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The Effectiveness of the Intervention Trial in Simplifying Some Concepts of the Immune System among Kindergarten Children

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Abstract

Background: The immune system is a complex network of specific immune cells and proteins that work in synergy to protect the body from foreign invaders and harmful toxic substances from the environment. The researchers found that most of the children's questions were related to the child's attempt to know some of the terms related to the immune system and its mechanism of dealing with pathogens Aim: the current research aimed to verify the effectiveness of the story of our amazing immune system in simplifying some concepts of the immune system for kindergarten children. Subject and methods: the research was applied to a sample of 50 children enrolled in the second level of Muhammad Abu Zaid Al-Saidi School affiliated to the West Al-Mahalla Educational Administration, and the researcher followed the semi-experimental approach and adopted the experimental design with one group (pre and post application on one experimental group), The research tools were represented by the researcher preparing a picture story entitled "Our Amazing Immune System" in order to involve the child in cognitive processes through which the researcher simplifies some concepts of the immune system, and preparing: a battery for assessing the knowledge of some concepts of the immune system in kindergarten children, and the T- test was used for analyzing the data quantitatively. Results: the results revealed that there were statistically significant differences at the level of significance ($\alpha \leqslant 0.05$) between the mean scores of the children of the experimental group for the pre and post measurements on the battery of assessing the knowledge of some concepts of the immune system for the kindergarten child, which indicates the effectiveness of the story used in simplifying some concepts of the immune system of a kindergarten child..

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Keywords: *Stories, the immune system, kindergarten child.*

Introduction

Humanity has repeatedly faced epidemics of known and new pathogens, and the immune system has adapted to survive. Perhaps this is what we are witnessing in the current period of the spread of emerging diseases (Covid-19), which made children ask many questions regarding the spread of the Corona virus; This prompted the researchers to conduct a

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questionnaire directed to families in order to find out the most frequently asked questions by their children related to the period we are currently witnessing from the spread of emerging diseases, home quarantine, social distancing, and following precautionary measures.

Children's thoughts and daily questions in every branch of science are logical questions, and therefore, if left undiscussed and untreated, they can be an obstacle to learning **(Malleus *et al.*, 2017),** and this is what prompted researchers to design a story aimed at providing the child with knowledge about some concepts of the immune system, with the researchers fully aware that the process of educating the kindergarten child stems from sensory processes, hence the following question: How do we teach the child the concept of the immune system of the human body on the basis of his thinking and sensory education? What are the levels of abstraction that are adopted to convey the concept to the child?

Despite making sure that the child's education is sensory, and the researcher wants to communicate the concept, but I do not have a second solution other than the scientific simplification of the concept using the picture story, and there are many studies that dealt with illustration of scientific concepts, such as the study of **Hadzigeorgiou, (2015)** that focused on the ideas of young children in Physical sciences, specifically on the concepts of matter, changes in the state of matter, heat, evaporation, water cycle, force, buoyancy, sinking, electricity and light, and the study of **Malleus *et al.*, (2017)**, which aimed to reveal children's concepts towards some scientific concepts such as clouds and waterfalls, and address children's misconceptions about them and illustrate concepts in a scientifically sound manner. The study of **Kalogiannakis *et al.*, (2018)** aimed to examine whether five- to seven-year-olds could develop their understanding of the concept of gravity and planetary knowledge using hands-on activities, as well as smart mobile devices and the Scratch programming environment, The results of the study were very encouraging as the children began to develop an understanding of the concept of gravity, and there was an improvement in their existing knowledge of the planets.

The immune system is a complex network of specific immune cells and proteins that work in synergy to protect the body from foreign invaders and harmful toxic substances from the environment. Foreign substances that trigger an immune response are called antigens **(Vojdani *et al.*, 2020). Chaplin (2010)** noted that the immune system protects a child's body from external invaders, such as bacteria, viruses, fungi, and toxins (chemicals produced by microbes), and is made up of different organs, cells, and proteins that work together.The human body has three basic lines of defense to fight off foreign invaders, including viruses, bacteria, and fungi. The three lines of defense of the immune system include physical and chemical barriers, innate (non-specific responses), and adaptive (specific) responses **(Howell & Shepherd, 2018; Saghiv & Sagiv, 2020).**

