2528-9705

Örgütsel Davranış Araştırmaları Dergisi
Journal Of Organizational Behavior Research
Cilt / Vol.: 5, Sayı / Is.: 2, Yıl/Year: 2020, Sayfa/Pages: 11-31

IMPROVING THE INFORMATION ENCODING AND ITS IMPACT ON THE WORKING MEMORY OF LEARNING DISABILITIES STUDENTS

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ABSTRACT

Background: The study aimed to improve the levels of information encoding. It examines the extent of the impact of this on the working memory capacity of students with learning difficulties, as these students use inappropriate strategies in their academic fields, which causes a feeling of inability to achieve what is expected from them. The research sample consisted of (20) male and female students in the fourth grade of primary school, who were between the ages of (8-11). The researcher used the experimental approach with two groups design and the pre-and-post and follow-up measurement of the study variables. Research tools consisted of the Stanford Binet Intelligence Scale, Information Encoding Level scale, Quick Neurological Screening Test, and the program of the levels of information encoding. The results of the research were analyzed using statistical methods represented in the standard averages and deviations - the "T" test for the related sample - the "T" test for the independent sample through the statistical program.

Keywords: *working memory, information encoding, learning disabilities, early childhood*

INTRODUCTION

The theoretical frameworks indicate that people with learning difficulties have difficulties in encoding the information and creating the knowledge links between them, as they choose the strategies randomly due to their weak skills used in organizing and coding information. Encoding means entering information or stimuli into memory after converting them into certain symbols. Psychologists prove that the way we symbolize information directly affects opportunities of reminding us of them and give it some special meanings. Thus, students with learning difficulties don't have the ability to the cognitive representation and understanding the weakness of their cognitive structure. (Swanson et al., 2004) indicate that the processes involved in memory like encoding, processing, and retrieving information are considered skills that do not differentiate between mental abilities and learning (Haque et al., 2018). (Swanson and Ashbaker, 2000) note some evidence assures that the problems related to the working memory predict how an individual will perform any task. The information that the individual receives is entered into the Sensory register, if it had attention, it would be transferred to the short-term memory, or it would be transferred to the working memory until it is prepared and processed (Daniel Hilalhan et al., 2006). The information is represented in three stages. The first stage is the coding process (Suleiman Abdul Wahid, 2010) where the cognitive code is created. The second stage is the storage and processing process, and this process is evidenced by the retrieval process, which represents the third stage (Anwar Al Sharkawi, 1992). The format of the information varies with the store, as it is converted to telegraphic codes (Walid Afifi, 2008).

Geliş tarihi/Recieved: 17.07.2020 – Kabul tarihi/Accepted: 02.12.2020 – Yayın tarihi/Published: 21.12.2020

Greeno Hicks divides the coding into six types of sequences (Suleiman Abdel Wahid, 2010; Anwar El Sharkawy, 1992): visual, auditory, operative, verbal, semantic, and dynamic coding, and there are encoding and coding of taste, smell, emotional coding. (Leahey and Harris, 2003) argues that the best cognitive way to improve memory is to improve the encoding process for more efficient and effective retrieval.

Research Problem

The cognitive deficiencies resulting from learning difficulties are among the most serious problems for these students, as they appear weak in the working memory activity because the executive capacity of it affects all the different academic fields. The encoding difficulties also appear in them in the low capacity in general. It has been shown that they don't have the ability to make connections between knowledge units and information and therefore easily forget them. Therefore, the problem of the research can be stated in the following question: What is the effect of training on improving levels of information encoding (phonemic coding - Semantic encoding - Semantic- phonemic encoding) in improving the working memory capacity for students with learning difficulties?

Research Objectives

This research aimed to achieve the following goals:

- Knowing the extent to which the coding levels are improved through strategies and techniques used in the sessions of the program.
- Knowing the effect of the program on improving the working memory capacity for the students with learning difficulties through the post- and pre-tests.
- Discovering the most important skills and methods that change the habits of recalling information and affect the students' achievement abilities.

Terminology of the Research

- Encryption: The process of converting the perceived information and stimuli, from their primary form to specific symbols and codes with other forms of cognitive representation until they become meaningful, which helps to create the effects of specific meanings, so it can be organized, prepared, processed, and kept to be recalled later.
- Working memory: a system that is responsible for storing information and processing it temporarily perceived by the individual's daily perceptual activities, it is characterized by a limited capacity (Alloway and Alloway, 2014; Fouladi and Goli, 2018).
- The training program: aims to improve the levels of information encoding for people with learning difficulties through training on a set of activities and methods that include a number of techniques for developing three levels, Phonemic Code Level, Semantic Code Level, Semantic and Phonemic Code Level, in which it provides sessions that help to encode information based on their acoustic and semantic properties, whereby students associate single words and vocabulary with their meaning according to their cognitive experience, as well as using keywords with to indicate the meaning of each phrase and other methods that reach them to the best level to encode and represent information and then store and keep it for as long as possible (Askari et al., 2019; Elsadany et al., 2019).

