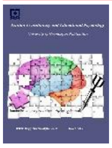
**Original Article**



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# Comparing The Effectiveness of Instructional Package of Cognitive- Metacognitive Strategies and Cognitive Intervention in Solving the Mathematical Verbal Problem and Cognitive Functions in Students with Special Learning Disabilities

**Abbasali Soleymani Khashab[1], Fariborz Dortaj[2]*, Esmaeil Sadipour[3], Ali Delavar[4], Kamran Shivandi Cheliche[5]**

1. Ph.D. Student of Educational Psychology, Faculty of Psychology and Educational Sciences, Allameh Tabatab,i University, Tehran, Iran.
2. Professor, Department Of Educational Psychology, Faculty of Psychology and Educational Sciences, Allameh Tabatab,i University, Tehran, Iran.
3. Professor, Department Of Educational Psychology, Faculty of Psychology and Educational Sciences, Allameh Tabatab,i University, Tehran, Iran.
4. Professor, Department Of Assessment and Measurement, Faculty of Psychology and Educational Sciences, Allameh Tabatab,i University, Tehran, Iran.
5. Assistant Professor, Department Of Educational Psychology, Faculty of Psychology and Educational Sciences, Allameh Tabatab,i University, Tehran, Iran.

* Corresponding author's Email: dortajf@atu.ac.ir

**ABSTRACT:** According to the purpose of the research, the present study is designed as pre-test and post-test, follow-up tests and time series. The statistical population of the study consist of all fourth grade students with special learning disabilities in Bahmaei city, Iran, in 2019-2020. From this population, 16 elementary students are selected as the research sample by purposive sampling method. The training package is accomplished in 9 sessions of 45 minutes with content validation. The research tools are developed by a researcher-made questionnaire of Mathematical verbal problem solving; Wechsler scale indices of children version 5, and Ki Matt scale are formed, and the analysis method was performed by repeated measures analysis of variance test. The results show that the C-MSI and CCI increase cognitive functions and math verbal problem solving in students with special math learning disabilities (P< .01). Mean post-test and follow-up in variables of mathematical verbal problem solving (MD= .31, P< .52), planning (MD= .13, P< .99), Simultaneous processing (MD= .38, P< .49), and sequence processing (MD= .25, P< .12), show that there is no noticeable change in the post-test after two months. With this result, it could be said that the training package has been effective in the long run (P< .01). On the other hand, teaching cognitive and metacognitive strategies has a greater effect on the variables of mathematical verbal problem solving (T=3.12, P< .01) and simultaneous processing (T= 3.22, P< .01) than cognitive intervention. In addition, cognitive functions, P (MD= .31, P< .52), S (MD= .38, P< .49), S (MD= .25, P< .12) and mathematical verbal problem solving (MD= .31, P< .52) in students are followed up after the post-test, and the results showed that there was no noticeable change in the post-test after two months. With this result, it can be said that C-MSI has also been effective in the long run (P< .01). On the other hand, C-MSI has a greater impact on the variables of math problem solving and simultaneous processing than Captain Log's cognitive intervention. Therefore, this type of education can be used to improve Simultaneous processing (T= 3.22, P< .01) and the ability to solve verbal problems (T= 3.12, P< .01) in students with MSLD.

**Keywords:** Cognitive and metacognitive strategies training package, cognitive functions, mathematical verbal problem solving, mathematics specific learning disability.

## Introduction

Learning disabilities are one of the main reasons for academic failure in students. These disabilities are a heterogeneous group of disorders, the most important features of which are difficulty in learning and

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functioning of reading, writing and arithmetic, which has a developmental process that begins in primary school and continues into adulthood (Berkeley & Larsen, 2018). One type of learning disability is a specific learning disability in mathematics, which refers to a wide range of math deficits throughout life. Mathematics is very important in daily and professional life with the development of technology; So that the level of knowledge and mathematical skills is directly related to the standards of individual quality and social life ((Mutlu, 2019). Estimates of the prevalence of specific learning disabilities in mathematics are not the same and vary from community to community according to the criteria used, but the range of 3.6 to 9.8% has been reported in various studies (Iglesias-Sarmiento, Deaño, Alfonso, & Conde, 2017). Bonifacci et al. (2020), in their study of the emotional problems of children with special learning disabilities conclude that math problems begin in the preschool years; counting difficulties, comparing quantities, recognizing numbers, and the working memory are considered important indicators in early detection of children's math problems. There is ample evidence of students' difficulty in solving verbal problems (Im & Jitendra, 2020). The ability to solve a math verbal problem is recognized as a fundamental component of mathematical ability. Research has shown that students with special math learning disabilities often have difficulty solving verbal problems (Krawec, 2014), since mathematical problem solving involves analyzing and interpreting the problem as well as identifying the necessary computational operations (Passolunghi, 2011). It is a challenge for many students and is strongly associated with math success (Geary, 2011). Furthermore, these students often use inappropriate strategies to solve math problems which lead to problems concerning cognitive functions (Diamond, 2013). The verbal problem-solving process is a multi-step process that causes students to give up the desire to find sudden and quick solutions and follow structured and purposeful steps (Melin, Castillo, Kacprzyk, Reformat, & Melek, 2017). Phonapichat, Wongwanich, and Sujiva (2014) believe that although the main purpose of mathematics education is to enable students to solve problems in everyday life, most students still lack math problem solving skills; this may be the reason for the overall low progress in mathematics. Andersson (2010) has reported major weaknesses in solving the problem of students with learning disabilities in the third and fourth grades of elementary school. Mathematical problems are influenced by cognitive processes, and many researchers have emphasized cognitive functions and verbal processes in solving mathematical problems (Anderson, Betts, Ferris, & Fincham, 2011; Arsalidou & Taylor, 2011). Research evidence suggests that specific learning disabilities are affected by genetic and environmental risk factors, developmental characteristics, comorbidities, and cognitive impairments (Tannock, 2013). Cognitive functions are a comprehensive structure for cognitive processing (L. Meltzer, 2018), and identifying weaknesses in cognitive functions associated with specific learning disabilities as an empirical. Clinical goal is important for two reasons. First, as a guide to preventive studies with the aim of identifying early cognitive risk markers for learning disabilities. Second, as a guide to longitudinal studies focusing on identifying unusual cognitive development pathways for specific learning disabilities. Cognitive functions are one of the psychological assets that help people to perform life tasks at any stage of development. The theory of cognitive functions (PASS) is one of the new explanatory models for the etiology, diagnosis and treatment of special learning



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disabilities, which has been designed according to the problems of intelligence assessment and tools used to identify and intervene in learning disabilities. This theory, as a theory of cognitive processing, includes four cognitive processes of planning, attention, simultaneous processing and successive processing (PASS) which is rooted in Loria's neuropsychological conceptualization of cognitive processes (Power et al., 2011). Research on the effectiveness of PASS theory and cognitive evaluation system in cognitive evaluation of people with special learning disorders in reading and specific learning disorder in mathematics has also been done (Kroesbergen, Van Luit, & Naglieri, 2003; Naglieri & Das, 2005; Naglieri & Rojahn, 2004; Taddei & Contena, 2017; Wang, Georgiou, & Das, 2012).

