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The Effectiveness of a Counseling Program Based on the Cognitive Load Theory in Developing Logical Thinking for Kindergarten Children

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ABSTRACT
The current research aimed at developing logical thinking for kindergarten children, through the use of a counseling program based on the cognitive load theory, and to identify the continuity of the effectiveness of the program after the end of the application and during the follow-up evaluation. To achieve this goal, the research sample consisted of (60) children at early childhood stage, and they were divided into two groups (i.e. experimental – control group), with equivalence in the experimental group in variables of age, intelligence and logical thinking. The following tools were used: Raven's Colored progressive matrices test of intelligence (prepared, modified and rationed by Ali, 2016), Logical Thinking Scale for Kindergarten Children (Prepared by the author), and a Counseling Program Based on the Cognitive Load Theory to Develop Logical Thinking for Kindergarten Children (Prepared by the author). It were found statistically significant differences between the mean scores of the experimental group members in the pre- and post-measurements on the logical thinking scale for children in favor of the post-measurement after the application of the program, and there were also statistically significant differences between the mean scores of the experimental and control group in the logical thinking scale for children in favor of the experimental group, while no statistically significant differences were found between the mean scores of the experimental group members in the post and follow-up measurements on the logical thinking scale.
keywords: logical thinking, cognitive load theory, counseling program

1. Introduction

Childhood is one of the most important stages in the formation of an individual's personality. It is a period in which tendencies and attitudes are formed, abilities become more open and skills and knowledge are acquired, and in which the course of the child's growth is determined physically, mentally, socially and emotionally. This is achieved to the extent that the surrounding environment provides its cultural, social and educational elements to the child, so that growth is allowed to reach its maximum goals.

Moreover, childhood is the cornerstone of the educational process, through which a child acquires basic information, skills and attitudes, and interacts with small environment within home and neighborhood to create an educational atmosphere that helps development and education (Mansi & Al-Munir, 2015, p. 4).

Thus, the interest in childhood in the developing countries has become a civilized and life necessity imposed by the current scientific and technological challenges. Therefore, the educational system for children in kindergarten is required to search for multiple ways for education, as well as to provide children with the appropriate educational environment for his mental and temporal age, in a way which arouses children's attention, and develops motivation and desire to learn and develops various thinking skills, including logical thinking (Ghanem, 2015, p. 11).

Modern education has tended to develop thinking of various kinds, including logical thinking. So, educational institutions have sought to develop and strengthen logical thinking in order to make it a habit acquired by children, and because this type of thinking requires the use of large amounts of information in order to reach logical solutions, and often occurs when using a large amount of information that exceeds the child's ability to absorb it, which is called the cognitive load, which in turn negatively affects the learning process (Jenny & Laura, 2017, p. 12).

In such a case, a child needs to reduce the cognitive load imposed on the working memory during learning, in order to learn based on the use of thinking skills and development. It addresses more than one sense, which facilitates the learning process and the work of memory until the correct link between variables and concepts is established. The cognitive load theory put forth two bases to achieve the greater amount of learning. First, the building of educational designs based on child's cognitive construction, and second, to highlight more on the construction method, and to link the child's cognitive construction with educational designs (Kamii & yasuhiko, 2017, p. 46).

Therefore, the problem of the current research was apparent in revealing the effectiveness of a counseling program based on the cognitive load theory to develop logical thinking for kindergarten children.

2. Problem of Research

The sense of the problem of the current research stemmed from what the researcher observed of the deficiency in the development of logical thinking in children of kindergarten, as many kindergarten children suffer from difficulty in reaching the desired goal, but they find many obstacles in their way to reach the logical sequence in the thinking process, as the logical thinking process requires the child to be able to organize concepts, divide knowledge and link each other to obtain a good level of understanding. And they also suffer from difficulty linking one concept to the other as well as concept organization and classification. The difficulty lies in the inability to perceive the similarities and differences between stimuli and observation, compare sizes and weights, added to the problem with the concepts of counting and numbers, the skill of cause and effect, the skill of perceiving relationships, and the skill of sequencing and arrangement, which are skills that fall under logical thinking processes.

