doi:10.22100/ijhs.v10i1.096
Original Article

IJHS 2024;10(1):49-59
ijhs.shmu.ac.ir

IJHS
International Journal of Health Studies

# The Effectiveness of Cognitive Rehabilitation on Improving Executive Functions, Performance and Attitude towards Reading in Children with Dyslexia

**Marjan Dashtipour[1], Mahboobe Taher[2*], Hamid Vahedi[3], Abbas Ali Hossein Khanzadeh[4]**

[1] PhD student, Department of Psychology, Shahrood Branch, Islamic Azad University, Shahrood, Iran.
[2] Assistant Professor, Department of Psychology, Shahrood Branch, Islamic Azad University, Shahrood, Iran.
[3] Assistant Professor, Department of Gastrointestinal Diseases, Faculty of Medicine, Shahroud University of Medical Sciences, Shahroud, Iran.
[4] Associate Professor, Department of Psychology, Faculty of Literature and Humanities, University of Guilan. Rast, Iran.

Received: 18 March 2024
Accepted: 9 April 2024

## Abstract

***Background:*** *The present study aimed to investigate the effectiveness of cognitive rehabilitation on improving executive actions, performance, and attitude toward reading in children with dyslexia.*
***Methods:*** *In terms of nature, the research method is practical and semi-experimental. The research design was pre-test-post-test with the control group. The statistical population includes all male and female students between the ages of 8 and 12 who were dyslexic and referred to learning disabilities centers in Shahroud City in 1401, from which a sample of 30 people was selected purposefully. The data collection tool was the behavioral rating questionnaire of executive actions, the official test of reading and dyslexia (Karma Nouri and Moradi, 2017), and the attitude test toward reading (McKenna and Kerr, 1990). The experimental group underwent cognitive rehabilitation training for children with dyslexia using working memory software for 11 sessions of 60 minutes, and the control group did not receive training during this period. For data analysis, univariate and multivariate analysis of covariance and Bonferroni post hoc test were used with the help of SPSS26 software.*
***Results:*** *The results showed that cognitive rehabilitation training improved executive actions, reading performance, and attitude toward reading in dyslexic children. Therefore, it is suggested to use computer-aided cognitive rehabilitation due to its attractive environment and sound, image, and video for children with special needs who have a low threshold of patience and attention.*
***Conclusions:*** *Because these children get tired and bored during training and need a strong stimulus to continue training, it is necessary to provide rewards at the time of success and by giving immediate feedback at the moment of failure.*

**Keywords:** Cognitive rehabilitation, Executive function, Reading performance, Attitude towards reading, Dyslexic children, Learning disability.
***Corresponding to:** M Taher, **Email:** Mahboobe.Taher@yahoo.com
**Please cite this paper as:** Dashtipour M, Taher M, Vahedi H, Hossein Khanzadeh AA. The Effectiveness of Cognitive Rehabilitation on Improving Executive Functions, Performance and Attitude towards Reading in Children with Dyslexia. Int J Health Stud 2024;10(1):49-59.

## Introduction

Reading is one of the most common means of acquiring knowledge. Students who are weak in their reading skills, during their school years and even afterwards are more vulnerable in learning various topics. Dyslexia is a neurological disorder affecting the brain's ability to receive, retain, and respond to information, and it describes students whose reading progress is significantly below their normal intelligence[1,2].

The foundation of reading is decoding and the ultimate goal of reading is comprehension Therefore, learning this skill is an important factor in the student's educational process .Proper reading requires that students use comprehension strategies while reading the text carefully[3]. According to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders, dyslexic students have characteristics such as the inability to accurately and fluently identify words, inappropriate decoding, poor spelling ability, and difficulties in understanding the meaning of text. Dyslexia in the age of primary school usually manifests as difficulty in learning letter-sound relationships, fluent decoding of words, spelling, or math rules. Reading aloud is slow, inaccurate, and requires effort. The prevalence rate of reading disorder in the ages of 6 to 10 years is 12%, and boys have this disorder 1.6% more than girls. In this context, has reported an overall prevalence rate of 5.8% by examining the results of research conducted in Iran. In general, researchers report that the rate of infection in boys is 1.1 to 2.2 percent more than in girls[4].

Studies have shown that reading ability is closely related to executive actions, which is damaged in dyslexic children[5,6]. The term executive actions refers to a general structure that includes various skills such as decision-making, planning, inhibition, and organization and requires higher cognitive activities of the brain such as attention, working memory, language, perception, and creative thinking. These actions help people in learning tasks, mental functions, and academic activities[6]. Executive actions play a key role in academic success and social transformation. Based on the results of research, failure in executive actions can disrupt planning for the beginning and end of the task and memorizing the tasks[7]. Executive performance deficits in children with learning disabilities show that these children have difficulty focusing on important aspects of the task, inhibiting responses unrelated to the task, and retaining information from the environment. As a result, they cannot delay reaching the reinforcer and perform tasks and daily activities in a task-oriented manner[8].

A skilled reader has a strong command of phonological awareness, phonology, and vocabulary and can better understand the meaning of the text. In this case, it can be said

that the person's performance in reading is good[9]. In addition, reading fluency is considered a significant predictor of overall reading ability (including reading comprehension and performance in academic achievement tests). Reading is one of the most difficult tasks in which children must have the optimal level of abilities to perform properly. Therefore, executive components play a vital role in reading performance[7]. Preschool children's ability to work memory skills can predict their level of reading performance six years later or even in adulthood[10].

Today, experts believe that the best way to deal with learning disabilities is remedial education. The best time to start treatment is before the age of ten; because there is a general belief that since the flexibility of the brain decreases after the age of 12, remedial education after this age will not be very useful. Therefore, the important problem after diagnosing dyslexia is to apply timely and appropriate treatment methods to improve the problems of these students and prevent further damage. One of these treatment measures is cognitive rehabilitation. Cognitive rehabilitation can be considered a learning experience to restore impaired brain function and improve real-life performance. The main goal of this treatment is to improve a person's cognitive functions such as memory, executive functions, social understanding, concentration, and attention. Cognitive rehabilitation therapy is a specific and unique type of therapy that focuses exclusively and primarily on cognitive abilities[11]. Cognitive rehabilitation is a type of learning experience that includes a wider field than cognitive retraining. Cognitive retraining is used to improve cognitive function insufficiency. However, in cognitive rehabilitation, functional adaptation in daily activities is also targeted[12]. Also, in the method of cognitive rehabilitation, the materials and content of training are not dependent on personal views[13]. These two techniques can be used together as components of a comprehensive multidisciplinary cognitive rehabilitation program. Many studies show the positive effects of cognitive rehabilitation in improving the symptoms of learning disabilities in children and adolescents[14]. The findings of these studies show the effectiveness of this method in improving the mathematical performance of students with learning disabilities[15], and improving the working memory and verbal fluency of dyslexic students[16]. Improving attention and memory in children with math learning and dyslexia, and improving cognitive deficits in primary and middle school children[17].

