The Effect of CogmedComputerProgram on Working Memory and Spelling in Girl with Disability Learning

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Abstract

The scope of this current research is to study the effect of cogmed program on working memory and spelling disorder. the method of this research is experimental with pre-test and post-test, with controlling group.Statistical societywere in third grade elementary school in Yazd and they had referred to the learning disorder centers. The sample size in this research is 30 persons, which randomly 15 persons were placed in the experimental group and 15 persons in the controlling group. The data obtained from the spelling tests, the subtests of width extension of digits of Wechsler scale 5 (auditory assessment of working memory), Kartoldi test (visual-spatial assessment of working memory), were analyzed by MANOVA method.According to the results between the average scores of the experimental and controlling group, there are significant difference. The effect of Cogmed program on working memory, are confirmed.

Key words: Cogmed program, spelling. Memory. Girls, yazd city

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Introduction

Memory is a complex system that have influenced on all human behaviors. For this reason this subject can be studied and reviewed in different sciences, and this subject can be discussed in different aspects such as medical, psychology, educational psychology, learning psychology, teaching, curriculum programming(Beckmanon,et al., 2007). Premuzic&furnham (2003) argue that memory has akey role in learning activities and academic achievement, especially during school years and in general after those years.

Nowadays, educational psychology knows that learning is the product of using the correct and optimize of working memory (Baddeley, 2002). Working memory refers to the storing ability and temporary manipulation of information to a mental position (Robertsea al., 2011).Working memory is strongly related to the reading, writing. Literacy and computational skills (Thomson&Gathercole, 2006), and the children who are entered in to school by weak working memory, it is hard to be active in learning the reading, writing, mathematics and science in expected level (Gathercoleet al., 2003), learning disabilities are psychiatric-Nervous disorders in them a person by having natural intelligence has difficulties in one or more transformational or educational back-grounds.

These kinds of disabilities can generally be divided into two groups : academic disabilities and transformational disabilities .The academic disabilities are as follow: disability in reading, mathematic,

and written expression, and transformational learning disabilities are as follow: insufficiency in attention and perception, memory disorders, perceptual-motor deficits, language and intellectual disorders (Swanson& Siegel, 2011).Neurological studies show that the students with learning disabilities have difficulties in different learning homework such as memory, attention and the relations between objects.Neurological assessments explain and show the existence of the relation between neurological structure and different kinds of related assignment to the learning (ShokohiYekta&Parand, 2010). Different studies show that children with learning disabilities have many problems in executive functions (Smith-Spark&Fisk,2007). Writing expression needs executive functions and need to the writing skills which are related to the high level of executive functions (Nathaan, 2009). Writing needs to the executive functions of working memory, sustained attention, inhibit response,self-monitoring andplanning (Clikeman-Semrod&Elison, 2009). Hooper etal., (2002) had studied the role of executive functions of working memory and organizing in the writing.Kelag (2001) argued that all the processes of writing need to working memory, especially these two verbal and executive components of this memory.

Working Memory & Computer Programs

According to the important role of working memory, there are some learning in relation of improving these functions in the children who have difficulties in them, including the

children with disabilities in learning design (Kling Berge et al., 2002;Klingberg etal., 2005). The studies, too, show that the capacity of working memory can increase and improve by education (Oryadi, et al. 2019). Olesen, et al. (2004) have found that the activity of the brain by working memory in relating to working memory is increased by educating in this memory.In general, it can be said, that training in working memory, can be used as therapeutic intervention factor on the people by the low workingmemory which is the limiting factor for academic performance of these kinds of people (Kinkbreg, 2010). Graham, & Harris (2003) in their research, have achieved to this result that educational and therapeutic interventions have more influence on improving learning disorders in reading. The studies show that, there are significant evidence, based on this subject that training of executive functions has positive and strong influence on writing skili and ability of the children, too (Maltzer, 2007). All the researches, completely show that the capacity of the working memory is increased by training (Costaet al., 2015; Reet al., 2015; Swanson, 2015;Cornoldiet al., 2017).

Research on working memory and its upgrade by using different programs become the focus of many researchers. One of the orientations in the field of working memory is using from computer programs that in this regard can name or refer to the program Brain ware safari, the Jungle memory program, Coglab program, Robomemo program and Cogmed program. Cogmed is an educational approach for improving the

working memory and for accuracy and reinforcement of executive function and this approach will be exploited in categories, this research. This program is introduce in there preschool group package, elementary group package and adult group package.