Theoretical Framework and Previous Studies

Encoding

A process in which information is transformed into a set of images or symbols (i.e. a code that has a special meaning). The correct coding helps to establish information for the required period of time, and it becomes resistant to any changes that occur to it. Also, the reformulation of information with new codes helps to install it through the process of re-encoding. In order for the encoding process to take place easily, cognitive strategies such as self-designation, mental maps, keyword, summary, assonance, organization, stories, mental perception, etc. must be used. (Hamdi, 2008) states that after the sensory recording process of sensory stimuli is done, the information is transmitted to be processed and represented more complexly. In this, psychologists argue that encoding leaves an impact on the memory system. This effect can be changed in a dynamic way, either by weakening it or becoming distorted over time if the correct coding is not done (Talaat, 2019). The individual employs sensory information through the representation process, by converting the form of information from its physical state into a code that has several meanings, whether it is (Acoustic code, Visual code, Haptic code, Semantic code) (Anwar, 1984). Hossam Khalil's study (2014) found the effectiveness of the spatial topics strategy and reclamation strategies when applying a program to students with developmental learning difficulties, as indicated by (Adel Hussein, 2001), which aimed to identify the differences between the excelled students and stumbled students in the process of coding and immediate and postponed recall for tasks (numbers, letters, macroscopic words, abstract words, and meaningless syllables) to the importance of using strategies (organization, rehearsal, memory aids).

Information encoding levels

Contemporary studies show that many students with learning difficulties face memory problems when using strategies that their regular peers use regularly, such as the repetition strategy. (Reddy and Bellezza, 1983) compared different coding strategies in the recall, where the repetition group was trained on thinking about the meanings of the displayed words, and another group trained to form the story using visual images, and the results showed that there are statistically significant differences in calling the words between the students of the two groups for the group that was trained in the developed repetition strategies, as well as the organization strategy such as classification of those things the individual remembers according to the same characteristics like remembering what an individual needs from the grocery store, for example, when he remembers that he needs some things to prepare dinner. The Boltwood (1970) presented a set of coding strategies used by university students, where a group trained in a strategy (story, initials, and organization). The results indicated that 38% of students tended to use the first letter strategy, 31% used organizational strategies, and 22% used Go ahead story strategy. There are also mnemonics, that is, the order in which they are multiplied by multiplication of numbers (Daniel Hilalhan et al., 2007).

Working memory

Working memory (WM) is a cognitive system with limited capacity that enables the temporary storage and manipulation of information. WM is necessary for such complex tasks as comprehension, learning, and reasoning, and comprises the following three components: the

phonological loop, visual-spatial sketchpad, and central executive system. The phonological loop is a temporary storage system in which acoustic or speech-based information can be held as memory traces that spontaneously fade. The visual-spatial sketchpad temporarily stores visual and spatial information (Ma, et al., 2017).

Working memory relates the information received by the individual to those that already exist in his/her long-term memory repository. In this context, modulation can be used to chunking, clustering, or rehearsing. This information may be exposed in the working memory of the loss for many reasons, mostly such as interference, displacement, or decay. Baddeley & Hitch (2000)have demonstrated that working memory is a system that temporarily holds information and processes it during the performance in various cognitive tasks. Then, after realizing the information from its physical state, it is converted into a code with several meanings. The study of Ramadan, R., & Magd, Sh., (2001) also discussed some coding strategies in improving the recall process, and the results showed that there were statistically significant differences in performance on the task of verbal coding between the two groups of students in favor of those with high recollection. Although the working memory capacity varies, it is considered small compared to the capacity that characterizes long-term memory (Daniel et al., 2007). Walid's (2004) attempted to reach a model describing the relationships between strategies for performing cognitive tasks in memory. And in a study, (Danielsson, et al., 2006) explained that learning disability can be simulated by raising the working memory demands, at least in this type of recognition task. Figure 1. shows the Working Memory Model.

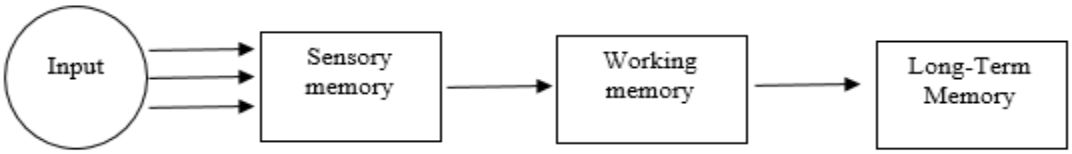

Figure 1. The Working Memory Model (Baddeley and Hitch, 1974)

Hypotheses

The current study aimed at testing the following hypotheses:

- There are statistically significant differences between the mean scores of the experimental group in the pre- and post-tests of the information encoding scale in children with learning difficulties in favor of the post-measurement.
- There are statistically significant differences between the mean scores of students of the experimental and control groups in the post-test of the information encoding scale in children with learning difficulties for the experimental group.
- There are statistically significant differences between the mean scores of students with learning difficulties in the pre- and post-tests of applying the program on the working memory in the students with learning disabilities for the post-test
- There are statistically significant differences between the mean scores of the experimental group in the pre- and post-tests of the working memory test in children with learning disabilities for the post-test.
- There are statistically significant differences between the mean scores of the students with learning difficulties in the post and tracing tests of applying the program on the scale of

information encoding on the students with learning disabilities for the tracing experimental group.

- There are no statistically significant differences between the mean scores of the students with learning difficulties in the post and tracing tests of applying the program on the working memory scale in the students with learning disabilities.
- There is a statistically significant positive correlation between the grades of students with learning difficulties on the information encoding scale and their grades on the working memory scale after applying the program.

RESEARCH METHODOLOGY

Data collection and sampling

The research used the experimental approach. The research sample consisted of (40) male and female students with learning difficulties in the fourth grade of primary education (Northern Borders - Saudi Arabia), whose ages ranged from (8) to (11) years. They were divided into two groups each with (20) male and female students: the experimental group who were exposed to the training program used, and the control group who were not exposed to the program.