Today, psychiatrists and education experts agree that children with learning disabilities need fundamental changes in the subjects, assignments, teaching methods, and tests due to problems in the fields of learning. Regardless of where students are taught, individual needs and individualization of curriculum and instruction are needed. Also, recent studies have provided satisfactory results for the use of cognitive rehabilitation in the work with neurodevelopmental disorders[18].

Timely recognition of children with learning disabilities helps teachers and parents solve their learning problems and prevent academic decline, which is a major scourge of the educational system. In the field of dyslexia, it is better to be diagnosed and treated during primary school years. Therefore, it is necessary to study the process and examine it in dyslexic students[8]. Considering the problems faced by people with dyslexia, it seems necessary to provide educational interventions to this group of people; because students, as one of the most vulnerable sections of society, do not have enough knowledge and skills to properly manage their problems.

Although some studies have investigated the effectiveness of cognitive rehabilitation training programs on the problems of children with dyslexia. In the current research, many research gaps make more studies necessary.

## Materials and Methods

The current research method is practical in terms of its research nature, and in terms of the amount of manipulation of independent variables by the researcher, it is in the category of semi-experimental research; This is because at the beginning of the sample people was selected purposefully and then they were randomly replaced in an experimental group and a control group. The research plan is pre-test-post-test with the reference group. Its diagram is shown in Table 1. Cognitive rehabilitation intervention programs were implemented as an independent variable in an experimental group, but the control group did not receive any intervention. The variables of executive actions, performance, and reading attitude were also the dependent variables of this research.

**Table 1. Diagram of the pre-test-post-test plan with a control group**

| Groups | Appointment | Pre-exam | Post-exam | Intervention |
|---|---|---|---|---|
| **Cognitive rehabilitation** | T2 | X1 | T1 | R |
| **Control group** | T2 | - | T1 | R |

*** T1 means pre-test, T2 post-test, R means random assignment of groups, and X means intervention methods.**

The statistical population studied in this research included all 8-12-year-old male and female students with dyslexia who were referred to learning disability centers in Shahroud city in 2023, and 30 male and female students were selected from this population in the following way:

First, after the approval of the proposal, the necessary permits were obtained from the university, then by referring to the Shahroud Department of Education, a permit was obtained for the implementation and introduction to learning disorders centers. In the next stage, two centers were selected from the list of learning disorder centers in Shahroud. It should be noted that the sample size was adopted based on the formula provided by Tabaknik, Fidel and Palant for the experimental designs[19]. According to this formula, the sample size in each group

should not be less than 15 people. After visiting the selected centers, the sample people were selected according to the entry and exit criteria.

Criteria for entering the research were written consent from parents and students with dyslexia to participate in the research, obtaining the required cut-off score in the Executive Functions Behavior Rating Questionnaire (BRIEF), the official reading and dyslexia test (NAMA), and the reading attitude scale for all three groups, diagnosing dyslexia based on the official Wechsler Four test, age range (8 to 12 years), and absence of neuro-developmental disorders or other concurrent mental disorders such as attention-deficit/hyperactivity disorder, and physical-motor problems.

Exclusion criteria were receiving training and cognitive rehabilitation, intervention based on the Barclay model, or biofeedback at least one year before the implementation of the study, continuous failure to attend intervention sessions (failure to attend more than 2 sessions), or refusal to continue treatment and participate in research, and use of psychotropic drugs for all three groups.

**Questionnaire for behavioral rating of executive actions (short form):** This questionnaire prepared by Gerrard, et al., and containing 86 items for teachers and parents, is the best checklist for measuring and testing the executive functions of elementary school children[20]. In the present study, the object trainer form was used. The time required to complete this questionnaire is 10 to 15 minutes, and the teacher must specify the options "never=1, sometimes=2, and always=3" in response to the relevant options for the child. In this questionnaire, higher scores mean fewer executive functions and lower scores mean more executive functions. This questionnaire is designed for the behavioral interpretation of executive functioning in children aged 5 to 18 years and measures 8 domains of executive functioning: inhibition (14 items), attention (11 items), emotional control (10 items), initiation (8 items), working memory (11 items), planning (15 items), material organization (8 items), and control (9 items). The results of these eight domain indicators are summarized in two overlapping indicators: Behavior regulation skills (inhibition, attention transfer, and emotional control), and metacognition skills (planning, organizing materials, monitoring, working memory, and initiation). The makers of this scale have reported the reliability of this questionnaire for clinical samples in the teacher form, 82.0-98.0. In the research of Abdulmohammadi et al.,[21], the validity and reliability of the questionnaire were measured, and the test-retest reliability coefficient of the subscales of the behavioral rating test of executive actions was as follows: inhibition component 90.0, attention transfer 81.0, emotional control 91.0, initiation 80.0, working memory 71.0, planning 81.0, material organization 79.0, control 78.0, behavior regulation index 90.0, metacognition index 87.0, and the total score of executive functions was 89.0. The internal consistency coefficient of this questionnaire was reported from 87.0 to 94.0, which indicates the high internal consistency of all subscales of the questionnaire.

**The official test of reading and dyslexia (NAMA):** In the present study, this test was used to identify children with dyslexia and to measure reading performance variables. This test was created by Kermi-Nouri et al.,[22], and was standardized on 1614 students (770 boys and 844 girls) in five grades in Sanandaj, Tehran, and Tabriz. After collecting the data and performing statistical operations for each grade in each city, raw grades, and standard grades were calculated. This test consists of ten sub-scales where the subject gets one mark for each correct answer and the total score of the test is calculated from the sum of the sub-scales. This test is held individually and according to its cut-off point (157), a student with a score of 157 or less is accepted as a dyslexic student. In the research of McClurg et al.,[23], the sub-tests of this scale and its Cronbach's alpha coefficients are reported as follows:

The word reading test includes three lists of 40 words and at the level of words (like lead and fox) with Cronbach's alpha of 0.98, words like (table and bus) with Cronbach's alpha of 0.99, and words like (water and jelly) with Cronbach's alpha was 0.91; Non-word reading test including 40 words (such as Sora, Dalibal, Sharke) with Cronbach's alpha 0.85; The word comprehension test includes 30 questions where the student chooses one of the four options as the correct answer (such as value means? A: price, B: Debt, C: loan, D: profit) with Cronbach's alpha 0.65. The text comprehension test includes ten sub-tests (common text for the second and third grades and two specific texts for each grade). The number of words in the texts is 320 and 340 words, and 8 questions with 4 options are considered for each text (text question example: Where did the dragonfly live?). The third basic text of form A and B respectively with Cronbach's alpha 0.61 and 0.62; The rhymes test consists of 20 rhyming words, and the subject finds the rhyming word and the target word, and Cronbach's alpha was calculated as 0.88. The picture naming test includes two versions, A and B, and each version has 20 shapes that the student remembers the look and name of each shape, and Cronbach's alpha was calculated as 0.75. The sound elimination test consists of 30 words, and the subject says each word after removing the desired sound, and its Cronbach's alpha is 0.78. The letter sign test includes three letters (A, R, N) that the subject remembers the number of words that start with these letters, and Cronbach's alpha was reported as 0.66. The word sign test includes 6 words (boy's name, girl's name, fruit name, kitchen utensils, body parts, and colors) that the subject remembers the number of words related to each category, and its alpha is reported as 0.75. Also, Hosseini, et al., reported the validity of this scale with the help of factor analysis as 62.03.[24]

