

The Impact of a Training Program Based on Working Memory Strategy (Verbal and Symbolic) on Developing Word Reading Skills in Dyslexic Individuals - A Field Study on a Sample of Dyslexic Students from Fourth and Fifth Grade

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Abstract:

Reading is the process of extracting information from written language in order to construct meaning directly. It typically involves mentally processing visual symbols, comprehending them, and storing them. Proficiency in reading is indicative of competence in other academic subjects, while weakness in reading may lead to poor performance in other subjects. Therefore, educators, especially those responsible for curriculum development, focus greatly on developing children's reading skills during the early years of primary education. However, some children face clear difficulties in reading, extending beyond mere challenges in word recognition and decoding written symbols. Since working memory is responsible for encoding and decoding the read information, it is essential to utilize memory strategies in training these students to enhance and improve their reading abilities at all levels. This should be done practically, ensuring that they achieve good academic performance in reading activities. To achieve this, specialized training programs should be developed for students who struggle with reading, relying on verbal and symbolic memory strategies. This is the main objective of our current study.

Keywords: phonological awareness; dyslexia; reading words ; Working memory ;training program

1- Problem statement:

The learning process is built upon one of the most complex cognitive operations, which requires the utilization of working memory strategies in both its verbal and symbolic aspects. The verbal working memory strategy focuses on recognizing letter and word sounds and reading them, while the symbolic working memory strategy primarily involves encoding, decoding, comprehending, storing, and retrieving information when needed. Effective utilization of these strategies improves the performance of a range of educational skills, with reading being a fundamental process. Reading encompasses the ability to convert written symbols into spoken symbols, as well as understanding and distinguishing their meanings. This process requires visual, auditory, motor, and cognitive coordination.

Reading activity is considered one of the essential activities in the learning process, especially during primary education, where students build their scientific knowledge. However, not all students can master this skill with the required fluency and proficiency. Some struggle with reading difficulties, experiencing "specific difficulties in the basic phonological skills necessary for perceiving the relationship between spoken sounds and perceiving them as symbols" (Al-Zayyat, 2004, p. 49).

Moreover, they find difficulty in reading words and may demonstrate clear difficulties in reading performance across three levels (frequent words, infrequent words, pseudo-words).

Therefore, there is a need to train students with reading difficulties, commonly referred to as struggling readers, who are "students who have difficulty comprehending and decoding written symbols." This can be achieved by building training programs that help improve their reading skills and abilities, based on cognitive memory strategies (verbal and symbolic).

Therefore, the following question arises: Does the training program based on cognitive working memory strategies (verbal and symbolic) have a positive impact on developing the ability to read words at all three levels (frequent words, infrequent words, pseudo-words) among struggling readers?

2- Research Hypotheses:

- There are statistically significant differences between pre-test and post-test measurements in the ability to read frequent words in favor of the post-test measurement among struggling readers.
- There are statistically significant differences between pre-test and post-test measurements in the ability to read infrequent words in favor of the post-test measurement among struggling readers.
- There are statistically significant differences between pre-test and post-test measurements in the ability to read pseudo-words in favor of the post-test measurement among struggling readers.

3- Study Importance:

The significance of this study lies in focusing on the importance of cognitive working memory as a strategy to enhance reading ability among struggling readers, particularly because it is fundamental in the process of decoding, interpreting, and encoding written and verbal symbols. It helps improve academic performance in reading activities by providing practical training services that assist individuals in developing and enhancing their word reading abilities based on their working memory capacities (verbal and symbolic).

4- Study Objectives:

- This study aims to assist struggling readers in utilizing the cognitive working memory strategy (verbal and symbolic) and employing it to improve their reading ability across various dimensions.
- It attempts to mitigate the negative effects of reading difficulties in this group of struggling readers by developing a training program based on the cognitive working memory strategy (verbal and symbolic).
- It seeks to draw attention and raise awareness among stakeholders in the educational process about the significance of reading difficulties faced by struggling readers, especially during the early stages of primary education, where the foundations of reading and writing are acquired in the learning process.

