



## EFFECTIVENESS OF AN EDUCATIONAL PROGRAM TO IMPROVE WORKING MEMORY AMONG STUDENTS WITH LEARNING DISABILITIES

Suhail Mahmoud Al-Zoubi

Department of Special Education, Najran University, Kingdom of Saudi Arabia  
[suhailalzoubi@yahoo.com](mailto:suhailalzoubi@yahoo.com)

Majdoleen Sultan Bani Abdel Rahman

Department of Special Education, Najran University, Kingdom of Saudi Arabia  
[Majdoleen77@yahoo.com](mailto:Majdoleen77@yahoo.com)

### ABSTRACT

This study aimed at measure the effectiveness of an educational program to improve working memory (WM) among students with learning disabilities (SLD). The sample of the study consisted of (57) SLD enrolled in the resource rooms at Najran, Kingdome of Saudi Arabia. The sample was distributed into two groups, control and experimental. The WM scale was developed and applied for both groups as pretest and posttest. The students of the experimental group joined an educational program to improve WM for two months. While, the students of the control group were not enrolled in the same program. The results revealed the effectiveness of the program on improving the WM in favor of the students in the experimental group.

**Keywords:** educational program, learning disabilities, working memory

### INTRODUCTION

As a result of the various problems that exhibited by SLD some experts in the field of special education have attempted to classify learning disabilities in order to facilitate the process of studying. This phenomenon suggests diagnostic methodologies and solutions for each group, since the method that succeeds with one group with learning disabilities may not succeed with other groups. The experts find numerous ways to classify learning disabilities. In fact, there are more than one classification systems for learning disabilities (Gregg & Mather, 2002). Some the SLD display one academic learning disabilities, such as mathematics, reading, or writing. However, others display multiple academic learning disabilities accompanied by Attention Deficit Hyperactivity Disorder (ADHD) leading to the complication of their academic problems and making them more difficult (Bryant, Bryant & Hammill, 2000).

Learning disabilities can be classified based on the nature of the problems into two types: the developmental and the academic learning disabilities. The developmental learning disabilities include disorders in attention, memory and perception. These groups of capabilities are considered the essential requirements for the learning process, whereas, the academic learning disabilities contain reading, writing and arithmetic (Smith, 2004; Lerner, 2003). Memory and learning include cognition, which is our capability to reason. Memory is the center of the cognitive processes and their core which affect all the cognitive processes (Bandura, 1993; LaBar & Cabeza, 2006). Moreover, the cognitive processes are related to perception and attention and any disorder in perception or attention or both will directly affect the competency of the memory (Chepenik, Cornew & Farah, 2007). According to Gathercole and Alloway (2008) the students with high the WM scores usually demonstrate excellent reading skills. On the other hand, the students with relatively poor WM scores tend to achieve average levels on the reading skills.



Memory is considered an important factor in the learning process since learning on the human part is conducted through experiencing specific experiences stored in the memory until it is used in similar situations (Alloway, 2009). Memory disorders include auditory and visual disorders. The students who have auditory and visual difficulties will have difficulty in learning to read. Furthermore, auditory memory deficiency may lead to deficiency in the child's language development, (Kirk, Gallagher, Coleman, & Anastasiow, 2009).

However, the Information Processing Theory interpreted the learning process and memory. The information the human receives passes through what is called Sensory Register, such as the eyes and the ears. If this information doesn't go through any processes, it will be lost but if the attention is given, it will be transferred to the short-term memory where it will be kept for a short time before being lost or transferred to the WM where new information is connected to it and to the information already in the long-term memory where it will be stored for a long time (Lutz & Huitt, 2003; Salvin, 2003; Benson, Nicka, & Stern, 2006).

Memory associated with the learning process; it is responsible for storage and retrieval of information that has been learned. Furthermore, the memory is repository in which various information is saved. The way to remember information depends on the method of storing (Westerberg & Marsolek, 2003). The learning process of a human being passes through stages such as: attention, perception and memory. Moreover, after the process of attention comes the perception process of stimuli and identify them, the WM recorded the information in the long-term memory. In addition, the WM call information and previous experience from the long-term memory and these three stages working together dynamically (Cowan, 2008).