There are two main parts of the immune system. **The first is the innate immune system**, which is the body rapid immune response system. It patrols a child's body and is the first to respond when it finds an invader. The innate immune system is inherited and active from the moment a child is born. When this system identifies an invader, it starts working immediately. The cells of this immune system surround the gas and swallow it. The invader is killed inside the cells of the immune system. This process is called phagocytosis **(Nicholson, 2016). The second is the acquired immune system**. The acquired immune system, with the help of the innate system, produces cells and antibodies to protect the body from germs. These antibodies are developed by B lymphocytes after the body is exposed to invaders. The antibodies remain in the child's body. It may take several days for antibodies to form. But after the first exposure, the immune system will recognize the germ and defend it. The acquired immune system changes throughout a child's life, and immunizations help the child's immune system to make antibodies to protect it from harmful diseases **(Delves & Roitt, 2000).**

Many scientists, such as **Nasr & Lakkis, (2016); Carver, (2017); Nikolich-Zugich, (2018) and Lewis & Blutt, (2019)** mentioned the parts of the immune system as follows: bone marrow, lymph nodes and vessels, spleen, Skin, thymus gland, tonsils. A number of different cells work together within the immune system to fight infections and diseases such as B cells, CD4+ helper T cells, CD8+ killer T cells, dendritic cells, macrophages, and regulatory T cells. Each type of these cells plays an important role in identifying, differentiating, and destroying harmful cells that enter or develop in the body **(Nicholson, 2016).**

Xie (2022) indicated that during infancy we find that children acquire a collection of stories. Even if they can't read, children love to see the pictures of those books and convince their parents to read them. Picture stories are designed stories that include pictures and illustrations to tell a story. Some of these only tell the story with pictures without any text but others use both text and visual. Children prefer visuals over written text. They have always been attracted by the world of colors and visuals shaped like illustrations or cartoons in picture books; each page turn reveals a new image or group of images. This continuity takes more and more children's attention. The use of storytelling to learn science is a wonderful and effective method that helps to acquire basic science concepts and develop scientific concepts in the long term. Learners remember more science concepts when they are taught through

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storytelling-based teaching methods **(Zhang et al., 2020).**

Subject and methods:

Study design:

The current research followed the **quasi-experimental research approach**, which aims to study events and problems based on the scientific method based on observation, imposing hypotheses, and a precise controlled experiment that controls the adjustment of different variables intentionally, and the **experimental design of one group (measurement before the experiment)** was used research and then for one group); Where the research group was deliberately chosen from the phenomenon community, and the dependent research variable was measured before the influence of the experimental variable (the independent variable), and then measured again after the experiment; This is to detect the differences between the averages of each variable before and after the experiment. .

Sample:

The current research was limited to 50 kindergarten children enrolled in the second level, KG 2, at the Muhammed Abu Zaid Al-Saedi Primary Joint School in the village of Balqina, Al-Mahalla Al-Kubra district, Gharbia Governorate, which is affiliated to the West Al-Mahalla Educational administration.

Research tools:

1- **Experimental tool: a storyboard entitled "Our Amazing Immune System"**

The story is read to the child, taking care to engage in dialogue with the child so that there is interaction throughout reading the story; this is to involve the child in cognitive processes in which some concepts of the immune system are simplified. The story consists of 22 scenes in addition to the cover; So that each scene of the story includes a component of the immune system and the role it plays within the immune system. The last three scenes of the story aim to develop the child's awareness of the methods that enhance the immune system. Below are pictures of some of the story's scenes:

Figure (1) Story cover photo

2- **Measurement tool: a battery to assess the knowledge of some concepts of the immune system of a kindergarten child.**

- **Introducing the battery:** It consists of three parts to assess the knowledge of some concepts of the immune system in kindergarten children.
- **Battery description:**

- This battery aims to reveal the kindergarten child's knowledge of some concepts related to the human body's immune system by conducting structured interviews with the children of the research sample.
- The battery was designed in three parts (the first part aims to assess the child's knowledge about germs, the second part aims to assess the child's knowledge of some information about the mechanism of the immune system of the human body, and the third part aims to measure the kindergarten child's awareness of some healthy methods to strengthen the immune system.
- The battery is not designed as a standardized test; this is due to the difficulty of applying a test that includes 59 questions to the child in one interview.
- The battery contains a set of questions. During its formulation, the researcher took into account the use of simple language appropriate to the nature of the age and mental stage of the kindergarten child. So, the questions are written in the language of the child.
- The battery includes some questions aimed at determining the child's knowledge of some terms; this is to determine the child's knowledge of some of the components of the immune system.
- The illustrated questions contained in the battery contain drawings that were specially designed for research.

