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Educational Effects of Delis–Kaplan Executive Function System and Dawson–Guare Program on Neuropsychological Functions in Students with Dyslexia

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Abstract

The present study aimed to investigate the effectiveness of the Delis–Kaplan Executive Function System (D–KEFS) and Dawson–Guare program on neuropsychological functions in students with dyslexia. This was a quasi-experimental study with a pretest-posttest design, a control group, and a follow-up period. The statistical population included all male and female third-graders in Tehran in the academic year 2018–2019. Based on the inclusion criteria, convenience sampling was employed to select 45 dyslexic students from all the male and female third-graders with dyslexia. The Raven IQ Test for Children (1983) and the Reading and Dyslexia Test (2016) was conducted for screening, and the Conners' Continuous Performance Test (2004) was utilized for assessment before and after interventions. The first experimental group received 17 sessions based on the D–KEFS whereas the second experimental group received 17 sessions in the Dawson–Guare Program. The ANCOVA was then used in SPSS-24 for data analysis. The mean of the post-test and follow-up scores of neuropsychological functions in the D–KEFS and Dawson–Guare Program groups significantly decreased compared to the control group ($p<0.01$). Moreover, the D–KEFS intervention improved neuropsychological functions more than the Dawson–Guare Program ($p<0.05$). Based on the findings, it can be concluded that there is a high correlation between enhancing executive skills in dyslexic children and improving their neuropsychological functions. It is possible to enhance neuropsychological functions, which underlie the reading skill, in dyslexic children through interventions that target a wide variety of executive functions.

Keywords: Dawson–Guare, Delis–Kaplan, Dyslexia, Neuropsychological, Students

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Introduction

Reading is the process of sense-making through letters that are lingual symbols. In research and education, reading is a multifaceted process which deals with lexical recognition, spelling, dictation, phonological awareness, reading comprehension, easy reading, and

motivation (Chamba & Ramirez-Avila, 2021). Capabilities of reading comprehension and analysis are activated while reading. In fact, reading is a process that activates imagery, stimulates memory centers in the brain, and helps remember information and stabilize emotions. Reading helps novice learners and elementary school students expand their mental abilities by coming up with new ideas (Bagheri Nia et al., 2022; Meixner et al., 2019). The importance of reading also lies in the fact that it allows for creative thinking. In other words, reading learns the brain to concentrate properly. The importance of concentration on daily affairs is hidden to nobody. It is essential for children to learn to read in order to achieve academic success, for reading allows them to access further lessons, enhance communication, and improve lingual skills (Namaziandost et al., 2021; Nouwens et al., 2021). Learning to read is an important criterion for a child's development. In fact, children learn to read in order to comprehend the written contents and improve their lingual skills. According to this classical point of view, reading is the product of lingual decryption and comprehension. When contents are decrypted correctly, a string of letters will be perceived as a word. However, recent studies have pointed out the roles of executive functions such as memory, attention, and cognitive flexibility in reading (Sharifi & Rezaei, 2018; Toffalini et al., 2017).

Known as a reading disorder, dyslexia would cause problems with reading. It does not affect the intelligence. Dyslexia, also called the inability to read, affects the areas of the brain that process language. Dyslexic individuals experience different reading difficulties such as spelling words, speed reading, writing words, pronouncing words, and perceiving what is read (Sharifi & Rezaei, 2018). Dyslexia results from a genetic interaction with the environment. The underlying mechanism of dyslexia ensues from differences in lingual processing in dyslexic people's brains. Dyslexia can be diagnosed through memory tests as well as spelling and reading tests. This condition differs from the reading problems caused by visual impairment, hearing impairment, or lack of proper education opportunities for learning (Barbosa et al., 2019). Nearly 3–7% of students are affected by this disorder, manifesting approximately 20% of its symptoms (Moura et al., 2015). Since dyslexic students may show various problems in different areas such as reading, writing, and spelling, they should be taught potential and alternative learning strategies and methods to overcome these problems. Students with dyslexia have average intelligence and usually have normal vision. Early assessment and timely intervention in students with dyslexia can lead to the best treatment results. Most children with dyslexia can succeed with private tutoring or a particular education program in school. Emotional support also plays an essential role in their success (Snowling et al., 2020).