The WM is one of the most significant theoretical constructs in cognitive psychology (Melby-Lervag & Hulme, 2013). This impact gains through the relationship between measures of WM ability and a wide diversity of real world skills (Cohen & Conway, 2008). The term of the WM has developed through previous concepts of short-term memory. In addition, short-term memory that seen as a limited capability memory store was subject to quick loss due to decay. Baddeley defines the WM as an intellectual system that gives temporary storage and manipulation of the information (Melby-Lervag & Hulme, 2013). While, Alloway (2006) emphasizes that the concept of the WM used to refer to the system of storage and processing information on a temporary basis, it is a system used to support daily mental cognitive activities such as thinking, language and understanding, etc. D'Esposito (2007) points out that the concept of the WM refers to the process of temporary retention of information received by the individual from the external environment, which then retrieved from the long-term memory.

The WM is responsible for provisionally maintaining information through cognitive movement (Baddeley, 2002). As well as, the WM is associated with the academic achievement at the field of reading, writing, mathematics, and science (Abu-Rabia, 2003; Gathercole, Pickering, Knight, & Stegmann, 2004; Swanson, Zheng, & Jerman, 2009; Swanson & Jerman, 2006). Moreover, the WM is related to a wide range of high-level cognitive abilities such as reasoning, problem-solving, and learning (Yuan, Steedle, Shavelson, Alonzo & Oppezzo, 2006). The WM plays a vital function in cognitive activity, scholars are exploring the method of concerning WM research to improve abilities such as intelligence, understand multifaceted relationships and problem-solving (Martinez, 2000).

The WM has been known to contribute to the gaining and processing of language, as well as supporting a whole range of complex everyday cognitive activities counting logic, language comprehension, long-term learning, and intellectual arithmetic (McCabe, Roediger, McDaniel, Balota & Hambrick, 2010). The modern theories divided WM into numerous components; Baddeley (1992, 2000) divided WM into three



components: the central executive, the phonological loop, and the visual-spatial sketchpad. The central executive is the control centre of the system; therefore it selects and operates the suitable cognitive processes. Additionally, the central executive has a storage function with the result that capacity limitations are applicable to this part of the system, the phonological loop maintains verbal material through sub-vocal rehearsal, and the visual-spatial sketchpad conserves imagery and spatial material during visualization.

### ***Learning disabilities and WM***

The disabilities in WM are characteristic of a group of developmental disorders and learning disabilities; furthermore, ADHD, dyslexia, and reading and mathematical difficulties (Archibald & Gathercole, 2007; Holmes et al, 2010; Mezzacappa & Buckner, 2010). Besides, the WM deficits have also been recommended to represent a key component in illuminating the cognitive difficulties seen in children with autism spectrum disorders (Kenworthy, Yerys, Anthony, & Wallace, 2008) and specific language impairment (Archibald & Gathercole, 2006).

The several studies have provided evidence on the relationship between the learning disabilities and the deficits in the WM (Passolunghi & Siegel, 2001; Pickering, 2006; Schuchardt, Maehler, & Hasselhorn, 2008; Swanson, 2006; Holmes, 2012; Alloway & Gathercole, 2006; Maehler and Schuchardt, 2009). However, some studies revealed that students with reading disabilities have experience deficits on the phonological processing, the central executive functioning, and the visual-spatial of the WM (Swanson, 2006; Landerl, Bevan & Butterworth, 2004; Kibby, Marks, Morgan & Long, 2004; Maehler and Schuchardt, 2009). Abd Ghani and Gathercole (2013) indicate that the students with dyslexia performed significantly more poorly on measures of verbal the WM.

Another studies indicated that students with mathematics learning disabilities have deficits on the central executive functioning, and visual-spatial of the WM (Maehler and Schuchardt, 2009; Passolunghi, 2006; Swanson & Sachse-Lee, 2001). But the results of the other research showed that the deficits in the phonological loop may not be a significant characteristic for students with mathematics learning disabilities (Van der Sluis, Van der Sluis & de Jong, 2005; Passolunghi, 2006).

Swanson & Sachse-Lee (2001) believe that SLD suffer from memory problems as a result of problems in the WM and the long-term memory. On the other hand, Hulme and Snowling (1993) believe that the performance of the SLD in the auditory and the visual memory is less than that of their normal peers. The SLD display obvious difficulties remembering what they saw or heard and these difficulties are related to the auditory and the visual memory. Similarly, the SLD have difficulty in the visual memory have difficulty drawing geometric shapes and drawing pictures. In this regard, Levine and Reed (1999) confirm that majority of the SLD faced difficulties in the short-term and the long-term memory, causing the loss of a large part of the information they receive and these difficulties make the teachers repeat the instructions for the daily courses.