Table 1. Characteristics of the experimental and control group

Variables	Group	N	Medium	Standard Deviation	mean rank	Sum of ranks	U Value	Z Value	Sig
Age	Experimental	20	8.600	1.578	16.43	350.0	164.0	0.49	No
	Control	20	9.375	1.642	18.33	385.0			
Intelligence	Experimental	20	94.55	7.315	19.65	327.5	179.5	0.77	No
	Control	20	94.40	5.571	19.45	394.5			
learning disabilities	Experimental	20	51.32	1.484	21.24	377.0	133.7	0.62	No
	Control	20	54.71	1.633	21.56	376-0			
levels of information encoding	Experimental	20	44.32	3.45	20.79	326.0	156.0	0.52	No
	Control	20	45.48	2.47	18.21	338.0			
working memory	Experimental	20	44.36	4.24	17.30	353.0	143.0	0.70	No
	Control	20	44.45	4.26	18.24	347.0			

Table 1 shows that there were no statistically significant differences between the mean levels of the experimental group scores and the control group children in terms of age, intelligence, learning difficulties, levels of information encoding, and working memory, which indicates the homogeneity of these children.

Tools of the study

- Stanford Binet Intelligence Scale 5th: Stanford Binet Scale Fifth Edition is a test for individuals to measure their cognitive abilities and their intelligence from the age of 2 to 85 years, and the well-known usage of the Stanford-Binet scales includes diagnosing different states of cognitive retardation in children, mental retardation, learning disabilities, and autistic people, and mental talent.

- A questionnaire to identify the levels of information encoding for students with learning difficulties (preparation/researcher): The questionnaire was aimed to determine the different levels of encoding for students with learning difficulties through three levels (Phonemic Code Level - Semantic Code Level - Phonemic & Semantic Code Level), where the questionnaire explains the method the student uses to encode cognitive units based on their vocal or semantic properties, or both. The psychometric properties of the scale of the levels of information coding have been confirmed by validation coefficients; as the validity of the arbitrators: the researcher presented the scale to (10) experts specialized in the educational and psychological fields, and the experts agreed with the validity of the phrases and the alternatives to answer the desired purpose, and the honesty transactions for the arbitrators ranged between 0.80 & 1.00, which indicates the validity of the phrases using the "Loach" formula Lawshe. Likewise, global honesty, the researcher conducted the exploratory factor analysis of the scale by analyzing the basic components of the Hulling method on a sample of 100 children, and the results of the global analysis resulted in the presence of three underlying root factors greater than the correct one at the Kaiser test, which has a statistical significance, and then the researcher rotated Axes of the Varimax method. Tables (2, 3, 4) explain the saturation of these factors after rotation.

Table 2. The first factor saturation of Phonemic encoding

No	Saturation	Sentence
1	The student prefers memorizing the vocabulary alike in the rhyme.	0.76
2	The student is fluent in crafting a musical melody for memorizing vocabulary and texts.	0.74
3	The student converts the text vocabulary into syllables.	0.73
4	The student memorizes songs, although he does not understand their meanings.	0.72
5	The student prefers to help him convert the texts into rhymed sentences.	0.67
6	The student remembers the rhymed songs and texts easily.	0.65
7	The student easily memorizes songs easily.	0.62
Variance Ratio		18.63%
Eigen Value		3.43

Table 3. The second factor saturation of semantic coding

No	Saturation	Sentence
8	The student is interested in looking for the meanings of the vocabulary to understand it before studying.	0.74
9	The student finds it difficult to memorize incomprehensible songs.	0.71
10	The student is interested in researching the origins and meanings of vocabulary.	0.70
11	The student memorizes the texts that have a clear meaning for him easily.	0.69
12	The student is constantly asked about the meanings of vocabulary and words.	0.64
13	The student classifies words and vocabulary according to their meanings.	0.62
14	The student searches for the relationship between vocabulary and words according to their meanings.	0.59
Variance Ratio		15.43%
Eigen Value		3.15

Table 4. The Third Factor Saturation of phonemic and semantic encoding

No	Saturation	Sentence
15	The student associates the same rhyme words and vocabulary with their meaning according to their previous cognitive experience.	0.70
16	The student uses rhymed keywords to signify the meaning of each phrase.	0.68
17	The student mimics the meanings of words and represents them with their peers in rhymed phrases.	0.67
18	The student associates the learned material with new connotations that have the same rhyme.	0.67
19	The student classifies the information in lists according to its meaning while associating it with a familiar tone.	0.61
20	The student synthesizes a meaningful story that connects the rhymed words to be learned.	0.52
Variance Ratio		11.13%
Eigen Value		2.84

Tables 2, 3, and 4 show that all saturations are statistically significant, as the value of each of them is greater than 0.30 at the test of Guildford.

The researcher also calculated the stability coefficients of the levels of information encoding scale dimensions by alpha-Cronbach technique on a sample of (100) children and found that the coefficients of stability for phonemic coding (0.77), semantic coding (0.75), phonemic and semantic coding (0.76), and the overall score (0.77). Then she calculated the stability coefficients by re-applying the method with a two-week time interval on a sample of (100) children and found the coefficients of phonemic coding (0.94), semantic coding (0.96), phonemic coding (0.97), and the total score (0.95), have a high degree of stability in both methods, which indicate the stability of the scale.