Executive functions are defined as a set of skills enabling people to adopt socially acceptable and purposive behaviors to respond to a new situation adaptively with conscious control (Friedman & Miyake, 2017). Many studies have pointed out executive functions in reading. In general, executive functions include several cognitive processes of supreme levels with interrelated functions. Neuroimaging findings has systematically proved the involvement of the frontal-parietal network in the regulation of these separate processes. In addition, executive functions are specifically related to three areas: shifting, working memory, and response inhibition. These three functions can together support the targeted planning capacity (Diamond, 2013). The inabilities of executive functions have been proven present in developmental inabilities. Regarding dyslexia, studies have often focused on the effects of working memory inabilities, especially in the phonological loop, and have identified the phonological loop dysfunction in this disorder (Aghdar et al., 2020; Lallier et al., 2016). There are bilateral relationships between executive functions and reading. From the very first grade, executive functions help with reading comprehension. From the second grade on, reading comprehension helps with executive functions (Dolean et al., 2021). According to scientific evidence, dyslexia is probably correlated with executive dysfunction on a broader level. A meta-analysis indicated that dyslexic individuals had many problems in executive functions as opposed to people with good reading skills. Furthermore, these two groups of individuals differ in the type of evaluation assignments (Cancer & Antonietti, 2017). Dyslexic children showed further errors in inhibition control (i.e., the command execution error). In fact, they were characterized by a wider variety of responses, higher perseveration error rates, and lower levels of response consistency. These cases refer to inhibition control problems such as impulsivity and sustained attention deficits (Peterson & Pennington, 2015). Other studies also identified deficits in multiple areas of executive functions among dyslexic children such as deficits in verbal fluency, attention, and phonological loop. As a result, certain problems were identified in dyslexic children's verbal fluency and movements (Lonergan et al., 2019; Martínez-Álvarez, 2018).

Neuropsychology analyzes the brain functions concerning cognitive formations in childhood and adolescence, for these stages of life are characterized by 1- evolutionary developments, 2- developmental transformations in the nervous system and behavior, and

3- possibility of environmental and biochemical problems (Gabriel et al., 2021). Scientific discoveries of the brain and its correlations with learning processes have allowed for the better perception of how students learn and how interventions should be used from a neuropsychological perspective to enhance learning. Neuropsychology, psychology, and education should be employed within an interconnected framework to obtain reputable scientific interpretations for learning improvement (Polanczyk et al., 2015).

The use of neuropsychological skills in education and learning refers to Luria's model stating that information processing is the key to intervention programs in education. In fact, Luria's model emphasizes the optimal activation of the cerebral cortex in attention, sensory information input, information storage in memory for audiovisual manipulation, irrelevant stimulus inhibition control and planning, and stimulus selection (Das, 2003). A theoretical framework should be developed to design and employ certain interventions to deal with neuropsychological skills in education. Given the comprehensiveness of D–KEFS, the present study used this system as the basis to design an intervention in a bid to target neuropsychological skills in learning.

According to the research literature, deficits in the working memory and flexibility are directly correlated with reading difficulties (Ghazzai Alsulami, 2019). There is also a substantial load of evidence regarding the academic failures of dyslectic students who had normal IQs (Kormos, 2017; Solovieva & Quintanar Rojas, 2017), something which indicates the necessity of designing and implementing certain interventions to rehabilitate such students and correct their unfavorable conditions. Hence, this study aimed to fill the research gap in the effectiveness of cognitive interventions to improve these skills, for the analysis of children's behavioral regulation has often been discussed with respect to different concepts such as behavioral inhibition and self-control. All of these terms refer implicitly to behavioral correction capabilities based on cognitive, emotional, and social demands (Cardona & Rojas, 2018). Accordingly, this study aimed to compare the effectiveness of the D–KEFS and Dawson–Guare program on neuropsychological functions in students with dyslexia. Therefore, the most important questions of the present research are as follows:

- Does D–KEFS have an effect on neuropsychological functions in students with dyslexia?
- Does Dawson–Guare Program have an effect on neuropsychological functions in students with dyslexia?
- Is there a difference between the D–KEFS and Dawson–Guare Program in terms of effectiveness on neuropsychological functions in students with dyslexia?

Method

Design

This study adopted a quasi-experimental design with a pretest-posttest design, a control group, and a two-month follow-up period.

