journal of
Adolescent and Youth Psychological Studies
www.jayps.iranmehr.ac.ir

Summer and Fall 2022, Volume 3, Issue 2, 70-75

The Effectiveness of Training Package based on Executive Functions of Delis-Kaplan on Reading skill of Dyslexic students

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ARTICLE INFORMATION

Article type
Original research
Pages: 70-75

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Article history:
Received: 2022/06/20
Revised: 2022/08/30
Accepted: 2022/09/21
Published online: 2022/11/03

Keywords:
executive functions, reading skill, dyslexia.

ABSTRACT

Background and Aim: Reading is considered as one of the first ways to acquire knowledge, and students with poor reading skills learn more during and after school. The present research aimed to evaluate effectiveness of training package based on executive functions of Delis-Kaplan on reading skill of dyslexic students. **Method:** This was quasi-experimental study with pre and post tests and following up. Statistical population was all male and female students in third grade in Tehran who were studying in 2018-19. Thirty dyslexic students were selected by multi- clustering random sampling, then according to inclusion and exclusion criteria, 15 subjects were selected for experimental group and 15 for control group. Experiment group received training package based on executive functions of Delis-Kaplan in 17 sessions each lasting for 60 minutes, but control group did not. The tools used in present research were Raven intelligence test and reading test of Kormi Noori and Moradi (2018). Data were analysed using covariance analysis by SPSS.22. **Results:** The results showed that training package based on executive functions of Delis-Kaplan has significant effect on reading skill in dyslexic children ($p<0/001$). **Conclusion:** According to these results, it can be said that improving executive functions in early years of schooling may improve reading skills of dyslexic students.

How to Cite This Article:
Ehtesabi, A., Faramarzi, S., Ehteshamzadeh, P., Bakhtiarpour, S., & Ghamarani, A. (2022). The Effectiveness of Training Package based on Executive Functions of Delis-Kaplan on Reading skill of Dyslexic students. *jayps*, 3(2): 70-75.

Introduction

Based on the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), special learning disorder is defined as a disorder in which students' academic performance is lower than expected, considering their age and IQ (Raj & Sibey, 2021). About 5-15% of the child population has a specific learning disorder, which is more common in boys than in girls (Holt & Yuill, 2017). One of the most common and important specific learning disorders in students is dyslexia. Dyslexia is a language-based developmental and neurological learning disability that affects the ability to read and makes it difficult to develop spelling skills. People with dyslexia have difficulty connecting spoken language and printed vocabulary. So, dyslexia can lead to poor academic performance, low self-esteem, and lack of motivation. Developmental dyslexia is when a person has difficulty decoding words and spelling. In simpler words, when a dyslexic student begins to learn reading skills, he will have problems at the level of phonemes and sounds, which harms spelling and reading. The result is difficulty in understanding the text and reducing the reading experience (Berninger, Richards, and Abbott, 2015).

One of the characteristics of dyslexic students is weakness in active memory and attention. The role of verbal working memory in clear reading has been proven (Drigas, Elektra, 2016). People with dyslexia have problems in the graphic handwriting circle (ability to form letters, spelling, reading, and writing) and the morphological circle (development of reading and vocabulary) of working memory. Therefore, in the middle of childhood, the education of people with dyslexia should be focused on phonetics, morphology, handwriting and changing the focus of attention, and improving the capacity of active memory. However, cognitive challenges such as poor phonological awareness and rapid naming skills, defects in working memory, defects in written language, and changes in attention focus are issues that affect reading and writing literacy (Medina et al., 2019).

It is not possible to identify dyslexia patients with IQ and language tests. It is necessary to pay attention to executive cognitive skills, which are called executive functions, in diagnosing dyslexia. Executive functions are higher cognitive processes that include working memory, attention, cognitive flexibility, inhibition, problem-solving, and organization. As Dawson and Gaure (2018) stated, executive functions help regulate behavior in two ways. The first way requires using specific mental functions to select the target. These functions include planning: the ability to create and produce a road map to achieve a goal; Organization: the ability to design and maintain systems to preserve information and content; Time management: time estimation; Active memory: the ability to keep information in the mind while doing the task; Metacognition: the ability to reflect and see oneself in a situation. The second way is the functions that we need to reach the goal and guide the behavior in the direction of achieving the goal, which is: response inhibition: the capacity to think before action; Emotional control: the ability to direct emotions and emotions to achieve the ultimate goals and direct behavior; Sustained attention: increasing the ability to pay attention to a situation or task despite the presence of distraction; Task initiation: the ability to start a task without delay at the right time and flexibility: involves adapting to new situations (Dawson & Guare, 2018).