One of the most widely used cognitive interventions based on PASS theory in helping people with cognitive disorders is the Captain Log-based computer-centered cognitive rehabilitation intervention; its main purpose is to overcome defects, cognitive changes and improve the level of individual adaptation (Cicerone et al., 2011). In fact, cognitive interventions are a set of purposeful programs that are used to repair or improve cognitive functions. Treatment for cognitive disorders for people with a cognitive or behavioral disorder and promotion is for strengthening cognitive functions in people with special educational or professional needs. The basis of cognitive interventions is based on the principle that the brain is a flexible and changeable organ that can be repaired or strengthened with appropriate cognitive interventions (Coltman, Cashaback, & Gribble, 2019).

With the increasing advancement of computer technologies, accuracy and ease of use, a variety of computer programs in various fields of education have been designed to enhance cognitive capabilities. In addition, face-to-face cognitive rehabilitation programs are costly. Because of the spread of computers in the field, research has been conducted to evaluate the effectiveness of these programs (Royatvand & Amiri, 2018). Computer education is an engaging and motivating learning approach that seems to familiarize students with special learning disabilities with successful learning experiences. This program provides instant feedback to students, provides step-by-step content. It, thus, reduces student errors and also enables teachers to track student learning curves and draw their progress in graphs. Captain Log software is an educational suite for enhancing higher cognitive functions and processes, and is a multidimensional cognitive rehabilitation tool capable of enhancing a wide range of cognitive functions. In this way, in addition to cognitive training programs, offered to strengthen and improve mental and cognitive skills, it also increases self-esteem, self-efficacy and self-control. This collection has 2000 different programs and tasks at different levels.

Coltman et al. (2019), in their research, show that Captain Log software is functional in attention deficit hyperactivity disorder. Royatvand and Amiri (2018) in their research, confirm the effectiveness of this intervention on student's working memory with learning disabilities. However, no research has been conducted by the researcher to investigate these types of intervention on cognitive functions and mathematical verbal problem solving in students, especially students with special learning disabilities. However, various studies have supported the effectiveness of teaching cognitive and metacognitive strategies in this field (Miri & Maleki, 2014). Students often use inappropriate strategies to solve math

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problems, which causes problems in using both cognitive and metacognitive processes to solve the problem.

Ifenthaler, Eseryel, and Ge (2012) and Culaste (2011) emphasize that problem solving requires strategy choice and also metacognitive aspects of problem solving in addition to cognitive aspects. Therefore, paying attention to the educational program based on cognitive and metacognitive strategies is of great importance. Sweller (2016) considers the usual problem-solving approach in mathematics education ineffective, because the cognitive burden of working memory is so heavy with new cognitive operations that the student becomes involved in problem-solving process. As a result, new information cannot be transferred to long-term memory and learning will not happen (Treffers, 2019). Therefore, one of the major approaches in the research literature related to the development of mathematical verbal problem solving skills for students with learning difficulties is cognitive strategies teaching that address the inefficiency of students' cognitive and metacognitive processes in solving mathematical verbal problem (Montague & Dietz, 2009; Montague, Krawec, Enders, & Dietz, 2014). active learning is the main feature of approaches based on Vygotsky (1978) theory, in which through dealing with the teacher, the student is able to develop an understanding and flexibility to succeed in solving mathematical verbal problems (Montague et al., 2014). Ma, Du, Hau, and Liu (2018) emphasize that a positive teacher-student relationship, as an external motivating factor, contributes to learning outcomes.

Cognitive strategies as learning tools are: repetition or review strategies, strategies for semantic expansion and expansion and organizational strategies (Seif, 2011). Metacognition is also the knowledge of the individual about how to learn. Metacognition and awareness of cognitive processes has become one of the most important and influential areas in the field of cognition and education in recent years (Seif, 2011; Sweller, 2016). Yang (2005) considers the combination of cognitive and metacognitive strategies as a powerful tool for revealing how the learning process develops. They enhance self-learning skills, promotes independence, and facilitates learning ability. Experts such as Palinscar and Brown (1984) attribute many learning problems to a lack of metacognitive skills and strategies that students need in areas such as self-regulation, self-monitoring, planning, and determining the purpose of the necessary training (Mohammad Aria, Seifunraqi, Delavar, & Saadipour, 2012). Teaching students with cognitive strategies with learning disabilities help them use appropriate strategies in dealing with academic problems and solve academic problems (Stacy, Cartwright, Arwood, Canfield, & Kloos, 2017). But researchers have shown that the use of cognitive and metacognitive strategies have long-term effects on students' academic performance (Mesrabadi & Alilou, 2016). Desoete and De Craene (2019), in their research conclude that metacognition has a significant impact on math skills. In general, there has been a lot of research on cognitive interventions in students with special math disorders. And research has emphasized the importance of paying attention to cognitive and metacognitive skills. But so far, no educational package based on both cognitive and metacognitive skills has been developed to improve math problem-solving skills and cognitive functions (PASS) in students with specific math disorders. On the other hand, the issue of explicit and implicit education in students with mathematical disorders is one of the issues that has attracted the attention of experts.

Sweller (2016) argues that exploratory learning should be distinguished from direct learning, in a way that with explicit, direct training and providing appropriate strategies and examples, it greatly reduces the student's cognitive burden and facilitates the transfer of information from short-term to long-term memory. On the other hand, engaging and active learning, which is the main feature of these approaches, is based on Vygotsky (1978) theory, in which by facilitating the teacher, it enables the student to develop understanding and flexibility to succeed in solving mathematical verbal problems (Montague et al., 2014). On the other hand, the Captain Log intervention package emphasizes the implicit teaching which major approaches in the research literature relate to the development of mathematical problem-solving skills for students with learning difficulties, teaching cognitive strategies (such as the Capt. Log intervention package). But some critics insist on the inefficiency of students' cognitive and metacognitive processes in solving mathematical problem in teaching of purely cognitive strategies (Montague & Dietz, 2009; Montague et al., 2014).

On the other hand, the discussion of the effectiveness of instruction against intervention was considered by researchers. Despite the importance of diagnosis in timely and accurate intervention process, some experts in this field believe that overemphasis on extensive assessment and diagnosis processes ultimately do not help much to solve the problem of reducing the disorder. On the contrary, they believe that the main emphasis should be on coherent and accurate instructions related to the unique type of specific learning disability.

The fact that cognitive assessments and academic assessments are correlated cannot indicate the direction of causality. Also, cognitive impairment does not indicate why a child has a learning disability, because learning difficulties may cause cognitive impairment. The other reason that makes the priority of instruction more specific than intervention is that the cost of cognitive assessments is that if these costs are spent on more interventions, it will be more effective in improving learning disabilities (Fletcher & Miciak, 2017) and finally believe that interventions based on cognitive skills in the absence of instruction does not improve reading, writing and math skills (Melby-Lervåg, Redick, & Hulme, 2016). As an alternative concept, we must focus on the inadequate response to adequate instruction. In prioritizing instructional interventions, the main idea is that the child with a learning disability is learning harder - not that he or she is not able to learn. This type of research supports a hybrid approach based on academic evaluation that includes the evaluation of instructional answers, the minimum success criteria based on valid university-standardized tests, and the underlying factors hindering success.