Training in this program include an special setting of working memory activities which are done on computer in school, home, or the place where the user choose. The difficulty level is set according to an special and very sensitive algorithm. Each trainee must do everyday, and every session that is lasted 30 or 45 minutes. This program is set for 5 days aweek and it is set for more than 5 weeks (Cogmed.com, 2016). According to the neuro-science findings that indicate the flexibility of the brain areas which include working memory capacity. An innovation from Karolinska Institute had been appeared that shows the working memory, actually, can be taught in order to process the information more and better.

Cogmed Working Memory Program

These discoveries were the basis that the teaching of Cogmend working memory program was created (Klingberg et al.,2002; Westerberg &Kilingberg, 2002). This program challenges the trainee working memory. Computer and cognitive exercises which are designed by neuroscientists in order to target this key cognitive function that is fundamental for function and executive attention. The details of designing the exercise allow this program to be focused, and at same time present few change. Therefore, the method of teaching based on computer is an effective training

method to strengthen the working memory and to improve the spelling performance.Thedone researches confirm the effect of Cogmed program. Roording-Ragetlie et al. (2016) during their research in memory training of children, working memory with neuro-developmental disorders use the Cogmed program, too. Otterson&Gril (2015) during their study the advantages of developing and adjusting the level of difficulty in computer cognitive training of children with mental disabilities, have used the Cogmed program. The result of their research showed that children who received simpler homework, make more meaningful improvement in verbal working memory tasks than those children who have done more homework, Donk et al. (2015) in studying "cognitive training for the children with hyperactivity", used a controlled randomized trial of Cogmed working memory training and attention in class by help of Cogmed software. Halmz etal.(2015) in doing their research, in order to improve the working memory of the students by low verbal abilities, had used the Cogmed program. The results showed that intensive working memory exercise can improve the verbal abilities. Roche & Johnson (2014) examined the product of Cogmed working memory training. The results of this research highlighted this subject that the Cogmed program has the potential to help persons to improve their working memory and focused attention. Akerlund et al.(2013) in their research under the name of "Does computer working memory improve working memory, cognition and mental health?" come to this conclusion that the Cogmed working memory curriculum can improve the working memory, cognition, and mental health. Dahlin (2013) in studying the working memory training and its effect on the student math success with the attention deficiency and special needs in order to train working memory has used the Cogmed program. Holmes et al. (2007) had used from the Cogmed program for overcoming on the common disorders in working memory and learning difficulties related to working memory in 10 years old children. They made different suggestions for exercise which include temporary storage of spatial-visual information and verbal information or both of them for 5 to 7 weeks. Most chilldrenwho have completed this program, could have significantly improve their working memory and 6 months after the test, asignificant increase in their mathematical performance was found.

Purpose of This Study

According to what was said about the importance of working memory and the important of its role in the field of learning and learning disorders, it is clear that the children need serious helps.According to the important and new role of Cogmed program in this regard and according to this fact there have not done any research in relation to the role of this program about spelling function, the purpose of the current research is the effectiveness of Cogmed method on the working memory and spelling function in order to show the effect of this program in these subjects.

Method

Sample

In terms of methodology, conducting the research is in the group of experimental researches with pretest or post-test by controlling group. The statistical society of this research includes all the female students who have spelling disorder and they were in third grade elementary school in Yazd and they had referred to the learning disorder centers in this city. The sample size in this research was 30 persons, and they were randomly put in to a15 persons of experimental group and 15 persons in the controlling group.In this research because of being limited the sample size of statistical society, all of these students were selected in large numbers but selecting the students in experimental and controlling groups were done randomly.

Instruments

Spelling test:this test was prepared by Karimi (2014). This test has 50 words which had been prepared for Persian language, was based on the book of "Reading" from third grade elementary school for persian's students. Test reliability based on Cronbach's alpha has reported 0/98. In order to determine the validity, have been used from the method of determining the validity, have been used from the method of determining the group differentiation and cutting point and the power of differentiation between normal students and those who suffer from spelling disorders, the results had been 18.18 for normal group and 4.96 for spelling disorder group. The cutting point has obtained 13.40

that show the durability and validity of the test had been acceptable. In this test, every student can get a score between 0-20.The reliability coefficient of this test was reported to be 0.89 by retest method(Aghababaei et al., 2010).