5- Procedural Control of Study Variables:

- The training program based on the cognitive working memory strategy (verbal and symbolic): It is an experimental variable that involves building an organized and scientifically designed practical plan based on the cognitive working memory strategy (verbal and symbolic). Its aim is to train struggling readers to enhance their effectiveness in reading-related tasks and train them to master these tasks according to sound scientific principles.
- Reading ability: It is a dependent variable that refers to the ability to convert written symbols into spoken symbols, as well as understanding the meanings of these symbols and distinguishing between them. This requires visual, auditory, motor, and cognitive coordination. It is measured across three levels: the ability to read words (frequent, infrequent, pseudo-words) using a set of tests prepared by Mr. Ismail.

6- Study Sample:

The study sample consists of 8 students who suffer from reading difficulties out of a total of 20 weak readers studying in the fourth and fifth grades of primary school. They were purposively selected using the Raven's Progressive Matrices test to determine their intelligence level and a diagnostic reading ability test. The main characteristics of the study sample are as follows: Their age ranges from 9.5 to 12 years, they are in the fourth and fifth grades of primary school, their average intelligence quotient is 20.67, and they suffer from reading difficulties.

7- Research Methodology:

Since the research problem focuses on studying the impact of the training program based on the cognitive working memory strategy (verbal and symbolic) on developing reading ability among struggling readers, a quasi-experimental methodology with a pretest-posttest single-group design was adopted. The quasi-experimental approach is chosen because it aims to uncover the causal relationship between phenomena and variables compared to other methodologies.

8- Study Instruments:

- **Reading Test:** This test measures reading ability by directing the student to read a set of words at three levels: reading frequent words, reading infrequent words, and reading pseudo-words. It is divided into the following sections:

- **Frequent Words:** This test consists of 40 simple words that are relatively easier for the student, divided into simple and compound words, with 20 simple words and 20 compound words.
- **Infrequent Words:** This test consists of 40 words, divided into simple and compound words, with 20 simple words and 20 compound words.
- **Pseudo-Words:** It consists of two parts:
 - Part 1: It includes compound letters presented as a word without any meaning.
 - Part 2: It includes real words with mixed-up letters.

The student is instructed to read the words in order, and they are given a score of 1 for each correct word and 0 for each incorrect word at all levels of the test.

Raven's Matrices Test: This test consists of 20 images divided into three sets of papers, each carrying different shapes, where each shape is missing a part. The missing part is located in one of the drawn parts below the shape, and the child points to the parts below the page until the original shape of the image is completed, one by one. Initially, a demonstrative model is provided to the child to ensure understanding of the test. This test was adopted in this study as a diagnostic tool to identify the individuals in the main sample. The average intelligence quotient of the sample was estimated at 20.53.

9- Psychometric Characteristics of Study Instruments:

The reliability and validity of the tests were previously calculated within a project conducted by the Laboratory of Psychological and Educational Applications (LPPE) at Mentouri University Constantine. The project's title was "A Practical Diagnostic Model for Academic Learning Disorders (Reading and Mathematics) in School Students" as part of the National Program for Scientific Research.

Project Leader: Dr. Leila Ismail

- Training Program Based on Working Memory Strategies (Verbal and Symbolic)
- Program Name: Training Program Based on Working Memory Strategies (Symbolic and Verbal)
- **Problem Identification and Diagnosis:** The main problem lies in the difficulty that students face in mastering reading skills. They exhibit a range of symptoms, such as the inability to read words, whether common or uncommon, or pseudo-words, as well as difficulties with letter transformations, substitutions, and deletions, etc. Reading difficulties are diagnosed based on a set of tests, including the Raven's Matrices IQ Test.
- **Program Objectives:** The program aims to improve the reading ability of a sample of fourth and fifth-grade students with reading difficulties by developing their word reading skills at various levels (common, uncommon, pseudo-words). This enables students to read words accurately and recognize written symbols and letters in terms of their form (morphology) and sound (phonology). This is achieved by utilizing their abilities to employ both verbal and symbolic working memory strategies in processing, storing, and retrieving letters, whether in terms of sound or shape.
- **Theoretical Foundation of the Program:** The program is based on the theoretical foundation of cognitive working memory, specifically its verbal and symbolic aspects. The program was designed

using an organized methodology and based on the findings of Arabic and foreign studies that explored the role of working memory in the reading process and its relationship to reading difficulties among students.

- **Methods Used in the Program:** Two methods will be used to train children with reading difficulties: the Orton Gillingham method and the Orton method. The selection between the two methods will depend on the training activity provided to the students.