In addition, Cusimano (2002) states that a majority of the students suffer from auditory memory deficiency need some therapy and help to develop this skill. She recommended that the educational curricula in the basic stages should include training exercises for the auditory memory. However, in the visual memory, Cusimano explains that the academic environment in the classroom must focus on symbols, numbers, letters and words. Mercer and Pullen (2009) also state that the SLD suffer from difficulty in visual and auditory remembering. They assumed that the SLD have defects in the WM.



While, Maehler and Schuchardt (2009) stress that students with academic learning disabilities suffer from the deficits in the WM tests with tasks for the phonological loop, the visual–spatial sketchpad and the central executive.

McNamara and Wong (2003) reveal that the performance of the SLD was weak in remembering academic information particularly in reading skills. In addition, Van Der Sluis, Van Der Leij, and De Jong (2005) show that the SLD have a weakness in the WM, particularly when applying visual tasks and activities in the field of arithmetic and reading. Moreover, Passolunghi and Mammarella (2012) illustrate that the children with severe mathematics learning disabilities failed in spatial WM tasks compared with children with low mathematical achievement. They emphasized that the SLD have a failure in the ability to recall information from WM, and this failure leads to the weakness of their academic achievement.

The visual and spatial representation of mathematical information in the WM is also an important factor associated with learning disabilities in mathematics (Cornoldi, Venneri, Marconato, Molin & Montinari, 2003). Several studies found that the children with mathematical difficulties had lower scores on spatial tasks and poor problem-solving (Mammarella, Lucangeli & Cornoldi, 2010; Passolunghi & Mammarella, 2012).

The SLD suffer from memory problems, undermining their capabilities to learn since this was considered one of their main and more common features. The majority of the teachers in the resource rooms suffer from the low level of students remembering capabilities. This fact forced them to constantly repeat the information in order to help them remember more. Since memory is one of the developmental disabilities; special educators seek to solve it, because it is the cause for academic learning disabilities in most cases. Educational interference became a must by designing training programs to develop the WM for the SLD. In the present study our aim was to measure the effectiveness of an educational program to improve WM for the SLD.

## METHOD

### *Research Design*

Non-equivalent control group from the quasi-experimental designs was used in this study to measure the effectiveness of educational program in improving WM among SLD. In this design the WM scale was applied for experimental and control groups as pretest and posttest.

### *Participants*

The sample of the study consisted of (57) SLD enrolled in learning disabilities resource room from fourth, fifth and sixth grades at Najran, Kingdom of Saudi Arabia. The SLD were divided into two groups, one of the group was randomly chosen to be the experimental (n=29) and the second as the control group (n=28). The students in the experimental group enrolled into the educational program based on improving working memory; while the students in the control group were not exposed to the same program.



## *Instruments*

To achieve the objectives of this study the researchers were developed the following instruments:

1. **Working Memory Scale:** the scale was developed by reviewing the theoretical literature and previous studies. The first version of the scale was modified by experts in the field of special education from Najran University. However, the final draft of the scale consisted of (30) true / false questions. The questions of memory scale measure the visual, auditory, and visual-motor memory of the SLD. In addition, a mark of (1) was given to the correct answer and a mark (0) to the wrong answer; the highest mark achieved by a student's is (30) and the lowest mark is (0). To calculate the reliability of the scale; test-retest reliability was used. The scale was implemented as a pilot study on (12) SLD. Then, the scale was implemented again after two weeks on the same individuals. The Person Coefficient Correlation between the two implementations was (0.87).
2. **The Educational Program:** The program was developed in order to improve WM among SLD. In order to prepare the program, the researchers reviewed the previous studies and literature that related to the WM. In order to ensure the validity of the program it has been presented to the same group of experts they modified the WM scale. Nevertheless, based on the opinions of experts modifications have been done to some items of the program and the final draft of the program consists of (50) educational session duration of each session (25) minutes every day and (5) days in per week. The program consists of four domains , as follows:
  - I. **Visual Memory:** The visual memory is the ability to remember the visual former and visual experiences accurately, since the visual memory is essential to learn, recognize and retrieve the numbers, the alphabets, and the printed words, in addition to the skills of writing and spelling. This domain consists of (15) educational session.
  - II. **Auditory Memory:** The auditor memory refers to remember the former auditory experiences accurately. This is considered essential to the development of language oral reception and expression skills. SLD may have difficulty in recognizing the voices they had heard. This domain consists of (12) educational session.
  - III. **Visual-motor Memory:** Visual-motor memory refers to the ability of producing movements prior to visual experiences to extract sequences of memory items. It includes storing motor models in a sequenced pattern, storing and retrieving them. The visual imagination may interfere to help the children to remember motor sequenced patterns. This domain consists of (10) educational session.
  - IV. **Meaning and Memorizing Memory:** Meaning and memorizing memory refers to understanding and maintaining the information by relating them together with previous experiences. This domain consists of (13) educational session.