Participants

The statistical population included all male and female third-graders in Tehran in the academic year 2018–2019. To select the sample, two districts were randomly selected from among the educational districts of Tehran. Among the male and female primary schools in these two districts, 30 schools were randomly selected. Convenience sampling was employed to select 45 dyslexic male and female students, who were then assigned to two experimental and one control groups (n= 15 per group). In this research, 45 students with dyslexia were included using G-power software (test power=0.90, effect size=1.62, α=0.05), the inclusion and exclusion criteria and the scientific evidence of other studies (Azhdari et al., 2022). The two experimental groups received 17 intervention sessions whereas the control group received no interventions. The inclusion criteria were defined as being seriously weaker at reading than other students based on a teacher's opinion and academic reports, lacking any comorbid disorders, having a normal IQ, and receiving parental consent to children's participation in the research process. The exclusion criteria were defined as being absent for more than three consecutive sessions and failing to do exercises and assignments in three consecutive sessions.

A letter of introduction was first obtained from the Education Department to visit schools in different districts of Tehran. The Raven IQ Test for Children and the Karami–Nouri Reading Test (1999) were conducted to identify dyslexic students. Randomly, 45 male and female dyslexic students were then selected and assigned to two experimental and one control groups. The Conners' Continuous Performance Test was then used as a pretest to evaluate neuropsychological functions in all groups. In this stage, the first experimental group received the researcher-made D–KEFS-based program whereas the second experimental group received the Dawson–Guare program in 17 sessions lasting for 45–60 minutes. The control group received no interventions. After the sessions were over, the posttest and follow-up were measured in the two

experimental and the control groups. All ethical research considerations (i.e., consent of participants and their parental consent forms) were observed. Descriptive statistics (i.e., mean and standard deviation) and inferential statistics (i.e., univariate ANCOVA) were used for data analysis in SPSS-24.

Instruments

The Conners' Continuous Performance Test: This questionnaire was designed by Conner in 2004 to evaluate different neuropsychological skills such as attention, sensorimotor functions, lingual functions, memory and learning functions, executive functions, and cognitive processing speed within four ranges (from "unobserved" to "observed") among children aged 5–12 years old. Given the questionnaire scoring method, lower scores indicate higher functions. In an Iranian study, the internal reliability coefficients were reported to range from 0.75 to 0.90, whereas the eight-week retest reliability coefficients were reported to range from 0.60 to 0.90. The construct validity of this tool was evaluated at an appropriate level through factor analysis. The reliability of the questionnaire was obtained as 0.79 using Cronbach's alpha (Ghalamzan et al., 2014). In the present study, Cronbach's alpha coefficient was 0.80 for the questionnaire.

Raven's Colored Progressive Matrices for Children: This tool was designed by Raven in 1938, this is a nonverbal intelligence test. It was normalized in Iran (Rasouli Foshtami et al., 2022), and its revised retest coefficients were reported as .60 and .80 for children aged 6.5 and 9.5 years old, respectively, within one year. This test has 36 questions and one point is given to each correct answer. These results indicated the test sensitivity to fluctuations in the outputs of intellectual activities within early childhood (Rasouli Foshtami et al., 2022). In the current study, Cronbach's alpha coefficient was .86 for the questionnaire.

Reading and Dyslexia Test: The Reading and Dyslexia Test was designed to analyze the reading abilities of normal boys and girls from first-graders to fifth-graders and to diagnose children with dyslexia (Moradi et al., 2016). It consists of ten subtests: word-by-word reading, reading comprehension, a chain of words, lexical comprehension, rhythm, ellipsis of phonemes, meaningless word reading, image calling, symbols of letters, and symbols of words. The reliability of the Reading and Dyslexia Test was obtained as .82 using Cronbach's alpha (Moradi et al., 2016). In the present study, Cronbach's alpha coefficient was .79 for the questionnaire.

Intervention Program

The researcher-made D–KEFS-based protocol was held in 17 group sessions lasting for 45–60 minutes to improve working memory, attention, audiovisual processing speed, cognitive flexibility, problem-solving, perception, creativity, and decision-making through various assignments. A questionnaire was then designed to validate the intervention. The nonrandom purposive (snowball) sampling method was adopted to select 10 professors specializing in the education of children with special needs. The experts scored the themes on a four-point scale from 1 to 4. The content validity index (CVI) for each expert-asked item was greater than the minimum validity required for the 10-member panel (0.62); hence, the resultant content had the content validity. Table 1 presents an overview of the intervention sessions.