Therefore, in connection with the discussion of the importance of giving priority to explicit or implicit education, as well as the priority of education or intervention, there are ambiguities that the present study tries to clarify. Therefore, this study has aimed to compare the effectiveness of cognitive and metacognitive strategies instruction (CSI & MSI) and cognitive intervention Captain log on cognitive functions (PASS) and verbal problem solving in students with specific learning disorder in math (MSLD).

## Material and Methods

The aim of this study is to determine the effectiveness of the instructional package of cognitive and metacognitive strategies and compare it with cognitive intervention. The statistical population of the study includes all fourth-grade elementary students with special learning disabilities in Bahmaei city, Iran in 2019-2020. Of this population, 16 elementary students are selected by purposive sampling, as research samples. Sample selection is done in two stages:

**a) Screening interview**: In the screening interview, the parents answer questions about the child's developmental, medical, personal and educational history and information about exit factors (such as severe concussion, hearing and vision difficulties, and specific genetic and medical problems such as epilepsy are presented. **B) Comprehensive assessment**: If the initial interview shows that the child does not cope with the exclusion criteria, an appointment is scheduled for the comprehensive assessment, and the child completes a set of tests. In order to obtain the cognitive profile of the child, Wechsler 5 test and K Matt test and solving mathematical verbal problem are used. The research design is quasi-experimental. First, instruction and practice of cognitive and metacognitive strategies, nine 45-minutes sessions, are performed on students in the form of a group correlated with pre-test, post-test and follow-up. Individual and design of a group are correlated with pre-test, post-test and follow-up, and data are collected and analyzed by repeated measures.

### Measuring tools

**Mathematical Verbal Problem Solving Test in five parallel forms**: Mathematical Verbal Problem Solving Test made by a researcher is prepared based on the problems and topics in the fourth-grade elementary mathematics textbook. This test consists of five parallel forms. To select these 5 forms, first 100 questions are designed and then to determine the apparent and content validity, provided to 10 teachers of this grade to evaluate the questions based on a three-point scale (useless, useful and necessary). According to the average scores given by the judges to each question, that question is deleted or approved. (If 5 out of 10 judges find the question useless, the question will be removed). After evaluating the questions, the 50 questions that received the highest level of agreement among the evaluators are selected and randomly divided into 5 categories. At each stage of the research, a form of them is used.

**Iran K-Mat Math Test:** The K-Mat math test is developed and standardized by Connolly (1988). This test is used to determine the strengths and weaknesses of students in different areas of mathematics (Mohammadesmaeil & Hooman, 2003). In terms of content and sequence, it includes three parts of basic concepts (three subtests of counting, rational numbers and geometry), operations (several subtests in the field Is addition, subtraction, multiplication, division and mental calculation) and application (questions to measure time, money, estimate and interpret data, and problem solving). This test was standardized in Iran for students aged 6 to 11 and its validity was documented using factor analysis. The Cronbach's alpha was reported to be optimal for this test. Cronbach's alpha of this test at the level of subtests in this questionnaire was .82, .81 and .78, respectively. Also, the total reliability coefficient of this test was calculated to be .79 using Cronbach's alpha method.

**Wechsler Intelligence Scale for Children**: This scale consists of 5 main indicators of verbal perception, spatial vision, fluid reasoning, working memory and processing speed. The scores of each of these 5 main indicators are obtained by means of two sub-tests. In addition to the 5 main indicators, the fifth edition Wechsler test has 5 sub-indicators and 3 supplementary indicators. The 5 sub-indicators are general ability, cognitive, nonverbal, quantitative reasoning, and auditory working memory. These indicators enable the specialist examiner and therapists to examine specific cognitive hypotheses that are related to children's test scores. Three additional indicators have been added to the test in the fifth edition of Wechsler. These three indicators which are naming speed, symbol reversal, storage and retrieval are designed to provide detailed information about the psychological evaluation of children referred for specific learning disabilities (Weiss, Saklofske, Holdnack, & Prifitera, 2015).

This scale was used for two purposes: identifying children with specific math learning disabilities and assessing cognitive functions (planning, attention, simultaneous processing, successive processing). In order to identify students with special learning disabilities, subtests of naming speed literacy, naming speed value, instant translation of the symbol, delayed translation of the symbol, translation of symbol recognition are used. Also based on the definitions of indicators and subtests of the Cattell-Horn-Carroll IQ model version 2.2 (Schneider & McGrew, 2012), as well as the Wechsler 5 Interpretation and Evaluation Book (Weiss et al., 2015) and the Cognitive Assessment System Book: From theory to practice (Naglieri & Otero, 2012)Wechsler 5 indicators and subtests have been used instead of components and metrics of the Cognitive Assessment System (CAS) In order to evaluate students' cognitive functions of fluid reasoning subtests (matrix reasoning and recognition of weights and concepts of image and calculation) for planning (P), processing speed (cryptography, symbolism and alignment) for attention (A), visual space (design of cubes and riddles) is used for simultaneous processing (S) and working memory (number and image width and letter and number sequence) was used for successive processing (S). The reliability of this questionnaire has been reported in a similar way in the technical and interpretive guide for general intelligence from .96 to .97 (Cormier, Kennedy, & Aquilina, 2016). Also, the average internal consistency for 16 subtests is from .81 for symbolization to above .94 for weight detection and the reliability of retest (26 days interval) for overall IQ is .92. The retest reliability of the five indicators ranges from .75 for fluid reasoning to above .94 for verbal comprehension. The average retest reliability for the subtests ranges from .71 for visual concepts to above .90 for the vocabulary. Reliability of all subtests except visual concepts and matrix reasoning (.78) is .80 or higher (Cormier et al., 2016). On the other hand, the validity of the criterion based on Kaufmann evaluation for children shows a good convergence: comprehension and knowledge / GC (crystallized ability) correlation .74; Visual-spatial index and non-verbal index of correlation .60; Active memory index and mental processing index correlation .65; and the fluid reasoning index and the crystalline-fluid index had a correlation of .63 (Weiss et al., 2015).

