KMAN PUBLISHING INSTITUTE
Journal Website

Article history:
Received 29 June 2023
Accepted 07 September 2023
Published online 20 September 2023

Journal of Assessment and Research in Applied Counseling

Volume 5, Issue 3, pp 103-112

E-ISSN: 3041-8518

The effectiveness of self-regulation learning training on the executive functions of male elementary school students with reading disabilities

Neda. Garosian Shad[1], Jahanshir. Tavakolizadeh[2*], Reza. Dastjerdi[3], Hamid. Taheri[4]

[1] Graduate Student of Educational Psychology, Qaenat Branch, Islamic Azad University, Qaenat, Iran
[2] Professor, Department of Educational Psychology, Qaenat Branch, Islamic Azad University, Qaenat, Iran
[3] Assistant Professor, Department of Psychology, Birjand Branch, University of Medical Sciences, Birjand, Iran
[4] Assistant Professor, Department of Basic Sciences, Qaeenat Branch, Islamic Azad University, Qaeenat, Iran

*** Corresponding author email address**: naseryoosefi@yahoo.com

A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Garosian Shad, N., Tavakolizadeh, J., Dastjerdi, R., & Taheri, H. (2023). The effectiveness of self-regulation learning training on the executive functions of male elementary school students with reading disabilities. *Journal of Assessment and Research in Applied Counseling, 5*(3), 103-112.
https://doi.org/10.61838/kman.jarac.5.3.14

A B S T R A C T

Objective: The objective of the present research was to examine the effectiveness of self-regulation learning training on the executive functions of male elementary school students with reading disabilities in District 2 of Tehran during the 2022-2023 academic year.

Methods and Materials: This study, considering its goals, was an applied study and, in terms of data collection method, was a quasi-experimental study employing a pre-test, immediate post-test, and delayed post-test design with a control group. The population comprised all male elementary students in District 2 of Tehran, totaling 6,515 students. The sample consisted of 40 male students (10 years old) from the fourth grade, selected through multi-stage cluster sampling. Within each cluster, participants were chosen through simple random sampling. At the end of the study, an educational package for teaching Persian language content, focusing on reading processes as outlined in the textbook, was prepared based on the resources mentioned in the research text. This package aimed at enhancing reading fluency and addressing reading difficulties. In each group, 20 students received either witness or self-regulation learning instruction. The self-regulation group underwent 16 sessions of 45-minute training focusing on executive functions. Following the training, an immediate test and a follow-up test two months later were administered to evaluate the intervention's sustainability. The research tools were the Stroop Test (2006), the Wisconsin Card Sorting Test (1948), the Continuous Performance Test (1956), and the N-back Test. Data were analyzed using a mixed ANOVA test with SPSS-V.24 software.

Findings: The results indicated that self-regulation learning training effectively impacted the executive functions of students with reading disabilities ($P = 0.01 < 0.05$).

Conclusion: It can be concluded that educational interventions, especially self-regulation learning training, are efficient and effective strategies for enhancing performance and skills in students, particularly those with reading difficulties, in the realm of executive functions.

Keywords: *self-regulation, executive functions, dyslexia, students.*

1. Introduction

Reading is one of the brain-based activities and a way of transferring the thoughts and culture of a society, as many concepts and thoughts of a society are embedded in written books. Progress in any society depends on acquiring knowledge and information, and given the written nature of knowledge, attention to reading is important (Atadokht, Hedayat, & Sepehrinasab, 2020). Reading is a form of expression that establishes a connection and familiarity with the thoughts, information, and teachings that exist in written form and is considered an important tool for learning. Reading requires skills such as attention, inhibition, flexibility, information processing, accuracy, and phonological processing. Experts unanimously agree that the ultimate goal of reading is to acquire information, knowledge, pleasure, or other higher-level benefits. However, some students, despite having natural intelligence and suitable educational opportunities, have difficulties in learning, especially reading (Safari, Baezzat, & Qaffari, 2019).