- Quick Neurological Screening Test Arabization: to identify those with learning difficulties from individual short methods (it takes 20 minutes), a fast way to monitor the objective observations about the neurological integration in its relationship to learning and a test including a series of brief tasks derived from the neurological examination of children were used. The value of the coefficients of honesty was found to be (0.889) which is a high value indicating the validity of the scale. The high value of the stability coefficients (0.944) indicates the stability of the scale.
- A scale for the working memory tasks (storage - processing) Amal Abdel Mohsen Al-Zoghbi (2017): The scale aims at measuring the storage and processing capacity of Articulatory loop and visual-spatial stimuli, as well as to measure the ability to determine the requirements for each task in the case of performing dual tasks and the ability to distribute tasks among a two sub-components of the working memory (verbal-visual location), and the researcher has verified the psychometric properties of the working memory scale by calculating validity coefficients by finding the correlation coefficients between the working memory scale setting (Amal Abdel Mohsen Al-Zoghbi) and the test of intelligence for Stanford-Binet as an external examiner on a sample of (80) students; I found that the validity coefficients for Articulatory loop (0.96), visual-Spatial sketchpad (0.97), Central executive (0.95), and overall score (0.96) have a high validity coefficients, which indicates the validity of the scale. The researcher also computed the internal consistency of the scale by finding correlation

coefficients between the dimensions of each dimension of the scale and the overall degree of it, and found that the coefficients of the validity of Articulatory loop (0.89), Visual-Spatial sketchpad (0.91), Central executive (0.93), and the total score (0.90) are all statistically significant correlation coefficients at the significance level of 0.01, which indicates the consistency of the scale. Stability coefficients were also calculated on the dimensions of the working memory scale by the Alpha Cronbach method on a sample of (80) students, and stability coefficients were found for the Articulatory loop (0.81), Visual-Spatial sketchpad (0.78), Central executive (0.76), and the total score (0.79), which are high values. Also, stability factors were found by re-applying method with a two-week time interval on a sample of 80 students, and stability parameters were found for the Articulatory loop (0.93), Visual-Spatial sketchpad (0.95), Central executive (0.94), and the total score (0.93), which have high values in both ways and indicates the scale stability.

Description of the current program

The following is a description of the procedures and steps followed by the researcher to achieve the main objective of the research.

- The program consists of (30) sessions, three sessions per week for two months, the aim of improving the levels of encoding the three information encoding levels; Phonemic encoding Level ،Semantic encoding Level, and Semantic and Phonemic encoding Levels.
- The content: The researcher used a set of techniques appropriate to the characteristics of students with learning difficulties. She assured introducing the element of suspense and excitement to increase the focus and attention of the students during the exercises, with diversity and flexibility and not to rely on one method, then she prepared the worksheets and tools for each session, taking into account the graduation while performing the required tasks, and the work of the session evaluation form, and the program was presented in its image. The final lists shall include a group of arbitrators specialized in the field. Table 5 shows the distribution of teaching plan for the program.

Table 5. Distribution of the teaching plan for the program

Lesson	Topic	No. of Sessions
	Phonemic encoding	
First	-Memorize similar rhymed vocabulary. -Composing paragraphs of texts with a familiar musical composition. -Convert vocabulary to audio syllables.	4
Second	-memorizing songs and rhymed texts. -Repeating words with a single rhyme till memorize them. -Analyze words into syllables.	4
Third	-Extract words that are similar in their syllables. -Singing the songs with a familiar melody	2
	semantic encoding	
Fourth	-Search for more than one meaning for a term before memorizing it. -Convert words into synonyms and meanings. -Classify words and vocabularies according to their meanings.	3

	-Search for the relationship between the vocabularies of the lesson.	
Fifth	-Find the vocabulary grid for some words in the lesson. -Draw meaningful pictures to memorize the written text. -The lesson is summarized in meaningful phrases. -extracts the general idea for each paragraph.	3
Sixth	-Determining the meanings of the new vocabulary with the lesson. -Writing a lesson from fiction after reading several times. -Determine the main idea of the song. -Explaining the song after understanding it.	3
Seventh	-Connect words with their synonyms, then form useful sentences for them. -Finding the correct meaning of audible words. -Peer participation in a dialogue on the meanings and synonyms of the subject of the lesson. -Create useful phrases from given words. -Design a word map for some synonyms of the lesson.	3
phonemic and semantic encoding		
Eighth	-Searching for the meaning of similar vocabulary in rhyme. -Using keywords that have acceptable meaning and rhyme. -Actively representing the meanings of words with their peers in rhymed terms. -Linking the meanings of the learned vocabulary with similar words in rhyme.	4
Ninth	-Classify vocabulary in lists according to their meaning, and link them to a familiar tone. -Tell a story with meaningful musical performance.	2
Tenth	-Extracting opposites and meanings for each word.	2
Total		30

Program Strategies Applied

- Working in groups (cooperative learning): exchanging ideas and dialogue and developing a spirit of cooperation.
- Immediate correction of errors: The teacher notes the student when he/she makes a mistake and corrects it by providing the required answer.
- Reinforcement: Provides immediately following the issuance of the correct response, with diversity in offering reinforcement physical, verbal, symbolic, nutritional, and active.
- Homework: By giving exercises and examples that the student applies at home.

Study Application Procedures

The researcher followed these steps to prepare the research tools in their final form:

- The tools used in the research have been prepared and ensuring their suitability for the research sample.
- Primary schools were selected to implement the program.
- Quick Neurological Screening Test, and the Stanford Binet scale.
- Checking the equivalence of the two study groups in each of the time age and IQ before applying the program.