Table 1

An Overview of the Researcher-made D–KEFS-Based Intervention

Session	Purpose	Content
1	Introduction and Presentation	Making introductions and contacting the group members; defining and describing the concept of dyslexia and executive functions
2	Speed naming, visual attention, short-term memory	Teaching how to read the alphabet and paying attention to different forms of letters
3	Active phonological memory, speed naming, cognitive flexibility, subtle skill	Underlining a specific letter out of many letters.
4	Speed naming, active phonological memory, active verbal memory	Reading letters and groups of letters out at the maximum rate of speech; highlighting letters or a group of letters that are the same as previous letters of a group of letters.

Session	Purpose	Content
5	Nonverbal active memory, divided attention, cognitive inhibition, cognitive flexibility	Reading groups of Persian alphabets out and coding them in a pattern within the shortest time possible; naming images of fruits with a group of letters simultaneously; reading words quickly and irreversibly; underlining the words that are the same as the two last words.
6	Cognitive flexibility, selective attention, cognitive inhibition	Connecting letters from the first letter to the last letter within the shortest time possible; connecting numbers from 1 to 90 within the shortest time possible; combining letters from only yellow rectangles.
7	Selective attention, cognitive inhibition, verbal processing speed, phonological active memory	Reading words in only colorful circles; reading and identifying words with specific letters, names of fruits, and names of animals.
8	Visual-spatial active memory, long-term memory, speed naming, inhibition, visual perception	Writing the words that begin with specific letters.
9	Visual-spatial active memory, verbal fluid memory, speed naming, phonological active memory	Look at the pictures for 40 seconds, and then name all pictures and words that you remember; writing words with letters in accordance with instructions
10	Visual attention, cognitive inhibition, cognitive flexibility, verbal processing speed, nonverbal active memory	Reading words and highlighting the words that are the same to the previous three words; reading pale letters; writing names of boys and girls
11	Phonological active memory, speed naming, visual perception, selective attention, cognitive inhibition	Reading words after deleting the first and last letters; reading words in green squares; connecting different words
12	Cognitive flexibility, cognitive inhibition, selective attention, visual-spatial active memory, visual attention	Write the following words without writing their first letters inside colorful circles within the allowed time. First, read the words in specific directions, and then write the meanings of undirected words at the bottom of the page.
13	Divided attention, cognitive inhibition, visual perception, problem-solving, planning, organizing, visual-spatial active memory	Categorizing shapes and explaining categorization purposes; guessing the specific images and words.
14	Cognitive flexibility, verbal active memory, problem-solving, planning, organizing, auditory attention	Answer the questions after reading or listening to the stories.
15	Verbal processing speed, visual attention, stable attention, short-term memory	Reading stories; reading and remembering the meanings of words in the story; reading the story text; answering the questions
16	Cognitive flexibility, divided attention, nonverbal active memory, auditory perception, problem-solving	Connect the synonymous words of the story within five minutes. Answer the questions.
17	Evaluation, form completion	Evaluating the experimental and control groups; form completion by parents

Dawson–Guare Program: Based on games and practice, this education program was developed to improve executive functions in children. In addition to games, this program focuses on children's cognitive empowerment, for it is based on the assumption that executive functions are correlated with neurological/developmental learning. Therefore, improving executive functions can enhance learning and

development. Table 2 presents an overview of the intervention sessions.

Table 2.
An Overview of Executive Functions in Dawson–Guare Program

Session	Purpose	Content
1	Introduction	Making acquaintances between caregivers and children and introducing the activities of group sessions Setting rules and presenting each member's tasks Expressing children's feelings about their presence in the program in one sentence Doing one favorite activity of children to establish friendly, secure relationships and encouraging children to participate in each session
2	Inhibition improvement, response, time management, organizing skill improvement, planning, time management	Performing a reverse play activity Performing a tower-making activity
3	Attention memory, assignment initiation active memory, flexibility	Performing a circle task and having children sing a chant Performing a task without using any thumbs
4	Response inhibition, assignment initiation, time management, planning, attention retention	Performing a happiness wave task Performing a chair game
5	Active memory, attention retention, time management	Performing the task of red and black cards
6	Attention retention, active memory, planning, attention retention, initiation, assignment	Performing the polar bear chase game Performing the Rostam-said task
7	Attention retention, response inhibition, flexibility	Performing the children's mirror image task
8	Time management, response inhibition, attention retention	Reviewing exercises from the previous sessions Performing the tasks of neighbors
9	Assignment initiation, initiation, assignment, attention retention	Playing tag with a ball Playing animal games
10	Initiation, assignment, attention retention, response inhibition	Reviewing previous sessions Performing the hand sandwich activity Hand freeze activity
11	Response inhibition, attention retention, emotional control, time management, attention retention, assignment initiation	Performing the proper gesture activity
12	Attention retention, planning, time management, attention retention, response inhibition, assignment initiation	Playing hopscotch Performing the activity of lamps, scissors, knives, and forks
13	Attention retention, assignment initiation	Reviewing previous sessions Performing the don't-follow-your-trainer activity
14	Planning, organizing, attention retention	Playing the game of guessing the animal names Performing the socks activity and object identification
15	Response inhibition, emotional control, assignment initiation, attention retention	Performing the serious laughter activity Performing animal pantomime activity
16	Working memory, attention retention, assignment initiation	Reviewing previous sessions Performing the chain reaction activity
17	Reviewing the previous sessions Performing an activity suggested by children Allowing parents to complete forms	