- **Targeted Group:** The program targets male and female students with reading difficulties in the fourth and fifth grades of primary school.

- **Key Axes of the Training Program:**

- **Axis 1:** Practical Axis, which focuses on training to develop reading ability at the three levels (common words, uncommon words, pseudo-words) using the working memory strategy (verbal and symbolic) and applying practical training methods.

- **Axis 2:** Measurement of reading ability through pre-test and post-test assessments and comparing the results.

- **Dimensions of the Training Program:** The program is divided into three main dimensions, consisting of a range of diverse and progressively challenging sections:

- Dimension 1: Ability to read common words.

- Dimension 2: Uncommon words.

- Dimension 3: Pseudo-words.

- **Program Units:**

- **Unit 1:** Sub-objective: Recognition of letters and sounds within words and individually.

- Preparation Stage: Introducing different sounds and their corresponding letters, connecting letters and sounds, discovering sounds within words.

- **Unit 2:** Analyzing the phonetic units that make up a word or combining them to form a new word. In this stage, the child is trained to differentiate letters based on their sound and then analyze the word according to its sounds and positions.

- Sub-objective: Helping the child understand the relationship between sound and symbol.

- **Unit 3:** Segment processing and word analysis into segments, deleting segments.

- Sub-objective: Training the child to differentiate letters based on their sound and then analyze the word according to its sounds (recognizing words through their pictures).

- **Unit 4:** Recognition of sound through images.

- Objective: Recognizing sounds within words.

- **Unit 5:** Recognition of images through sound.

- Objective: Recognizing images that contain the required sounds.
- **Unit 6:** Recognition of similar words in sound and shape but with different positions and formations.
- **Objective:** Learning the association between letters and sounds in different positions and formations.
- **Program Duration:** The program is delivered over 12 sessions spread over 6 weeks, with two sessions per week. Each session lasts for 45 minutes.

The tools used in the program include various means and tools, such as:

- Pictures and illustrated cards
- Alphabet cards
- Computer
- Blackboard and chalk
- White papers
- Pencils
- Pictures of animals and objects

Presentation of Study Results:

1. Presentation and analysis of the results of the first hypothesis and its analysis: To test the validity of this hypothesis, the normality of the distribution was ensured using the Shapiro test and calculating the skewness coefficient. The results were as follows:

Tests of distribution normality

Resolution	(3,3-ient (Torsion coeffic		Shapiro Test		Moderation of distribution
	(Telemetry(n=8	-Pre (measurement(n=8	(Telemetry(n=8	-Pre (measurement(n=8	
Moderation of distribution	-1.309	-0.472	.1730	0.9560	Read frequently used words

Based on the results shown in the table regarding the reading of common words, since the significance level for the Shapiro test was calculated as (.9560 / .1730) for the pre-test and post-test, which is greater than (0.05), and the skewness coefficient was calculated as (-0.472 / -1.309), both values falling within the range of (-3, 3), it can be inferred that the distribution is normal.

2. Presentation and analysis of the results of the second hypothesis and its analysis: To test the validity of this hypothesis, the normality of the distribution was ensured using the Shapiro test and calculating the skewness coefficient. The results were as follows:

Tests of distribution normality

Resolution	(3 ·3-Torsion coefficient (		Shapiro Test		Moderation of distribution
	(Telemetry(n=8	-Pre (measurement(n=8	(Telemetry(n=8	-Pre (measurement(n=8	
Moderation of distribution	-0.088	-0.146	0.991	0.986	-Read non circulating words

Based on the results shown in the table regarding the reading of non-common words, it is evident that the significance level for the Shapiro test was calculated as (0.986 / 0.991) for the pre-test and post-test, which is greater than (0.05). Additionally, the skewness coefficient was calculated as (-0.146 / -0.088), and both values fall within the range of (-3, 3). Therefore, it can be inferred that the distribution is normal.