The term learning disability was first introduced by Samuel Kirk in 1963. One of the disabilities students face, leading to failure and frustration during their academic career, is dyslexia. Dyslexia is a learning disorder characterized by deficits in word recognition, fluency and reading speed, spelling issues, comprehension problems, errors in reading similar words, guessing words based on their beginning and end, mirror reading or reverse reading, severe problems in syllabication, reluctance and aversion to reading, difficulty in distinguishing part from whole, and a pronounced deficit in decoding or syllabifying words (Caravolas, 2018). Specific learning disorder with reading difficulties or dyslexia is the most common characteristic of specific learning disorders among primary school students. Despite extensive research in recent years, it remains a hot area of study, with a prevalence rate of 5 to 15 percent among elementary school children across different languages and cultures (Ganji, 2020).

Students with dyslexia may face issues such as weaknesses in subjects, lack of academic progress, being labeled by classmates, decreased self-confidence, interpersonal skills, social adaptation, behavioral problems including internalized and externalized issues, socio-emotional difficulties, deficits in social data processing, high levels of social rejection, loneliness, and poor interpersonal skills. These students, due to their continuous and repeated academic failures, are 1.5 times more likely to drop out during adolescence (Crisci et al., 2021). Children with dyslexia, if identified and provided with remedial education in the early years of schooling, can overcome this disorder in mild cases as early as the first or second grade. In more severe cases, depending on the pattern or severity of the deficits, remedial education may continue until mid or late high school (Atadokht, Hedayat, & Sepehrinasab, 2020).

In Persian language lessons, reading is an important aspect that our educational system should pay serious attention to and identify students with reading difficulties from the beginning to prevent future damages to the learner's progress. Therefore, reading is a necessary and fundamental aspect of a learner’s success, to the extent that failures in the learning process are largely due to incompetency in reading skills (Soleimani Davoodli et al., 2019).

Education, as a way of transmitting concepts and significant achievements, is crucial in preventing disorders and promoting all-around progress of learners. The development of technology has led the educational system to use various and modern methods, such as self-regulation learning, to improve performance and progression, which directly supervise information processing, storage, brain functions, cognitive measures, and the learning process, thus preventing potential disorders that students may encounter in their educational journey (Fateh Rad, Mohammad Khani, & Mosleh, 2021).

Among the issues that should be considered for improvement in teacher performance and the educational system are the components of executive functions such as increasing attention, impulse control, planning ability, self-control, self-leadership, self-belief, and self-regulation, which can significantly enhance concentration accuracy, response speed, memory enhancement of students with learning disorders, particularly dyslexic learners (Chen & Goverover, 2021). One of the common problems of dyslexic students in the realm of executive functions is directly related to the health of the frontal lobe of the brain. Executive functions act as intermediaries between complex neural circuits, establishing separate connections in the frontal lobe with other cortical and subcortical structures (Aghaziarati, Nejatifar, & Ashori, 2021). They also positively correlate with cognition and awareness (Ghaemi et al., 2022). The performance of students with reading disorders in executive function tests is significantly poorer than that of normal children, and this deficiency in neuropsychological skills can predict children's reading disabilities (Momeni Shahraki et al., 2018).

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E-ISSN: 3041-8518

As such, deficits in executive functions are recognized in many multi-deficit cognitive models of dyslexia. Some research indicates that adequate performance in executive functions can be a suitable predictor of children's reading abilities and appropriate academic performance in subsequent school years. Additionally, deficits in executive functions reduce academic success and increase the likelihood of risky behaviors (Hashemi, Eyni, & Shahjoee, 2022).

Bradley (2014) showed in his research that among the three areas of executive functions, which include flexibility, inhibition, and control, cognitive flexibility is an important factor in the learning process in various subjects, including Persian and reading. Given that cognitive flexibility is a vital and necessary part of learning, any deficit in this area can have irrevocable consequences. The academic success of students, especially dyslexic learners, is largely dependent on their ability to plan, organize, prioritize information, regulate their attention, manipulate information in working memory, monitor their progress, and the weakness of executive functions in response inhibition, sustained attention, organization, and planning negatively affects their academic progress (Khalili, Emadian, & Hassanzadeh, 2022).

Today, given the significant transformation in treatments and interventions to reduce and improve learning disorders, educational systems and institutions dealing with these disorders have turned to efficient and modern educational methods. One of the educational methods that can be effective in improving the performance and learning process of dyslexic students is self-regulation learning, introduced by Bandura in 1976. This educational method is based on the expansion and development of concepts and methods of traditional cognitive therapy, combining the principles and foundations of attachment, constructivism, and gestalt schools in an educational and conceptual model (Torbatinezhad, Kavyar, & Ghandizadeh, 2022).

