



## **Effect of Learning Based on Mathematics Applications in Life on Academic Attainment Level in Mathematics for Preparatory School Students “Field Study”**

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### **Abstract :**

This research aims to determine how effective it is to add some real-life examples into mathematics curriculum teaching on academic achievement level in mathematics for preparatory school stage. Because of the lack of real-life mathematics applications examples in some lessons in the preparatory schools' mathematics curriculum and using the traditional method in teaching that led to only memorize the mathematical concepts and arithmetic operations by heart without understanding. The researchers used the analytical descriptive curriculum and the experimental curriculum with a quasi-experimental design of one experimental group for the first and second preparatory grades. The research population was selected from the students of the first and second grades of preparatory school at Martyr Mohamed Ahmed Lotfy El Ashry Integrated Language School, Heliopolis Educational Zone in Cairo Governorate. Two research samples were randomly selected from (99) students in the first preparatory grade, and (120) students in the second preparatory grade, and each of them studied mathematics according to the traditional method (control group) and using learning based on mathematics applications in life (experimental group). Two tests will be given as part of the research for the first and second grades preparatory students: pre-test on the control group and post-test on the experimental group. In this research, we applied two achievement tests in mathematics to verify the effect of the proposed teaching method. The research results explained that there is statistically significant difference in the mathematical achievement level between the control and experimental groups for the first and second grades preparatory students in favor of the experimental group. The research concludes that the learning based on real-life applications of mathematics has a positive effect on their academic achievement level in mathematics for the first and second grades preparatory students. The research recommends increasing awareness about the importance of mathematics applications in real life and creating new learning methods to link between the applications and our real life.

**Key Words:** Learning based on mathematics applications in life, Academic achievement level, First and second grades preparatory students

## 1. Introduction:

In light of the tremendous and rapid progress in technology and information that has directly affected various aspects of science and various industries, the field of the education sector had the largest share of this effect and a radical change occurred in the principles and objectives of learning and its implementation mechanisms. Education environments differ from traditional environments, despite the fact that learning based on life applications is not a modern concept in these days, it is a science that is being developed and its tools developed with the development of technology, sciences and information technology techniques, and then the creation and development of its tools.

This research investigates the potential of integrating real-life applications into the learning process in to enhance student understanding and academic achievement in mathematics for preparatory (prep) school students. mathematics is regarded as the most important scientific discipline, because of it is a versatile tool with a multitude of potential applications in our daily life in many fields, including engineering, physics, finance, computational science, education and so on. In the current world, almost all results and truths are linked to it and is used in teller devices, games, safe internet pages, polls, evaluation of statistical information, and numerous additional uses since the dawn of civilization Mathematics has had numerous applications since the beginning of time, including: Construction and building, Economic and finances. Our daily lives are heavily influenced by it, which is now essential to the advancement of the modern world. The majority of students are curious as to why they are required to master different mathematical concepts. Many topics have utilization in actual life that teachers are unable to think of, most students agree that the study of Math is the worst course in education. It consists of tedious,

monotonous, challenging, obscure, and irrelevant computations that have nothing associated with creativity or exploration. This research studies the ability of incorporating real situations uses for the study of mathematics into the learning process to increase proficiency in it for first and second grades prep students. The main objective of this research is that learning based on real-life applications in mathematics enhances academic achievement levels in mathematics for first and second grades prep students.

## 2. The Theoretical Framework:

### 2.1. Previous Studies

According to many research studies, using mathematical applications helps student achieve better mathematically and solve problems more effectively. These applications promote the comprehension of particular instruction, assist with math difficulties, and enhance student achievement. Promising outcomes have been shown in research on incorporating real-life circumstances into mathematical teaching. Researches examining strategies such as:

**Problem-Based Learning (PBL) in Mathematics:** "is an instructional strategy that enables students to conduct research, combine theory and practice, and apply their knowledge and abilities to create an answer for the issue in question" (Savery, 2006, p.9).

**Realistic Mathematics Education (RME):** "is one method that tackles issues brought on by acquiring mathematical knowledge in a traditional and general way" (Bray & Tangney, 2015).