Memory Expansion Test:subtest from Wecsler scale (Auditory assessment of working memory): the fourth version of Wecsler memory scale were translated in Iran &published and it was adapted and standardized in Iran.This scale has ten subtests, that in current research, has been used from this cultivar subtest from Wecsler in order to assess the working memory. This subtest includes forward, backward. Reliability in this scale was 0.83fot both forward & backward. In addition, there was a significant difference in the distinction between the memory of normal children and children with symptoms of hyperactivity (Daneshvar et al., 2018).

Carnoldy test(visual-spatial measurement of working memory): This test is known as working memory matrix, and it was designed by Rigoni et al. (1988). The end of the test is obtained bused on the calculation of Cronbach's coefficient 0.78, In this test a 3.3 matrix is used, that only square on theleft in the bottom is red. The red square is considered as the starting point. From the students who are under the test, requested to look at the matrix very carefully and save it in their memories. Then they are told to listen carefully to the instructions given to them by the examiner to the right, left, down and up. And based on these instructions they try to move the red

square in to the matrix, and at the end of the instruction that require moving in the matrix, the examiner told them to show the box that the red square has been moved there. There test is performed three times. And each time is made of 6 instructions. The score of each test based on the achievement in this stage is calculated. For every achievement stage score 1 is considered. Generally, every student under examination will get the score between 0-3 (Azizian et al., 2017).

Design

In the pre-test stage, working memory and spelling tests from all the participants were taken during 2 weeks. All the students were randomly placed in two training group with software and controlling group. In this research, experimental groups were trained on computer working memory for 5 weeks and 5 times a week. The difficulty level of the assignment was such that as the skills of subjects (students with spelling problem) developed, the assignments become progressively more difficult. The second group who were placed in controlling group, will use special training in the conventional way in learning disorder centers. All the training sessions were controlled and managed by the researcher. Finally, the intervention program was once again taken from the students in order to test the effectiveness of independent variable in improving the capacity of working memory and spelling disorder as a working memory assessment test and diagnostic training for spelling disorder. The method of holding the exam was in accordance with the way of

working post- test.The obtained data were analyzed by the MANCOVA& MANOVA analysis's methods in the version 23 Spss software (version 23, IBM corporation Armonk, Ny).

Results

Examining the Assumptions & descriptive Results

In order to perform covariance analysis, the assumptions of variance homogeneity, linear regression slope, multi-collinearity and regression slope homogeneity were examined and because all the assumptions were not met, specially regression slop homogeneity as the important assumption were regected, $F(2,27) = 221.515$, MSE $= 84.202$, p<.001. In order to study the effectiveness of Cogemed program on the spelling performance and working memory, the MANOVA analysis was done. According to the table-1, post-test scores if the working memory and spelling performance in relation to pre-test of working memory and spelling performancescores have been increasingly steadily.Scores in Cogmed experimental group in pretest was (M = 7.88, SD = .306) and in posttest was (M = 11.80, SD = 1.37). Scores in control group in pretest was (M = 7.46, SD = .99) and in posttest was (M = 7.53, SD = 1.06). Scores in spelling experimental group in pretest was (M = 13.33, SD = 1.79) and in posttest was (M = 16.53, SD = 1.88). Scores in control group in pretest was (M = 13.60, SD =1.40) and in posttest was (M = 13.86, SD = 1.40) (tabe 1).

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Table1

Mean and standard deviation of the Working memory and spelling scores in two groups Of research, before and after training

Variables group		N	Mean	Std. Deviation	Std. Error Mean
Memory pretest	experiment	15	7.8667	1.18723	.30654
	control	15	7.4667	.99043	.25573
Memory Post test	experiment	15	11.8000	1.37321	.35456
	control	15	7.5333	1.06010	.27372
spelling pretest	experiment	15	13.3333	1.79947	.46462
	control	15	13.6000	1.40408	.36253
spelling Post test	experiment	15	16.5333	1.88478	.48665
	control	15	13.8667	1.40746	.36341

Note: Mens& SD in experimental Cogmed. Experimental spelling and control groups in pre test&post test. Results showed that difeerence between pre tests and post tests in experimental groups were bigger than control group.

The results, show that the homogeneity of the errorvariances assumptions are observed for pretest and post test in working memory and spelling. $F(1,28) = 1.260$, $p<. 271$, for posttest working memory, $F(1, 28) = .355$, $p<. 556$, for pretest working memory, $F(1,28) = .921$. $p<. 345$, for pretest spelling and $F(1,28) = 1.973$, $p<. 171$ for posttest spelling (table 2).