**Reading attitude test:** In the present study, the scale of attitude towards reading by McKenna and Kerr, compiled in 1990, was used[25]. This questionnaire has 20 items that describe the attitude toward academic reading and the attitude towards recreational reading. The respondents must read each item and rate their level of agreement with the statement based on a Likert scale that is visualized using the image of the cartoon character Garfield. Responses ranged from one (very sad) to four (very happy). Recreational attitude to study refers to studying in free time and outside the school environment. The academic subscale also measures reading in the school environment. This subscale includes long reading in class, reading workbooks, assignments, and school books. The leisure attitude subscale has ten items, for example, "How do you feel

when you read a new book?". The academic subscale also has ten items such as "In Farsi class, how do you feel when you have to read from a book?". A separate score is calculated for each answer in each of the subscales. Accordingly, the range of individual scores in each subscale will be from ten to forty. The creators of this scale reported its reliability for the subscale of attitude towards recreational reading as 0.78, the subscale of attitude towards academic reading as 0.83, and Cronbach's alpha as 0.80 for the whole scale. Also, the structural validity study showed that the two subscales of the reading attitude test are distinguishable and prominent. Hossein Chari et al.,[24], also calculated the reliability of this test using Cronbach's alpha method for the whole scale of 0.88. Also, the construct validity of this scale was reported as acceptable and high in their research.

To teach active memory in 2018 under the supervision of psychology professors of Ferdowsi University of Mashhad and in collaboration with the Sina Behavioral-Cognitive Sciences Research Institute, a software similar to Robomo was created based on existing theories[26], and its adaptation to Iranian culture was adjusted and confirmed its content validity. This software offers separate exercises in three parts of auditory, visual, and spatial memory using numbers, letters, and shapes. The degree of difficulty of each task is from 1 to 9, and the user can choose the degree of difficulty he wants and start practicing in that degree of difficulty. However, after starting the training, the level of difficulty will increase automatically, allowing the maximum memory capacity to be used and the memory level to be increased for further training. The difficulty level of the exercises is designed in such a way that as the subjects' skills progress, the tasks become progressively more difficult. On the left side of the screen bar, the score bar gives the user the number of points earned from the exercise, and 20 points are added for each correct attempt. Also, 10 points are deducted for each mistake, and if you get 100 points, the degree of difficulty of the exercise is increased by one degree[27]. This software affects the working memory ability of the student through the method of positive reinforcement as well as repetition practice and sensory stimulation of hearing and vision. The student gradually learns how to use his senses and mental space to retain more letters and numbers in his mind.

Upon approval of the thesis proposal, the ethics code to IR.IAU.SHAHROOD.REC.1401.009 and statistical examples of two learning disabilities were selected. Parents' consent was obtained after explaining the purpose of the research and confidence to the participants and their parents that the information is confidential. The samples were randomly placed in two groups (15 children in the Cognitive Rehabilitation Group and 15 children in the certification group). At this stage, the questionnaires were implemented as a pre-test. Then, in the cognitive rehabilitation node, the education of children by reading software was provided in 110 minutes. While the group was on the waiting list and received no cure. Then it was executed for each group. The subject was asked to answer the questions honestly. The execution was separate and there were no restrictions on account. The research implementation process was carried out from March 1400 to the end of 1401 and the data were collected. It should be noted that for the implementation of the intervention sessions, the researcher completed the necessary training courses, and was implemented together with the trainer and lecturer of learning disorders. To analyze the data and respond to the research hypotheses, descriptive statistics methods such as frequency, mean, and standard deviation, as well as the Shapiro-Wilks coefficient to check the normality of the data at an inferential level while respecting the assumptions of Univariate covariance analysis and Multivariate and Bonferroni post hoc test were used with the help of SPSS26 software. The Imatrix command was used to check the effect size of each group.

## Results

In this research, 30 children with dyslexia were examined in two cognitive rehabilitation (15 people) and control (15 people) groups. As can be seen in Table 2, the average age of children with dyslexia in the cognitive rehabilitation group was (9.00±1.46) years, and in the control group (8.93±1.53) years. In each studied group, 7 children (46.7%) were boys and 8 children (53.3%) were girls. Based on the chi-square test, no significant difference was observed between the 2 study groups in terms of the gender of children with dyslexia, and based on the analysis of variance, no significant difference was observed between the 2 study groups in terms of age, and both groups were homogeneous in terms of these variables (P-value=0.968).

**Table 2. Demographic characteristics of two treatment and control groups in children with dyslexia (number: 30)**

| Demographic variable | Group | | Result |
|---|---|---|---|
| | Cognitive rehabilitation (percentage) number | Control group (percentage) number | |
| **Gender** | | | |
| **Boys** | (7/46)7 | (7/46)7 | χ2(3)=00/0<br>P-value=1 |
| **Girls** | (3/53)8 | (3/53)8 | |
| **Age (years); (standard deviation) average** | (46/1)9 | (47/1)93/8 | F(3,56)=0.09<br>P-value=0.968 |

**χ: chi square test, F: analysis of variance test.**

As can be seen in Table 3, the average scores of the research variables of its components in the cognitive rehabilitation training groups have changed in the post-test stage compared to the pre-test stage. These changes confirm that in the training groups, the post-test scores of the participants in the variable of executive actions and its

components have decreased. Also, the average scores of the variables of performance and attitude towards reading and its components in the training groups have increased in the post-test stage compared to the pre-test stage.