Presentation and analysis of the results of the third hypothesis and its analysis: To test the validity of this hypothesis, the normality of the distribution was ensured using the Shapiro test and calculating the skewness coefficient. The results were as follows:

Tests of distribution normality

Resolution	(3 ·3-Torsion coefficient (		Shapiro Test		Moderation of distribution
	(Telemetry(n=8	-Pre (measurement(n=8	(Telemetry(n=8	-Pre (measurement(n=8	
Moderation of distribution	0.041	0,218	0.630	0,336	Reading -quasi words

Based on the results shown in the table for the pseudo-words, it is evident that the significance level for the Shapiro test was calculated as (0.336 / 0.630) for the pre-test and post-test, which is greater than (0.05). Additionally, the skewness coefficient was calculated as (0.218 / 0.041), and both values fall within the range of (-3, 3). Therefore, it can be inferred that the distribution is normal.

Table (04): Means, standard deviations, and t-value with their significance between pre-test and post-test measurements in reading common words.

η^2	M.D	D.H	Value of t	(Telemetry(n=8		-Pre (measurement(n=8		0,96
				on	M	on	M	
0,96	0,000	7	-13.8	4.200	35.75	3.11	23.50	Read frequently used words

Based on the results recorded in the above table, we find that the t-value for the "t-test" was calculated as (13.89_) for reading common words, at a significance level of (0.000). Since the hypothesis is directional, the probability value (0.000) needs to be divided by two, resulting in (0.000). This value is smaller than the significance level (0.05), indicating significant differences between the pre-test and post-test measurements in the assessed abilities, favoring the post-test measurement among the study sample individuals. To further confirm the significance, the effect size value was calculated using the eta coefficient, which was determined as (0.96) in order. Since the effect size value is greater than (0.14), it signifies a large effect.

Table (05): Means, standard deviations, and t-value with their significance between pre-test and post-test measurements in reading non-common words.

η^2	M.D	D.H	Value of t	(Telemetry(n=8		-Pre (measurement(n=8		0.91
				on	M	on	M	
0.91	0,000	7	-8,47	3,42	31.62	3,31	21,12	Unspoken words

Based on the results recorded in the above table, we find that the t-value for the "t-test" was calculated as (8.47-) for reading non-common words, at a significance level of (0.000). Since the hypothesis is directional, the probability value (0.000) needs to be divided by two, resulting in (0.000). This value is smaller than the significance level (0.05), indicating significant differences between the pre-test and post-test measurements in the assessed abilities, favoring the post-test measurement among the study sample individuals. To further confirm the significance, the effect size value was calculated using the eta coefficient, which was determined as (0.91) in order. Since the effect size value is greater than (0.14), it signifies a large effect.

Table (06): Means, standard deviations, and t-value with their significance between pre-test and post-test measurements in reading pseudo-words.

η^2	M.D	D.H	Value of t	(Telemetry(n=8		-Pre (measurement(n=8		0.91
				on	M	on	M	

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				on	M	on	M	
0.91	0,000	7	-8,91	4,43	26,20	3,45	12,25	words-Semi

Based on the results recorded in the above table, we find that the t-value for the "t-test" was estimated at (8.91-) for reading pseudo-words, at a significance level of (0.000). Since the hypothesis is directional, the probability value (0.000) needs to be divided by two, resulting in (0.000). This value is smaller than the significance level (0.05), indicating significant and substantial differences between the pre-test and post-test measurements in the assessed abilities, favoring the post-test measurement among the study sample individuals. To further confirm the statistical significance, the effect size value was calculated using the eta coefficient, which was determined as (0.91) in order. Since the effect size value is greater than (0.14), it signifies a large effect.

Research Summary and Recommendations:

After implementing the training program, which was primarily based on the memory strategy (verbal and symbolic), consisting of a series of sessions that included various training activities aimed at enhancing and developing reading abilities among dyslexic students within a period of six weeks, with two sessions per week, and by applying pre-test and post-test measurements to assess their reading abilities, the following results were obtained:

Significant statistical differences were found between the pre-test and post-test measurements in the ability to read common words, favoring the post-test measurement among dyslexic students. The training program also achieved a significant effect on their reading ability.

Significant statistical differences were found between the pre-test and post-test measurements in the ability to read non-common words, favoring the post-test measurement among dyslexic students. The training program also achieved a significant effect on their reading ability.

Significant statistical differences were found between the pre-test and post-test measurements in the ability to read pseudo-words, favoring the post-test measurement among dyslexic students. The training program also achieved a significant effect on their reading ability.

This confirms that the training program, based on the cognitive memory strategy (verbal and symbolic), had a positive impact on the development of reading ability among dyslexic students.

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