Mina study (2006) "The Link between Mathematical Modeling and real-world uses of Mathematics" "Numerous scholars and academics concurred on the issue. Even though there is a lot of connection between mathematical modeling and mathematical applications, mathematical modeling is just the application of Math to real-world situations, a guide to it, or programs that are transformed into mathematical challenges and

overcome. Applying mathematical concepts, putting suitable solutions to the assessment, and then selecting the most effective ones. El Morsy study (2020) "The Impact of the Introduction to Practical Applications of Mathematics for Middle School Students on Achievement and Critical Thinking". The research aimed to study the impact of the practical applications approach on developing academic achievement and critical thinking skills among middle school students, and the results were: The lack of an effect of the introduction to practical teaching applications of mathematics in developing general critical thinking skills and its presence in developing critical thinking skills in mathematics. Uyen et al. study (2021) "The Effectiveness of Applying Realistic Mathematics Education Approach in Teaching Statistics in Grade 7 to Students' Mathematical Skills". The study aimed to evaluate the effect of applying Realistic Mathematics Education (RME) on developing statistical skills among seventh grade students. The results showed that RME had a positive impact on students' skills. Premadasa & Bhatia study (2013) " Real Life Applications in Mathematics: What Do Students Prefere?". The research aim of the two studies is to explore students' preferences for certain types of practical applications in solving word problems. The problems were divided into problems of specific severity. There are three categories: the category of problems that students can easily identify with, the category of research and the category of problems that do not fall into the first two categories. There are many studies that have addressed this topic, including (Asli & Marchis, 2021; Dayiha, 2014; Gupta, 2018; Khan & Salman, 2000; Manjunath et al., 2021; Rani et al., 2023; Yavuz Mumcu, 2018)

## 2.2 Research Problem:

The researchers were observed during field training at Martyr Mohamed Ahmed Lotfy El Ashry integrated Language School, Heliopolis Educational Zone in Cairo Governorate that the traditional method of teaching causes students to memorize the mathematics curriculum without understanding it, which results in their lack of achievement and awareness of its significance. As a result, we used some real-life mathematical examples in some lessons, and the outcomes were good.

## 2.3 Hypotheses of the Research:

The purpose of the current research is to achieve the following hypotheses:

- The first hypothesis: There is a statistically significant difference at a 0.01 level of significance between the mean scores of the two pre- and post-tests for students of the research group from the first-grade prep students, in favor of the post-test.
- The second hypothesis: There is a statistically significant difference at a 0.01 level of significance between the mean scores of the two pre- and post-tests for students of the research group from the second-grade prep, in favor of the post-test.

## 2.4 Delimitations of the Research:

The research was limited to:

### 2.4.1 Objectivity Limitations:

- A group of (99) students of the first prep grade and a group of (120) students of the second prep grade at Martyr Mohamed Ahmed Lotfy El Ashry integrated Language School, Heliopolis Educational Zone in Cairo Governorate.
- We applied some examples of mathematics applications in life in some lessons in mathematics curriculum:
  - For the first prep grade students was the "Numbers and Algebra" unit and the lesson "Repeated Multiplication". The lesson of

geometry is "Pythagoras' theorem" and "Geometry and Measurement" unit.

- For the second prep grade students was the "Factorization" unit and the lesson "Factorizing quadratic trinomial in the form:  $x^2 + bx + c$ ". The lesson of geometry is "Follow: Corollaries on theorem (1)" and "Areas" unit.

#### 2.4.2 Place Limitations:

The graduation project was implemented at Martyr Mohamed Ahmed Lotfy El Ashry integrated Language School, Heliopolis Educational Zone in Cairo Governorate, because it is the school where the researchers are trained in field training.

#### 2.4.3 Time Limitations:

The second semester of the academic year 2023/2024.

#### 2.5 Research Terms:

- **Impact:** Procedure-wise, the researchers describe it as the statistically significant difference among the average score's learners in the control group traditionally study the mathematics curriculum, while those in the experimental group get used to applying the teaching methodology for real-world applications.
- **Mathematical Modelling:** is the process of expressing real-world scenarios and their interactions using mathematical expressions. Real-world problems are translated into mathematical language, solved in a mathematical system, and then the solutions are tested once more in the real-world system. This is a cyclical process.  
Building mathematical models of the natural and social events that are motivated by the real problem is necessary for mathematical modelling, which extends beyond the physical characteristics of a real-world scenario to investigate its structural elements using mathematics.

- **Academic Achievement:** is the accomplishment of learning goals and objectives, including passing tests, finishing school, getting degrees or certifications, and achieving good grades. It is a gauge of a student's proficiency in a certain subject or area of study in terms of knowledge, skills, and talents. Achieving success in research, publications, presentations, and other intellectual endeavours can also be referred to as academic achievement.

In the real world, mathematics is used for time management, budgeting, cooking, shopping, and travel planning. What is the salary of a mathematician? The pay for mathematicians varies according on their level of training, industry, and experience.