This was confirmed by the results of the study conducted by Abdel Aty (2018), which indicated that the real issue in educating kindergarten children lies in the increased cognitive load, which is represented in the huge amount of knowledge, sciences and concepts that require a child to link them together, as the designers of curricula and educational programs for kindergarten children increase the cognitive load of children by increasing the amount of facts and concepts and solving problems in one unit of activity, and this in turn requires children to receive, code, encode and find relationships and procedural concepts. between them simultaneously, which leads to difficulty in receiving and processing them due to limited working memory.

The previous was confirmed by the results of studies by Abu Jaoude (2014), Al-Amiri (2017), Al-Sabab (2017), Hindiya (2016), Jalil (2016), Lopez, et al (2019), Makki (2018) and Yung and Paas (2017), which found a positive relationship between cognitive load, mental capacity, level of task difficulty, preferred learning style, and the effectiveness of programs based on cognitive load theory in improving the level of logical thinking skills, increasing cognitive achievement, information retention and visual thinking, spatial intelligence, as well as the effectiveness of learning through visual representation, and the strategy of cognitive supports, in lowering the level of cognitive load in kindergarten children.

The aforementioned statement agrees with Smith and Thompson's (2017) study, which indicated that a child's performance decreases when the level of cognitive load increases, and also with Haapalaainen et al (2018) study which indicated that the child's cognitive load constitutes a pressure on working memory during information processing, and the results of the Song's (2018) study that showed that a child's cognitive processes can be carried out without fatigue and suffering of working memory, if they are processed normally, and at the same time commensurate with the storage capacity. The results also indicated that when the processing burdens exceed the working memory capacity, it becomes one of the main reasons for not being able to carry out the processing process of information effectively, and the results showed a positive correlation between cognitive load and mental capacity, which is important for logical thinking.

Accordingly, the problem of the current research is stated in identifying the effectiveness of a counseling program based on the cognitive load theory in developing the logical thinking of kindergarten children, and thus, the research problem can be identified by answering the following main question:

- What is the effectiveness of a counseling program based on the cognitive load theory in developing the logical thinking of kindergarten children, and what is the possibility of continuing the effectiveness of the program after a period of time has passed from its application?

The following sub-questions arise from the main question:

1- Are there differences between the scores of the experimental group members in the pre- and post-measurements on the logical thinking scale for children after applying the program?
2- Are there differences between the scores of the experimental and control group members on the scale of logical thinking for children?
3- Are there differences between the scores of the experimental group members in the post and follow-up measurements on the logical thinking scale for children?

3. Research Objectives

The current research aimed at:

- Developing logical thinking among kindergarten children through a counseling program based on the cognitive load theory.
- Verifying the continued effectiveness of a counseling program based on the cognitive load theory among kindergarten children.

3.1. Theoretical framework and Literature Review

The subject of thinking has received wide attention in most educational research and its related practical applications, because thinking is a feature that distinguishes man from other

beings, a concept that has many dimensions and opinions, that reflects the complexity of the human mind and the complexity of its processes. Thinking is carried out through a series of mental activities carried out by the brain when exposed to a stimulus that is received through one or more of the five known senses. Thinking includes the search for meaning and requires a reflection and contemplation on the components of the situation or experience that a child is goes through (Jarwan, 2015, p. 42).

Abdel-Aal (2014, p. 225) defined it as: a dynamic purposeful activity, where an individual relies in his life on three mental processes, i.e. perception, remembering, and thinking. Through perception, an individual can obtain information from the environment, saves information through remembering to use it at future, while thinking deals with the information perceived and mixed by a person with those information.

It was defined by Al-Ghariri (2017, p. 84) as the thinking to be practiced at the attempt of finding the reasons behind things. And logic is the science that deals with the principles of thinking, as thinking logically occurs when we want to know the results of what we do. However, it is more than just determining cause and effect as it means obtaining evidence that supports or proves the validity of some point of view or its implementation.

