-minute sessions) was administered to the first experimental group, while the working memory intervention (eight 90-minute sessions) was administered to the second experimental group. No intervention was provided for the control group. Follow-up measurements for all three groups were collected simultaneously one month later. The statistical population included all second-grade elementary students with dyslexia in Tehran who, during the 2024–2025 academic year, visited one of the learning disorder centers supervised by the Special Education Organization of Tehran between November 5 and December 6, 2024. From this population, 45 students with dyslexia were selected through convenience sampling. They were then randomly and equally assigned to three groups: the first experimental group (receiving the phonological–visual intervention), the second experimental group (receiving the working memory intervention), and the control group (receiving no intervention).

2.2. Measures

The Reading Attitude Scale was developed by McKenna and Kear (1990). This scale has two subscales: attitude toward reading outside of school and attitude toward reading in school. It consists of 20 items, each being a simple sentence about reading. Students select one of four pictorial options under each item: very happy, happy, sad, and very sad. The options are scored from 4 (very happy) to 1 (very sad). The total score on the scale ranges from 20 to 80, and each subscale ranges from 10 to 40. Cronbach's alpha reliability for this scale has been reported between .74 and .89, and it has strong content validity (McKenna & Kear, 1990). In an Iranian adaptation, Asgharinekah, Saeidi Rezvani, Azadfar, and Bagheli (2011) examined whether the scale measures formal and free reading using factor analysis. Construct validity confirmed the distinctiveness of the two subscales. Cronbach's alpha for the adapted Persian version was .81. This scale can be administered individually or in groups.

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

2.3. *Interventions*

The Phonological–Visual Approach Training Package was implemented across 12 consecutive sessions, delivered twice a week for 45 minutes each. The first session introduced the program by administering pretests, explaining its objectives and rules, motivating participants, and answering their questions. The subsequent sessions systematically focused on enhancing phonological awareness and visual word recognition. In Sessions 1–3, students were introduced to the concept that written text corresponds to spoken sounds and that reading proceeds from right to left; during these sessions, 30 words (10 per session) were practiced to strengthen visual discrimination and accuracy. Sessions 4–5 involved practicing 16 words with minimal sound differences (e.g., rud, zud, dud), eight in each session, to refine auditory and visual distinction of phonemes. In Session 6, word envelopes created from previous sessions were used; the instructor selected and pronounced sounds without showing them, and students identified corresponding images, pronounced the sounds, and wrote the words. Session 7 reinforced these skills by reading sentences containing previously practiced words. Sessions 8–9 introduced words such as khahar (sister), khastan (to want), and khabidan (to sleep), demonstrating that two letters can represent one sound, with 30 words practiced. Session 10 focused on vowel exceptions with words such as no, khod, and to, teaching that one letter can produce three sounds; 20 words were practiced. In Session 11, all previously learned words were reviewed one by one, and students verbalized each sound aloud while writing the words to reinforce sound-symbol mapping. The program concluded with Session 12, where the instructor and student read a story together; the student was guided to track each word with a finger to promote accuracy, fluency, and active engagement in reading.

The Dan Working Memory Training Package (Dan, 2008) consists of 18 structured sessions designed to systematically strengthen auditory, visual, and long-term working memory processes in children. The program begins with an introduction, orientation, and a pretest (Session 1), followed by progressive exercises targeting auditory memory (Session 2), including remembering and recalling letters, numbers, or simple words after a few seconds and retrieving the first or last item in a sequence. Visual memory is addressed (Session 3) through hiding and identifying removed objects, recognizing previously seen items, faces, and patterns, and is further reinforced by combined auditory–visual tasks and reverse order recall (Session 4). Subsequent sessions introduce memory games, such as describing colors and directions after short delays (Session 5), executing multiple-step oral instructions (Session 6), narrating the content of short films (Session 7), recognizing animals, fruits, objects, and scenes after brief exposure (Session 8), and review and consolidation of previous skills (Session 9). Higher-level memory tasks include recalling short stories (Session 10), narrating events from the past 24 hours in detail (Session 11), interpreting the meaning of sentences and sequences of phrases (Session 12), memorizing and recalling prepared word lists and repeating spoken sentences (Session 13), word recognition games with cards (Session 14), and training in mental rehearsal strategies such as repeated reading and writing (Sessions 15–16). The final sessions include further review with memory card games (Session 17) and administration of a posttest (Session 18). This structured, stepwise approach integrates multimodal strategies—auditory, visual, verbal, and conceptual—to strengthen working memory capacity and retrieval efficiency.