- **Battery correction key**
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Table (1): ***The key to correcting the battery for evaluating the knowledge of some concepts of the immune system of a kindergarten child***

Battery parts	Full mark
The first part: a test measuring the kindergarten child's knowledge of germs.	**The test consists of sixteen (16) questions, the researcher gives one point for each question in case the child answers were wrong or refuses to answer the question, and two degrees in case the child answers were correct, so that the total score for the test is 32. (The range of scores ranges from 16 to 32).**
The second part: a test to measure the kindergarten child's knowledge of some concepts of the immune system.	**The test consists of twenty-five (25) questions, the researcher gives one point for each question in the event that the child answers were wrong or refuses to answer the question, and two marks in the case of the child answers were correct, so that the total score for the test is the sum of the child's responses to all the questions is 50 (The range of scores ranges from 25 to 50).**

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The third test: a test measuring the kindergarten child's awareness of some healthy methods to boost the immune system	**The test consists of sixteen questions, the researcher gives one mark for each question in case the child answers were wrong or refuses to answer the question, and two marks in case the child answers were correct, so that the total score for the test is 32. (The range of scores ranges from 16 to 32).**
Total score of battery parts	**The score ranges from 57 to 114**

Calculating the psychometric efficiency of a battery to assess the knowledge of some concepts of the immune system of a kindergarten child:

To calculate the psychometric efficiency (honesty/validity and reliability), the researcher applied the battery to a sample of 50 children who were selected from the second-level children enrolled in the Martyr Muhammad Al-Durrah Official Language School affiliated to the West Mahalla Administration, after applying the data collection form and distributing the informed consent letter to the parents, in addition to taking children's consent to participate.

First: Calculating the validity of the battery for assessing the knowledge of some concepts of the immune system of a kindergarten child:

1. **Content Validity:** This type of validity refers to the extent to which the battery represents all the general characteristics associated with the concept that the current research aims to measure; Where the researcher relied on the literature and previous studies on which it was based in presenting the theoretical framework in extracting the questions related to the three parts related to the battery of evaluating the knowledge of some concepts of the immune system of the kindergarten child .
2. **The validity of the internal consistency:** The researcher examined the extent to which the sub-component parts of the battery agree to reach homogeneous parts, by calculating the correlation coefficient of the degree of each part of the battery and the total degree of the battery, where the Pearson correlation coefficients were calculated between the mark of each child in each of the tests battery and the total score of the battery, and the following table (2) shows these results.

Table (2) Pearson correlation coefficient for a battery to assess the knowledge of some concepts of the immune system of a kindergarten child

Battery parts	Pearson correlation coefficient	Significance level
The first part: a test measuring the kindergarten child's knowledge of germs.	**0.777****	**0.01**
The second part: a test to measure the kindergarten child's knowledge of some concepts of the immune system.	**0.705****	**0.01**
The third test: a test measuring the kindergarten child's awareness of some healthy methods to boost the immune system.	**0.705***	**0.01**

It is clear from the previous table (2) that there are statistically significant correlation coefficients at the significance level of 0.01, and which indicate that there is an internal consistency of the battery of evaluating the knowledge of some concepts of the immune system of the kindergarten child.

Second: Calculating the stability of the battery to assess the knowledge of some concepts of the immune system of a kindergarten child.

Split half reliability calculation

The half-partition method depends on dividing the battery into two halves, and then finding the correlation coefficient between the two halves of the battery using Pearson's method (= 0.868), and then correcting the two halves of the battery using the Spearman-Bown coefficient, to equalize the contrast values for the two halves.

Table (3) the value of the stability coefficient by the split half method (Spearman-Brown coefficient).

Calculating the stability of the battery to assess the knowledge of some concepts of the immune system of a kindergarten child.	The value of the stability coefficient by the split half method (Spearman-Brown coefficient)	Significance level
	0.929	**0.01**

It is clear from the table that the values of the stability coefficient using the fractionation half method (Sieberman's equation) for the battery of evaluating the knowledge of some concepts of the immune system of the kindergarten child. Statistical function at the level of significance (0.01) equal to (0.929); Hence, the battery has high psychometric properties that qualify it for use in the current research .