Abu Al-Saud (2018, p. 47) pointed out that logical thinking is a type of thinking by which a result is obtained from introductions that include the result with all the included relationships, and depends on reasoning to understand and comprehend things, while reasoning is a step in the way of measurement, and thus it is noted that there is a reason to understand things by linking them to their causes or data to their results.

On the other hand, Mustafa (2020, 66) pointed out that logical thinking is evidence-based, and a type of thinking that helps us reach the best answer to the questions we ask or the problems we are trying to find a solution to.

According to Piaget, there are five characteristics that distinguish logical thinking:

3.1.1. Prepositional Reasoning

It is the reasoning that requires an individual to be able to infer the nature of the proportional relationship between more than one element using ratio and proportion (Allen, 2013, 62).

3.1.2. Controlling Variables

It requires an individual to be able to isolate factors that affect a particular phenomenon, among a set of pre-determined factors.

3.1.3. Correlational Reasoning

It requires the recognition of correlations between factors and then make a decision about them (Hallahan & Kauffman, 2013, p. 358).

3.1.4. Probabilistic Reasoning

It requires ability to study the quantitative relationships between the elements of a group or groups, determine the proportions of each, then compare the ratios and finally give certain probabilities.

3.1.5. Combinatorial Reasoning:

In their study, Jenny and Laura (2017) aimed to find out the impact of some methods of processing information associated with problem solving on cognitive load. The study sample consisted of (25) kindergarten children, and a problem-solving test and a PAAS cognitive

load scale were applied to determine the amount of mental effort used in problem solving. The study found that there was no significant effect of training on problem-solving information processing methods on cognitive load.

According to Baptiste and Bell (2015, 215), logical thinking in children can be understood according to the following assumptions:

- Logical thinking is a conscious cognitive mental process.
- Logical thinking is a process of finding relationships and links between phenomena, objects or events stored in the child's cognitive store.
- Logical thinking depends on what experiences and retained knowledge set in a child's mind.

In the current research, the following logical thinking skills are addressed:

- **Classification skills**: classification is one of the basic skills under logical thinking, which means learning the common characteristics between the vocabulary of a certain category that distinguishes it from other categories. Through classification, unfamiliar objects become more familiar, by linking new topics with the already known one, and classification is an essential component of human knowledge and thinking processes. Moreover, classification is a mental process by which certain things or phenomena are grouped on the basis of their common features, and the process of attributing or returning an object or phenomenon to a certain category confirms our knowledge of objects or phenomena (Doolittle, 2017, p. 81).

- **Sequencing skill**: It is the organization of information or objects according to a sequence, either temporal (the presentation of historical events according to their chronological occurrence) spatial (such as displaying objects or events according to their proximity or distance), or other criteria (such as ordering by size, weight, and height).

- **The relationships perception skill**: faced with two or more things, a human mind tends to realize the relationships between them and thus are called that the mind compares between them with belongings, and the attribute or idea that connects them is called the existing, as well as the relationship between night and day is an antagonistic relationship that determines the difference between them.

- **Deduction skill (cause and effect):** it refers to identifying and providing the necessary elements to draw logical conclusions of intended or actual inferential relationships among statements, adjectives or questions through logical steps (Richardson & Webster, 2016, p. 144).

Mental development and the development of logical thinking for the kindergarten child is a basic pillar of the formation of a normal personality for the integrated, where it is imperative for the development of thinking programs to achieve basic goals for the upbringing of the kindergarten child in light of the need for these young people to express their ideas in multiple ways and methods They possess tremendous energies and use innovative methods in dealing with different situations They resort to the use of symbolic media or mental images or rich activities of drawing and coloring, and such capabilities represent another pillar of the pillars Development of logical thinking (Masoudi, 2015, p. 58).