**Execution method and instruction package of cognitive and metacognitive strategies:**

In order to build this **instructional** package, various theories, resources and researches in the field of teaching cognitive and metacognitive strategies are studied. Based on the implications of Vygotsky's

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theory and research on the priority of **instructional** interventions over cognitive interventions (Sweller, 2016) in improving the skills of mathematical verbal problem solving, especially Montague's researches (Montague & Dietz, 2009; Montague et al., 2014), an educational package is designed and developed. In addition to the above activities, in designing and compiling the educational package, the age and cognitive status of students with learning disabilities and the opinions and suggestions of experts in this field are taken into account. In addition to the above points, diversity is needed to keep students motivated and excited, with maintaining the existence of educational programs. In order to validate the educational package, the opinions of experts and professors in the field of educational psychology, learning psychology, special learning disability and curriculum planning in 2020 are taken into account. In this way, with the opinions of the supervisors and consultants, 30 specialists are identified, and an internal validation questionnaire is sent to them via e-mail. After several times of informing and following up, finally 20 members of the statistical sample complete the questionnaire. Content validity index (CVI) and general appropriateness (S-CVI) are used to evaluate the validity of closed content. The Content Validity Index (CVI) represents the comprehensiveness of judgments about the validity or enforceability of a training package, test, or final instrument. the content validity index can be calculated by counting the number of positive scores of 4 or 5 of each criterion, divided by the number of experts. Since the minimum acceptable value for the content validity index is .79, the results show that this number is above .80 for all criteria of the training package. Therefore, it can be concluded that the proposed package has good content validity. Also, the mean approach is used to calculate the overall appropriateness of the proposed package in this study. In other words, the average of the total content validity indices is divided by the total number of criteria. The results of the table show that the general appropriateness of the proposed model is .85. Since this number is higher than the minimum desired appropriateness of .79, it can be concluded that experts have evaluated the training package of cognitive and metacognitive strategies as appropriate. In order to teach and practice cognitive and metacognitive strategies, 9 sessions of 45 minutes are considered. Thus, in the first to third sessions, each of the cognitive and metacognitive skills and the importance of using them are explained to the students by the instructor; at the end, a sample exercise using cognitive and teacher's metacognitive strategies is solved. From the third to the ninth session, in each session, a number of verbal problems were solved by the instructor and students. In the process of solving these problems, cognitive scaffolding (which is the process of gradually reducing the guidance of the expert to the novice to the level of mastery) was used as one of the key concepts proposed in Vygotsky's theory. Accordingly, during the first 3 sessions, the instructor directly solved exercises to model the students, and only in some cases did he ask guiding questions from the students to participate in problem solving. At the end of these three sessions, students were asked to solve a math verbal problem using cognitive and metacognitive skills using the problem-solving cards they had. When the problem was solved by the students, the instructor directly supervised and provided timely feedback. The content of the problems raised in these three sessions was related to the four main mathematical operations with the lowest level of difficulty. Subsequently, during the sessions, the number of exercises that the teacher did directly decreased and the number of exercises that the students performed increased. At the same time, the instructor reduced the amount of guidance and supervision he provided, so much so that in the last session, without any guidance from the teacher, the students solved 4 verbal problems, and the instructor provided the necessary feedback only at the end. The difficulty level of the problems also increased as the students progressed. Throughout the educational intervention, the instructor's training methods included the implementation of step-by-step cognitive strategies and metacognitive activities with a particular focus on approaches such as "thinking high", explicit training, demonstration of skills, scaffolding, collaborative work, responsive support, and timely feedback.

In this study, cognitive and metacognitive strategies training package during nine 45-minute sessions were taught as follows:

**Cognitive and metacognitive strategies package training**

**First session**: Communication, introduction and empathy

**Second session**: Teaching the concepts of scaffolding, approximate growth area and the concepts of internal, external and optimal cognitive loads

**Third session**: Teaching cognitive and metacognitive strategies

**Fourth Session**: Practice cognitive and metacognitive strategies to solve problems in groups of three with the help and supervision of the teacher

**Fifth Session**: Practice cognitive and metacognitive strategies to solve problems in groups of three without the help and supervision of the teacher (independently)

**Sixth Session**: Practice cognitive strategies for solving problems individually with the help and supervision of the teacher and using the problem-solving card

**Seventh session**: Practice metacognitive strategies for solving problems individually with the help and supervision of the teacher and use the problem-solving card

**Eighth session**: Students can go through the steps of cognitive and metacognitive strategies to solve math verbal problems independently without teacher supervision.

**Ninth session**: Students can correctly use the cognitive and metacognitive strategies which are needed to solve mathematical verbal problems (at least 3 of the 4 problems).

It should be noted that the meetings are held every other day. Each session usually lasted 45 minutes. At the beginning of each session, 10 minutes are allocated to reviewing the assignments and reviewing the previous session, and in the remaining 35 minutes, the assignments of that session are performed.

**Cognitive intervention implementation method (Based on Captain Log computer software):**

Captain Log software is designed as one of the most widely used programs to rehabilitate and improve cognitive functions. The use of this program can improve and enhance the mental abilities of people in various fields. The program which has more than 2,000 different exercises for 20 cognitive skills is designed to improve the performance of people with ADHD, dementia and Alzheimer's, learning disabilities, brain damage, developmental delays, mental retardation, and psychiatric disorders such as schizophrenia, Mood disorders are designed for age 6 and older; they have different levels of difficulty that are determined by the individual. This software has been provided by Avijeh Innovators Company





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which operates in Iran. All tasks in this program are multidimensional and generally focus on more than one cognitive skill, so both basic cognitive functions and excellent cognitive functions are simultaneously improved and enhanced in this program. Some participants needed training because the language of the software used was English and they were not fluent in English. The questions are generally explained at the beginning of each session, but sometimes it requires direct supervision or the parents accompanying parents. As some participants gets tired, they are given rewards every four sessions to strengthen and increase the continuity of cooperation. In each session, what the participant does, is stored, and in the next session, the game is continued. Due to the fact that students receive the intervention individually, the intervention process is different for each one. Based on the initial evaluation by the software, specific cognitive interventions are defined according to the cognitive weakness of each student. After the software identifies interventions for each student, the learner receives the interventions on a regular basis.

**Ethical considerations**: In this research, the observance of the human rights of the participants has been respected in all the principles of the research. Also, the informed consent of the participants and their families has been observed in collecting and disseminating data in accordance with ethical principles. This article is taken from the dissertation of first author at Allameh Tabataba,i University.

## Results

In this section, the results perform in relation to the dependent variables, and the results of the effectiveness of the interventions are presented.

**Table 1**. Descriptive information of pre-test, post-test and follow-up of research variables

| | | Pre-test stage | | Post-test stage | | Follow-up stage | |
|---|---|---|---|---|---|---|---|
| ***Variable*** | Group | Mean | SD | Mean | SD | Mean | SD |
| ***Verbal problem solving*** | Cognitive intervention | 7 | 2.25 | 13.25 | 1.99 | 13 | 1.81 |
| | CSI & MSI | 13 | 1.82 | 16.75 | 1.77 | 16.43 | 1.78 |
| ***Simultaneous processing*** | Cognitive intervention | 11.56 | 3.36 | 13.75 | 3.58 | 13.93 | 3.29 |
| | CSI & MSI | 13.93 | 3.29 | 17.50 | 3.46 | 17.87 | 3.31 |
| ***Planning*** | Cognitive intervention | 12.25 | 5.06 | 16.43 | 5.97 | 16.68 | 6.41 |
| | CSI & MSI | 16.68 | 6.41 | 21.25 | 7.27 | 21.12 | 7.10 |
| ***successive processing*** | Cognitive intervention | 5.43 | 1.82 | 6.37 | 2.09 | 6.31 | 2.15 |
| | CSI & MSI | 6.31 | 2.15 | 7.37 | 2.39 | 7.12 | 2.33 |
| ***Attention*** | Cognitive intervention | 12.68 | 2.30 | 13.87 | 2.33 | 13.50 | 2.32 |
| | CSI & MSI | 13.50 | 2.33 | 14.87 | 2.72 | 14.43 | 3.14 |

* Metacognitive Cognitive Strategies instruction= CSI & MSI

As the results of Table 1 show, in all the above variables, the post-test scores of both intervention methods have increased compared to the pre-test, but we do not see much difference in the mean of the post-test and the follow-up stage of both methods. Before analyzing the research hypotheses and

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questions, the assumptions of repeated measures test are tested. Kolmogorov-Smirnov test is used to evaluate the normality of the distribution of variables in the research group. The results are shown in Table 2.