**Table 3. Descriptive indices of the research variables and their components separately from the 2 studied groups (number: 30)**

| Variable | Phase | Test | | Control group | |
|---|---|---|---|---|---|
| | | Mean | Standard Deviation | Mean | Standard Deviation |
| Executive actions | Pre-test | 206.60 | 7.99 | 212.93 | 10.18 |
| | Post-test | 169.46 | 14.54 | 214.20 | 12.73 |
| Behavior regulation skills | Pre-test | 85.06 | 4.96 | 89.66 | 5.62 |
| | Post-test | 70.00 | 7.28 | 90.20 | 6.29 |
| Metacognitive skills | Pre-test | 121.53 | 5.82 | 123.26 | 5.48 |
| | Post-test | 99.46 | 8.12 | 124.00 | 7.23 |
| Reading performance | Pre-test | 137.73 | 36.01 | 128.86 | 36.54 |
| | Post-test | 156.80 | 36.75 | 126.80 | 34.41 |
| Visual-phonological processing ability | Pre-test | 60.93 | 19.61 | 53.73 | 18.51 |
| | Post-test | 69.00 | 17.74 | 53.86 | 18.44 |
| Cognitive processing speed and accuracy | Pre-test | 76.80 | 16.69 | 75.13 | 18.95 |
| | Post-test | 87.80 | 20.31 | 72.93 | 17.79 |
| Attitude towards reading | Pre-test | 46.80 | 4.79 | 43.60 | 9.61 |
| | Post-test | 59.20 | 5.84 | 45.00 | 7.34 |
| Reading outside of school | Pre-test | 23.66 | 3.19 | 21.86 | 5.40 |
| | Post-test | 29.20 | 3.36 | 22.46 | 4.82 |
| Reading at school | Pre-test | 23.13 | 2.94 | 21.73 | 4.65 |
| | Post-test | 30.00 | 3.60 | 22.53 | 3.83 |

To check the effectiveness of the intervention in the post-test phase, univariate covariance analysis and multivariate covariance analysis were used, considering the pre-test variables as covariance variables. In this section, the results of the single variable covariance analysis test for the total score of the variables of executive actions, performance, and attitude towards reading and the multivariate covariance analysis test for the components of executive actions, performance, and attitude towards reading were presented, and then, in the next section, research hypotheses were proposed and these hypotheses were answered by using pairwise comparisons of groups with Imatrix command.

## Assumptions of Univariate and multivariate analysis of covariance

Being normal: The results of the Shapiro-Wilk test in Table 4 showed that the significance level of the research variables and their components in each of the training and test groups in the pre-test and post-test phases was greater than 0.05 (P-value>0.05). Therefore, according to the Shapiro-Wilk test, the research variables are not significant at the 0.05 level, which means that the data is normal.

**Table 4. The results of the Shapiro-Wilk test**

| Variable | Phase | Test | | Control group | |
|---|---|---|---|---|---|
| | | S-W | Probability value | S-W | Probability value |
| Executive actions | Pre-test | 0.96 | 0.64 | 0.93 | 0.21 |
| | Post-test | 0.90 | 0.06 | 0.97 | 0.86 |
| Behavior regulation skills | Pre-test | 0.94 | 0.32 | 0.98 | 0.92 |
| | Post-test | 0.93 | 0.29 | 0.95 | 0.51 |
| Metacognitive skills | Pre-test | 0.88 | 0.07 | 0.96 | 0.70 |
| | Post-test | 0.93 | 0.25 | 0.97 | 0.86 |
| Reading performance | Pre-test | 0.93 | 0.25 | 0.91 | 0.11 |
| | Post-test | 0.96 | 0.67 | 0.90 | 0.11 |
| Visual-phonological processing ability | Pre-test | 0.94 | 0.31 | 0.89 | 0.08 |
| | Post-test | 0.95 | 0.47 | 0.93 | 0.22 |
| Cognitive processing speed and accuracy | Pre-test | 0.94 | 0.37 | 0.88 | 0.06 |
| | Post-test | 0.96 | 0.57 | 0.88 | 0.06 |
| Attitude towards reading | Pre-test | 0.94 | 0.30 | 0.89 | 0.09 |
| | Post-test | 0.95 | 0.46 | 0.93 | 0.38 |
| Reading outside of school | Pre-test | 0.91 | 0.13 | 0.93 | 0.21 |
| | Post-test | 0.94 | 0.30 | 0.90 | 0.08 |
| Reading at school | Pre-test | 0.94 | 0.45 | 0.90 | 0.10 |
| | Post-test | 0.96 | 0.58 | 0.97 | 0.87 |

Homogeneity of the regression slope: The results of Table 5 showed that the multivariate statistics of Wilks' lambda about the components of executive actions, performance, and attitude to reading in the post-test stage were not significant at the 0.05 level. Therefore, the assumption of homogeneity of regression coefficients is maintained. According to the assumption of the slope of the regression line, we are allowed to use Univariate and multivariate analysis of variance.

**Table 5. Examining the homogeneity of the regression slope for multivariate covariance analysis of the research components in the post-test stage**

| Variable | Component | Wilkes' lambda | Degree of freedom | Degree of freedom of error | F statistic | Meaningfulness |
|---|---|---|---|---|---|---|
| **Executive actions** | Behavior regulation skills | 0.812 | 6 | 94 | 2.195 | 0.512 |
| | Metacognitive skills | 0.889 | 6 | 94 | 1.739 | 0.747 |
| **Reading performance** | Visual-phonological processing ability | 0.885 | 6 | 94 | 0.988 | 0.438 |
| | Ability to speed and accuracy of cognitive processing | 0.868 | 6 | 94 | 1.147 | 0.341 |
| **Attitude towards reading** | Reading outside of school | 0.909 | 6 | 94 | 0.770 | 0.596 |
| | Reading at school | 0.831 | 6 | 94 | 1.521 | 0.179 |

Homogeneity of variances: The results of homogeneity of variance showed that Levine's test was not significant for all variables in the post-test stage (P-value<0.05). Miles and Banyard (2007) suggest that if the number of samples in the groups is equal, the variance of the dependent variable in these groups is considered equal. Considering that in the current study, the number of people in the groups is equal; According to the recommendation of Miles and Banyard (2007), the variance of the variables was homogeneous in the groups.

Homogeneity of variance-covariance matrix: The results of the M-square test showed that the homogeneity of the correlation matrix of the components of executive functions, performance, and attitude to reading was confirmed at the level of 0.05 in all levels of the independent variable (groups).

Sphericity or meaningful relationship between research components: Bartlett's chi-square test was used to check sphericity. According to Table 6, there was a significant relationship between these components.

**Table 6. The results of checking the sphericity in the post-test stage**

| Variable | Cai de Bartlett | Degree of freedom | Degree of freedom |
|---|---|---|---|
| **Executive actions** | 44.787 | 1 | <0.001 |
| **Reading performance** | 11.135 | 1 | 0.004 |
| **Attitude towards reading** | 8.433 | 1 | 0.015 |

## Absence of outlier data and non-collinearity of research components

Also, the absence of multivariate outlier data was checked using Mahalanobis distance, and no outlier data was found and the validity of this hypothesis was tested. Also, the correlation coefficient between dependent variables was examined with the correlation coefficient between pairs of variables and it was considered that all correlations between pairs of variables are within the average range (0.3 to 0.5), which confirmed this theory. Also, according to the average correlation, it can be concluded that there is no more linear relationship between the variables.