## **RESULTS**

Before answering the questions of the study, the researchers calculated the equivalence of the two the groups on the pre-working memory scale (PWMS). Table 1 presents the differences between the means on the PWMS according to the variables of group and gender. In order to investigate the statistical significance of these differences, Two-Way Analysis of Variance (ANOVA) was used; table 2 demonstrates that there are no statistically significant differences at ( $P \leq .05$ ) due to the variables of group or gender. Consequently, these results indicated that the two groups are equivalence on the PWMS.

**Table 1. Means and standard deviations according to the PWMS**

Group	Gender	M	SD	N
Control	Male	20.3	2.27	16
	Female	19.6	2.25	13
Experimental	Male	21.0	2.28	14
	Female	20.3	2.09	14

**Table 2 ANOVA results according to the PWMS**

Source of variance	$\sum$	df	Mean Square	F	P
Group	5.894	1	5.894	1.184	.281
Gender	6.225	1	6.225	1.251	.268
Group $\times$ Gender	.006	1	.006	.001	.973

Results related to the first question: “What is the effect of an educational program in improving WM among SLD”? For this question means and standard deviations on the post-working memory scale (POWMS) were calculated as shown in table 3. Table 3 illustrates that there are differences between the students of the control group ( $m=21.79$ ) and the experimental group ( $m=25.69$ ) on the POWMS. Furthermore, in order to examine the statistical significance, 2-Way Analysis of Variance (ANOVA) was used as shown in Table 4. Table 4 shows the existence of statistically significant differences on the POWMS attributed to the variable of group, in favor of the experimental group ( $F= 61.262$ ,  $P= .000$ ), and this statistically is significant.

**Table 3 Means and standard deviations according on the POWMS**

Group	M	SD	N
Control	21.79	1.93	28
Experimental	25.69	1.83	29

**Table 4 ANOVA results on the POWMS**

Source of variance	$\sum$	df	Mean Square	F	P
Between groups	217.114	1	217.114		
Within groups	194.921	55	3.544	61.262	.000*

\*  $P \leq .05$

Results related to the second question: “Is there any effect of an educational program in improving WM among SLD due to the gender”? For this question means and standard deviations on the POWMS were computed as shown in table 5. Table 5 shows that there are differences between the means of the male ( $m=24.27$ ) and the female ( $m=23.22$ ) on the POWMS. Additionally, in order to examine the statistical significance, 2-Way Analysis of Variance (ANOVA) was used as shown in table 6. Table 6 demonstrates that there are no statistically significant differences at ( $p \leq .05$ ) on the POWMS among the mean scores of students that can be attributed to the gender.

**Table 5 Means and standard deviations according to the gender on the POWMS**

Gender	M	SD	N
Male	24.27	2.71	30
Female	23.22	2.65	27

**Table 6 ANOVA results according to the gender on the POWMS**

Source of variance	$\Sigma$	df	Mean Square	F	P
Between groups	15.502	1	15.502		
Within groups	396.533	55	7.210	2.150	.148

## DISCUSSION

The purpose of this study was to identify the effectiveness of an educational program on improving WM among SLD. The results indicated that the effectiveness of the program to improve WM, after the application of the program on the experimental group.