**Table 2.** Evaluation of normality of variables by Kolmogorov-Smirnov test

| **Test** | Verbal problem solving | | Simultaneous processing | | planning | | successive processing | | Attention | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cog intervention | CSI & MSI | Cog intervention | CSI & MSI | Cog intervention | CSI & MSI | Cog Intervention | CSI & MSI | Cog intervention | CSI & MSI |
| K-S | .86 | .54 | .96 | .98 | .65 | .79 | .72 | .49 | .91 | .50 |
| Sig. | .45 | .93 | .32 | .29 | .79 | .56 | .68 | .96 | .37 | .96 |

According to Table 2, the results of the Kolmogorov-Smirnov test show that all variables are at a non-significant level, which indicates that the distribution of variables is normal. Therefore, according to what has been discussed so far, the conditions are in place for performing repeated measurement analysis. Table 3, the results of the multivariate test, showed that the Wilkes lambda test for verbal problem solving, planning, attention, concurrent processing and sequential processing (F = 5.01 (14 and 2) and Sig = .001) and ETA squares also showed Gives.

Also, the results of multivariate analysis of variance test for comparison of pre-test, post-test and follow-up at the level (.0001) are confirmed. The results of Wilkes lambda test for educational intervention and cognitive intervention are designated in the variables of verbal problem solving, planning, attention, concurrent processing and sequential processing, respectively (F = 51.01, 66.44 and Sig = .0001), (37.48) And F1.31 / 17 and Sig = .0001), (89.58, F = 10.70 and Sig = .0001) and (12.57, F = 40.79 and Sig = .0001).

**Table 3.** Multivariate analysis of variance test to compare pre-test, post-test and follow-up

| ***Test*** | Verbal problem solving | | Simultaneous processing | | planning | | successive processing | | Attention | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Wilks Lambda*** | Cog intervention | CSI & MSI | Cog intervention | CSI & MSI | Cog intervention | CSI & MSI | Cog Intervention | CSI & MSI | Cog intervention | CSI & MSI |
| *F* | 66.44 | 51.01 | 31.17 | 37.48 | 25.74 | 10.70 | 89.58 | 40.79 | 12.57 | 11.50 |
| *Sig.* | .001 | .001 | .001 | .001 | .001 | .001 | .001 | .001 | .001 | .001 |

Table 3 shows that the multivariate analysis of variance test was approved for comparison of pre-test, post-test and follow-up at the level (.0001). Due to the significance of the multivariate test, in order to check the uniformity of the covariance of the measurements, the Mauchly's Test of Sphericity is used. The results of sphericity test show that verbal problem solving is significant for cognitive intervention and metacognitive cognitive strategy instruction, so the covariance of the measurements are not the

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same. As a result, Greenhouse–Geisser alternative test is used to evaluate the effect of the intervention method on the verbal problem-solving variable. The results of the Greenhouse test, as a result, the alternative Greenhouse-Geisser test is used to investigate the effect of the intervention method on the verbal problem-solving variable. The results of Greenhouse test in cognitive intervention (F = 99.06 and Sig = .0001) and metacognitive intervention (F = 67.49 and Sig = .0001) on problem solving are significant, indicating that at least between the mean of the two, there is a significant difference in the stage of performances. Also, spherical sphericity is not significant for simultaneous processing and sequential processing, but is important in planning and attention for cognitive intervention. Sig = .0001 and (F = 7.51 and Sig = .007) are produced. On the other hand, Mauchly's Test of Sphericity for simultaneous processing is not significant in Captain Log cognitive intervention, just for planning, attention and processing of Greenhouse test. As a result, Greenhouse- Geisser substitute test is used for these components, which are F (56.66 and Sig = .0001 (F = 9.52 and Sig = .005) and (F = 16.84 and Sig = .0001). The table below shows the test results within the group.

**Table 4.** The Impact of Captain Log Cognitive Intervention on Students' Verbal Problem Solving and Components of Cognitive Functions

| Variable | Source Effect | Total Squares | Df | Mean Squares | F | Sig. | Eta |
|---|---|---|---|---|---|---|---|
| Verbal problem solving | Evaluation stage | 288 | 1 | 288 | 96 | .0001 | .87 |
| | Error | 45 | 15 | 3 | | | |
| planning | Evaluation stage | 157.53 | 1 | 157.53 | 56.30 | .0001 | .79 |
| | Error | 41.96 | 15 | 2.79 | | | |
| attention | Evaluation stage | 5.28 | 1 | 5.28 | 4.12 | .05 | .22 |
| | Error | 19.21 | 15 | 1.28 | | | |
| Simultaneous processing | Evaluation stage | 45.12 | 1 | 45.12 | 85.59 | .0001 | .85 |
| | Error | 7.87 | 15 | 0.52 | | | |
| successive processing | Evaluation stage | 6.13 | 1 | 6.13 | 13.36 | .002 | .47 |
| | Error | 6.87 | 15 | .45 | | | |

According to the table above, the results of intra-group test show that the method of cognitive intervention on verbal problem solving, planning, attention, Simultaneous processing and successive processing with Eta squared, respectively, could be .87, .79, .23, .85 and .47 are effective. Due to the significance of the results of the group test, in order to know the location of the difference, a two-to-two comparison of the evaluation steps is given in Table 5. According to the results of Table 5, the average of problem solving, scheduling, concurrent processing and consecutive processing in the pre-test is less than the post-test, which indicates that the Cognitive Log intervention has a significant effect on increasing these components. Also, the average of problem solving, planning, Simultaneous processing and successive processing in the pre-test is less than the follow-up stage, which indicates that the impact of the intervention is maintained in the long run. However, there is no significant difference between the mean of the post-test and the follow-up stage, which indicates that the effect of Captain Log's cognitive intervention on problem solving, planning, simultaneous processing and successive processing do not decrease significantly in the long run. The average attention in pre-test is less than post-test, which indicates that Captain Log's cognitive intervention has a significant effect on increasing attention. However, there is no significant difference between the mean of pre-test and post-test, which indicates that the effect of instructional intervention is not maintained in the long run. Also, there is no significant difference between the mean of the post-test and the follow-up stage, which indicates that Captain Log's cognitive intervention cannot significantly increase attention in the long run.