Results

Data analysis:

The research hypothesis states: There are no statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the mean scores of the experimental group children for the pre and post measurements on the battery of assessing the knowledge of some concepts of the immune system of the kindergarten child. In order to verify the validity of the research hypothesis, the researchers calculated average scores in the total score and sub-degree for the pre and post applications of the battery to assess the

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knowledge of some concepts of the immune system in kindergarten children and calculated the value (T) for a related group to reveal the significance of differences between the averages using the SPSS statistics version 25 program.

Table (4): Means, standard deviations, and T- test values for the scores of the children of the experimental group before and after applying the program on the battery to assess the knowledge of some concepts of the immune system of the kindergarten child

Battery Subcomponents	Measurement	Mean (Average)	Standard Deviation	Degrees of freedom	t value	P value
Kindergarten child's knowledge of germs.	Pre	20	1.87	49	19.81	0.05
	Post	27.3	2.60			
A test measuring the kindergarten child's knowledge of some concepts of the immune system.	Pre	25.9	1.37	49	25.36	0.05
	Post	39.6	3.71			
A test to measure the kindergarten child's awareness of some healthy methods to boost the immune system.	Pre	23.78	2.70	49	15.09	0.05
	post	30.06	2.18			
Battery for evaluating knowledge of some concepts of the immune system of a kindergarten child						
The total score of the battery for evaluating the knowledge of some concepts of the immune system of a kindergarten child	Pre	69.68	4.52	49	28.67	0.05
	Post	96.96	6.89			

It is clear from the previous table 4 that:

1- By comparing the mean scores of the children of the experimental group for the pre and post measurements in the total score and the sub-scores on the battery of evaluating the knowledge of some concepts of the immune system of the kindergarten child, that the posttest means are higher than the pretest ones, and the researcher can attribute the differences between the average scores of the children of the experimental group on the battery evaluating the knowledge of some concepts of the immune system of kindergarten children to the effect of experimental treatment using the story of our amazing immune system, which in turn attributed to an increase in the mean scores of the experimental group in the post-measurement over the pre-measurement, and this is evident in the following graphic representation:

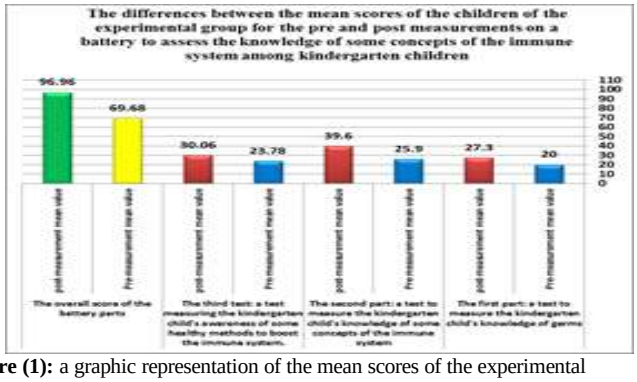

Figure (1): a graphic representation of the mean scores of the experimental group children for the pre and post measurements on the battery to assess the knowledge of some concepts of the immune system of the kindergarten child**.**

2- The results of the T- test to indicate the differences between the mean scores of the experimental group for the pre-measurement and the post-measurement for the sub-tests that make up the battery. It is clear through extrapolation of Table (4) and Graph (1) that:

a) The calculated **T**-value of the differences between the mean scores of the experimental group for the pre and post measurements of the first part (a test measuring the knowledge of a kindergarten child in germs), which is (19.816) is greater than the tabular "t" value, which is (1.729); This indicates that there are statistically significant differences at the level of significance ($\alpha \leq 0.05$), and this indicates that: I have to test a kindergarten child's knowledge of germs.

b) The **T**-value calculated for the differences between the mean scores of the experimental group for the pre and post measurements of the second part (a test measuring a kindergarten child's knowledge of some concepts of the immune system), which is 25.369 is greater than the tabular "T" value, which is 1.729; This indicates that there are statistically significant differences at the level of significance ($\alpha \leq 0.05$), and this indicates that: I have to test the kindergarten child's knowledge of some concepts of the immune system.

c) The calculated **T**-value of the differences between the mean scores of the experimental group for the pre and post measurements of the third sub-test (a test measuring a kindergarten child's awareness of some healthy methods to boost the immune system). It is (15.095) greater than the tabular "t" value, which is (1.729); This indicates that there are statistically significant differences at the level of significance ($\alpha \leq 0.05$), and this indicates that: The post-test is to measure the kindergarten child's awareness of some healthy methods to boost the immune system.