The study by Abou Jaoude (2014) aimed to identify the impact of an educational program based on the theory of cognitive load in developing the critical thinking skills of the kindergarten child. The study sample consisted of (60) children, in Zarqa Governorate, Jordan, who were divided into two equal experimental and control groups. By measuring the impact of the program by testing critical thinking skills, the study found the effectiveness of the program in improving the level of the experimental group of critical thinking skills, and

there are differences between males and females in thinking skills The critic after being exposed to the program in favor of females.

The cognitive load theory is a cognitive theory that sought to identify the means and methods that reduce the level of cognitive burden resulting from the limited mental capacity of working memory. Thus, it is thought that the likely absence of interaction among the cognitive elements makes a child able to absorb the learned material better. It also attributed the increased cognitive load resulting from the limited working memory to the nature and method of processing information that requires great interaction between many cognitive elements (Al-Banna, 2014, p. 10).

The cognitive load was defined by Qatami (2018, p. 84) as the total amount of mental activity during processing in working memory at a certain period of time, and can be measured by the number of cognitive units and elements that contribute to mental processing at a specific time.

In his study, Ragdan (2017) aimed at identifying the impact of the level of difficulty of task and the experience of a child on the cognitive load associated with solving problems, on a sample of 40 boys and girls, with age ranged between (4-6) years, It were found statistically significant differences in the decreased level of cognitive burden associated with solving problems according to levels of difficulty and in favor of the level of the easy task.

Cognitive load refers to the load placed on working memory during problem solving. It also refers to the total cognitive charge of a task through two main parts: the intrinsic cognitive load and the Extraneous cognitive load. For the Intrinsic Cognitive Load, it refers to the number of elements that have to be processed simultaneously in working memory, which means the interaction of these elements with each other, causing the cognitive load and requires dealing with the internal cognitive load of a learner through educational processors. For example, the burden can be reduced internal knowledge by deleting some elements and relationships in the initial stages of education or replacing them with relatively simpler tasks (Periem & Dion, 2015, p. 147).

Extraneous Cognitive Load, on the other hand, is the load on working memory caused by the educational conditions and the learning environment. The way information is presented to the learner, and this type of cognitive load depends partly on the environment, as it is considered an excess of the information being learned (Matar, 2016, p. 22).

According to Mahdi (2017, p. 33), the cognitive load is either affected by the internal nature of the material (internal cognitive load) or by the way in which the information or activities required of the learners are presented (external cognitive load). Moreover, a child who suffers from the cognitive load shows symptoms of disability, mental closure, low level of competence and motivation in performing tasks, difficulty in collecting information, inability to retain the required information, in addition to the inability to understand it, even with a high degree of attention to the stimuli presented. If the concept contains many elements that cannot be processed simultaneously in working memory, the concept becomes difficult to understand (Yaman, 2017, p. 83).

Moreover, Lopez et al (2019) conducted a study which aimed at identifying the impact of the cognitive supports strategy on the cognitive load and academic achievement of children. The study sample consisted of (54) children, and it were found statistically significant differences between the experimental and control groups in academic achievement and cognitive load in favor of the experimental group.

4. Research Methodology

4.1. Research Sample

The research sample consisted of (60) children with age ranged between (5 - 6) years old. The chronological age of the sample was considered (i.e. 5 to 6 years old), with equivalence in terms of chronological age. All children of the sample were not suffer from any disabilities, and this was done by asking their caregivers, the careful observation of the children by the researcher, and through the general appearance. In addition, the homogeneity of children in terms of the economic-social-cultural level were taken into account, by choosing schools from one geographical area.

The respondents were divided into two equal groups; i.e. the experimental group (N= 30 children), with applying the training program to them. The second group, the control group (N = 30 children) did not receive any experimental treatment.

The researcher conducted equivalence between the two groups of the study in the demographic and basic variables, as follow:

First: Equivalence between the control and experimental groups in demographic variables:

The two groups (i.e. the experimental and control groups) were matched before applying the program in the variables of chronological age, IQ; and the (T) test was utilized to measure the significance of the differences between the mean scores of the experimental and control groups in age and IQ. The results are presented in Table 1.