Training in self-regulation strategies includes cognitive processes, self-assessment, and self-control, enabling students, especially dyslexic learners, to engage more task-orientedly in academic tasks and daily activities, be aware of the usefulness of specific strategies for efficient problem-solving and learning, re-evaluate their repeated failures, assess new approaches and methods to achieve their goals, believe in their abilities, and ultimately improve active learning (Johnson, Masser, & Spears, 2023).

Therefore, the need to employ appropriate and desirable learning methods in education is so significant that educational science stakeholders emphasize the importance of using these methods to reduce problems, increase progress, and improve the performance of learners, particularly dyslexic students. Therefore, in enhancing the efficiency and advancement of these students in the Persian reading subject, what contributes to increasing their skills is the use of effective educational methods such as brain-based and self-regulation learning, which leads to progress in other areas and enhances their performance in executive function components and other skills (Soltani & Hemti Alamdarlou, 2021).

Since many essential aspects of the growth and development of dyslexic students in learning environments are not sufficiently addressed, optimal learning does not occur in these learners. Therefore, the educational system should pay more attention to the limitations and problems of these learners and use efficient and effective teaching methods and models tailored to their needs, gaps, and educational issues to create a practical environment for effective learning in them (Kadivar, 2021).

Therefore, it is essential to consider the needs of students in addressing the problems they face, and the structure and content of education for them should be tailored to their abilities to overcome problems and weaknesses in the learning process. Expanding the use of efficient and effective teaching methods in a way that enables dyslexic students to achieve desirable outcomes according to their learning capacity and talent is one of the significant educational goals (Hong, Lee, & Ye, 2021). Thus, by managing and integrating educational methods such as self-regulation learning, an effective step can be taken towards information processing, improving the quality of performance of dyslexic students in emotional, cognitive, self-efficacy, comprehension, and better learning. This approach makes the teaching process more effective for teachers and enhances the memory efficiency, response speed, organization, reasoning, and other functions of these students in the learning process. It also allows learners to store educational content in memory more accurately and organizedly (Falakdin, 2021).

Conducting this research under the current conditions, where the country's education system is looking for a new approach to participatory and active teaching methods, seems necessary and extremely important. It is also necessary from a practical point of view to ascertain the effectiveness of these efficient learning methods on academic progress, improved efficiency, and performance of dyslexic students in Persian reading lessons (Seif, 2021).

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E-ISSN: 3041-8518

2. Methods and Materials

2.1. Study Design and Participants

The research method of the present study was quasi-experimental, and the design used in this research was a pre-test, immediate post-test, and delayed (follow-up) post-test with a control group. The pre-test-post-test control group design consisted of one experimental group and one equivalent control group. Each group was measured twice, the first measurement with a pre-test before the training, and the second measurement after the completion of the required trainings. For the formation of three groups, using a multi-stage sampling method, 20 subjects were randomly assigned to the self-regulation learning training group and another 20 to the control group.

The statistical population used in this research comprises all 4th-grade male students of public schools in District 2 of Tehran's Education Department in the year 2023, totaling 6515 students. The sample and sampling method, based on Cohen's table and considering that in experimental and quasi-experimental research, the smaller our sample size, the greater the obtained validity and better conclusions, the statistical sample size of this research consists of 40 4th-grade female students (10 years old). They were selected for the study through multi-stage cluster sampling and within each cluster, randomly.

Forty 4th-grade male students from five schools and four classes from each school in District 2 of Tehran were selected, making a total of 20 classes from the 4th grade, with 2 dyslexic students from each class (totaling 40 students) and 1 normal student from each class (totaling 20 students) selected for simultaneous placement in the self-regulation learning training group and the control group, with 20 students in each group. Also, an explanatory session was held for the students by teachers and researchers.