**Table 5.** Comparison of Verbal Problem Solving in the Three Stages of Evaluation with Captain Log Cognitive Intervention

| Variable | Time 1 | Time 2 | Average difference | SD | Sig. |
|---|---|---|---|---|---|
| Verbal problem solving | Pre-test stage | Post-test stage | -6.25 | 0.60 | .001 |
| | | Follow-up stage | -6 | .61 | .001 |
| | Post-test stage | Follow-up stage | .25 | .14 | .31 |
| planning | Pre-test stage | Post-test stage | -4.19 | .48 | .001 |
| | | Follow-up stage | -4.44 | 0.59 | .001 |
| | Post-test stage | Follow-up stage | -.25 | .23 | .89 |
| attention | Pre-test stage | Post-test stage | -1.19 | .29 | .003 |
| | | Follow-up stage | -.81 | .40 | .18 |
| | Post-test stage | Follow-up stage | .38 | .22 | .32 |
| Simultaneous processing | Pre-test stage | Post-test stage | -6.25 | .60 | .0001 |
| | | Follow-up stage | -6 | .61 | .0001 |
| | Post-test stage | Follow-up stage | .25 | .14 | .31 |
| successive processing | Pre-test stage | Post-test stage | -4.19 | .48 | .0001 |
| | | Follow-up stage | -4.44 | .59 | .0001 |
| | Post-test stage | Follow-up stage | -.25 | .23 | .89 |

According to the table 6, the results of intra-group test show that the method of CSI & MSI on verbal problem solving, planning, attention, Simultaneous processing and successive processing with ETA squares, respectively, can be .78, .77, .24, .88 and .46 are effective. Due to the significance of the test results within the group, in order to know the location of the difference, a two-by-two comparison of the evaluation steps is given in Table 7.

**Table 6.** The Impact of CSI & MSI on Students' Verbal Problem Solving and Components of Cognitive Functions

| *Variable* | Source Effect | Total Squares | Df | Mean Squares | F | Sig. | Eta |
|---|---|---|---|---|---|---|---|
| *Verbal problem solving* | Evaluation stage | 94.53 | 1 | 94.53 | 54.60 | .0001 | .78 |
| | Error | 25.96 | 15 | 1.73 | | | |
| *planning* | Evaluation stage | 107.53 | 1 | 107.53 | 54.99 | .0001 | .77 |
| | Error | 42.96 | 15 | 2.86 | | | |
| *attention* | Evaluation stage | 7.03 | 1 | 7.03 | 4.69 | .04 | .24 |





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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Error | 22.45 | 15 | 1.49 | | | |
| *Simultaneous processing* | Evaluation stage | 124.03 | 1 | 124.03 | 112.97 | .0001 | .88 |
| | Error | 16.46 | 15 | 1.09 | | | |
| *successive processing* | Evaluation stage | 5.28 | 1 | 5.28 | 12.73 | 0.003 | 0.46 |
| | Error | 6.22 | 15 | 0.41 | | | |

**Table 7.** Comparison of Verbal Problem Solving in the Three Stages of Evaluation with CSI & MSI

| Variable | Time 1 | Time 2 | Average difference | SD | Sig |
|---|---|---|---|---|---|
| Verbal problem solving | Pre-test stage | Post-test stage | -3.75 | 0.35 | .0001 |
| | | Follow-up stage | -4.44 | 0.47 | .0001 |
| | Post-test stage | Follow-up stage | .31 | .22 | .52 |
| Planning | Pre-test stage | Post-test stage | -4.56 | .56 | .0001 |
| | | Follow-up stage | -4.43 | .60 | .0001 |
| | Post-test stage | Follow-up stage | 0.13 | .22 | .99 |
| attention | Pre-test stage | Post-test stage | -1.37 | 0.29 | .001 |
| | | Follow-up stage | -.94 | .43 | .14 |
| | Post-test stage | Follow-up stage | .43 | .23 | .15 |
| Simultaneous processing | Pre-test stage | Post-test stage | -3.56 | .26 | .0001 |
| | | Follow-up stage | -3.93 | .37 | .0001 |
| | Post-test stage | Follow-up stage | -.38 | .25 | .49 |
| successive processing | Pre-test stage | Post-test stage | -1.06 | .21 | .0001 |
| | | Follow-up stage | -.81 | .23 | .008 |
| | Post-test stage | Follow-up stage | .25 | .11 | .12 |

According to the results of Table 7, the average of problem solving, planning, simultaneous processing and successive processing in the pre-test is less than the post-test, which shows that the intervention of CSI & MSI has a significant effect on increasing these components. Also, the average of problem solving, planning, simultaneous processing and successive processing in the pre-test is less than the follow-up stage, which indicates that the impact of educational intervention is maintained in the long run. However, there is no significant difference between the mean of the post-test and the follow-up stage. This indicates that the effect of CSI & MSI on problem solving, planning, simultaneous processing and successive processing has not decreased significantly in the long run. The average attention in the pre-test is less than the post-test, which indicates that the intervention of CSI & MSI has a significant effect on increasing attention. However, there is no significant difference between the mean of pretest and the follow-up, which indicates that the effect of CSI & MSI is not maintained in the long run. Also, there is no significant difference between the mean of the post-test and the follow-up stage, which indicates that the intervention of CSI & MSI could not significantly increase attention in the long run. In order to teach the two methods of CSI & MSI, Captain Log cognitive intervention on solving mathematical problems and cognitive functions of paired t-test using Gain Score technique (deducting

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post-test score from pre-test in each intervention method and then taking paired t-test from Two averages) are used. The table below shows the results of this analysis.

**Table 8**. Comparison of the effect of two methods of CSI & MSI and cognitive intervention on students' verbal problem solving and cognitive functions

| Variable | Intervention method | Average | SD | Average difference | T | Df | Sig. |
|---|---|---|---|---|---|---|---|
| Verbal problem solving | Cog-intervention | 3.75 | 1.39 | 2.50 | 3.12 | 15 | .007 |
| | CSI & MSI | 6.25 | 2.41 | | | | |
| Planning | Cog-intervention | 4.56 | 2.22 | .37 | .63 | 15 | .54 |
| | CSI & MSI | 4.19 | 1.90 | | | | |
| Attention | Cog-intervention | 1.37 | 1.14 | 0.19 | .56 | 15 | .58 |
| | CSI & MSI | 1.18 | 1.16 | | | | |
| Simultaneous processing | Cog-intervention | 2.18 | 1.16 | 1.37 | 3.22 | 15 | .006 |
| | CSI & MSI | 3.56 | 1.03 | | | | |
| successive processing | Cog-intervention | 1.06 | .85 | .13 | .62 | 15 | .54 |
| | CSI & MSI | .93 | .77 | | | | |

As the results of Table 8 show, the difference between the mean of the two methods of CSI & MSI and Captain Log's cognitive intervention on solving the verbal problem and simultaneous processing of students is significant. Thus, the difference between the mean of pre-test and post-test of the method of CSI & MSI in the variables of verbal problem solving and simultaneous processing is greater than the difference between the mean of pre-test and post-test of Captain Log. This difference is significant at .007.