The results of Univariate covariance analysis (Table 7) showed that by considering the pre-test scores as a covariate (auxiliary) variable, the effect of the group on executive actions (P-value<0.001 and $F_{35.55}$=35.844), reading performance (P-value<0.001 and $F_{3.55}$=8.948), and attitude towards reading (P-value<0.001 and $F_{3.55}$=35.953) were significant in children with dyslexia. Also, the effect size value shows, that 66.2% of individual differences in executive actions, 32.8% of individual differences in reading performance, and 66.2% of individual differences in the attitude towards the reading of children with dyslexia were due to the difference in group membership (the effect of education). Also, the statistical power of 1 indicated the adequacy of the sample size and acceptable statistical accuracy for this conclusion. Therefore, there was a significant difference between the cognitive rehabilitation and control groups in terms of improvement of executive actions, reading performance, and attitude towards reading in the post-test phase by adjusting the pre-test scores.

**Table 7. The results of single-variable covariance analysis to investigate the difference between the training group and the control group in the research variables in the post-test stage**

| Variable | Source | Sum of squares | Degree of freedom | Mean of squares | F statistic | Meaningfulness | Effect size | Test power |
|---|---|---|---|---|---|---|---|---|
| **Executive actions** | Modified pattern | 15703.449 | 2 | 3925.862 | 32.829 | <0.001 | 0.662 | 1 |
| | Pre-test | 524.182 | 1 | 524.182 | 4.383 | 0.041 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Group | 12859.329 | 1 | 4286.443 | 35 | <0.001 | | |
| | Error | 6577.284 | 55 | 119.587 | 0.844 | | | |
| **Reading performance** | Modified pattern | 61072.648 | 2 | 15268.162 | | <0.001 | 0.328 | 0.993 |
| | Pre-test | 48935.381 | 1 | 48935.381 | 64.996 | <0.001 | | |
| | Group | 6305.934 | 1 | 2101.978 | 208.315 | <0.001 | | |
| | Error | 12920.085 | 55 | 234.911 | 8.948 | | | |
| **Attitude towards reading** | Modified pattern | 3446.284 | 2 | 861.571 | | <0.001 | 0.662 | 1 |
| | Pre-test | 241.084 | 1 | 241.084 | 30.728 | 0.005 | | |
| | Group | 3024.084 | 1 | 1008.062 | 8.598 | <0.001 | | |
| | Error | 1542.116 | 55 | 28.038 | 35.953 | | | |

The results of the multivariate covariance analysis in Table 8 shows the effect of the group on the composition of executive action components ($F(6,106)=12.529$, P-value<0.001, $\eta^2=0.415$), reading performance ($F(6,106)=4.109$, P-value=0.001, $\eta^2=0.189$), and the attitude towards reading ($F(6,106)=13.376$, P-value<0.001, $\eta^2=0.431$) in children with dyslexia was significant in the post-test stage based on the Wilks's lambda effect.

**Table 8. The results of the multivariate covariance analysis test for the research components among the groups in the post-test stage**

| Variable | Tests | Value | Degree of freedom | Degree of freedom of error | F | Meaningfulness | η2 | Test power |
|---|---|---|---|---|---|---|---|---|
| **Executive actions** | Pillai effect | 0.668 | 6 | 108 | 9.019 | <0.001 | 0.334 | 1 |
| | Wilkes' lambda | 0.342 | 6 | 106 | 12.529 | <0.001 | 0.415 | 1 |
| | Hotelling's work | 1.892 | 6 | 104 | 16.400 | <0.001 | 0.486 | 1 |
| | Roy's Largest Root | 1.877 | 3 | 54 | 33.783 | <0.001 | 0.659 | 1 |
| **Reading performance** | Pillai effect | 0.346 | 6 | 108 | 3.765 | 0.002 | 0.173 | 0.955 |
| | Wilkes' lambda | 0.658 | 6 | 106 | 4.109 | <0.001 | 0.189 | 0.970 |
| | Hotelling's work | 0.513 | 6 | 104 | 4.445 | <0.001 | 0.204 | 0.980 |
| | Roy's Largest Root | 0.500 | 3 | 54 | 9.001 | <0.001 | 0.333 | 0.993 |
| **Attitude towards reading** | Pillai effect | 0710 | 6 | 108 | 9.911 | <0.001 | 0.355 | 1 |
| | Wilkes' lambda | 0.324 | 6 | 106 | 13.376 | <0.001 | 0.431 | 1 |
| | Hotelling's work | 1.982 | 6 | 104 | 17.180 | <0.001 | 0.498 | 1 |
| | Roy's Largest Root | 1.928 | 3 | 54 | 34.699 | <0.001 | 0.658 | 1 |

To investigate the difference in the components of executive functions, performance, and attitude toward reading between the cognitive rehabilitation group and the control group, the results of one-way covariance analysis are given in Table 9. The results showed that by considering the pre-test scores as covariates (auxiliary) variables, the use of cognitive rehabilitation training in children with dyslexia led to a significant difference between the test and control groups in the components of behavior regulation skills and metacognitive skills.

In executive actions, the effect rate for behavior regulation skills is 55.7% and metacognition skills are 64.6% (P-value<0.05). In reading performance, the effect rate for visual-phonological processing ability is 25.7%, and cognitive processing speed and accuracy ability is 25.2% (P-value<0.01). In the variable of attitude towards reading, the effect rate for reading outside the school was 58.1% and reading inside the school was 56.7% (P-value<0.01).

**Table 9. The results of one-way covariance analysis related to the difference between groups of research components in the post-test stage**

| Variable | Component | Source | Sum of squares | Degrees of freedom | Mean of squares | F | Level of meaningfulness | Eta squared |
|---|---|---|---|---|---|---|---|---|
| **Executive actions** | Behavior regulation skills | Intergroup | 2264.351 | 2 | 754.784 | 24.600 | <0.001 | 0.577 |
| | | error | 1656.849 | 28 | 30.682 | | | |
| | Metacognitive skills | Intergroup | 3727.077 | 2 | 1242.359 | 32.840 | <0.001 | 0.646 |
| | | error | 2042.827 | 28 | 37.830 | | | |
| **Reading performance** | Visual-phonological processing ability | Intergroup | 1194.819 | 2 | 398.273 | 6.219 | 0.001 | 0.257 |
| | | error | 3458.442 | 28 | 64.045 | | | |
| | Ability to speed and accuracy of cognitive processing | Intergroup | 2071.370 | 2 | 690.457 | 6.050 | 0.001 | 0.252 |
| | | error | 6162.986 | 28 | 114.129 | | | |
| **Attitude towards reading** | Reading outside of school | Intergroup | 751.153 | 2 | 250.384 | 25.00 | <0.001 | 0.581 |
| | | error | 540.825 | 28 | 10.015 | | | |
| | Reading at school | Intergroup | 717.631 | 2 | 239.210 | 23.598 | <0.001 | 0.567 |
| | | error | 547.384 | 28 | 10.137 | | | |

### Hypothesis 1: Cognitive rehabilitation training is effective in improving executive actions in children with dyslexia.