2.2. Measures

2.2.1. Stroop Test

Stroop Test: The Stroop Test, one of the most commonly used tests for selective or focused attention and response inhibition, is a laboratory model and considered a basic test for the function of the brain's frontal lobe. In the current research, a computerized version of the Stroop Test (Word/Color) was conducted on subjects in three stages. This software-based test in the current study is considered an indicator of inhibition. It has been used to measure cognitive inhibition in some studies. The indices measured in this test include accuracy (number of correct responses) and speed (average reaction time of correct responses to stimuli in milliseconds). This test consists of 14 main cards. Each card contains a word in green or red, shown eight times, with the display and color of these cards randomly changing each time. The display time for each card is one-eighth of a second. Therefore, the subject must try to recognize the colors of the cards as quickly as possible and indicate it using two green or red keys. The shorter the time and the higher the number of correct answers (up to a maximum of 112 correct answers), the higher the subject's score in this test. The reliability of the Stroop Test has been reported in the range of 0.80 to 0.91 using the retest method. Research around this test indicates its reliability and validity in adults and children (Crisci et al., 2021).

2.2.2. Wisconsin Card Sorting Test (WCST)

The Wisconsin Card Sorting Test (WCST) is a neuropsychological test that measures abstract reasoning, cognitive flexibility, perseveration, problem-solving, concept formation, set shifting, the ability to test hypotheses, and the use of error feedback, initiation and cessation of action, and sustained attention. This test was designed to measure abstract reasoning and the ability to adapt cognitive strategies to environmental challenges. Therefore, it is believed that the Wisconsin test measures a complex range of executive functions including planning, organizing, abstract reasoning, concept formation, maintaining cognitive rules, the ability to change, and inhibiting impulsive responses. The original version of WCST included 60 response cards (or 64 response cards) in front of 4 key stimulus cards. This test is also used to measure cognitive flexibility. In the current study, a computerized version of the test was used, which has 64 non-identical cards and is considered an indicator of cognitive flexibility. The higher the number of correct answers, the better the individual's performance. The highest score is 64 and the lowest is zero (Crisci et al., 2021; Khalili, Emadian, & Hassanzadeh, 2022).

2.2.3. Continues Performance Test (CPT)

The Continuous Performance Test (CPT) was designed in 1956 by Rosvold and colleagues and has since been used as one of the common and powerful tools in assessing patients with attention deficit and hyperactivity disorder. This test requires the inhibition of unwanted responses and the

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E-ISSN: 3041-8518

continuous monitoring of target responses. In this test, the individual must make a movement (pressing a key) in response to a target stimulus in a series of target and non-target stimuli presented. The outputs of this test include: correct response to the target stimulus, average time of correct response, incorrect response to the non-target stimulus, and no response to the target stimulus (error of omission). In the test used for the current research, two numbers appear on both sides of the screen, and the individual is asked to press the space key on the keyboard as accurately and quickly as possible if the two numbers displayed on the screen are the same. This task allows for continuous monitoring of stimuli while also repeatedly changing the target stimulus. In this test, there are 150 numbers as stimuli, and of these, 30 stimuli (20 percent) are considered target stimuli and the remaining 80 percent as non-target stimuli. The presentation time for each stimulus is 200 milliseconds and the interval between two stimuli is one second. The duration of the test, including the practice phase, which is conducted to enhance the subject's understanding before the main phase, is 200 seconds. In this test, two types of errors are counted by the computer program. In addition to this, the number of correct responses (up to a maximum of 150 responses) and the reaction time of the subject to the stimulus are also calculated (Ghaemi et al., 2022).

2.2.4. N-Back Test

The N-Back Test, first designed by Kirchner in 1958, is a task measuring cognitive performance related to executive functions. Since this test requires both the retention and manipulation of information, it has been deemed highly suitable for assessing working memory. In this test, a series of visual stimuli appear on a screen, and the individual must respond under two different working memory load conditions. Under low load conditions, the individual must press a specified key if a stimulus matches the previous one. Under high load conditions, the individual must compare each stimulus with the two preceding ones and press the key if they match. The test outputs include the number of correct and incorrect responses. The obtained data consist of the number of correct responses, the number of incorrect responses, the number of unanswered items, and the average reaction speed of correct responses. The total score is the number of correct responses. The more correct responses and the fewer incorrect responses, along with shorter response times, indicate an optimal state of an individual's working memory. Both domestic and foreign studies have reported the test's reliability to be in the range of 0.54 to 0.84, and its validity is also considered acceptable (Caravolas, 2018).