Considering the abundance of research on dyslexia and the emphasis of previous research on the need to improve executive functions in dyslexic students, no research has attempted to design a new intervention based on Delis Kaplan's executive functions to improve reading performance in dyslexia. So this research, in addition to adding insights about the structure of executive functions in dyslexia patients, has designed a new intervention whose effectiveness can create significant growth in the field of dyslexia interventions. Therefore, the current research was conducted to investigate the effectiveness of an intervention based on Delis Kaplan's executive functions on the reading skills of dyslexic students.

Method

The current study is a quasi-experimental research with a pre-test and post-test design, a control group, and a two-month follow-up. The statistical population included all male and female normal and dyslexic third-grade primary school students in Tehran in 2017-2018 academic year. 60 dyslexic students were

selected using a multi-stage random sampling method. Then they were assigned to two groups. The treatment based on the Delis-Kaplan method was implemented. In the second stage, 30 students who had obtained a lower score in Delis Kaplan's executive function were selected from the statistical population of dyslexic boys and girls. They were randomly divided into an experimental group (7 girls, 8 boys) and a control group (7 girls, 8 boys). Before the treatment sessions, group members were introduced and familiarized with the therapist. Then, the explanation of the executive function training package based on Delis Kaplan and the emphasis on effective work methods in this course were discussed. The criteria for entering the research are: 1- Having a severe weakness in reading skills compared to other subjects based on the teacher's opinion and academic record, 2- Diagnosing a specific learning disorder characterized by dyslexia, 3- Having an average IQ 4- Parents' will to their child's participation in the research process.

The criteria for withdrawing from the research are: the student's absence for more than three consecutive and non-consecutive sessions, and failure to complete exercises and homework during three consecutive and non-consecutive sessions.

Ethical considerations in this research were such that participation in this research was completely voluntary. Before starting the project, the participants were familiarized with the specifications of the project and its regulations. People's attitudes and opinions were respected. The members of the experimental and control groups were allowed to withdraw from the research at any stage. In addition, if interested, the control group members could receive the intervention performed for the experimental group in similar treatment sessions after the completion of the plan. All documents, questionnaires, and confidential records were only available to the executives. Written informed consent was obtained from all volunteers

Tools

1. Raven's Colored Progressive Matrices Test for Children: This test is one of the non-verbal intelligence tests that Raven developed in 1938. Psychologists have used its revised form since 1956. The colored form of this test has been published for children aged 5 to 11 years. The scoring of Raven's test is zero and one. If the subject answers the question correctly, he gets a score of one, and if he does not answer correctly, he gets a score of zero. The minimum and maximum scores are 0 and 36, respectively. Raven intelligence test has no time limit. The final test retest coefficients range has reported from 70% to 92%. Rajabi (2008) reported the retest coefficients of the Revised Raven Test for children aged 6.5 and 9.5 years with an interval of 0.60 and 0.80, respectively, which indicates the test's sensitivity to fluctuations in the output of activities. Intelligence is early childhood.

2. Reading and Dyslexia Test (Nama): This test (Karmi Nouri & Moradi, 2017; quoted by Khodamehri et al., 2015) is designed to check the reading ability of normal male and female students, first to fifth-grade students. It also diagnoses children with reading problems and dyslexia. This test has consisted of ten sub-tests, including word reading test, text reading comprehension test, word chain test, word comprehension test, rhyme test, phoneme elimination test, nonsense word reading test, picture naming test, the letter sign test, and the word sign test. The alpha coefficient of the whole test in Heidari's (2013) and Khodamehri et al.'s (2015) research was 82%.

3. Delis-Kaplan Executive Function System (D-KEFS): This test is the first set of executive tests and is specially designed to measure executive functions in both verbal and non-verbal dimensions in a wide range of age groups of children and adults (between 8 and 89 years old). (Delis-Kaplan, 2001, quoted by Qavami et al., 2016). This test has nine sub-tests, and six sub-tests were used in this research. 1- Tracking test 2- Verbal fluency test 3- Design fluency test 4- Color and word test 5- Card sorting test 6- Twenty questions test 7- Word texture test 8- Tower test 9- Proverb test. Qavami et al. (2016) prepared the Persian version of Delis-Kaplan's collection through cross-cultural adaptation to evaluate patients. The research analysis results show the Persian version's high and acceptable convergence validity in evaluating executive functions as a multidimensional and non-unitary construct. Moreover, the general results of the research showed that most of the test scales have sufficient validity regardless of age group.