Table 2. Assumption of Equality of error variance

Levene's Test of Equality of Error Variances[a]				
	F	df1	df2	Sig.
Post t. working memory	1.260	1	28	.271
Pre t. working memory	.355	1	28	.556
Pre t. spelling	.921	1	28	.345
post. spelling	1.973	1	28	.171

Note: Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + group

Statistical Effectiveness Report

Multi variate test showed that Pillai's trace, Wilks Lambda, Hotelling trace and Roy's largest Root with F(121.319, p<.001) were significant(table 3). Table3. Multivariate test for effectiveness Cogmed

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.990	597.274[b]	4.000	25.000	.000
	Wilks' Lambda	.010	597.274[b]	4.000	25.000	.000
	Hotelling's Trace	95.564	597.274[b]	4.000	25.000	.000
	Roy's Largest Root	95.564	597.274[b]	4.000	25.000	.000
group	Pillai's Trace	.951	121.319[b]	4.000	25.000	.000
	Wilks' Lambda	.049	121.319[b]	4.000	25.000	.000
	Hotelling's Trace	19.411	121.319[b]	4.000	25.000	.000
	Roy's Largest Root	19.411	121.319[b]	4.000	25.000	.000

a. Design: Intercept + group
b. Exact statistic

Therefore, it can be concluded that at least one of the experimental groups is significantly different from the control group. The continuation of the analysis showed that there are significant differences in the post-test of Cogmed group and spelling.F(1,28) = 90.734, MSE = 136.533, p<.oo1 for between control and Cogmed groups in post working memory. F(1,28) = 19.277, MSE = 53.333, p<.001 for between control and Cogmed groups in post spelling(table 4).

Table 4. Test of Betwwen groups comparisions

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Post t. working memory	136.533[a]	1	136.533	90.734	.000
	Pre t. working memory	1.200[b]	1	1.200	1.004	.325
	Pre t. spelling	.533[c]	1	.533	.205	.654

	post. spelling	53.333^e	1	53.333	19.277	.000
Intercept	Post t. working memory	2803.333	1	2803.333	1862.975	.000
	Pre t. working memory	1763.333	1	1763.333	1475.299	.000
	Pre t. spelling	5440.533	1	5440.533	2088.687	.000
	post. spelling	6931.200	1	6931.200	2505.253	.000
group	Post t. working memory	136.533	1	136.533	90.734	.000
	Pre t. working memory	1.200	1	1.200	1.004	.325
	Pre t. spelling	.533	1	.533	.205	.654
	post. spelling	53.333	1	53.333	19.277	.000
Error	Post t. working memory	42.133	28	1.505		
	Pre t. working memory	33.467	28	1.195		
	Pre t. spelling	72.933	28	2.605		
	post. spelling	77.467	28	2.767		
Total	Post t. working memory	2982.000	30			
	Pre t. working memory	1798.000	30			
	Pre t. spelling	5514.000	30			
	post. spelling	7062.000	30			
Corrected Total	Post t. working memory	178.667	29			
	Pre t. working memory	34.667	29			
	Pre t. spelling	73.467	29			
	post. spelling	130.800	29			

Note:Multivariate analysis showed that for between effects only for post tests of working memory and spelling were significat.

It means that training with the computer method cause to improve spelling score and working memory. The results in table 5. Showed that difference between control group and Cogmed in working memory post test and spelling group weresignificat (p<.001).

Table 5. Pairwise comparision between groups

Pairwise Comparisons							
Dependent Variable	(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.^{b}	95% Confidence Interval for Difference^b	
						Lower Bound	Upper Bound
Post t. working memory	cogmed	control	4.346*	.321	.000	3.687	5.004
	control	cogmed	-4.346*	.321	.000	-5.004	-3.687
Post t. spelling	cogmed	control	2.886*	.219	.000	2.436	3.336
	control	cogmed	-2.886*	.219	.000	-3.336	-2.436

d

Note: Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Discusion

The current research was done with the purpose of studying the effectiveness of Cogemed program in the capacity of working memory and spelling performance of the third grade elementary students who suffered learning disorders in Yazd.The obtained results show that teaching with the Cogemed method cause to improve the working memory capacity. The result of this finding are alignment and similar to the research which have done by landquist et al. (2010), Holm et al. (2010), Oganand Hedvin (2011), Lahang et al. (2011), Gari et al. (2012), Bergman Nateli&clinkberg (2014), VenDengenBomesma et al. (2014), Reetz et al. (2016), Hardy et al. (2013), HermensonGranold et al. (2016), Pamkaha et al. (2017), tessy et al. (2013), latagenite et al. (2013), Dahline (2013), Rech&Jahson (2014), Aterson&Greel (2015), Dank et al. (2015), RpringRegtelli et al. (2016).