Table 1.
Means and standard deviations, Rank averages, the sum of ranks, the value of (Z) and its significance for equivalence between the two groups (i.e. the experimental and control groups) in chronological age and IQ

Variables	Group	N	Means	Standard Deviations	Mean Differences	T-Value	Significance Level
Age	Experimental	30	67.30	3.21	0.16	0.171	insignificant
	Control	30	67.31	3.22			
IQ	Experimental	30	110.73	3.96	0.86	0.847	insignificant
	Control	30	111.60	3.95			

It is evident from Table 1 that the T value is not statistically significant, which indicates that there are no differences between the two groups. Moreover, it is evident that the averages of the two groups (i.e. the experimental and control) are close in both chronological age and IQ.

Second: The equivalence of the experimental and control groups in the dimensions of the logical thinking scale:

The T - test was utilized to measure the significance of the differences between the mean scores of the experimental and control groups in the pre-application of the logical thinking scale, and the results are presented in Table 2.

According to Table 2, there are no statistically significant differences between the mean scores of the children of the two groups (the experimental and control group) in the pre-application of the logical thinking scale, as the (t) test is not statistically significant; as the (t) value calculated from the test is smaller than the value of tabular (t) value. These results come to confirm the equivalence of the two research groups before the start of the experiment. The results also show that the mean scores of the children of the two groups

(experimental and control) on the dimensions of the logical thinking scale are close, meaning that the two groups are equivalent, and this is a necessary condition for conducting the experiment, which is that the two groups are equal before applying the program.

Table 2.
The value of T for the comparison between the mean scores of the research sample (i.e. the experimental and control group) on the logical thinking scale in the pre-application

	Group	N	Mean	Standard Deviation	Mean Difference	Calculated T	Significance
Classification	Experimental	30	18.00	1.53	0.066	0.166	Insignificant
	Control	30	18.06	1.57			
Symmetry	Experimental	30	14.50	2.59	0.23	0.333	Insignificant
	Control	30	14.26	2.82			
Sequencing	Experimental	30	14.96	1.79	0.26	0.564	Insignificant
	Control	30	15.23	1.86			
Cause and Effect	Experimental	30	15.50	2.40	0.56	1.015	Insignificant
	Control	30	16.06	1.89			
Logical Thinking	Experimental	30	62.69	5.08	0.66	0.474	Insignificant
	Control	30	63.63	5.78			

4.2. Research Tools

4.2.1. The Colored Progressive Matrices Test for IQ by John Raven (Amended and Standardized by/ Emad Ahmed Hassan Ali, 2016)

The test consists of three sections of gradual difficulty are (A, Ab, and B). Each section includes (12) items and the respondent has to choose the missing part of the design from among (6) given alternatives, there is only one correct alternative, and he gives one mark for the correct answer, and zero for the wrong answer.

In calculating the validity of the test in its original form, several methods were used, including: factorial validity, predictive validity, and correlative validity, by calculating a correlation coefficient with each of the Stanford Bennett scale, the Wechsler scale, and the man drawing test. The values of the correlation coefficients ranged between (0.23-0.86), and all of them has a (0.01) level validity.

4.2.2. The Logical Thinking Scale (Prepared by the Researcher)

The scale aims to measure the logical thinking of children, in order to obtain codified data that can be subjected to statistical analysis in order to select the research sample, and to identify the level of logical thinking through pre-measurement and the effectiveness of the program in developing logical thinking by comparing the pre- and post-measurement for scale.

Based on a literature and previous scales review, the researcher defined the concept of logical thinking, identified its components, and then formulated it with the scale vocabulary in a simplified and easy manner devoid of complexity, as follows:

Table 3.
The Scale Dimensions

Basic Dimensions	Numbers of Items
Classification	15
Symmetry	10
Sequencing	12
Cause and Effect	13
Total Score	50

The researcher took into account the nature of the research sample, and attempted to make the scale simple in its content and express the real capabilities of this category. Moreover, it was taken into account the number of phrases, the length of the scale, and the accuracy of its expressions, as the researcher sought to formulate the phrases in their initial form to be easy, clear, and short, and not carry more than one meaning; and to measure what was set to measure it without ambiguity, and to express different points of view, and for the response to be useful and short.