- The primary schools to which the program will be applied in Rafha Governorate were chosen.
- The students were divided into two groups: an experimental group and a control group.
- Before the implementation of the program, experimental and control samples were pre-tested.
- The post-test was applied to identify the levels of information encoding for students with learning difficulties, and the scale of working memory tasks (storage-processing) on the two research groups.
- The follow-up test was applied one month after the end of the program.
- Carrying out suitable statistical procedures to investigate the hypotheses of the study.

The study design

- Design: This research had two variables, a semi-experimental: an independent variable and a dependent one. Pre/post/follow-up tests were followed by a layout of the control and experimental groups.

Study variables: the current study consisted of the following variables:

- Independent variable: the program.
- Dependent variable: Information Encoding and Working Memory.
- Results were analyzed using an equivalent group method to determine the effect of the independent variable on the dependent variable. The study used a group of statistical methods to analyze the results:
- Correlation, medians, means, and standard deviation.
- T-test and Wilcoxon's test to find out the significant differences between the means.

RESULTS OF THE STUDY

Hypothesis 1:

- There are statistically significant differences between the average ranks of students with learning difficulties in the pre- and post-tests of the program of the information encoding scale for students with learning difficulties for the post-test.

To validate this hypothesis, the researcher used the Wilcoxon test to find the differences between the average grade levels of the students with learning difficulties in the pre- and post-tests of the program on the scale of information encoding.

Table 6. Differences between the average ranks of students' degrees with learning difficulties in the pre- and post-tests of the program on the scale of information encoding for students with learning difficulties

Variables	Measurement Pre – Post	No	Mean Rank	Sum of Rank	Z	Significance Level	Significance direction

Phonemic encoding	Negative Ranks Positive Ranks Ties Total	1 19 - 20	1 11	1 209	3.893	Sig. at 0.01	In the direction of Post
Symantec encoding	Negative Ranks Positive Ranks Ties Total	- 20 - 20	- 10.5	- 210	3.930	Sig. at 0.01	In the direction of Post
Phonemic and Symantec encoding	Negative Ranks Positive Ranks Ties Total	- 20 - 20	- 10.5	- 210	3.926	Sig. at 0.01	In the direction of Post
Total score	Negative Ranks Positive Ranks Ties Total	- 20 - 20	- 10.5	- 210	3.924	Sig. at 0.01	In the direction of Post

Z = 2.58 at the level of 0.01 Z = 1.96 at the level of 0.01

Table 6. shows that there are statistically significant differences between the average scores for students with learning difficulties in the pre- and post-tests for the program on the scale of information encoding for students with learning difficulties.

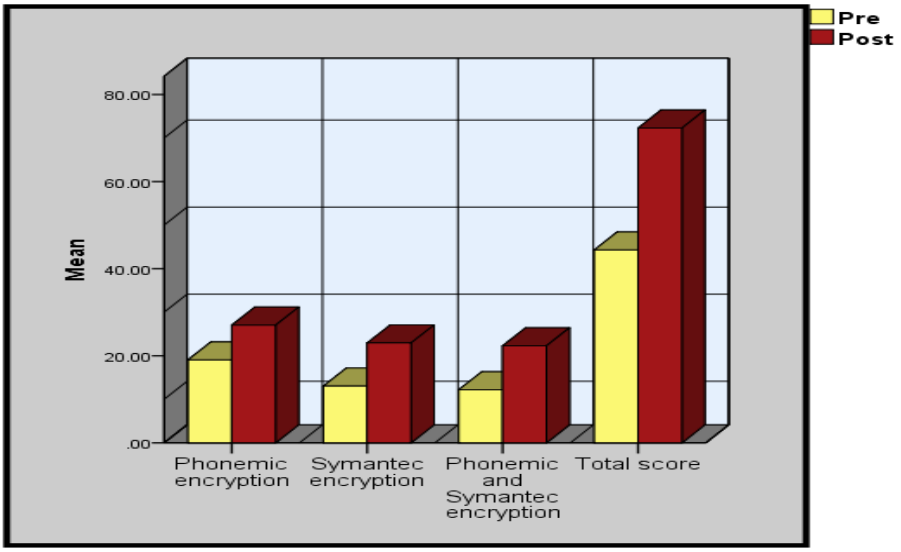

Figure (2) Differences between the average ranks of students' degrees with learning difficulties in the pre- and post-tests for the program on the scale of information encoding for students with learning difficulties

The improvement rate was found between the average grades of students with learning difficulties in the pre- and post-tests for the program.

Table 7: The percentage of improvement between the average grade levels of students with learning difficulties in the pre- and post-tests for the program on the scale of information coding for students with learning difficulties

Variables	Pre-test average	Post-test average	Improvement percentage
Phonemic encoding	19.05	27.05	29.57%
Symantec encoding	13.05	22.95	43.13%
Phonemic and Symantec encoding	12.2	22.3	45.29%
Total score	44.3	72.3	38.72%

Hypothesis 2:

-There are statistically significant differences between the mean scores of students of the experimental and control groups in the post-test of the encoding information scale for students with learning difficulties in favor of the experimental group.

To verify the validity of the hypothesis, the researcher used the t-test to find differences between the mean scores of the students of the experimental and control groups in the post-test of the encoding information scale for students with learning difficulties.