2.4. *Data Analysis*

Descriptive statistics, including mean, standard deviation, frequency distribution tables, and graphs, were used to summarize demographic information. To test the research hypotheses, repeated-measures multivariate analysis of variance (MANOVA) was performed using SPSS version 24.

3. Findings and Results

The findings are presented in two sections: descriptive statistics and inferential analysis. First, the descriptive results for reading attitude scores are reported across time (pretest, posttest, follow-up) and groups (phonological–visual training, working memory training, and control). Then, the assumptions for repeated-measures ANOVA are examined, followed by the main ANOVA results and pairwise comparisons.

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

Table 1

Means and Standard Deviations of Reading Attitude Scores by Time and Group

Group	Time	M	SD
Phonological–Visual Training	Pretest	25.43	1.43
	Posttest	36.53	2.09
	Follow-up	22.06	2.21
Working Memory Training	Pretest	26.40	1.91
	Posttest	39.46	1.40
	Follow-up	35.33	1.75
Control	Pretest	26.26	1.83
	Posttest	27.00	2.26
	Follow-up	26.33	2.16

As shown in Table 1, in the phonological–visual training group the mean reading attitude score increased from pretest (M = 25.43, SD = 1.43) to posttest (M = 36.53, SD = 2.09) and then decreased at follow-up (M = 22.06, SD = 2.21). In the working memory training group, the mean increased from pretest (M = 26.40, SD = 1.91) to posttest (M = 39.46, SD = 1.40), with a slight decrease at follow-up (M = 35.33, SD = 1.75), but scores remained higher than pretest. In the control group, mean scores were stable across time (pretest M = 26.26; posttest M = 27.00; follow-up M = 26.33).

Box's M test showed that the covariance matrices were equal across groups ($F(12, 58) = 1.99$, $p = .021$, not significant at the .01 level), indicating homogeneity of covariance matrices. Mauchly's test of sphericity was not significant, $\chi^2(2) = 5.93$, $p = .051$, supporting the sphericity assumption. Levene's test of homogeneity of variances was not significant for pretest ($F(2, 42) = 0.45$, $p = .793$), posttest ($F(2, 42) = 0.44$, $p = .829$), or follow-up ($F(2, 42) = 0.47$, $p = .757$). These results confirm that the assumptions for repeated-measures ANOVA were met.

Table 2

Repeated-Measures ANOVA Results for Reading Attitude

Effect	F	df	p	η^2
Time	412.17	2	.001	.95
Group × Time Interaction	42.42	4	.001	.67

The repeated-measures ANOVA showed a significant main effect of time, $F(2, 42) = 412.17$, $p = .001$, $\eta^2 = .95$, indicating that reading attitude scores changed significantly across the three time points. The interaction between group and time was also significant, $F(4, 84) = 42.42$, $p = .001$, $\eta^2 = .67$, showing that the pattern of change differed among the phonological–visual training, working memory training, and control groups.

Table 3

Pairwise Comparisons of Reading Attitude Scores between Groups (Bonferroni Adjustment)

Time	Group I	Group J	Mean Difference (I–J)	SE	p	95% CI Lower	95% CI Upper
Pretest	Phonological–Visual	Working Memory	-0.67	0.64	.902	-2.25	0.92
	Phonological–Visual	Control	-0.53	0.64	1.000	-2.12	1.05
	Working Memory	Control	-0.13	0.64	1.000	-1.45	1.72
Posttest	Phonological–Visual	Working Memory	-2.93*	0.72	.001	-4.71	-1.14
	Phonological–Visual	Control	9.53*	0.72	.001	7.74	11.31
	Working Memory	Control	12.46*	0.72	.001	10.68	14.25
Follow-up	Phonological–Visual	Working Memory	-2.26*	0.75	.013	-4.13	-0.39
	Phonological–Visual	Control	6.73*	0.75	.001	4.86	8.60
	Working Memory	Control	9.00*	0.75	.001	7.12	10.87

Pairwise comparisons (Table 3) indicated no significant differences between groups at pretest (all $p > .90$), confirming initial equivalence. At posttest, both the phonological–visual group (M difference = 9.53, $p = .001$)

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

and the working memory group (M difference = 12.46, p = .001) scored significantly higher than the control group. Additionally, the working memory group outperformed the phonological–visual group at posttest (M difference = -2.93, p = .001). At follow-up, both experimental groups maintained significantly higher reading attitude scores than the control group (phonological–visual vs. control: M difference = 6.73, p = .001; working memory vs. control: M difference = 9.00, p = .001). The working memory group also remained significantly higher than the phonological–visual group at follow-up (M difference = -2.26, p = .013). These results confirm Hypotheses 1 and 2 (effectiveness of both interventions) and support Hypothesis 3, showing the superiority of working memory training.