Findings

The participants included 45 students with dyslexia with an average age of 9.21±0.35 years. Demographic characteristics of students are presented in Table 3. Table 4 presents the means and standard deviations (SD) of pretest, posttest, and follow-up stages in the experimental and control groups.

Table 3.
Demographic Characteristics of the Participants

Groups	Age (years)	Gender	
		Girl	Boy
D–KEFS	8.65±0.71	7 (46.67%)	8 (53.33)
Dawson–Guare program	8.70±0.78	7 (46.67%)	8 (53.33)
Control	8.60±0.73	7 (46.67%)	8 (53.33)

Table 4.
Mean and Standard Deviation (SD) of Research Variables in the Experimental and Control Groups

Dependent variable	Phases	D–KEFS	Dawson–Guare program	Control
		Mean ± SD	Mean ± SD	Mean ± SD
Neuropsychological functions	**Pretest**	109.26 ± 10.07	113.00 ± 8.66	108.40 ± 9.22
	Posttest	84.86 ± 7.79	101.26 ± 8.42	108.06 ± 6.74
	Follow-up	86.93 ± 7.67	101.31 ± 8.39	108.26 ± 8.72

Before analyzing the hypotheses, the hypotheses were analyzed to ensure that the research data would meet the ANCOVA. For this purpose, the normality of data due to the insignificance of the Kolmogorov–Smirnov Z indicate that the neuropsychological function variable followed a normal distribution (Z= 0.134, p=0.200). Moreover, Levene's test was employed to analyze the homogeneity of variances (for the consistency of variances between the two experimental and the control groups). According to the results, the variance homogeneity hypothesis was confirmed, and the ANCOVA was permissible (F= 0.951, p= 0.394). Furthermore, the ANOVA was utilized to analyze the regression line slope homogeneity (F= 1.917, p= 0.174). The insignificance of this interaction indicated that the regression line slope homogeneity hypothesis was confirmed. Therefore, this hypothesis was true for all research variables, and the ANCOVA was permissible.
Table 5 reports the ANCOVA results. According to the Table, the F ratio of univariate ANCOVA for the dependent variable indicated that the experimental groups and the control group were significantly different in terms of neuropsychological functions (p<0.01). Hence, at least one intervention had a significant effect on the dependent variable.

Table 5.
Results of Univariate Analysis of the Effect of Educational Programs on Neuropsychological Functions on the Posttest and follow-up Phases

Phases	Source	SS	df	MS	F	p	η2	Power
Posttest	**Group**	4349.61	2	2174.80	215.79	0.001	0.92	1.00
	Error	393.04	39	10.078				
Follow-up	**Group**	3962.95	2	1981.47	240.95	0.001	0.92	1.00
	Error	320.74	39	8.22				

The Bonferroni post-hoc test was employed to determine whether an intervention was effective or there were significant differences between various interventions. According to the results, the mean difference was 23.20 between the D–KEFS group and the control group in terms of neuropsychological functions (p<0.01). This finding indicates that the D–KEFS-based intervention improved neuropsychological functions. Furthermore, the mean difference was 6.80 between the Dawson–Guare program group and the

control group in terms of neurological functions ($p<0.05$). This finding indicates that the Dawson–Guare program enhanced neuropsychological functions. In addition, the mean difference was 16.04 between the two experimental groups in terms of neuropsychological functions ($p<0.01$). Hence, there was a significant difference between the two groups in favor of the D–KEFS intervention. Based on the results, the effectiveness of training programs continued until the follow-up stage (Table 6).