Table 8: Differences between the mean scores of students of the experimental and control groups in the post-test of the encoding information scale for students with learning difficulties

Variables	Experimental group N1= 20		Control group N2= 20		T	Significance level	Significance direction
	M1	S.D1	M2	S.D2			
Phonemic encoding	27.05	3.59	18.15	2.62	8.953	Sig. at 0.01	In the direction of Experimental group
Symantec encoding	22.95	2.25	12.95	2.37	13.652	Sig. at 0.01	In the direction of Experimental group
Phonemic and Symantec encoding	22.3	2.45	12.2	1.79	14.86	Sig. at 0.01	In the direction of Experimental group
Total score	72.3	4.94	43.3	4.2	19.982	Sig. at 0.01	In the direction of Experimental group

t = 2.42 at the level of 0.01 t = 1.68 at the level of 0.01

Table 8. shows that there are statistically significant differences at the level of 0.01 between the mean scores of students of the experimental and control groups in the post-test of the encoding information scale in students with learning difficulties for the experimental group.

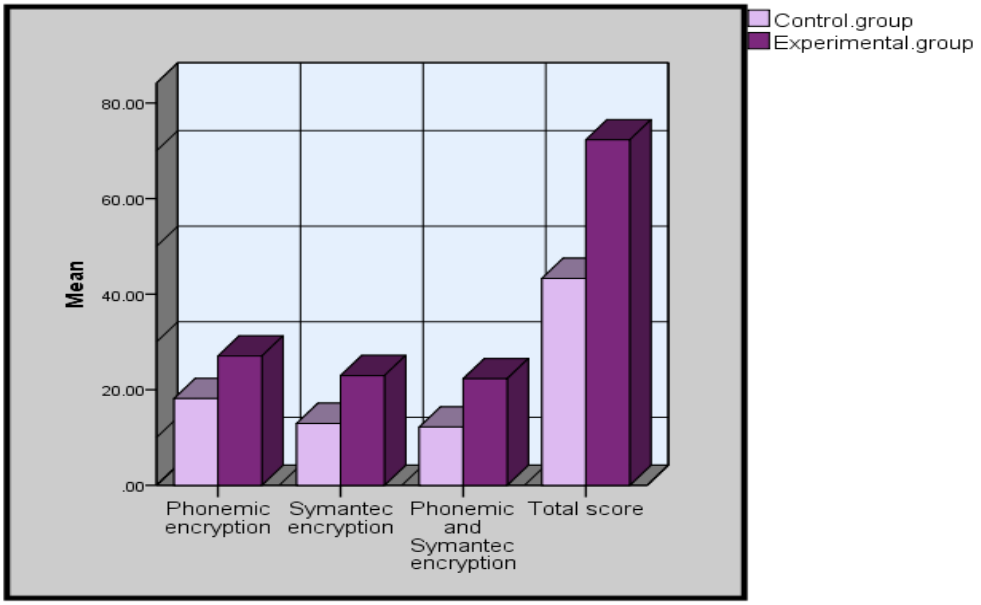

Figure 3: differences between the mean scores of students in the experimental and control groups in the post-test of the encoding information scale in students with learning difficulties.

Hypothesis 3:

-There are statistically significant differences between the average grades of students with learning difficulties in the pre- and post-test of the program on the working memory scale for students with learning difficulties for post measurement.

To verify the validity of this hypothesis, the researcher used the Wilcoxon test to find the differences between the average grade levels of students with learning difficulties in the pre- and post-test of the program to the working memory scale for students with learning difficulties.

Table 9. Differences between the average grade levels of pupils with learning difficulties in the pre- and post-test of the program on the working memory scale for pupils with learning difficulties

Variables	Measurement Pre - Post	No	Mean Rank	Sum of Rank	Z	Significance Level	Significance direction
Articulatory loop	Negative Ranks Positive Ranks Ties Total	- 20 - 20	- 10.5	- 210	3.942	Sig. at 0.01	In the direction of Post
Visual-Spatial sketchpad	Negative Ranks Positive Ranks Ties Total	- 20 - 20	- 10.5	- 210	3.946	Sig. at 0.01	In the direction of Post
Central Executive	Negative Ranks Positive Ranks Ties Total	- 20 - 20	- 10.5	- 210	3.948	Sig. at 0.01	In the direction of Post

Total score	Negative Ranks Positive Ranks Ties Total	- 20 - 20	- 10.5	- 210	3.930	Sig. at 0.01	In the direction of Post

Z = 2.58 at the level of 0.01 Z = 1.96 at the level of 0.05

Table 9. shows that there are statistically significant differences at the level of 0.01 between the average grade levels of students with learning difficulties in the pre- and post-test of the program on the scale of working memory for students with learning difficulties.