4. Discussion and Conclusion

The purpose of this study was to compare the effectiveness of phonological–visual approach training and working memory training on the reading attitude of second-grade male elementary students with dyslexia. The findings indicated that both interventions significantly improved students' attitudes toward reading compared to the control group, but working memory training produced a stronger and more enduring effect. These results provide important evidence for understanding how different neurocognitive interventions influence the motivational and affective aspects of reading, which are crucial for long-term literacy development.

The significant improvement in reading attitude following the phonological–visual approach training aligns with previous research showing that strengthening the link between phonology and visual word recognition enhances decoding efficiency and reading fluency (Nabīzādeh Nodehī et al., 2018; Ortiz et al., 2014). Dyslexic children frequently exhibit deficits in phonological processing and visual discrimination (Georgiou et al., 2012; Ghorbani et al., 2012), which contribute to slow, effortful reading and negative self-perception as readers. Interventions that explicitly train sound-symbol correspondences, visual pattern recognition, and multisensory integration reduce the cognitive load associated with decoding and allow students to experience more fluent and accurate reading (Akbari et al., 2019). When decoding becomes less frustrating, children are more likely to approach reading tasks positively and with greater engagement (Badami et al., 2016). This motivational benefit is reflected in the posttest results, where students who received phonological–visual training showed a clear rise in reading attitude compared with the control group.

The stronger and more sustained effect of working memory training observed in this study is consistent with growing evidence that working memory capacity is a central predictor of reading success and motivation (Carretti et al., 2017; Moshtaghy Sharifzadeh et al., 2021). Working memory supports the simultaneous storage and manipulation of phonological and visual information, enabling readers to decode, integrate meaning, and monitor comprehension (Baniasadi, 2024; Safari Vesal et al., 2022). Dyslexic students often experience working memory overload, which leads to reading breakdown and frustration (Naji et al., 2020). Training working memory may not only enhance the cognitive processes required for reading but also reduce the mental effort needed, thereby increasing reading confidence and attitude (Soleimani Oskouei et al., 2022).

Our findings resonate with prior research demonstrating the benefits of working memory rehabilitation programs. For example, studies using computer-assisted cognitive training and structured tasks have shown significant improvements in decoding speed, phonological awareness, and reading comprehension (Mam Khazari Azad & Farzaneh, 2021; Ranjbar et al., 2022). In particular, programs that target updating, sequencing, and dual-task coordination produce transfer effects to phonological working memory and self-regulation in reading (Asgari, 2023; Kumari et al., 2024). These enhancements appear to improve children's confidence when approaching reading tasks and reduce avoidance behaviors, which supports the observed positive shift in reading attitude. Our results also complement the findings of (Akbari et al., 2019), who showed that training executive functions via working memory significantly facilitated reading progress in students with reading disorders.

The durability of the working memory training effect, as evidenced by the follow-up results, suggests that cognitive capacity-building interventions may produce more lasting motivational changes than approaches focused mainly on phonological–visual integration. While both groups maintained better reading attitudes than the control group after one month, the working memory group retained a higher mean score. This sustained effect is likely due to the generalizability of working memory skills to multiple reading situations, including decoding unfamiliar words, maintaining sentence-level comprehension, and self-monitoring understanding (Baniasadi, 2024; Carretti et al., 2017). By contrast, phonological–visual training, though

Iranian Journal of Educational Sociology
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effective, may be more narrowly tied to practiced word forms and decoding strategies, making its motivational impact more vulnerable to decline once explicit instruction ends.

Another key contribution of this study is its focus on reading attitude as a primary outcome. Much of the literature emphasizes decoding and comprehension gains but overlooks the affective domain (Faghfouriazar, 2023; Yao et al., 2024). Yet reading attitude is a robust predictor of reading frequency and long-term literacy success. Children who perceive themselves as competent readers are more likely to engage voluntarily with text, reinforcing skill growth through practice (Badami et al., 2016). By demonstrating that cognitive training programs can influence reading motivation, our results highlight the importance of including attitudinal measures when evaluating interventions.