After reviewing the previous scales, the theoretical framework, and the meetings and interviews that the researcher held with the children, their teachers, and their parents, the researcher determined the dimensions of the scale and formulated the scale items so that the scale consists of (50) distributed on the following dimensions:

Table 4.
The Logical Thinking Scale Items Numbers and Dimensions

Main Dimensions	**Scale**		
	No. of Items	**Min. Score**	**Max. Score**
Categorization	15	15	45
Parallelism	10	10	30
Sequencing	12	12	36
Cause and Effect	13	13	39
Total Score	50	50	150

The researcher used several methods to ensure the validity of the logical thinking scale including the logical validity and internal consistency. To prove logical validity, the researcher has built a scale of logical thinking and developed appropriate vocabulary to measure each component separately by calculating the average and relative weight of each component, and it falls under this type what is called the honesty of the arbitrator. In addition, the scale was presented in its initial form to a group of professors specialized in the field of education, curricula and kindergarten. For the internal consistency, the internal consistency of the items and dimensions of the scale were calculated. Specifically, the correlation coefficients between the degree of each statement and the total degree of the dimension to which this statement belongs were calculated.

The reliability of the scale was verified by Cronbach's alpha method and the test-retest method, where the researcher calculated Cronbach's alpha reliability. A high reliability coefficient of Cronbach's alpha on the logical reasoning scale was found, which proved reliability to be used.

4.2.3. A Counseling Program Based on the Theory of Cognitive Load Theory to Develop Logical Thinking for Kindergarten Children. Preparation (By the Researcher)

The counseling program is based on the cognitive load theory, which aims to develop the logical thinking of kindergarten children. The program aims to develop logical thinking, whose dimensions are represented as (classification, symmetry, sequencing, and cause and effect) in children through a counseling program based on the theory of cognitive load. The program includes 42 sessions, and its implementation took 3 months.

In preparing the program, the researcher relied on several sources, including access to programs designed for kindergarten children and studies that dealt with programs based on the cognitive load theory, as well as the theoretical framework of the study.

The current program aims to develop logical thinking, whose dimensions are represented as classification, symmetry operations, sequencing process, cause and effect in children through a counseling program based on the theory of cognitive load.

In addition, the procedural objectives (learning outcomes) of the program have been identified, and it has been taken into account the three domains (i.e. cognitive, emotional, and behavioral domains).

The research was conducted according to the following steps:

1- The researcher designed a scale of logical thinking for kindergarten children. The program is based on the cognitive load theory to develop the logical thinking of kindergarten children, and presented them to the supervisors, then they were rated by specialists in the field and modified some phrases based on their guidance.

2- After obtaining approval for the field application of the study, the researcher went to the chosen school administration, and obtained the approval for the field application.

3- The researcher conducted survey study using the logical thinking scale of kindergarten children and the program based on the theory of cognitive load to improve logical thinking; to verify the validity of these tools for application, as well as the extent to which they are suitable for the children of the study sample and their different characteristics and abilities.

4- After confirming the validity of the tools, the researcher conducted the pre-measurement using Raven progressive matrices, and the logical thinking scale (prepared by the researcher), to measure the extent of equivalence between the children of the control and experimental groups, and between the children of the experimental group themselves; and then carried out the pre-application of the logical thinking scale.

5- After completing the application of the program sessions, the researcher conducted the post-application of the kindergarten children logical thinking scale on the control and experimental groups, in order to verify the research hypotheses and achieve the objectives of the study.

6- One month after the post-application, the researcher conducted the follow-up measurement of the logical thinking scale on the control and experimental groups.

5. Results and Discussion

The first hypothesis states that "there are statistically significant differences between the mean scores of the experimental group in the pre and post measurements on the logical thinking scale in favor of the post measurement after applying the program." To validate this hypothesis, the means, standard deviations, and t-value for the differences between the two measurements were calculated in the logical reasoning scale. Table 5 presents the means, standard deviations, t-value and its significance.