The results of Table 10 showed that the adjusted average of executive actions and its components in the cognitive rehabilitation training group in the post-test stage based on the Bonferroni post hoc test was significantly lower than the average of the control group. The effect of cognitive rehabilitation training on executive actions was 65.9%, which indicated an acceptable difference between the cognitive rehabilitation training group and the control group in society. Therefore, cognitive rehabilitation training was effective in improving executive actions in children with dyslexia.

**Table 10. Examining the differences between two groups (cognitive rehabilitation training and control group) in executive actions**

| Variable | Group | Adjusted average | Average difference | Standard error | Effect size | Meaningfulness level |
|---|---|---|---|---|---|---|
| **Executive actions** | Test | 170.495 | -42.562* | 4.126 | 0.659 | <0001 |
| | Control group | 213.057 | | | | |
| **Behavior regulation skills** | Test | 71.115 | -18.320* | 2.152 | 0.573 | <0001 |
| | Control group | 89.434 | | | | |
| **Metacognition skills** | Test | 100.112 | -23.266* | 2.390 | 0.637 | <0001 |
| | Control group | 123.377 | | | | |

***P-value<0.05**

### Hypothesis 2: Cognitive rehabilitation training is effective in improving the performance of children's reading by disorder.

The results of Table 11 showed that the modified average of reading performance and its components in the Cognitive Rehabilitation Training Department in the post-test phase was significantly above the average of the certificate group. The effect of cognitive rehabilitation education on reading performance was 22.2 %, indicating an acceptable difference between the Cognitive Rehabilitation Training Department and the Certificate in the Society. Therefore, cognitive rehabilitation training was effective in improving reading function in children with failure to read.

**Table 11. Investigating differences Two to Two groups (cognitive rehabilitation and certificate) in reading performance**

| Variable | Group | Adjusted average | Average difference | Standard error | Effect size | Meaningfulness level |
|---|---|---|---|---|---|---|
| **Reading performance** | Test | 151.417 | 22.302* | 5.622 | 0.222 | 0.001 |
| | Control group | 129.115 | | | | |
| **The ability to process the visual-cognitive marriage** | Test | 65.471 | 9.338* | 3.054 | 0.148 | 0021 |
| | Control group | 56.133 | | | | |
| **Ability to speed and accuracy of cognitive processing** | Test | 86.378 | 14.021* | 4.077 | 0.180 | 0.007 |
| | Control group | 72.356 | | | | |

***P-value<0.05**

### Hypothesis 3: Cognitive rehabilitation training is effective in improving attitudes towards reading in children with dyslexia.

The results of Table 12 showed that the modified average of attitude towards reading and its components in the Cognitive Rehabilitation Training Department in the post-test phase was significantly higher than the average of the certificate group. The impact of cognitive rehabilitation education on attitude to reading was 44.8 %, indicating an acceptable difference between the Cognitive Rehabilitation and Certificate Department in the community. Therefore, cognitive rehabilitation training was effective in improving attitudes towards reading in children with a disorder.

**Table 12. Investigating the differences of two-to-two groups (cognitive rehabilitation and witness) in attitude towards reading**

| Variable | Group | Adjusted average | Average difference | Standard error | Effect size | Meaningfulness level |
|---|---|---|---|---|---|---|
| **Attitude toward reading** | Test | 58.580 | 13.137* | 1.967 | 0.448 | <0.001 |
| | Control group | 45.443 | | | | |
| **Reading outside of school** | Test | 28.998 | 6.071* | 1.176 | 0.331 | <0.001 |
| | Control group | 22.927 | | | | |
| **Reading at school** | Test | 29.702 | 7.065* | 1.183 | 0.398 | <0.001 |

| | | |
|---|---|---|
| | Control group | 22.637 |

***P-value<0.001**

## Discussion

Cognitive rehabilitation is effective in improving executive actions in children with dyslexia. The present study showed that there was a significant difference between the modified mean of the cognitive rehabilitation education group and the postponement phase in the variable of executive actions and its components. So, the average modification of executive actions and their components in the Cognitive Rehabilitation Training Department in the post-test phase was significantly lower than the average of the certificate. Therefore, cognitive rehabilitation training was effective in improving executive actions in children with failure to read. This finding is in line with the results of Afshari et al.,[14], Safari et al.,[17], Radfar et al.,[16]. This is because this research also emphasizes the effectiveness of cognitive rehabilitation education in improving executive actions in children. However, the studies were different in terms of the size of the effect and the level of meaning. Various studies have shown that students with learning disabilities have damaged executive actions compared to students without learning disabilities[28]. Executive actions are the performance of parts of the brain that are responsible for performing conversion assignments, multiplicity and two parallel duties, and control, direct, and coordinate other cognitive processes. These functions include all the complex cognitive processes needed to perform challenging or exquisite targeted tasks. Therefore, effective interventions in executive measures can naturally affect the development of reading skills in dyslexic students. In this regard, it can be said that cognitive rehabilitation is actually a learning experience that aims to restore damaged brain functions and improve real-life performance. Cognitive rehabilitation is a treatment whose main purpose is to improve cognitive functions and disorders such as memory, executive measures, social understanding, concentration, and attention[11]. Since the cognitive abilities of dyslexic students are disrupted, cognitive rehabilitation can play an effective role in improving them[16]. During cognitive rehabilitation therapy, training is based on the brain flexibility principle that is directly aimed at cognitive defects for these children, while the treatment includes exercises related to enhancing executive measures such as attention, concentration, and memory, and exercises to enhance verbal skills and skills of timeline manipulation are employed which lead to improvement of dyslexic students' executive actions. It can also be added to the results of this study that children with dyslexia have more problems storing verbal and visual-spatial information than children without dyslexia[29]. In computer-aided cognitive rehabilitation, the child must use his or her visual memory, audio, and space at each stage to succeed in exercises and levels of level, which enhances and enhances the capacity of these skills. Computer-aided cognitive rehabilitation is attractive because of its attractive environment and the use of audio, image, and video for children with special needs with low patience and attention. Also rewarding the child when he/she succeeds and immediate feedback at the time of failure is a strong booster for dyslexic children, as these children are easily tired of education and need a strong stimulus to continue training. One of the methods of computer-aided cognitive rehabilitation is stimulating a day-to-day life situation for teaching different skills to the child, this method seems to help the child adapt to the educated principles in real life and to sustain the learned skills.

Cognitive rehabilitation is effective in improving the performance of children's reading by disorder. The results showed that there was a significant difference between the modified mean of the cognitive rehabilitation training group and the control group in the post-test phase in the reading performance variable and its components; As the modified average of reading performance and its components in the Cognitive Rehabilitation Training Department in the post-test phase was significantly above the average of the testimony group; Therefore, cognitive rehabilitation training was effective in improving reading function in dyslexic children. This finding was in line with the results of Kaufman et al.,[30], Qajar et al.,[31], Safari et al.,[32], and Hossein Khanzadeh et al.,[33]. This is because the research also confirmed the effectiveness of cognitive rehabilitation in improving the performance of children. However, the studies were different in terms of the size of the effect and the level of meaning.