#### 2.6 Rresearch Aims:

The research based on mathematics applications in life and their impact on the academic achievement level in the first and second grades of prep school aims to provide students with a set of knowledge and skills that qualify them to solve applied problems and raise their importance.

#### 2.7 The Importance of This Research:

Mathematics is of great importance in life, such as Problem Solving: Whether at work, at school, or even in our personal lives, mathematics helps solve many of the issues and difficulties we face on a daily basis. Make decisions, gain understanding of the world around us, develop skills, and improve lives. The research aims to investigate the effectiveness of learning based on applications of mathematics in life at the level of academic achievement for middle school students, which leads to changing students' studies in the traditional way and memorizing mathematical concepts to awareness of their importance in life and understanding mathematical concepts and laws and increasing achievement and reducing the complexity of the subject for students.

### 3. Methods of Research and the Tools Used:

#### 3.1 Research Materials and Tools:

##### 3.1.1 The Research Materials are as follows:

The researchers prepared some examples of mathematics applications in life in some lessons in mathematics curriculum:

- For the first grade prep students was the "Numbers and Algebra" unit and the lesson "Repeated Multiplication". The lesson of geometry is "Pythagoras' theorem" and "Geometry and Measurement" unit.
- For the second grade prep students was the "Factorization" unit and the lesson "Factorizing quadratic trinomial in the form:  $x^2 + bx + c$ ". The lesson of geometry is "Follow: Corollaries on theorem (1)" and "Areas" unit.

##### 3.1.2 The Research Tools are as follows:

A pre-achievement test for the research group of students of the first and second grades prep in the second semester of the academic year 2023/2024, after teaching some lessons in the mathematics curriculum by using the traditional method and it was used to measure the academic achievement level in these lessons, then a post-achievement test was conducted for the same research group from the first and second grade prep after teaching them these lessons by adding some practical examples in life to them with the aim of measuring the effect of teaching using mathematics applications in life for the mathematics curriculum on students' achievement at this age.

#### 3.2 Research Methodology and Experimental Design:

- This research will use a field experiment structure.
- Sample: A selection of random sample of prep school students (aged 13-14 years old) will be obtained from the first and second grades prep. These students studied some lessons by using the traditional method (Control group) and also,

studied the same lessons after adding some examples of applications of mathematics in life (Experimental group) in mathematics curriculum.

- The researchers used the following two curriculums:

- **The Analytical Descriptive Curriculum:**

When developing the general framework for adding some life-applications examples of mathematics in mathematics curriculum for the first and second grades prep students, and when preparing the evaluation tools and using the appropriate analytical statistical method in data processing and analysis, and giving a appropriate logical explanations for them.

- **The Experimental Curriculum:** is the special part of the applied side of the research to confirm the effectiveness of learning based on the applications of mathematics in life on the academic achievement level of prep school students. We used a one-group research design and included the following variables: an independent variable (Learning based on the applications of mathematics in life), and a dependent variable, (the achievement level of students)

#### Data Collection:

**Pre- and post-tests:** A standardized assessment tool suitable for first and second grades prep students will be used to determine the control group and experimental group.

#### Data Analysis:

**Quantitative Data:** The learning accomplishment of the experimental and control groups will be compared by statistical evaluation of the pre-and post-test results utilizing techniques such as the Paired-samples T-test.

### 4. Results of Research:

The researchers tested the validity of the following research hypotheses:

**4.1. Testing the validity of the first hypothesis,** which states that: "There is a statistically significant difference at a 0.01 level of

significance between the mean scores of the two pre- and post-tests for the research group from the first grade prep students, in favor of the post-test". This was done by calculating the value of  $t$  and the effect size to indicate the significance of difference between the mean scores of the first prep grade in the two pre- and post-test using the T test for paired samples with the help of the Statistical Package for Social Sciences (SPSS) Version 25, and this is shown in Table (1).

**Table (1): The significance of difference between the mean scores the two pre- and post-tests of the first grade prep students (The final score of the two tests is 10 marks and the sample size  $N$  is 99)**

Test	Mean	Standard Deviation	t-value	Sig	Effect size (Cohen's $d$ )
Pre	6.68	3.353	9.140	0.000	0.918 (Very large effect size)
Post	9.56	1.163			

Cohen (1988) calculated the effect size ( $d$ ) for a paired-Samples T-Test from the following relation:  $d = \frac{\mu_1 - \mu_2}{\sigma}$ , where,  $\mu_1 - \mu_2$  represents the mean differences of the pairs of the population of interest and  $\sigma$  is the standard deviation of the mean differences of these pairs. He proposed the following interpretation of the  $d$  values:  $d = 0.2$ , it is a small effect size in dependent variable,  $d = 0.5$ , it is a medium effect size in dependent variable, and  $d = 0.8$ , it is a large effect size in dependent variable.