The improvement in the level of the WM among students of the experimental group can be attributed to the program which contains strategies that contributed to the enhancement of memory, and training activities, which were provided to members of the experimental group during the sessions of the program, were responsive to their needs in remembering what they have learned during their exposure to the positions of education, which contributed significantly to improve the level of their performance in the working memory. In addition the program included strategies contributed to improve working memory for the experimental group members, such as giving instructions, feedback, reinforcement, modeling, and homework.

Perhaps the individualized education, and education with small groups of students of the experimental group have given better opportunities for the application of educational activities, also make it easy to the teacher to follow the students' performance, the student attendance for all sessions of the program and the perseverance to complete homework diligently and the friendly atmosphere that was available to SLD during the application of the program were contributed to improve the WM among students of the experimental group.

The training based on memory strategies contributes to development of the memory of the SLD. Moreover, the memory strategies skills are like any other skills they can be learned if the suitable methods and appropriate ways are available to learn them. Bender (2008) suggested that manipulation of motivation, selective attention, or coding ability for memory will improve the memory of SLD. Klein and Schwartz (1979) point to the improvement of the level of memory among SLD who have a weakness in auditory memory as a result of joining to the training programs. Michael, Bert and Kenneth (1983) stress on improving the level of memory among SLD who have learned through the strategic repetition of verbal and visual imagination.

Condus, Marshall and Miller (1986) confirm the superiority of SLD on their peers to remember the content of images as a result of their learning strategy by keywords. Scruggs and Mastropieri (1989); Scruggs, Mastropieri and Terrill (2004) point out the effectiveness of the training based on the use of memory strategies by students with disabilities in the area of improving the immediate memory. Greene



(1999) emphasizes the importance of strategies memory to learn the basic skills in mathematics among SLD.

The WM can be improved through practice on the WM tasks by using the computerized training programs. These programs improve WM problems of children with poor WM. In particular ADHD (Dunning, Holmes & Gathercole, 2013; Holmes et al., 2010; Holmes, 2012; Kronenberger, et al, 2005; Gray et al , 2012). Al-Smady and Qutami (2010) stress on the effectiveness of the training programs in developing visual, auditory, visual-motor, meaning and memorizing memory for SLD. On the other hand, Al-Khateeb (2012) recommends that the curriculum of SLD should include activities and special training patterns of WM, and diversity in the use of audio and visual instructional aides to develop the WM among SLD. In addition, Morrison and Chein (2011) conclude that the WM training programs is a tool for general cognitive enhancement. Klingberg (2010) suggests that the WM training could be used as remedial intervention for individuals with low WM.

Al-Ayed and Al-Natur (2008) point out the effectiveness of training programs in developing the memory for SLD, especially when these programs contain the training strategies based on remembering of visual and auditory aspects. Al-Ayed and Abdel-Fattah (2009) confirm the effectiveness of computerized training programs on improving the phonological awareness, WM, and language skills SLD in reading difficulties. Mustafa (2003) confirms the role of the training programs on improving verbal working memory; in addition, these programs contribute the abilities of SLD in calling of direct information. Gray et al (2012) suggest that the computerized training may enhance some aspects of WM in youths with LD/ADHD. Al-Hassani (2011) confirm the effectiveness of training programs based on the WM skills on developing reading comprehension among SLD. Dahlin (2011) indicate that the WM training may help children with special needs becoming more proficient in reading comprehension

## Acknowledgment

The researchers are indebted to the Deanship of the Scientific Research in Najran University, KSA for funding this research project (NU/SHED13/101).

## References

- Abd Ghani, K., & Gathercole, S. (2013). Working memory and study Skills: A comparison between dyslexic and non-dyslexic adult learners. *Procedia-Social and Behavioral Sciences*, 97(6), 271–277.
- Abu-Rabia, S. (2003). The influence of working memory on reading and creative writing processes in a second language. *Educational Psychology*, 23(2), 209–222.
- Al-Ayed, W., & Abdel-Fattah, M. (2009). The effect of computerized training programs on improving the phonological awareness, WM, and language skills for students with learning disabilities in reading difficulties. *Journal of Arab Studies in Education and Psychology*, 3(1), 168-213(in Arabic).
- Al-Ayed, W., & Al-Natur, M. (2008). The effect of training programs in developing memory of students with learning disabilities. *College of Education Journal* ,32, 401-420(in Arabic).
- Al-Hassani, S. (2011). The effectiveness of training program based on the working memory skills on developing reading comprehension among students with learning disabilities. *Journal of Educational and psychological Studies*, 71, 191-256.