According to Table 5, there was a statistically significant difference between the mean scores of the experimental group students in the pre and post application of the logical thinking scale, as the (t) test is statistically significant; Because the calculated (t) value from the test is greater than the tabular (t) value with 58 degrees of freedom and a level of statistical significance (0.05). These results come to confirm the effectiveness of the program.

Table 5.
The "t" value for the comparison between the mean scores of the experimental group on the logical thinking scale in the pre and post application

	Group	N	Mean	Standard Deviation	Mean Difference	Calculated "t"	Significance
Classification	Pre	30	18.00	1.53	19.63	30.396	0.01
	Post	30	37.63	2.64			
Symmetry	Pre	30	14.50	2.59	11.86	20.092	0.01
	Post	30	26.36	1.62			
Sequencing	Pre	30	14.96	1.79	15.66	23.320	0.01
	Post	30	30.63	2.49			
Cause and Effect	Pre	30	15.50	2.40	17.83	27.794	0.01
	Post	30	33.33	2.64			
Logical Thinking	Pre	30	62.96	5.08	65.00	39.668	0.01
	Post	30	127.96	5.36			

Thus, the first hypothesis was verified, as the (t) value denotes the differences between the mean scores of children in the pre and post application on the logical thinking scale in the direction of the post measurement. This indicates the effectiveness of the counseling program based on the theory of cognitive load used in the current research, which led to a high average score of children on the logical thinking scale, which includes its dimensions (i.e. classification, symmetry, sequence, cause and effect), as well as the total score of the scale.

The indications of the differences between the scores of children in the pre and post measurements on the logical thinking scale are in favor of applying the use of the counseling program, which relies in its design on a set of strategies that use the brainstorming process in thinking, and the process of generating solutions and ideas for problems, and focuses on the child's positivity and activity through its reliance on more than one of the five senses, the audio-visual presentation in an interesting and attractive manner, and a strong focus on the cognitive aspect, which is the first pillar of the logical thinking process.

The researcher attributes the increase in the rate of improving logical thinking skills to the nature of the counseling program, which relies mainly on the brainstorming aspect, and also to the increase in the number of activities and exercises included in the program, which had a significant impact on the increase in this percentage. This was confirmed by many researches and studies, including the study of Zaidan (2017), which indicated the effectiveness of using the program in developing both classification sequence, memorization of information, logical reasoning, and the total score of the logical thinking skills test. Other studies including Al-Masoudi (2015) indicated that there are statistically significant differences between the pre and post children's scores on the logical thinking scale in favor of the post application, and also indicated the effectiveness of a counseling program and the use of its strategies in improving logical thinking skills and generating ideas among children.

The researcher concluded by interpreting the first hypothesis of the current research, and the results of previous studies that used programs in the development of logical thinking, to the importance of using the program, and the results indicated the extent of its effectiveness and its positive impact on children's scores on the logical thinking scale.

The second hypothesis states that "there are statistically significant differences between the mean scores of the experimental and control group members in the post-measurement on the children's logical thinking scale in favor of the experimental group". To validate this hypothesis, the means, standard deviations, and t-value of the differences between the two groups in the dimensions of the logical thinking and assistance scale were calculated. Table 6 presents the means, standard deviations, t-value and their significance. The results of the hypothesis can be presented as follows:

Table 6.
The "t" value for the comparison between the mean scores of the experimental and control groups on the logical thinking scale in the post application

	Group	N	Mean	Standard Deviation	Mean Difference	Calculated "t"	Significance	Direction of Significance
Classification	Exp.	30	37.63	2.64	19.33	34.371	0.01	Exp.
	Control	30	18.30	1.57				
Symmetry	Exp.	30	26.36	1.62	11.90	18.750	0.01	Exp.
	Control	30	14.46	3.07				
Sequence	Exp.	30	30.63	2.49	14.76	23.401	0.01	Exp.
	Control	30	15.86	2.38				
Cause and Effect	Exp.	30	33.33	2.64	15.33	23.181	0.01	Exp.
	Control	30	18.00	2.47				
Logical Thinking	Exp.	30	127.96	5.36	61.33	42.736	0.01	Exp.
	Control	30	66.63	5.74				

The results of the second hypothesis indicate that there are statistically significant differences between the mean scores of the experimental and control groups in the post-measurement of the logical thinking scale in favor of the experimental group. It was applied to the experimental group, including procedures, strategies and techniques of counseling, which would have led to the development of logical thinking among children.