## Discussion

The aim of this study is to compare the effectiveness of CSI & MSI and Captain Log cognitive intervention on cognitive functions and verbal problem solving in students with special learning disabilities in mathematics. The results confirm the effectiveness of both types of interventions, namely CSI & MSI and Captain Log's cognitive intervention on cognitive functions (PASS) and verbal problem solving, in students with MSLD. However, the results of the analysis of the findings show that CSI & MSI can have a greater impact on cognitive functions and verbal problem solving in these students.

The results show that CSI & MSI is effective on solving verbal problems in students with MSLD. This finding is in line with the studies of Desoete and De Craene (2019) and Gascoine, Higgins, and Wall (2017). Mohammad Aria et al. (2012) also show that CSI & MSI can have a positive effect on verbal problem solving. This instructional package combines cognitive and metacognitive components with an emphasis on the turning points of the theories of PASS, Sweller, and Vygotsky and provides a comprehensive and interactive view of solving a mathematical verbal problem. Math problem solving involves several cognitive processes that students need to understand and integrate problem information, produce and maintain mental images of the problem, create an appropriate solution, and calculate

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answers. Sweller (2016), the founder of Cognitive Load Theory (CLT), considers common problem-solving approaches in mathematics instruction to be ineffective, because the cognitive burden of working memory is so severely burdened by new cognitive operations that the student becomes involved in the problem-solving process. As a result, new information cannot be transferred to long-term memory, hence, learning does not happen (Treffers, 2019). Therefore, it suggests that student's involvement in learning and teaching process is in accordance with their cognitive abilities. In addition to emphasizing active student learning, Vygotsky emphasizes environmental factors as well as the role of teachers and smarter students in creating the capacity for better learning. Vygotsky, on the other hand, in the concept of scaffolding, first suggests that the learner should be guided by the teacher so that the learner assumes a small share of the responsibility. Gradually, as the learning progresses, the responsibility is fully transferred to the learner. Therefore, in this process, the student will gain more skills and abilities in problem solving. Doing students' independent activities requires a combination of cognitive and metacognitive skills. The combination of metacognition and cognition based on attention to self-talk, monitoring and questioning can help the cognition, and ultimately facilitate the possibility of learning and problem solving for students. Metacognition, by strengthening thinking about cognitions, allows for a better evaluation of the problem and solutions to achieve the answer and solution of the mathematical problem. And it seems logical that combining metacognitive and cognitive strategies will lead to improved math problem-solving skills in students with math disabilities.

The results also show that students who are exposed to the instructional package of CSI & MSI in terms of attention score as a cognitive function, perform better in the post-test and follow-up than the pre-test. This finding is consistent with the studies of Melby-Lervåg et al. (2016) and Jane, Burnett, and Sit (2018) Given that cognitive processes are the main building blocks of intelligence function (Naglieri, 1999). This novel result suggests that brain function can be affected with appropriate training. According to Naglieri and Das (1987), each form of conscious activity is always a complex functional system and is performed through the combined function of the cognitive functions of the pass, each of which has its share. Planning as the first cognitive function is the ability to execute regular, purposeful and consecutive actions according to the future goal, which is essential for the orderly and accurate execution of actions (A. H. Meltzer, 2010). Planning is a person's ability to create, monitor, and modify a program, and the anterior lobes of the brain regulate it (Taddei & Contena, 2017). With the educational package's inclusion of seven cognitive strategies and three metacognitive strategies, the student acquires the skill of planning and monitoring his academic progress with the help of teacher facilitation and reminder cards. And metacognitive strategies contribute to a range of student executive functions, such as attention, control, checking, scheduling and error detection performance. Attention, as the second cognitive function, is the ability to focus cognitive activity on specific stimuli, and it prevents reaction to competing stimuli. checking is an important feature of strengthening attention, which is focused on the cognitive and metacognitive strategies training package. Also, in explaining this finding, it can be said that the level of learners' attention to the subject of the lesson is one of the main factors in teaching and learning, so that Bandura emphasizes that the initial stage of any learning begins with attention.

Attention Deficit Disorder is one of the main nuclei of learning disabilities, especially mathematical disabilities. In the students' discussion training package, the seven cognitive stages, the three metacognitive stages for each of the cognitive stages and the facilitation and guidance of the teacher based on Vygotsky's approach and teaching in accordance with Sweller theory of cognitive load increase attention. Simultaneous processing, as the third cognitive function, is a mental process that, after specific stimuli have been identified with a common feature, integrates individual stimuli into a general unit, making words understood as a unified text. In fact, a high percentage of students with learning disabilities have low performance in the integrated information processing factor. Cognitive Imaging and Hypothesis Strategies and Metacognitive Strategies, the self-talk and Strategy Training Package review allow the integration of information that improve the cognitive function of concurrent processing. Sequential processing as the fourth cognitive function means combining stimuli in a specific order (Das, Misra, & Kukreja, 2009). Consecutive processing involves organizing a chain of sounds, such as learning the sounds behind the head and reading. The strategy training package, at the formal level, is a structured and step-by-step process in which, based on the concept of Vygotsky, scaffolding students are first guided by the teacher, then solving problems in groups, and eventually he encourages students to learn. On the other hand, at the content level, cognitive and metacognitive stages are developed, leading to the strengthening and improvement of the cognitive function of sequential processing.

According to the results of the analysis of the findings, Captain Log's cognitive intervention is effective in solving verbal problems in students with special learning disabilities. In this regard, it can be said that children with special learning disabilities show one or more basic psychological processes in relation to understanding or using oral and written language. Manifestations of this disability may include impaired listening, thinking, speaking, reading, writing, and arithmetic. Some theorists attribute learning disabilities to cognitive problems caused by dysfunction of the brain and central nervous system, the inability to copy geometric designs, the lack of understanding of similarities and the inability to recognize and solve problems. They mention the indicators of perceptual defects, because in all these cases, it is necessary for a person to receive information through the sense of sight and provide a suitable motor response (Najarzadegan, Nejati, Amiri, & Sharifian, 2015). So, due to the shortcomings that students have in the field of problem solving, the Captain Log software has 2000 different programs and tasks to improve the ability to solve problems. It can be said that the use of this software can greatly improve the shortcomings of these students in terms of problem solving ability.

Examination of the results of the analysis of the findings show that Captain Log's cognitive intervention is effective on the cognitive function of planning in students with special learning disabilities. This finding is in line with the studies of Poushaneh, Sharifi, and Motamed-Yeganeh (2015), Melby-Lervåg et al. (2016) and Jane et al. (2018), Captain Log software has different programs and tasks at different levels to enhance cognitive functions, and it includes a variety of exercises (selective accuracy, focused accuracy, continuous accuracy, parsed accuracy and attention shift), active memory, memory instant and short-term visual-auditory memory, visual-auditory processing speed, visual-auditory perception, sensory-motor coordination, hand-eye coordination improvement, visual processing, fine-motion