Turkish International Journal of Special Education and Guidance & Counseling 2015, volume 4, issue 2

Al-Khateeb, M. (2012). Working memory styles among students with learning disabilities in reading and mathematics. ( MA thesis.) Amman Arab University (in Arabic).

Alloway T., & Gathercole S. (2006). *Working memory and neurodevelopment disorders*. Psychology Press, Hove.

Alloway, T. (2006). How does working memory work in the classroom? *Educational Research and Reviews*. 1(4), 314-319.

Alloway, T. (2009). Working memory, but not IQ, predicts subsequent learning in children with learning difficulties. *European Journal of Psychological Assessment*, 25 (2), 92-98.

Al-Smady, H., & Qutami, N. (2010). The effectiveness of a training program in developing memory of students with learning disabilities. *International Journal for Research in Education*, 28, 48-76 (in Arabic).

Archibald, L., & Gathercole, S. (2007). The complexities of complex span: Storage and processing deficits in specific language impairment. *Journal of Memory and Language*, 57(2), 177-194.

Archibald, L & Gathercole, S. (2006). Short-term and working memory in specific language impairment. In T. P. Alloway & S. E. Gathercole (Eds.), *working memory in neurodevelopment Disorders* (pp. 139–160). England: Psychology Press.

Baddeley, A. (1992). Working memory. *Science*, 255(5044), 556-559.

Baddeley, A. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences*, 4(11), 417-423.

Baddeley, A. (2002). Is working memory still working? *European Psychologist*, 7(2), 85–97.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, 28(2), 117-148.

Bender, W. (2008). *Learning Disabilities: Characteristics, Identification, and Teaching Strategies*. Boston: Allyn & Bacon.

Benson, J. Nicka, M., & Stern, P. (2006). How does a child with sensory processing problems play? *The Internet Journal of Allied Health Sciences and Practice*, 4(4), 1-7.

Bryant, D., Bryant, B., & Hammill, D. (2000). Characteristic behaviors of students with LD who have teacher-identified math weakness. *Journal of Learning Disabilities*, 33(2), 168-177.

Chepenik, L., Cornew, L., & Farah, M. (2007). The influence of sad mood on cognition. *Emotion*, 7(4), 802-811.

Cohen, G., & Conway, M. (2008). *Memory in the real world*. England: Psychology Press.

Conduis, M., Marshall, K., & Miller, S. (1986). Effects of the keyword mnemonic strategy on vocabulary acquisition and maintenance by learning disabled children. *Journal of Learning Disabilities*, 19(10), 609-613.

Cornoldi, C., Venneri, A., Marconato, F., Molin, A., & Montinari, C. (2003). A rapid screening measure for the identification of visuospatial learning disability in schools. *Journal of Learning Disabilities*, 36(4), 299-306.

Cowan, N. (2008). What are the differences between long-term, short-term, and working memory? . *Progress in Brain Research*, 169 (169), 323–338.

Cusimano, A. (2002). *Learning disabilities: There is a cure: A Guide for Parents, Educators and Physicians* . Pennsylvania: Achieve Publication.

D'Esposito, M. (2007). From cognitive to neural models of working memory. *The Royal Society*, 362,761–772.



Turkish International Journal of Special Education and Guidance & Counseling 2015, volume 4, issue 2

Dahlin, K. (2011). Effects of working memory training on reading in children with special needs. *Reading and Writing: An Interdisciplinary Journal*, 24 (4), 479-791.

Dunning, D., Holmes, J., & Gathercole, S. (2013). Does working memory training lead to generalized improvements in children with low working memory? A randomized controlled trial. *Developmental Science*, 16(6), 915-925.

Gathercole, S. & Alloway, T. (2008). *Working memory and learning: A practical guide for teachers*. London: Sage.

Gathercole, S., Pickering, S., Knight, C., & Stegmann, Z. (2004). Working memory skills and educational attainment: Evidence from national curriculum assessments at 7 and 14 years of age. *Applied Cognitive Psychology*, 18(1), 1-16.

Gray, S., Chaban, P., Martinussen, R., Goldberg, R., Gotlieb, H., Kronitz, R., Hockenberry, M., & Tannock, R. (2012). Effects of a computerized working memory training program on working memory, attention, and academics in adolescents with severe LD and comorbid ADHD. *Journal of Child Psychology and Psychiatry*, 53(12), 1277-1284.