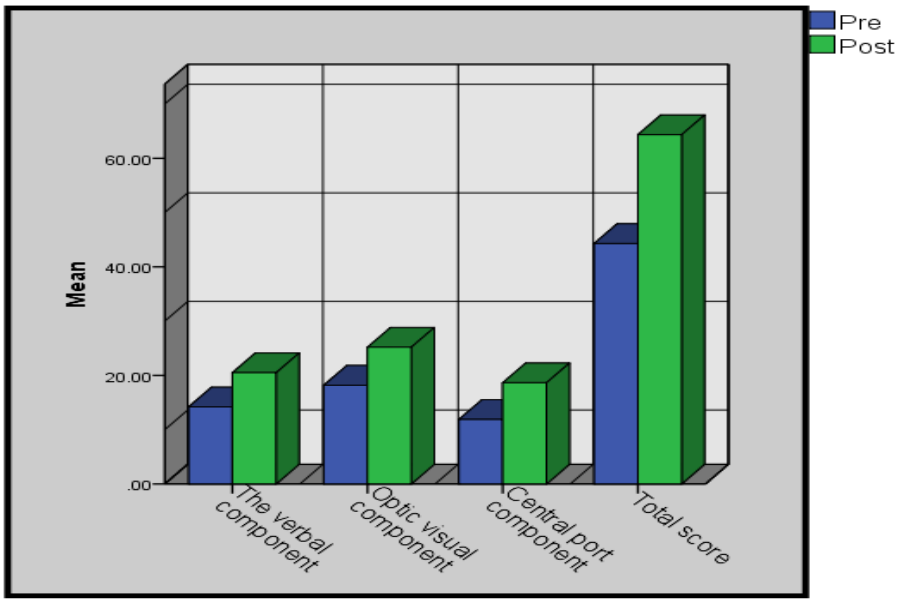

Figure 4. Differences between the average ranks of students' degrees with learning difficulties in the pre- and post-test of the program on the working memory scale for students with learning difficulties

The improvement rate was found between the average grades for students with learning difficulties in the pre- and post-tests of the program to the working memory scale for students with learning difficulties.

Table 10. The percentage of improvement between the average grade levels of students with learning difficulties in the pre- and post-tests of the program on the working memory scale for students with learning difficulties

Variables	Pre-test average	Post-test average	Improvement percentage
Articulatory loop	14.20	20.50	30.73%
visual-spatial sketchpad	18.20	25.20	27.7%
Central executive	11.90	18.65	36.19%
Total score	44.30	64.35	31.15%

Hypothesis 4:

-There are statistically significant differences between the mean scores of students of the experimental and control groups in the post-test of the working memory scale of students with learning difficulties for the experimental group.
To verify the validity of the hypothesis, the researcher used the t-test to find the differences between the mean scores of students in the experimental and control groups in the post-test of the working memory scale of students with learning difficulties.

Table 11. Differences between the mean scores of students in the experimental and control groups in the post-test of the working memory scale for students with learning difficulties

Variables	Experimental group N1= 20		Control group N2= 20		T	Significance level	Significance direction
	M1	S.D1	M2	S.D2			
Articulatory loop	1.39	20.5	14.45	2.06	10.859	Sig. at 0.01	In the direction of Experimental group
Visual - Spatial sketchpad	1.36	25.2	18.75	1.97	12.046	Sig. at 0.01	In the direction of Experimental group
central executive	1.66	18.65	12.8	1.82	10.6	Sig. at 0.01	In the direction of Experimental group
Total score	2.75	64.35	46	4.06	16.7	Sig. at 0.01	In the direction of Experimental group

t = 1.68 at the level of 0.05 t = 2.42 at the level of 0.01

Table 11 shows that there are statistically significant differences at the level of 0.01 between the mean scores of students of the experimental and control groups in the post-measurement on the scale of working memory in children with learning difficulties in favor of the experimental group.

Hypothesis 5:

There are statistically significant differences between the mean scores of students with learning difficulties in the two post and follow-up tests of the program with the information encoding scale for students with learning difficulties for the sequence test.
To verify the validity of this hypothesis, the researcher used the Wilcoxon test to find the differences between the average grade levels of students with learning difficulties in the two post and sequence tests.

Table 12. Differences between the average ranks of students' degrees with learning difficulties in the two post and follow-up tests of the program with the information encoding for students with learning difficulties

Variables	Measurement Pre – Post	No	Mean Rank	Sum of Rank	Z	Significance Level	Significance direction
Phonemic encoding	Negative Ranks Positive Ranks Ties Total	3 6 11 20	 4.5 5.25	 13.5 31.5	1.15	Sig. No	—

Symantec encoding	Negative Ranks Positive Ranks Ties Total	- 5 15 20	- 3	- 15	2.236	Sig. at 0.05	In the direction of follow
Phonemic and Symantec encoding	Negative Ranks Positive Ranks Ties Total	- 3 17 20	- 2	- 6	1.633	Sig. No	In the direction of follow
Total score	Negative Ranks Positive Ranks Ties Total	2 12 6 20	6 7.75	12 93	2.696	Sig. at 0.01	In the direction of Follow

Z = 2.58 at the level of 0.01 Z = 1.96 at the level of 0.05

Table 12 shows that there are statistically significant differences at the level of 0.01 between the average levels of students' degrees with learning difficulties in the two post and follow-up tests of the program in terms of the total score on the scale of information encoding for students with learning difficulties in the direction of the sequence test. Also, there are statistically significant differences at the level of 0.05 between the average ranks of students' degrees with learning difficulties in the two post and follow-up tests of the program in terms of semantic encoding on the information encoding scale for students with learning difficulties for the sequence test. It is also clear that there are no statistically significant differences between the average grades of students with learning difficulties in the two post and sequence tests of the program.

Hypothesis 6:

There are statistically significant differences between the mean scores of students with learning difficulties in the two post and sequence tests of the program with the working memory scale of students with learning difficulties for the follow-up test.

To verify the validity of this hypothesis, the researcher used the Wilcoxon test to find the differences between the average grade scores for students with learning difficulties in the two post and sequence tests.