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control, problem-solving skills, executive functions, reaction speed logical reasoning, inductive and inferential reasoning, improve impulse control, mental integration, categorization and arrangement (arrangement) of visual and auditory and spatial intelligence.Explaining this finding, it can be said that since planning is the ability of an individual to create, a program’s change and the anterior lobes of the brain regulate it (Taddei & Contena, 2017). It seems that cognitive interventions such as Captain Log's cognitive program can improve brain function. Captain Log programmatic exercises with experience-dependent formulation and spontaneous and directed improvements, gradually it brings about structural and functional changes in the neurons responsible for executive functions (the principle of neuroplasticity) and their long-term effects. This program improves the cognitive function of planning by its ability to evaluate and intervene intelligently, its proportion to the level of individual ability and adjustment the level of difficulty of the task from simple to difficult. The cognitive function of attention also selectively processes some events and ignores others. Conscious focus of the organ seems to be essential and the brain can only focus on limited subjects at a time so that it can focus on task-related stimuli. In general, it can be concluded from the present finding that the improvement in attentional function after Captain Log's cognitive intervention indicates changes in the nervous system that can be based on the hypothesis of brain plasticity due to neuropsychological exercises of cognitive intervention. In fact, Captain Log rehabilitation exercises in the form of hierarchical, multi-stage, attractive computer programs can enhance the attention of students with special learning disabilities. In cognitive functions, simultaneous and sequential processing combines stimuli into a perceptual or conceptual set and places stimuli in a specific series. These types of processing of executive functions are associated with parietal, temporomandibular, and posterior fragments behind the central groove of the brain (Taddei & Contena, 2017). And Captain Log's cognitive intervention seems to be a form of brain function. In Captain Log software, exercises for visual and auditory processing speed, sensory and motor coordination, hand-eye coordination improvement, visual processing and fine movement control, spatial intelligence, mental integration, visual classification and arrangement, and auditory are intended to reduce the problems in these areas. Also, due to the innovation in the type of training, its attractiveness, the involvement of both cerebral hemispheres and reward system of this software, the Log motivates the student to go to higher levels and understand better use of your visual-space. Therefore, it can be said that the use of this software can greatly address the shortcomings of students in terms of the ability to process simultaneously and sequentially (Royatvand & Amiri, 2018).

The results showed that the training program of cognitive and metacognitive strategies in solving the mathematical verbal problem is significantly different from the intervention of Captain Log. This finding is in line with the studies of Desoete and De Craene (2019) and Gascoine et al. (2017). Mohammad Aria et al. (2012) also showed that cognitive and metacognitive skills can have a positive effect on problem solving. Determining the contribution of cognitive, emotional, and metacognitive strategies to the performance of solving mathematical verbal problems, they concluded that metacognition plays a more fundamental role in solving mathematical verbal problems; Because the learner can rely on metacognitive skills to monitor their current knowledge and skill level, evaluate and limit their limited

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learning resources. many believe that cognitive interventions in the absence of education in academic skills do not lead to improved reading, writing, and mathematics (Melby-Lervåg et al., 2016). Captain Log software ignores face-to-face and flexible training, environmental learning, and even metacognitive skills, while the cognitive-metacognitive training package takes a multi-dimensional look and considers a variety of skills and factors. These factors facilitate problem-solving skills in a variety of ways. The main feature of this educational package is engaging and active learning (Vygotsky, 1978) which enables the student to develop understanding and flexibility to succeed in solving mathematical verbal problems (Montague et al., 2014). Cognitive intervention (Captain Log software) emphasizes cognitive effectiveness and lacks teacher facilitation conditions that increase the external cognitive, which is a burden on the student's working memory. Sweller (2016) questions the mere emphasis on cognitive activities in solving mathematical problems and believes that active learning and reducing cognitive load can improve learning. Paying attention to metacognition in addition to cognitive issues as well as the presence of the teacher facilitator can lead to more active and effective learning than purely cognitive education, and it seems logical that teaching cognitive and metacognitive strategies has a stronger effect than Captain Log's curriculum.

The results show that the training program of cognitive and metacognitive strategies in the functions of attention, planning and sequential processing, is not significantly different from the intervention of Captain Log. But in cognitive function of simultaneous processing, the training program of cognitive and metacognitive strategies is more effective than Captain Log intervention. Simultaneous processing combines the type of individual processing of stimuli into a perceptual or conceptual set, and it is seen as a coherent whole for categorizing information or grouping it. In this type of processing, the individual combines the stimuli into a perceptual or conceptual set. Cognitive interventions emphasize understanding and examining the problem from different dimensions, and metacognitive interventions refer to any cognitive knowledge or process in which there is cognitive evaluation, monitoring, or control (Baird, Smallwood, Gorgolewski, & Margulies, 2013; Flavell, 1979). In fact, metacognition is considered as a general aspect of cognition that plays a role in all cognitive activities. In other words, the combination of cognitive and metacognitive strategies leads to a holistic and comprehensive view of stimuli in a perceptual set that ultimately leads to improved problem solving. Sweller (2016) also takes a holistic view of cognitive theory and considers mere attention to cognitions to be ineffective. This combination of metacognition and cognition can improve the function of simultaneous processing. In fact, a high percentage of students with learning disabilities have low performance in the information processing factor. Therefore, teaching cognitive and metacognitive strategies has an effect on the simultaneous processing of information and better understanding of the texts of students with special learning disabilities. that one of the conditions for performing a complex cognitive task, such as understanding a text, is the ability to memorize and process information that depends on working memory. Using explicit and direct teaching methods in accordance with Sweller (2016) theory of cognitive load and using the concept of Vygotsky scaffolding, the least amount of external cognitive load is imposed on working memory, in addition to this training package and memory cards based on

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the concepts of theory Compiled by Vygotsky; The optimal maximum load is generated. As a result, the efficiency of this memory for simultaneous processing increases. Lack of attention to metacognition is the main weakness of cognitive intervention using Captain Log. In the process of educational intervention of cognitive and metacognitive strategies, students are encouraged step by step to be able to simultaneously obtain a new picture of the overall processing of the process through imaging and metacognitive strategies and to combine the necessary cognitive strategies. Students in the package of cognitive and metacognitive strategies that require the use of different capabilities such as metacognition and environmental factors that facilitate learning, show better performance in the cognitive function of simultaneous processing than Captain Log's cognitive intervention. These results are consistent with the findings of Fletcher and Miciak (2017), that indirect cognitive interventions are indirect and affect the cognitive functions and consequently on academic performance. But since the cause-and-effect relationship between cognitive and academic weakness is not clear, it is better to focus on education. The results of this study also point to the greater effectiveness of educational intervention than cognitive intervention on academic performance.

In general, it can be concluded that the cognitive and metacognitive strategic package, based on Vygotsky and Sweller (2016) theories, has a positive effect on improving cognitive functions and solving math verbal problems in students with special math learning disabilities.

In the present study, due to the limitations of Covid 19 and the time of students' attendance at school, it is not possible to implement a second follow-up course to evaluate the continuation of the effectiveness of education. Also, due to Covid 19's limitations and the number of students with special math learning disabilities, generalizing the results needs attention.

In general, based on the results of the research, the following suggestions are made:

- The training package developed in different groups with various problems to be implemented to increase the generalizability of the training program to review the content and training methods used.
- The training package should be used in in-service education courses.
- The strategy training package should be examined on more cognitive functions to increase its generalizability in the field of brain-based learning. Researchers are advised to apply this intervention to other groups of learning disabilities (reading and writing learning disabilities).

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