Greene, G. (1999). Mnemonic multiplication fact instruction for Students with learning disabilities. *Learning Disabilities Research*, 14, (3), 141-148.

Gregg, N., & Mather, N. (2002). School is fun at recess: informal analyze of writing language for students with learning disabilities. *Journal of Learning Disabilities*, 35(1), 7-22.

Holmes, J. (2012). Working memory and learning difficulties. from: <http://www.mrc-cbu.cam.ac.uk/wp-content/uploads/2013/09/Working-memory-and-learning-difficulties.pdf>.

Holmes, J., Gathercole, S., Place, M., Dunning, D., Hilton, K., & Elliott, J. (2010). Working memory deficits can be overcome: Impacts of training and medication on working memory in children with ADHD. *Applied Cognitive Psychology*, 24(6), 827-836.

Hulme, C. & Snowling, M. (1993). *Phonological deficits and the development of word recognition skills in developmental dyslexia*. (pp 225-236) In R.M. Joshi and C.K. Leong (Eds) *Differential Treatment of Reading and Writing Disorders*. The Hague: Martinus Nijhoff.

Hulme, C., & Mackenzie, S. (1992). *Working memory and severe learning difficulties*. Hillsdale, NJ: Erlbaum.

Kenworthy, L., Yerys, B., Anthony, L., & Wallace, G. (2008). Understanding executive control in autism spectrum disorders in the lab and in the real world. *Neuropsychological Review*, 18(4), 320-338.

Kibby M., Marks W., Morgan S. & Long C. (2004). Specific impairment in developmental reading disabilities: a working memory approach. *Journal of Learning Disabilities*, 37(4), 349-363.

Kirk, S., Gallagher, J., Coleman, M. & Anastasiow, N. (2009). *Educating exceptional children*. Boston: Houghton Mifflin.

Klein, P. S. & Schwartz, A. A (1979). Effects of training auditory sequential memory and attention on reading. *Journal of Special Education*, 13, (4), 365-374.

Klingberg, T. (2010). Training and plasticity of working memory. *Trends in Cognitive Sciences*, 14(7), 317-324.

Klingberg, T., Fernell, E., Olesen, P., Johnson, M., Gustafsson, P., Dahlstrom, ... & Helena, W. (2005). Computerized training of working memory in children with ADHD-a randomized, controlled trial. *Journal of the American Academy of Child and Adolescent Psychiatry*, 44(2), 177-186.



Turkish International Journal of Special Education and Guidance & Counseling 2015, volume 4, issue 2