However, the control group members did not improve in the post-measurement of logical thinking, which was expected since the members of this group did not receive any training and were not subject to the application of the program. The results of this hypothesis agreed with the study of Robertson (2013) which indicated the effectiveness of programs based on counseling provided to children in developing children's thinking skills.

Moreover, it is believed by the researcher that the use of collaborative learning groups has facilitated the learning process for children, due to the organization of the educational environment, the setting of goals clearly and accurately, as well as the clarity of tasks and the required educational activities, the identification of the role of each child, and the exchange of roles between them.

To verify the third hypothesis (i.e. there are no statistically significant differences between the mean scores of the experimental group in the post and follow-up measurements on the children's logical thinking scale), the means, standard deviations, and t-value for the differences between the two measurements were calculated in the logical thinking scale. Table 7 presents the means, standard deviations, t-value and its significance.

Table 7.
The t-value for the comparison between the mean scores of the experimental group on the logical thinking scale in the post and follow-up application

	Group	N	Mean	Standard Deviation	Mean Difference	Calculated t	Significance	Significance Direction
Categorization	Follow-up	30	37.73	2.51	0.10	1.795	0.083	Insig.
	Post	30	37.63	2.64				
Symmetry	Follow-up	30	26.46	1.61	0.10	1.795	0.083	Insig.
	Post	30	26.36	1.62				
Sequence	Follow-up	30	30.73	2.43	0.10	1.361	0.184	Insig.
	Post	30	30.63	2.49				
Cause and Effect	Follow-up	30	33.53	2.64	0.20	1.649	0.110	Insig.
	Post	30	33.33	2.64				
Logical Thinking	Follow-up	30	128.46	5.40	0.50	3.042	0.05	In favor of follow-up
	Post	30	127.96	5.36				

According to Table 7, no statistically significant differences were found between the mean scores of the experimental group of students in the post and follow-up application of the logical thinking scale, except for the total score, which was significant at 0.05 level.

Accordingly, it is evident that the third hypothesis has been verified, where the t-value denotes the differences between the mean scores of the children of the experimental group in the post and follow-up measurements of applying the counseling program based on the theory of cognitive load, and after a month of the program application on the logical thinking scale (non-significant), which indicates The continuing impact of the program on the research sample children after the application of the program during the follow-up period.

This result was matched to Abul-Saud (2018), which confirmed the possibility to develop logical thinking abilities in all children, provided that the type of programs offered to them is well-chosen.

These results are attributed to the continuity of the effectiveness of the independent variable (i.e. the counseling program based on the theory of cognitive load), which led to the development of logical thinking among kindergarten children. In addition, the program's dependence on many strategies and techniques that attract children such as reinforcement, dialogue, and discussion, had a clear impact on the continued effectiveness of the program.

It is believed that the productive environment of the program which was experienced by children had a role in providing them with logical thinking, which continued even after the end of presenting the program.

6. Research recommendations and Suggestions

According to the results and implications of the current research, the following recommendations and suggestions were made:

- Logical thinking skills should be incorporated in the curricula of kindergarten children.
- Children's families should be educated and provided with counseling programs to familiarize them with the importance of training children on logical thinking skills.
- Training courses should be provided for kindergarten teachers; to keep them updated with the all-new and the need to pay attention to the cognitive load of children in kindergarten.
- Training and continuous follow-up should be provided to all those involved in the education of pre-school children (i.e. family, teacher, and the kindergarten administration) to develop, maintain and strengthen logical thinking skills among children.

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