2.3. Implementation

The male students in this grade were equally placed in groups for self-regulation learning training based on executive functions (Johnson, Masser, & Spears, 2023; Khalili Sadrabad, Ebrahimi Ghavam, & Radmanesh, 2017), and the control group, with 20 students in each group. In the case of self-regulation training, learners were trained in a classes in 16 sessions of 45 minutes each trainers experienced in the 4th grade in collaboration with the researcher, and the results of the trainings provided to them were compared with the control group, which were normal students. Children in the self-regulation training group were trained in line with the components of executive functions, and the control group did not receive any training in self-regulation learning in line with executive functions and continued their normal and daily activities. After the training sessions ended, an immediate post-test was conducted in March 2023 for both groups under similar conditions based on the 4th-grade textbook and considering the components related to self-regulation learning. Two months later, in May 2023, the children again responded to questionnaires related to executive functions as a post-test.

2.4. Data analysis

After collecting the pre-test and post-test data, the collected information was analyzed using appropriate statistical tests, and the results of the groups were compared with each other and with the control group. In this research, descriptive statistics such as mean and standard deviation and inferential statistics including mixed ANOVA. Before analyzing the data, the SPSS software version 24 was used.

3. Findings and Results

The test scores related to self-regulation learning training in the field of executive functions of students with reading disorders were collected and analyzed in two parts: descriptive (Table 1) and inferential statistics. Forty male students (10 years old), from the fourth grade, were selected and matched into two groups of 20. The first group underwent self-regulation learning training, and the second

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E-ISSN: 3041-8518

group served as the control group. A mixed ANOVA design was used to examine the research hypotheses.

Table 1

Descriptive statistics findings (M: Mean, SD: Standard deviation)

Group	Variable	Index	Pre-test	Post-test	Follow-up
Exp.	Sustainable memory	M	90.81	40.97	50.102
		SD	77.8	46.10	90.9
Control		M	90.80	70.81	05.82
		SD	47.8	30.12	73.10
Exp.	Concentrated memory	M	00.82	60.90	00.90
		SD	86.11	49.7	75.9
Control		M	40.80	00.80	60.83
		SD	60.11	82.16	87.16
Exp.	Working memory	M	60.2	70.22	90.27
		SD	40.1	80.3	64.3
Control		M	90.20	50.19	40.20
		SD	81.3	02.5	05.5
Exp.	Cognitive flexibility	M	40.40	00.53	20.55
		SD	99.5	62.6	87.5
Control		M	80.41	00.38	60.39
		SD	52.6	55.8	92.8

Furthermore, the Shapiro-Wilk test was used to check the normality of the dependent variable due to the limited sample size. The obtained significance levels were greater than 0.05, thus confirming the assumption of normality of the dependent variable. The Box's test was used to examine the hypothesis of homogeneity of variance-covariance matrices in sustained attention (P=0.27>0.05, F=1.19, Box's M=15.58), focused attention (P=0.22>0.05, F=1.32, Box's M=19.25), active memory (P=0.30>0.05, F=1.14, Box's M=14.16), and cognitive flexibility (P=0.23>0.05, F=1.28, Box's M=18.33), with Box's M test significance levels being greater than 0.05. Therefore, the prerequisite of homogeneity of variance-covariance matrices in these variables was observed. The Levene's test was used to examine the homogeneity of error variances. Levene's test calculated for the variable of sustained attention (correct response) at the pre-test stage (P=0.20>0.05, F=1.60), post-test (P=0.38>0.05, F=0.97), and follow-up (P=0.62>0.05, F=0.47) stages, in the variable of focused attention (correct response), in the pre-test (P=0.63>0.05, F=0.46), post-test (P=0.061>0.05, F=2.79), and follow-up (P=0.078>0.05, F=2.66) stages, was obtained. In the variable of active memory (correct response) at the pre-test stage (P=0.24>0.05, F=1.44), post-test (P=0.13>0.05, F=2.05), and follow-up (P=0.23>0.05, F=1.50) stages, and in the variable of cognitive flexibility (correct response), in the pre-test (P=0.62>0.05, F=0.48), post-test (P=0.63>0.05, F=0.45), and follow-up (P=0.07>0.05, F=2.74) stages, were obtained. Therefore, the hypothesis of homogeneity of variances was also confirmed. The Mauchly's test of sphericity was used to examine the equality of variance of differences between combinations related to the groups (Table 2).