Table 13. Differences between the average ranks of students' degrees with learning difficulties in the two post and follow-up tests of the program on the working memory scale for students with learning difficulties

Variables	Measurement Pre - Post	No	Mean Rank	Sum of Rank	Z	Significance Level	Significance direction
Articulatory Loop	Negative Ranks Positive Ranks Ties Total	5 2 13 20	3.9 4.25	19.5 8.5	0.654	No Sig.	—
Visual-Spatial sketchpad	Negative Ranks Positive Ranks Ties Total	4 3 13 20	4 4	16 12	0.378	No Sig.	—

Central executive	Negative Ranks Positive Ranks Ties Total	5 5 10 20	6 5	30 25	0.277	No Sig.	—
Total score	Negative Ranks Positive Ranks Ties Total	8 6 6 20	7.69 7.25	61.5 43.5	0.578	No Sig.	—

Z = 2.58 at the level of 0.01 Z = 1.96 at the level of 0.05

Table 13 shows that there are statistically significant differences between the average grades of students with learning difficulties in the two post and sequence tests of the program on the working memory scale for students with learning difficulties.

Hypothesis 7:

- There is a statistically significant positive correlation between the degrees of students with learning difficulties on the encoding information scale and their degrees on the working memory scale after the program.

To validate the hypothesis, the researcher used the Spearman equation to find the relationship between the degrees of students with learning difficulties on the encoding information scale and their scores on the working memory scale after the program.

Table 14. The relationship between the degrees of students with learning difficulties on the encoding information scale and their grades on the working memory scale after the program

Working memory / encoding information	Verbal	Verbal spatial	Central perform	Total score
Phenomic encoding	0.97**	0.89**	0.96**	0.96**
Semantic encoding	0.89**	0.97**	0.94**	0.94**
Phenomic and semantic encoding	0.96**	0.90**	0.96**	0.96**
Total score	0.95**	0.89**	0.94**	0.96**

Table 14 shows that there is a statistically significant positive correlation at the level of 0.01.

DISCUSSION

The results of the study showed the program's contribution to improving the level of encoding for students with learning difficulties, as the ability of students to use special techniques that help them encoding the information well increased, which positively reflected on their ability to store, preserve, and retrieve information as shown in Table (7). The second hypothesis clarified the effectiveness of the sessions and activities presented to them, and that the foundations on which the program was prepared are appropriate for the experimental group students, as their ability to have both phonemic and semantic coding increased significantly compared to their peers from ordinary students as illustrated by the second hypothesis in a table (8). This is in line

with Hayes, 1987) study whose results confirmed the importance of good encoding by finding correlations between the learned material and the cognitive structure stored in memory, and that the more these correlations are, the deeper the coding of information and therefore does not require effort in the retrieve process.

The researcher also believes that the result of the third hypothesis is consistent with the objectives of the program, as students have increased the ability to memorize textual vocabulary and convert it into phoneme syllables, as well as increased their ability to analyze, compose, and enrich words as shown in Table (9). This is what Baddeley's (1972) study examined, as it showed the semantic encoding in short-term memory and its impact on the first component of recording information through encoding, as the study showed that using encoding strategies facilitates the retrieval of encoded information in a phonemic or a semantic way where it has strong effects in memory. The fourth hypothesis showed that the techniques that were activated during the program's sessions, such as the use of images to express the meaning of words, helped the students to understand the meaning of the words through a cognitive distinction between each other, which increased the opportunity to retrieve them and remember them, as the images helped to encode them deeply and thus reminds it faster.

The result of the fifth hypothesis is consistent with what was relied upon during the sessions of the program like representing the verbal, audio, and visual information to be more appropriate for encoding correctly, and this is shown in Table (12). It is clear from the sixth hypothesis that the techniques, which the students were trained on to memorize and encode information helped to improve the working memory performance, and it is possible to strengthen and activate the memory by linking the learned material and encoding it via different ways that make the student more positive and involved in the encoding process as Table (13), and this what Levy & Hinchley (1990) pointed out is the importance of improving the working memory performance. As when the working memory capacity is increased, identifying information becomes faster.

The last assumption, as shown in Table (14), reflects the ability of students to encode information and focus on forming links and relationships between these symbols through the cognitive strategies used and the impact of this on the working memory and the improvement of their level of effectiveness, and the extent to benefit from the program sessions, methods, and techniques presented through the students with learning difficulties responses in a positive and active manner.

CONCLUSION

In conclusion, in this research, I explored the efficiency of the program in improving the levels of information encoding of the students with learning disabilities, where the sessions include a number of exercises and activities aiming to used verbal, audio and visual information to be more appropriate for coding the information correctly. And the techniques that students were trained in to preserve information helped to improve the performance of working memory, and it is possible to strengthen and activate the memory by linking the learned material and encoding it in different ways that make the student more positive and involved.

General Recommendations

- Training students with learning difficulties to use a particular technique such as audiovisual aids to enable them to memorize and encode information in easier and more established ways at deep levels of the brain.
- The need to train students with learning difficulties to link the learning material to their cognitive structure in ways and knowledge strategies more effective to improve and activate the performance of working memory.
- Increasing interest in studies and research aimed at training children with learning difficulties to encode information, which is concerned with early therapeutic intervention.

Suggestions for further research

For further research on the current topic, the researcher suggests the following study:
-Encoding of Information into Long- Term Memory in children with Developmental Language Disorders

Conflict of interest

The researcher has no conflict of interest.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the approval and the support of this research study by grant no. 7544-SAR-2017-1-8-F from the Deanship of Scientific Research in Northern Border University in Arar, KSA.

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