It is clear from the previous table that the mean scores of post-test is greater than the mean scores of the pre-test. This indicates that the academic achievement of the research group of the first grade prep students has been improved after they

were taught by adding some life-practical examples in some lessons in the mathematics curriculum. Since Sig. = 0.000 < 0.01, there is a statistically significant difference at a 0.01 significant level between the mean scores of the two pre- and post-tests for students of the research group from the first prep grade, in favor of the post-test. Which proves the validity of the first hypothesis from the research hypotheses. By calculating the effect size  $d$  from above relationship, where  $\mu_1 - \mu_2 = 2.879$ ,  $\sigma = 3.134$ , we get the effect size in the development of academic achievement equals (0.918). This indicates that the proposed method has a very strong effect on the development of academic achievement of the research group of the first grade prep students.

**4.2. Testing the validity of the second hypothesis**, which states that: "There is a statistically significant difference at a 0.01 level of significance between the mean scores of the two pre- and post-tests for the research group from the second grade prep students, in favor of the post-test".

To verify this hypothesis, the researchers used the Paired-Samples T-Test, and their results can be presented in the following table:

**Table (2): The significance of difference between the mean scores for the two pre- and post-tests of the second grade prep students (The final score of the two tests is 10 marks and the sample size  $N$  is 120)**

Test	Mean	Standard Deviation	t-value	Sig	Effect size (Cohen's $d$ )
Pre	7.32	3.958	4.738	0.000	0.432 (small effect size)
Post	9.07	1.179			

From Table (2), it is clear that the mean scores of post-test is greater than the mean scores of the pre-test. This indicates that the academic achievement of the research group of the second grade prep

students has been enhanced after they were studied by adding some life-practical examples in some lessons in the mathematics curriculum. Since  $\text{Sig.} = 0.000 < 0.01$ , there is a statistically significant difference at a 0.01 significant level between the mean scores of the two pre- and post-tests for the research group from the second grade prep students, in favor of the post-test. Which proves the validity of the second hypothesis from the research hypotheses. By calculating the effect size  $d$  from above relationship, where  $\mu_1 - \mu_2 = 1.75$ ,  $\sigma = 4.046$ , we get the effect size in the development of academic achievement equals (0.432). This indicates that the proposed method has a small effect on the development of academic achievement of the research group of the second grade prep students, Because, most the second grade prep students have whose scores decreased or remained the same on post-test.

## 5. Interpretation of Results

In this research, the researchers attempted to find out the first and second grades prep students' achievement in mathematics. The results of this research will emphasize on whether the experimental group, which taught based on real-life applications in mathematics in some lessons in mathematics curriculum for first and second grades prep students, revealed a statistically significant enhancement in the academic achievement level in mathematics compared to the control group. There are many findings of previous research that have focused on application-based learning and its effect on student achievement. There are several factors to consider when interpreting the possible outcomes of student achievement in the pre-test of the control group and post-test of the experimental group for the first and second grades of prep students such as student engagement, motivation, and students' application of what they learned in mathematics to real-life situations.

The results of this research had shown that taught mathematics using learning based on mathematics applications in life performed better than learn them using the traditional method. From the analysis using Paired-Samples T-Test on post-test scores of the experimental group and pre-test scores of the control group showed that the students better in the post-test than the post-test and this result is consistent with the validity of the two proposed hypotheses. The findings revealed the efficacy of the use mathematics applications in life in improving students' achievement in mathematics.



**Figure (1): Some Photos During the Application of the Graduation Project research at the school**

Figure (1) shows the interaction of the students during the application of the graduation project research at the school.

## **6. Conclusion:**

This research emphasized improving the level of academic achievement in mathematics among research group students of the first and second grades prep students at Martyr Mohamed Ahmed Lotfy El Ashry Integrated Language School, Heliopolis Educational Zone in Cairo Governorate by adding some life-applications examples in some lessons in the mathematics curriculum. The researchers compared the test scores of the research group students who studied these examples in the traditional method, and their test scores again after teaching them some life-applications examples of mathematics in these same lessons, by using the Paired-Samples T-Test and calculating the effect size of their academic achievement level using the Cohen's  $d$  effect size. The results confirmed that the addition of life-applications examples of mathematics in the mathematics curriculum contributed to improving their level of achievement in mathematics. This research recommends integrating practical examples in life for the mathematics curriculum in the prep school to raise the academic achievement level of students in mathematics and provide them with some skills to apply what they have learned in life situations.