Table 2

Mauchly's test of sphericity

Variable	W	X^2	df	Sig.	Epsilon		
					Greenhouse-Geisser	Huynh Feldt	Lower bound
Sustainable memory	75.0	97.15	2	0001.0	72.0	80.0	50.0
Concentrated memory	465.0	87.42	2	0001.0	65.0	68.0	50.0
Working memory	68.0	81.32	2	002.0	65.0	69.0	50.0
Cognitive flexibility	59.0	75.28	2	0001.0	71.0	75.0	50.0

In Table 2, the significance level of Mauchly's test is not significant (P=0.0001<0.05). Therefore, the Greenhouse-Geisser criterion is used in hypothesis testing to achieve a more accurate approximation.

To examine the impact of self-regulation learning training on the scores of executive function components in the pre-test, post-test, and follow-up stages, a mixed analysis of variance method (one within-subjects factor and one between-subjects factor) was used. The three stages of pre-test, post-test, and follow-up were considered as within-subjects factor, and the grouping of subjects into two groups as a between-subjects factor (Table 3).

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Table 3

The results of mixed ANOVA

Variable	Effect	SS	df	MS	F	Sig	Effect size
Sustainable memory	Within-group	52.2561	72.1	19.1488	63.26	001.0	41.0
	Interaction	52.2056	72.1	80.1194	38.21	001.0	36.0
	Between-group	41.4600	00.1	41.4600	38.21	001.0	36.0
Concentrated memory	Within-group	27.672	50.1	03.449	62.8	001.0	19.0
	Interaction	405.60	50.1	91.270	20.5	02.0	12.0
	Between-group	20.1153	00.1	20.1153	75.4	04.0	10.0
Working memory	Within-group	80.120	78.1	85.67	01.8	001.0	17.0
	Interaction	07.253	78.1	14.142	79.16	001.0	31.0
	Between-group	53.1032	00.1	53.1032	41.25	001.0	40.0
Cognitive flexibility	Within-group	47.835	59.1	44.524	56.18	001.0	33.0
	Interaction	07.1861	59.1	24.1168	35.41	001.0	52.0
	Between-group	13.2842	00.1	13.2842	91.25	001.0	41.00

The summary of the results of the mixed analysis of variance for within-group and between-group factors is presented in Table 3. The results show that the calculated F value for the effect of stages (pre-test, post-test, and follow-up) is significant at the 0.05 level for all four components ($P<0.05$). Thus, the effectiveness of self-regulation learning training on the executive functions of male students with reading disorders is statistically significant, as the scores of the students in the executive function components significantly differ in the three stages of pre-test, post-test, and follow-up training. The results of the Bonferroni post-hoc test to examine differences between the means in the training stages showed that there is a significant difference between the scores of the executive function components in the pre-test compared to the post-test and the pre-test compared to the follow-up. In general, it can be concluded that the effectiveness of self-regulation learning training has had an impact on the scores of executive functions, such that the experimental group (self-regulation learning training) has led to an increase in executive function scores compared to the control group. Given that the increase in executive function scores in the follow-up stage compared to the pre-test was also significant, the trend of increasing executive function scores continued significantly in the follow-up stage compared to the pre-test stage, indicating the sustainability of training (self-regulation learning training) on executive function scores.

4. Discussion and Conclusion

The purpose of the present study was to investigate the effectiveness of self-regulation learning training on the executive functions of male primary school students with reading disorders in District 2 of Tehran during the academic year 2021-2022, and it achieved results that can be utilized to enhance and advance the educational system for all learners involved in education and training. Therefore, no training leads to effective learning without appropriate instructional design. Furthermore, one of the essentials of effective instructional design, particularly for students with reading disorders, is considering the effects of executive functions in the teaching-learning process. Recent studies on executive functions and teaching have laid the foundation for designing developmental educational systems based on the

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E-ISSN: 3041-8518

effective performance of dyslexic learners. Attention to executive function components in the teaching process of dyslexic learners is a characteristic of contemporary educational systems. It can also be applied in a wide range of learning environments, especially in multimedia educational environments and other learning disorders, as designing teaching materials linked to processing principles and the effects of these functions in the process of implementing better and more effective practices for these learners, reduces their errors in responding, increases the number of correct responses, focuses their attention, immerses them in active experiences, enhances comprehension, and other factors effective in a better learning process for dyslexic learners, and improves their academic progress (Hong, Lee, & Ye, 2021).