4. Executive function training package based on Delis-Kaplan Method. The researcher designed this package. In each session, after the implementation of the determined activities, homework was given in order to consolidate learning. The following steps were performed to check the validity and reliability of this

researcher-made package. In the first stage, the researcher identified and extracted the themes by examining the studies and scientific background available until 2018 inside and outside the country in relation to the components of executive functions, especially the executive function of Delis Kaplan. After forming and completing the theme network, the components related to each theme were identified separately. In the final stage, the drawn theme network includes 8 organizing codes and 23 basic codes. According to Atride-Sterling (2001), the overarching theme is at the center of the theme network; The theme of the organizer is the interface of the overarching and basic themes of the network, and the basic themes show an important point in the text. Moreover, by combining them, the theme of the organizer is created. A questionnaire was designed to validate the basic and organizing themes. The purpose of this questionnaire is to determine the validity of the themes for developing the executive function training package based on Delis Kaplan according to the opinions of a selected sample of specialists and experts. Sampling in this group was done in a non-random purposive method, and 10 expert professors in the field of exceptional children were selected. The experts expressed their opinion from 1 to 4 on the mentioned topics.

Results

In the present study, the percentage of male and female samples in the experimental group was 46.7 and 53.3, respectively, and in the control group, 46.7 and 53.3, respectively.

The results show that the average scores of reading words, chain of words, rhyming words, naming pictures, reading comprehension, understanding words, deleting sounds, reading non-words, letter symbols and category symbols have changed before and after the intervention. Considering the existence of one independent variable (education based on Delis Kaplan's system of executive functions) and ten dependent variables (reading words, chain of words, rhyming words, naming pictures, understanding reading, understanding words, eliminating sounds, reading non-words, letter symbols, and category sign) statistical test of multivariate covariance analysis was used. First, the normality of the data distribution was checked and confirmed using the Kolmogorov-Smirnov statistical test ($p<0.05$). Box test confirmed the assumption of homogeneity of variance-covariance ($F=1.299$ and $p=0.070$).

As the results showed, the intervention significantly affected the post-test scores of reading words, chain of words, rhyming words, naming pictures, understanding content, understanding words, removing sounds, reading non-words, letter symbols, and category symbols ($P<0.001$). According to the eta square, it can be stated as 0.87, 0.94, 0.80, 0.97, 0.93, 0.94, 0.96, 0.92, 0.98, and 0.99 percent, respectively. Therefore, the changes in each of the variables of reading words, chain of words, rhyming words, naming pictures, reading comprehension, understanding words, removing sounds, reading non-words, letter symbols, and category symbols stem from the participation of dyslexic students in the educational program based on Delice Kaplan's executive functions system .

Furthermore, the statistical tests of multivariate covariance analysis in experimental and control groups show that these groups are significantly different ($p<0.001$) in at least one of the dependent variables.

Conclusion

This research aimed to investigate the effectiveness of the executive function training package based on Delis-Kaplan on the reading performance of dyslexic students in the third grade of elementary school. The results indicated the effectiveness of the executive function training package based on Delis-Kaplan on the students' reading performance. It is confirmed by the study of Azadfar, Badri Gargari, Fathi Azar, Sabouri Moghadam and Hashemi (2019), Dehghani and Hekmatian Fard (2018), Toreyfi Hosseini, Shehni Yaiilagh, Haji Yakhchali and allipour Birgani (2018), Yousefi, Faramarzi, Malekpour, and Yarmohamedian (2018) have been consistent. In explaining this finding, it should be acknowledged that the theory of dyslexia can provide a low-level sensory or high-level cognitive explanation (König, Kühnberger, and Kietzmann, 2013). Low-level causal explanations of dyslexia include: 1-cortical dysfunctions that lead to motor and implicit learning problems that affect the automation of basic reading skills, 2-magnocellular dysfunctions that lead to low-level sensory deficits that affect visual control and phonological processing have cognitive effect and 3- defects in auditory processing that affect the development of phonological skills that are necessary to improve reading ability.

Explanation of the cognitive cause and effect of high-level dyslexia is the same phonological defect that appeared due to abnormality in the left hemisphere that affects the ability to read, and theories of high-level dyslexia refer to active memory and executive function systems and regulatory or explanatory executive function abilities (Snyder, 2015).

Intervention based on Delis-Kaplan's executive functions can play an important role in reading ability because executive functions are essential in decoding, fluency of words, and reading comprehension. Previous research has shown that executive functions such as decision-making, planning, and organization help a lot. They read. Studies concerning active memory of dyslexic and normal third-grade students showed a significant correlation between phonetics and active memory and its effect on dyslexia, and auditory and visual stimuli become important in acquiring reading skills. Compared to normal students, dyslexic students struggle more in tasks that deal with visual recognition and formation. It can be acknowledged that deficits in visual attention and visual processing are related to deficits in reading performance (Valdois, Bosse, and Tainturier, 2004).

One of the limitations of this research is that it does not compare two genders. According to statistics and figures, the rate of dyslexia in boys is far more than that of girls, which would be better if these two genders were investigated separately and the results of interventions were compared. Future studies should include self-concept and self-esteem in future modeling by comparing both sexes.

Conflict of Interest

According to the authors, this article has no financial sponsor or conflict of interest.

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