To explain this finding, it can be noted that despite the variety of statistics on the prevalence of learning disabilities, the prevalence of dyslexia is high in all available statistics, and providing therapeutic interventions, training, and utilizing rehabilitation strategies to this group of learning disabilities is important[34]. Dyslexic students fail more in the use of cognitive strategies while reading, while some students have no problem identifying letters and spelling them, and their only problem is using the proper use of cognitive strategies[35]. Therefore, the use of cognitive rehabilitation by improving cognitive actions reduces the symptoms of student's dysliexic symptoms and improves reading function. The application of the cognitive rehabilitation program allows selective attention by adding visual and auditory distractions and continuously providing underlying sounds during cognitive exercise, in which case the executor must be between relevant and unrelated stimuli, both of which both simultaneously submitted, distinguishing. Eliminating visual and auditory cues and signs along with visual and auditory feedback can also be used to optimize the failure threshold and remember the rules of practice, the duration of the practice of a cognitive skill can also be used to train sustained attention and response control. According to the nature of dyslexia disorder, the goals of cognitive rehabilitation are primarily to improve performance through adaptation to the disease (adjusting the person to the disability and the disease), then preventing and reducing maladaptive behaviors, and finally compensating for some of the lost defects[36]. Therefore, the sum of teaching features in sessions can directly and indirectly lead to the improvement of the reading performance of students with dyslexia.

Cognitive rehabilitation is effective in improving the attitude towards reading in children with dyslexia. The findings showed a significant difference between the adjusted average of the cognitive rehabilitation training group and the control group in the post-test stage in the variable of attitude towards reading and its components; So that the adjusted average of the attitude toward reading and its components in the cognitive rehabilitation training group in the post-test stage was significantly higher than the average of the control group. Therefore, cognitive rehabilitation training was effective in improving the attitude towards reading in children with dyslexia. This finding was consistent with the research results of Abyarki et al.,[37]. This alignment is because the effectiveness of cognitive rehabilitation in improving children's reading attitude was confirmed in the mentioned research. However, the mentioned studies were different from each other in terms of effect size and significance level.

To explain this finding, it can be mentioned that children with dyslexia feel helpless and inadequate due to poor academic performance. Low academic performance and self-comparison with others threaten the self-esteem and self-respect of these children. In addition to this isolation and rejection that these children experience, it makes them feel more than ever that they are not able to improve their academic performance and as a result, they do not have hope, motivation, and enthusiasm for school and education. Therefore, they feel that no matter how hard they try, it is useless and they will experience many negative memories in school. Because children with a specific learning disorder have a negative self-concept about themselves, this issue causes them to estimate their ability in all academic fields lower than their peers[38]. Their low self-esteem can negatively affect their academic performance because their feelings of inadequacy reduce their enthusiasm and motivation and act as a vicious circle, causing worse academic performance. The result is that cognitive rehabilitation is one of the appropriate treatment methods whose effectiveness has been shown in various researches. In this way, involving different senses in learning makes the task interesting. In addition, children are very interested in games, and the best way to teach children is through games, as a result, using cognitive therapy in the form of games can be very attractive for children, and this will increase their motivation. Using the software as an educational tool is also simple and easy and requires minimal computer skills such as clicking and dragging letters and words. The computer offers new capabilities such as color, sound and movement that can be used to understand new aspects of problems and facilitate education and increase child retention[39].

In fact, computer programs make students with learning disabilities recognize and correct their mistakes and choose the best answer, thus reducing their problems. Providing immediate reinforcement after the correct answer and providing incentives to help compensate for the decrease in self-esteem of these students is very valuable, and the sum of these factors directly and indirectly leads to the improvement of the attitude of students with dyslexia towards reading.
According to the results of research hypotheses based on the effectiveness of the intervention programs used in this study, it is suggested that these programs are essential and basic skills needed by dyslexic students in the early stages and lower levels of education as well should be taken into account to have better preventive results. It is suggested to use the intervention programs used in the present study in the education of students with other psychological disorders (autism spectrum disorder and developmental delays). Considering the cost-effectiveness, importance, and harmlessness of the intervention methods used in the present study, it is suggested to hold workshops for dyslexic students and their families to teach these skills.

## Ethical Considerations

This article is a part of the doctoral thesis of Shahrood Islamic Azad University, which was approved by the code of ethics IR.IAU.SHAHROOD.REC.1401.009 in the university.

## Acknowledgment

The authors thank and appreciate all the people who cooperated and accompanied us in collecting information, analyzing and publishing this article.

## Conflict of Interest

The authors declare that they have no conflict of interest.

## Funding

No financial support was received from any institution.

## References

1. Maughan B, Messer J, Collishaw S, Pickles A, Snowling M, Yule W, et al. Persistence of literacy problems: spelling in adolescence and at mid- life. Journal of Child Psychology and Psychiatry. 2009;50(8):893-901. doi: 10.1111/j.1469-7610.2009.02079.x

2. Hudson RF, High L, Otaiba SA. Dyslexia and the brain: What does current research tell us? The reading teacher. 2007;60(6):506-15. doi: 10.1598/RT.60.6.1

3. Ward A, Bush H, Braaten EB. Reading disorders/dyslexia. The Massachusetts General Hospital Guide to Learning Disabilities: Assessing Learning Needs of Children and Adolescents. 2019:21-37. doi: 10.1007/978-3-319-98643-2_2

4. Brooks AD, Berninger VW, Abbott RD. Letter naming and letter writing reversals in children with dyslexia: Momentary inefficiency in the phonological and orthographic loops of working memory. Developmental neuropsychology. 2011;36(7):847-68. doi: 10.1080/87565641.2011.606401

5. El Wafa HEA, Ghobashy SAEL, Hamza AM. A comparative study of executive functions among children with attention deficit and hyperactivity disorder and those with learning disabilities. Middle East Current Psychiatry. 2020;27(64):1-9. doi: 10.1186/s43045-020-00071-8

6. Spencer M, Cutting LE. Relations among executive function, decoding, and reading comprehension: An investigation of sex differences. Discourse Processes. 2021;58(1):42-59. doi: 10.1080/0163853X.2020.1734416

7. Barkley R. Executive functioning and self-regulation: Integration, extended phenotype, and clinical implications. New York: Guilford. 2011.

8. Fadaei E, Tavakoli M, Tahmasebi A, Narimani M, Shiri V, Shiri E. The relationship between executive functions with reading difficulties in children with specific learning disorder. Archives of Neuroscience. 2017;4(4). doi: 10.5812/archneurosci.13989

9. Moats LC, Tolman C. Language essentials for teachers of reading and spelling. Longmont, CO: Sopris West Educational Services. 2004.