### **6.1 The Recommendations:**

In light of previous results, we can make the following recommendations:

#### **6.1.1 For Students:**

- 1- The need to pay attention to training prep school students to link mathematics lessons with life applications.
- 2- Developing the learning pleasure of prep school students by studying mathematics through different life applications.
- 3- The need to work on training prep school students towards the use of mathematics in life.

4- Prep school students can apply mathematical concepts in out-of-school activities such as sports and the arts.

#### **6.1.2 For Mathematics Teachers:**

- 1- Not to reject any solution or idea about the problem presented by prep school students without their discussion in it.
- 2- Providing teachers with a theoretical framework on the applications of mathematics in life so that they can facilitate their learning process.
- 3- Study the needs and characteristics of prep school students when teaching geometry and algebra.
- 4- Directing the attention of mathematics teachers to the importance of mathematics applications in life.
- 5- Training teachers before and during the service to develop life applications.

#### **6.1.3 For Parents:**

- 1- Support and encourage your children to make the most of this educational opportunity, when the child feels your support, they are more willing to learn and innovate.
- 2- Help your child choose a topic that interests them and suits their intellectual level.
- 3- Encourage your child to develop skills such as teamwork, problem-solving, decision-making, and communication, which you can learn through the mathematics applications project.
- 4- Track your child's progress in mathematics after applying examples to realistic applications in life and provide him with the necessary support and guidance to overcome difficulties in this subject.

#### **6.1.4 For Researchers:**

- 1- The need for researchers to be interested in designing existing programs to train teachers on how to integrate life applications with mathematics lessons for the prep stage.
- 2- The need for researchers to be interested in researching how to use mathematics in scientific fields such as physics, chemistry, and biology, where it can be studied how to use mathematics in



the analysis of scientific data or applications of probability in the interpretation of natural phenomena.

3- Develop small research projects that explore mathematics applications in various fields such as science, technology, and economics where these projects can be an opportunity to apply analytical skills and creativity.

#### **6.1.5 For Mathematics Curriculum Planners and Developers:**

1- Reconsidering the preparation of mathematics curricula for the prep stage according to the applications of mathematics in life.

2- The need to include realistic examples and applications of mathematics in the curriculum, enabling students to see how mathematical concepts are used in everyday life.

3- Reviewing teacher preparation programs, so that the focus is on specialized skills and life applications and training them on learning methods by linking mathematics lessons with life applications to raise their competence in planning, implementing and evaluating the educational process.

4- Include mathematical applications that encourage students to think critically and creatively about how to use mathematical concepts to solve problems and challenges in daily life.

#### **6.1.6 For Local Community:**

1- Organize workshops and discussions in the local community to raise awareness of the importance of mathematics applications in daily life, and how to use it in various fields such as economics, technology and engineering and so on.

2- The local community can support educational initiatives aimed at enhancing students' understanding of mathematics applications, whether by providing resources or providing financial support.

3- The local community can encourage students to continue learning and explore the applications of mathematics in everyday life in various ways,

whether through educational courses or outdoor activities.

4- The local community can support schools and teachers in developing study programs that ensure that mathematics applications are included, and resources are provided.

### **6.2 The Proposals:**

- Develop a comprehensive educational curriculum based on the life problems and challenges faced by students in the prep stage, with a focus on the applications of mathematics in their daily lives.

- Train teachers by offering teacher training courses on how to include math applications in everyday lessons, as well as providing appropriate educational resources and learning tools.

- Provide interactive learning materials such as educational software and digital applications that facilitate the understanding and application of mathematical concepts in everyday life.

- Effectively evaluate the applications of mathematics in the prep stage and follow the progress of students in understanding and using mathematical concepts in daily life.

### **6.3 Suggestions for Future Research:**

According to the results of this research, further studies and researches can be suggested, including:

- Conducting a similar study of our study on the third-grade prep students.

- Conducting a study to measure students' trend towards mathematics before and after adding real-life applications examples in mathematics curriculum to the first and second grades prep students.

- Conducting a similar study of our study in other sciences.

- Conducting a similar study in which the effectiveness of the learning strategy based on the applications of mathematics in life are studied to teach mathematics to students with

special needs (slow learning - talented).

- Conducting a study to strategies for learning based on the applications of mathematics in life on other dependent variables.
- Conducting studies on the effectiveness of the program of teaching mathematics teachers in the prep stage based on strategy for learning of the applications of mathematics in life.

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