Table 6.
Bonferroni Post-hoc Test for Paired Comparison of Neuropsychological Functions across Time Series in the Experimental and Control Groups

Variable	Phases	Groups	Mean difference	SE	p
Neuropsychological functions	**Posttest**	D–KEFS - Control	23.20	2.66	0.001
		Dawson–Guare program - Control	6.80	2.87	0.021
		D–KEFS - Dawson–Guare program	16.04	2.96	0.001
	Follow-up	D–KEFS - Control	21.33	2.99	0.001
		Dawson–Guare program - Control	6.95	3.12	0.034
		D–KEFS - Dawson–Guare program	14.38	2.93	0.001

Discussion

This study aimed to compare the effectiveness of the D–KEFS and Dawson–Guare program on neuropsychological functions in students with dyslexia. According to the research findings, the D–KEFS intervention was effective in dyslexic children's neuropsychological functions. The effects remained within the two-month follow-up period. This finding is consistent with the results of a previous study (Alidoosti et al., 2021) reporting that improving executive functions would be correlated with the reading function in dyslexic children. It is also consistent with the results of another study (Toreyfi Hosseini et al., 2019) reporting that an empowerment program based on executive self-regulation functions would affect the reading function in dyslexic children. However, as far as the authors are concerned, no studies have yet analyzed the effectiveness of a D–KEFS intervention on the neuropsychological function improvement in dyslexic cases.

To explain the effectiveness of the D–KEFS-based intervention in dyslexic children's neuropsychological skills, it can be claimed that the intervention empowered, corrected, and developed brain regions by enhancing intellectual activities, which act as the basis for knowledge learning and require the cohesion of different cognitive processes. Integrating all cognitive processes of the D–KEFS, this researcher-made intervention was intended to involve all brain regions and not focus only on the phenomenological loop improvement of the active memory or the attention to the memory path. In fact, the implementation and rehabilitation modifications of this intervention were based on the D–KEFS functions, and certain assignments were defined to make all cognitive processes work (Fine & Delis, 2011).

Moreover, the Dawson–Guare program was effective in dyslexic children's neuropsychological functions. This finding is consistent with the result of a previous study (Yousefi et al., 2019) reporting that the Dawson–Guare program was more effective than the other metacognitive strategies in improving dyslexic children's executive functions. To explain the effectiveness of the Dawson–Guare program, we can argue that this intervention was based on the effective principle that playing games would substantially contribute to learning and cognitive development in children. This principle can be integrated into the approximate development region principle to possibly enhance the intervention effectiveness in improving neuropsychological functions (Yousefi et al., 2019).

Integrating behavioral and cognitive aspects, this intervention focuses on cognitive functions such as attention, memory, and cognitive flexibility. In other words, the rehabilitation program can adopt a cohesive approach to enhance neuropsychological functions. Although these functions are performed in different brain areas, all brain areas are generally involved in these functions; thus, it would be better to employ a cohesive approach (Siavoshifar et al., 2020). According to the results, the Dawson–Guare program was more effective than the D–KEFS intervention in dyslexic children's neuropsychological functions.

Conclusion

The researcher-made D–KEFS intervention was more effective than the Dawson–Guare program in improving

dyslexic children's neuropsychological functions. Thus, we could argue that the neuropsychological modification and rehabilitation program can leave positive effects on the regulatory and controlling functions viewed as dynamic, verbal, kinetic, and graphic skills as well as retention in different brain measures. These positive changes can help academic intellectual activities such as reading, writing, and doing mathematics (Medina & Guimarães, 2021). Furthermore, any improvements in different neuropsychological skills are correlated with stable cognitive variations from a cognitive perspective, and learnings through interventions are considered cognitive developments that become stable (Soares et al., 2020). The statistical population of this research was limited to dyslexic students in Tehran. Consequently, the generalization of the data to society must be carried out with caution. It is recommended that these education programs be implemented for other age groups and then the results be compared.

Finally, the intervention amplified the insight that targeting all cognitive processes involved in executive functions could comprehensively enhance neuropsychological functions underlying the reading skill. Hence, teachers and experts are recommended to adopt neuropsychological skill improvement techniques that help enhance dyslexic children's reading functions.

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Conflicts of Interest

No conflicts of interest declared.

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