10. Smith MC. A longitudinal study of the development of reading comprehension skills, metacognitive reading skills, and reading attitude: Childhood to adulthood: University of Wisconsin--Madison; 1988.

11. Wood RL. Towards a model of cognitive rehabilitation. Cognitive rehabilitation in perspective: Routledge; 2018. p. 3-26. doi: 10.4324/9780429490088-2

12. Baltaduonienė D, Kubilius R, Mingaila S. Computer-based cognitive rehabilitation for cognitive functions after stroke. Česká a slovenská neurologie a neurochirurgie. 2018;81(3).269-277 doi: 10.14735/amcsnn2018269

13. Balea M, Muresanu D, Alvarez A, Homberg V, Bajenaru O, Guekht A, et al. VaD-An integrated framework for cognitive rehabilitation. CNS & Neurological Disorders-Drug Targets (Formerly Current Drug Targets-CNS & Neurological Disorders). 2018;17(1):22-33. doi: 10.2174/1871527317666180219164545

14. Afshari A, Rezaei R. The effectiveness of Sand Smart software on executive functions (focused attention, the ability to organize and plan, and auditory and visual work memory) in students with dyslexia. Journal of Learning Disabilities. 2019;8(3):26-48.

15. Vesal MS, Nazari MA, Qaramaleki HB. The Effectiveness of Cognitive Rehabilitation in Improving Working Memory, Visual Processing, and Spatial Perception in Children with Math Learning Disorders.2022.9(3).78-92. doi: 10.52547/jcmh.9.3.8

16. Radfar F, Nejati V, Fathabadi J. The impact of cognitive rehabilitation on working memory and verbal fluency in dyslexic students (a single case study). 2016.40(10).17-26

17. Safari N, Baezzat F, Ghaffari M. Effectiveness of cognitive rehabilitation program on attention dimensions and reading efficacy in students with dyslexia. J Child Ment Health. 2020;7(3):167-81. doi: 10.52547/jcmh.7.3.14

18. Arjmandnia A, Sharifi A, Rostami R. The effectiveness of computerized cognitive training on the performance of visual-spatial working memory of students with mathematical problems. Journal of Learning Disabilities. 2014;3(4):6-24.

19. Arnqvist G. Mixed models offer no freedom from degrees of freedom. Trends in ecology & evolution. 2020;35(4):329-35. doi: 10.1016/j.tree.2019.12.004

20. Gioia GA, Isquith PK, Guy SC, Kenworthy L. Test review behavior rating inventory of executive function. Child Neuropsychology. 2000;6(3):235-8. doi: 10.1076/chin.6.3.235.3152

21. A Abdul Mohammadi KA, Gh Sormanabadi, M Taibali, F Ayatollah. Examining the psychometric properties of the executive function behavioral rating questionnaire (brief) in children aged 6 to 12 years. Educational Measurement Quarterly. 2017;8(30):135-51.

22. M Narimani AaN, F Shaerbafzadeh, T Torpedo. The effectiveness of training Jager's knowledge and metacognition skills program on the reading performance of students with learning disabilities. Learning disabilities. 2015;4(2):100-20.

23. McClurg VMJ. An Investigation of the Relationship between Dyslexia Risk, the Simple View of Reading, and the Tests of Dyslexia Probability Index. 2022.

24. M Hosseinchari AM. Psychometric indicators of reading attitude scale for middle school students. Educational Psychology Quarterly. 2015;11(38):1-25.

25. Chang SH. Reading Attitude of Struggling Elementary Students. Online Submission. 2010.

26. Klingberg T, Fernell E, Olesen PJ, Johnson M, Gustafsson P, Dahlström K, et al. Computerized training of working memory in children with ADHD-a randomized, controlled trial. Journal of the American Academy of child & adolescent psychiatry. 2005;44(2):177-86. doi: 10.1097/00004583-200502000-00010

27. D Shaban Ali Fami HMS. Review and comparison of classical and computer-based cognitive rehabilitation packages in improving the cognitive functions of children with special learning disorders: a systematic review of domestic researches in Iran from 2009 to 2019. Exceptional Children's Quarterly. 2022;22(3):35-56.

28. Fletcher JM, Grigorenko EL. Neuropsychology of learning disabilities: The past and the future. Journal of the International Neuropsychological Society. 2017;23(9-10):930-40. doi: 10.1017/S1355617717001084

29. Lanfranchi S, Cornoldi C, Vianello R. Verbal and visuospatial working memory deficits in children with Down syndrome. American journal on mental retardation. 2004;109(6):456-66. doi: 10.1352/0895-8017(2004)109<456:VAVWMD>2.0.CO;2

30. Kaufman AS, Kaufman NL. Specific learning disabilities and difficulties in children and adolescents: Psychological assessment and evaluation: Cambridge University Press; 2001. doi: 10.1017/CBO9780511526794

31. Qajar TaB, The effect of Jurchin electronic games on improving the reading performance of students with dyslexia. Exceptional Children Quarterly Research in the field of exceptional children,2018. 19(3), 14-5

32. Safari NH, F; and Ghaffari, M. The effectiveness of cognitive rehabilitation on the reading efficiency of dyslexic students. Psychological Studies Quarterly, 2018.15(3),105-122.

33. Hossein Khanzadeh A. Psychology and education of children and teenagers with special needs. Tehran: Avai Noor publishing house. 1390.

34. Anastopoulos AD, Shelton TL, DuPaul GJ, Guevremont DC. Parent training for attention-deficit hyperactivity disorder: Its impact on parent functioning. Journal of abnormal child psychology. 1993;21(5):581-96. doi: 10.1007/BF00916320

35. Exley S. The effectiveness of teaching strategies for students with dyslexia based on their preferred learning styles. British Journal of Special Education. 2003;30(4):213-20. doi: 10.1111/j.0952-3383.2003.00313.x

36. Abbasi Fashami N, Akbari B, Hosseinkhanzadeh AA. Comparison of the effectiveness of cognitive rehabilitation and neurofeedback on improving the executive functions in children with dyslexia. Quarterly Journal of Child Mental Health. 2020;7(2):294-311. doi: 10.29252/jcmh.7.2.25

37. Akyurek G, Bumin G. An investigation of executive function in children with dyslexia. Psychiatry and Behavioral Sciences. 2019;9(1-2):10-7. doi: 10.5455/PBS.20181128092027

38. Gillan LA. Self-concept of students with learning disabilities in self-contained environments: The relationships between global and academic self-concept, perceived social support, and academic "discounting": University of California, Riverside; 2008.

39. Sahin A, Özenç EG. The use of educational software in teaching initial reading and writing. International Journal of Progressive Education. 2021;17(4):373-89. doi: 10.29329/ijpe.2021.366.23