- LaBar, K & Cabeza, R. (2006). Cognitive neuroscience of emotional memory. *Nature Reviews Neuroscience*, 7(1), 54-64.
- Landerl K., Bevan A. & Butterworth B. (2004). Developmental dyscalculia and basic numerical capacities. *Cognition*, 93, 99–125.
- Lerner, J. (2003). *Learning disabilities: Theories, diagnosis, and teaching strategies*. Boston: Houghton Mifflin.
- Levine, D. & Reed, M. (1999). *Developmental variation and learning disorders*. Educators Publishing Service. Inc. Cambridge.
- Lutz, S., & Huit, W. (2003). Information processing and memory: Theory and applications. Educational Psychology Interactive. Valdosta, GA: Valdosta State University. Retrieved April 2014, from <http://www.edpsycinteractive.org/papers/infoproc.pdf>.
- Maehler, C., & Schuchardt, K. (2009). Working memory functioning in children with learning disabilities: Does intelligence make a difference? *Journal of Intellectual Disabilities Research*, 53(1), 3–10.
- Mammarella, I., Lucangeli, D., & Cornoldi, C. (2010). Spatial working memory and arithmetic deficits in children with nonverbal learning difficulties. *Journal of Learning Disabilities*, 43(5), 455-468.
- Martinez, M. E. (2000). *Education as the cultivation of intelligence*. New Jersey: Lawrence Erlbaum Associates.
- McCabe, D., Roediger, H., McDaniel, M., Balota, D., & Hambrick, D. (2010). The relationship between working memory capacity and executive functioning: evidence for a common executive attention construct. *Neuropsychology*, 24(2), 222–243.
- McNamara, J. & Wong, B. (2003). Memory for everyday information in students with learning disabilities. *Journal of Learning Disabilities*, 36(5), 394-406.
- Melby-Lervag, M., & Hulme, C. (2013). Is working memory training effective? A meta-analytic review. *Developmental Psychology*, 49 (2), 270–291.
- Mercer, C. & Pullen, P. (2009). *Students with learning disabilities*. NJ: Merrill-Prentice Hall.
- Mezzacappa, E., & Buckner, J. (2010). Working memory training for children with attention problems or hyperactivity: A school-based pilot study. *School Mental Health*, 2(4), 202–208.
- Michael, C., Bert, P., & Kenneth, L. H. (1983). Verbal rehearsal and visual imagery: mnemonic aids for learning-disabled children. *Journal of Learning Disabilities*, 16(6), 352-354.
- Morrison, A., & Chein, J. (2011). Does working memory training work? The promise and challenges of enhancing cognition by training working memory. *Psychonomic Bulletin and Review*, 18(1), 46–60.
- Mustafa, M. (2003). The effects of a training program based on verbal working memory for students with learning disabilities. *Journal of Educational, Psychological & Social Research*, 122, 172-225(in Arabic).
- Passolunghi M. (2006). Working memory and arithmetic learning disability. In T. P. Alloway & S. E. Gathercole (Eds.), *Working Memory and Neurodevelopment Disorders* (pp. 113–38). England: Psychology Press.
- Passolunghi, M & Mammarella, I. (2012). Selective spatial working memory impairment in a group of children with mathematics learning disabilities and poor problem-solving skills. *Journal of Learning Disabilities*, 45(4), 341-50.
- Passolunghi, M. C., & Siegel, L. S. (2001). Short term memory, working memory, and inhibitory control in children with specific arithmetic learning disabilities. *Journal of Experimental Child Psychology*, 80, 44–57.



- Pickering, S. (2006). *Working memory and education*. Burlington, MA: Academic Press.
- Salvin, R. (2003). *Educational psychology: Theory and practice*. Boston: Allyn & Bacon.
- Schuchardt, K., Maehler, C., & Hasselhorn, M. (2008). Working memory deficits in children with specific learning disorders. *Journal of Learning Disabilities*, 41(6), 514–523.
- Scruggs, T., & Mastropieri, M. (1989). Mnemonic instruction of LD students: A field-Based Evolution. *Learning Disability Quarterly*, 12, (2), 119-125.
- Scruggs, T., Mastropieri, M., & Terrill, M. (2004). SAT vocabulary instruction for high school student with disabilities. *Intervention in School and Clinic*, 39(5), 288 –294.
- Smith, D. (2004). *Introduction to special education: teaching in an age of opportunity*. Boston: Pearson Education, INC.
- Swanson H. & Sachse-Lee C. (2001). A subgroup analysis of working memory in children with reading disabilities. *Journal of Learning Disabilities*, 34(3), 249–263.
- Swanson, H. (2006). Cognitive processes that underlie mathematical precociousness in young children. *Journal of Experimental Child Psychology*, 93(3), 239–264.
- Swanson, H., & Jerman, O. (2006). Math disabilities: A selective meta-analysis of the literature. *Review of Educational Research*, 76(2), 249–274.
- Swanson, H., & Sachse-Lee, C. (2001). Mathematical problem solving and working memory in children with learning disabilities: Both executive and phonological processes are important. *Journal of Experimental Child Psychology*, 79(3), 294-321.
- Swanson, H., Zheng, X., & Jerman, O. (2009). Working memory, short-term memory, and reading disabilities: A selective meta-analysis of the literature. *Journal of Learning Disabilities*, 42(3), 260–287.
- Van Der Sluis, S., Van Der Leij, A., & De Jong, P. (2005). Working memory in Dutch children with reading and arithmetic related LD. *Journal of Learning Disabilities*, 38 (3), 207-221.
- Westerberg, C & Marsolek, C. (2003). Hemispheric asymmetries in memory processes as measured in a false recognition paradigm. *Cortex*, 39(4), 627-642.
- Yuan, K., Steedle, J., Shavelson, R., Alonzo, A., & Oppezzo, M. (2006). Working memory, fluid intelligence, and science learning. *Educational Research Review*, 1(2), 83–98.