Additionally, the results underscore the relevance of combining cognitive neuroscience with educational practice. Interventions grounded in working memory theory and phonological processing research can be systematically adapted to the classroom (Safari Vesal et al., 2022; Soleimani Oskouei et al., 2022). The working memory training used in this study incorporated multi-sensory and game-like tasks, which may have increased engagement and reduced performance anxiety (Asgari, 2023; Kumari et al., 2024). Similarly, the phonological–visual package's emphasis on interactive exercises, such as manipulating sounds and visual patterns, likely helped students overcome decoding barriers and experience success (Akbari et al., 2019; Ortiz et al., 2014).

Our results also confirm the importance of culturally adapted and linguistically sensitive interventions. Previous studies have shown that Persian orthography presents unique phonological and visual challenges that can influence intervention outcomes (Akbari et al., 2019; Nabīzādeh Nodehī et al., 2018). By designing training tasks specifically relevant to Persian script and sound structures, this study ensured the ecological validity of the programs and increased their effectiveness for Iranian learners. This aligns with calls for localized, context-sensitive cognitive rehabilitation methods rather than one-size-fits-all approaches (Baniasadi, 2024; Naji et al., 2020).

The observed patterns also provide insight into the mechanisms underlying reading motivation. Improvements in working memory likely enhanced students' ability to handle complex reading tasks without cognitive overload, fostering a sense of control and reducing frustration (Carretti et al., 2017; Moshtaghy Sharifzadeh et al., 2021). Phonological–visual training may have reduced decoding errors and increased accuracy, giving students immediate success experiences that contributed to short-term motivational boosts (Ghorbani et al., 2012; Ortiz et al., 2014). However, because working memory capacity supports a wider range of cognitive demands, its benefits may be more robust and self-sustaining over time.

Taken together, these findings confirm that while both phonological–visual and working memory–based interventions are valuable tools for supporting children with dyslexia, working memory training offers superior benefits for promoting a positive attitude toward reading and maintaining these gains beyond immediate instruction. This is significant because motivational improvements can drive sustained reading practice and further skill development, breaking the cycle of avoidance often seen in students with dyslexia (Faghfouriazar, 2023; Yao et al., 2024).

Despite its strengths, this study has several limitations. First, the sample size was relatively small and limited to male second-grade students in Tehran, which restricts the generalizability of the findings. Future studies should include larger, gender-balanced, and more geographically diverse samples to confirm the patterns observed. Second, the follow-up period was only one month; longer-term tracking would provide a clearer understanding of the durability of attitudinal and cognitive gains. Third, although we controlled for initial differences in reading attitude, other potentially influential variables—such as home literacy environment, parental support, and co-occurring attention difficulties—were not systematically assessed. These factors might moderate the effectiveness of the interventions. Finally, this study relied on a single self-report scale for reading attitude; incorporating behavioral measures (e.g., reading frequency logs, task engagement observations) could yield a richer understanding of motivational changes.

Future research should aim to compare hybrid intervention models that integrate both phonological–visual and working memory training, examining whether a combined approach yields additive or synergistic benefits. Longitudinal designs are recommended to track not only the persistence of reading attitude changes but also their impact on later reading achievement and academic outcomes. Researchers should also explore mediating mechanisms, such as reductions in reading anxiety or improvements in self-efficacy, to better understand how cognitive interventions translate into motivational gains. In addition, studies could employ neuroimaging or electrophysiological

Iranian Journal of Educational Sociology
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methods to examine brain-level changes associated with these training programs, providing insight into neural plasticity in dyslexic readers. Finally, culturally adapted digital platforms could be developed and tested for scalability and cost-effectiveness in educational systems with limited resources.

For educators and clinicians, these findings emphasize the value of incorporating working memory training into remedial reading programs, as it not only strengthens decoding and comprehension but also fosters a more positive emotional relationship with reading. Structured, engaging, and game-based exercises can make cognitive training appealing and increase children's persistence in learning tasks. Phonological–visual interventions should still be considered, particularly for students with severe decoding deficits, but they may be most effective when combined with working memory strengthening. School psychologists and special educators should also monitor students' attitudes toward reading alongside cognitive skill development, adjusting interventions to maintain motivation. Finally, tailoring instructional materials to the linguistic characteristics of Persian and similar scripts can increase intervention success and ensure cultural relevance.

Authors' Contributions

Authors equally contributed to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

All procedures performed in studies involving human participants were under the ethical standards of the institutional and, or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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