Research results showed that the self-regulation learning training method used in this study can improve the memory performance of learners with reading disorders and enable dyslexic learners to have more interactive, strategic, rapid, and effective capacities in learning subjects (Khalili, Emadian, & Hassanzadeh, 2022; Khalili Sadrabad, Ebrahimi Ghavam, & Radmanesh, 2017). This indicates that training must consider the limitations of self-regulation learning and emphasize the need for teaching techniques to be designed in line with the practical principles of the cognitive system and improving the skills of dyslexic students, especially in the area of executive functions, and skills that have been less focused on in their learning process, especially in the area of self-regulation, better understanding of content, focusing dyslexic learners' attention, and increasing the number of correct responses, need more attention and strengthening. Based on the results of recent research, trainings based on improving executive functions should enhance learning outcomes and minimize cognitive, perceptual errors, and factors that affect the reading process of dyslexic learners. Thus, designing educational environments based on self-regulation learning that is optimized based on active learning will help students understand the value of learning and realize that they can learn and progress with acceptable effort (Soltani & Hemti Alamdarlou, 2021).

5. Suggestions and Limitations

Regarding the limitations of the research, it can be noted that the sole tool used in this study was a questionnaire, which may lead to inaccuracies, lack of attention, or personal interpretations by the subjects. Additionally, the fact that the statistical population of this research consisted only of boys in the fourth grade of public schools in District 2 of the Education Department and represents a small part of the overall population, being specific to a particular time frame, necessitates caution in generalizing the findings to other members of society and educational levels.

In the educational system, teachers and learners should strive to strengthen the reading fluency skills of dyslexic learners, in alignment with modern teaching methods and employing various skills in line with executive functions. Utilizing diverse techniques and methods, teachers should guide and direct students by teaching correct techniques and rules and addressing their weaknesses. Learners, in turn, should actively collaborate with their teachers in this process and request that their teachers assist them by using self-regulation learning methods effective in improving their skills (Momeni Shahraki et al., 2018).

Therefore, considering the mentioned factors in the concerning the value and importance of the Persian reading subject, this subject is one of the important and practical subjects, especially in enhancing the skills of dyslexic students, using executive function components that help students think about the correct way of reading words and making sentences around the topic in question. Having ideas, creativity, and immersing students in classroom practices and their experiences in the Persian reading subject will contribute to the advancement of the goals of this subject (Atadokht, Hedayat, & Sepehrinasab, 2020).

Therefore, it is suggested that in designing and producing software and multimedia programs related to reading lessons, considerations should be made regarding the content of the programs and the objectives of the textbooks, as well as the components related to executive functions. In this context, longitudinal research should be conducted for more precise results. Furthermore, using self-regulation learning methods in centers for specific learning disorders, especially reading disorders, can be effective in reducing reading problems and increasing the attention of students with specific learning disorders. Finally, equipping teachers' work programs with a self-regulation learning approach and transferring necessary scientific information through booklets and brochures to students, especially dyslexic learners, can be very beneficial.

Acknowledgments

Special appreciation and gratitude are extended to all professors, managers, school staff, and all learners who

JARAC Assessment and Research in Applied Counseling
E-ISSN: 3041-8518

participated in the research and assisted the researchers in conducting this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethics principles

In this research, ethical principles including obtaining informed consent, ensuring privacy, and confidentiality were observed. Given the conditions and timing of completing the questionnaires, while emphasizing the completion of all questions, participants were free to withdraw from the research at any time.

Authors' Contributions

This article is extracted from a doctoral dissertation in Educational Psychology at the Islamic Azad University, Qaenat Branch.

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E-ISSN: 3041-8518

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