A'kerlund et al. (2013), in their research entitled: "Do computer teaching of working memory causes to improve working memory, cognition and mental health?" they come to this conclusion that Cogmed working memory teaching program can improve working memory, cognition, and mental health(Rocha and Johnson (2014). They studied the product of Cogmed working memory teaching program. The results of this research illustrate this point that the Cogmedprogram has the potentials to help persons to improve their capacity of working memory and focused attention.Holmes et al. (2009) used the Cogmed training program to overcome on the common disorder in working memory and learning problems related to the 10 years old children. They offered different suggestions for practices, including temporary storage of visual-spatial information, verbal information 5 or 7 weeks. Most children, who finished and complete the stages of this program, could significantly improve their working memory.

In explaining this hypothesis, we can say that the importance of the working memory in everyday life, and in learning and processing the data, it is obvious that the teaching of working memory is more important than ever. The improvement of working memory with Cogmed program is done by the change, in the activity of the brain performance (cogmed.ir). The tools such a Brain imaging or scanning (for example PET, MRI) that show the changed brain performance after the intervention of Cogmed program, specify that (a) there is a change in the chemical activity of the brain (Menab et al., 2009). (b) there is a good improvement in the activity performance related to the working memory (Olesen et al., 2004;Westberge, 2007;Brehmer et al.,

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2011;Stevens et al., 2015), (c)there is a functional connection durning rest (Astle et al., 2015). It claims that Cogmed program can improve the working memory capacity, is confirm and supported by 35 controlling studies.For the first time this hypothesis was confirmed by the studies of Clingberg et al.(2002,2005). Since then, some researches were independently and very carefully done all over the world and all of them confirmed this hypothesis. In doing meta-analysis of Cogmed researches in 2012 which include all the studies in the field of Cogmed up to that tome, have shown that, in average, the visual-auditory memory26%, verbal memory 23% in relation to controlling group have improved (Cogmed.com). Meta-analysis showed that improvement of working memory with Cogmed program have a great influence on the memory (d=1.8 in verbal memory and d=0.86 in visual-spatial memory). In doing meta-analysis by more than 100 studies (Weicker et al., 2016) in comparing with other working memory teaching program, the long term Cogmed effects is more than all the interventions. Therefore, the evidences show that the Cogmed program continuously causes to improve working, too. The results, too, showed that teaching with the Cogmed method caused to improve spelling score. The Cogmed program, sofar, has not directly been improving spelling function. But in explaining this hypothesis, it can be said that most of the researches has shown that teaching and the growth of executive function have the key roles in expanding the social, educational, capabilities and students

learning, especially those who have learning disorders (Sorel, 2007). This growth is related to the extensive background of the prefrontal cortex of brain, which include some process of cognition, self- discipline of the behavior, growth element of Cogmed, social and educational capabilities. These cognition capabilities include information storage in the working memory; inhibit response, sustained attention, goal pursuit. The correct growth and teaching of the executive functions have a key role in social growth and educational, academic success of the child (Freeman et al., 2013) and by the obtained findings of the research done by Clingberg et al. (2002), Slates Wehlms(2014), Dortag&Saadipoor(2017), TheCogmed program is effective in strengthening the working memory. Therefore, according to the role of Cogmed program in strengthening the visual-auditory memory, we can say that the Cogmed program by influencing on the working memory capacitycauses to improve the spelling function.

Limitation&Suggestions

Among the limitations of this research, it can be pointed out that the research relations were limited to the field of spelling, even in a particular degree. And because of time limitation and research possibilities, the ability to select a larger sample and include the boys group was not possible. Therefore, it is suggested in future researches, this research repent with different age groups or other educational degrees, in order to specify the effect of this program on other age categories. Due to the prevalence of

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working memory loss among student, it is suggested to hold workshops of Cogmed program for improving this field that can have positive effects on learning.

Conclusion

From a clinical point of view, these results showed that teaching with Cogmed program, can improve the working memory and spelling function. Because of the weakness in working memory can prevent the students to engage in educational programs, and because of the close relationship of working memory with educational success, the Cogmed program can be a useful tool for correcting learning disabilities, educational achievement and increasing the capacity of working memory.

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