3- The results of the T- test to indicate the differences between the mean scores of the experimental group for the pre and post measurements of the total battery score. It is obvious from Table (4) and Graph (1)

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The **T-**value calculated for the differences between the mean scores of the experimental group for the pre and post measurements of the total score of the kindergarten child's knowledge assessment battery of some concepts of the immune system, which is (28.671) is greater than the tabular "t" value, which is (1.729); Which shows that there are statistically significant differences at the level of significance ($\alpha \leq 0.05$), and therefore the **null (zero)** hypothesis was rejected and the following alternative hypothesis was accepted:

There are statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the mean scores of the experimental group children for the pre and post measurements on the battery of assessing the knowledge of some concepts of the immune system of the kindergarten child .

Discussion

The aim of the current research is to simplify some of the concepts of the immune system in kindergarten children by telling the story of our amazing immune system**. After quantitative analysis of the research hypotheses, the null (zero) hypothesis was rejected, which states that:**

There are no statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the mean scores of the experimental group children for the pre and post measurements on the battery of assessing the knowledge of some concepts of the immune system of the kindergarten child and **accepting the alternative hypothesis which states that:**

There are statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the mean scores of the experimental group children for the pre and post measurements on the battery of assessing the knowledge of some concepts of the immune system of the kindergarten child.

The researcher attributes the previous result obtained to the effectiveness of experimental treatment using the story of our amazing immune system, as the study of **Engel *et al.*, (2018)** that showed that scientific knowledge through storytelling can provide a source of inspiration for teachers and learners. The current research agrees with the research of **Zhang *et al.*, (2019)** which indicated that it may be difficult for students to visualize knowledge of and relate to immunology. To help students better understand the concepts of specific immunity and increase their motivation to learn and participate, the researchers designed the Immunology (VR) application, which offers a highly interactive, narrative-driven immersive experience that takes students on an exciting journey inside the human body.

The results of our research agree with the that of **Zhang, & Bowman, (2022)**, where the research was launched to try to answer some questions, including: How much detail should the creator of the story put in the basic elements of the story, so that the story effectively conveys the intended information to the learners? Can a dramatic story help learners retain information longer than a simple, more basic story? The researchers pointed out that complicated science concepts have very promising educational benefits. On the one hand, storytelling breaks the complexity of science concepts by linking them to people's daily experiences and familiar cognitive models. On the other hand, the learning process is further enhanced through the rich interaction that took place.

The current research is considered an investigative and exploratory research of what **Giuliani, (2020)** did, through which he reviewed his experiences in exploring the power of storytelling and how learning through stories may be a distinctive feature of what it means to be human. The researcher was trying to search for a way to help him strengthen his understanding and improve his approach to help students learn and understand the immune response, where he explained that the immune response is a complex aspect of physiology and can confuse students and teachers alike at times, and the researcher concluded that despite his attempts to understand the immune system so as to create an anecdotal summary of the immune system response so that It can be taught to his students, but this matter is difficult and not possible to achieve, and this matter was achieved by the current research, and its effectiveness came with a sample of a small age (5-6 years).

The current research differs with the research of **(Elliott, 2010; Raimondi, 2016 ; Su et al., 2014)** where we find that the current research includes a different approach to simplify immunological concepts, using a scientifically designed story that combines the provision of information in an accurate scientific manner. With attractive graphics and in a funny way that suits the nature of the child's age, The study **(Raimondi, 2016)** used digital games to communicate some immunological concepts, and the results of the study concluded that the game became a mere substitute for classroom lectures, in addition to the students feeling frustrated with the complexity of the game and ultimately did not enjoy playing it.A study **(Su et al. (2014)** used a card game to teach students immunology, and found that students became so engrossed in competition in the game that they tended to neglect to review the concepts involved and thus learned little about the immune system. **Elliott's (2010)** study aimed to use role-playing to improve students' learning of immunology concepts, however, limitations of the use of games were also found in that research. These limitations indicate that current game design for learning immunology does not do an ideal job of helping students understand Complex immunology concepts, although students prefer them more than traditional lectures.

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Conclusion

The effectiveness of the story of our amazing immune system in simplifying some of the concepts of the immune system of the kindergarten child. The research recommends applying the story of our amazing immune system with different age stages, including it within the governmental curricula for kindergartens, and using the stories in general as an entrance to simplify the scientific concepts of the kindergarten child.

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