The effect of mathematical modeling in solving applied problems of university students in mathematics (University of Sudan case study (2018-2020)

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Abstract:

This study aimed to know the effect of mathematical modeling method on solving applied problems for students of the University of Sudan in mathematics, and to achieve the objectives of the research, the researcher adopted the experimental method, and used the experimental design with the experimental and control groups with a subsequent test. I put the following null hypothesis: "There is no statistically significant difference at a level of significance (0.05) between the average grades of students who studied on me according to the method of mathematical modeling and those who study on me according to the traditional method of the applied solution. Problems in mathematics." After determining the research community that represents the University of Sudan, the research sample was selected from (62) students at the third level of the University of Sudan who were chosen by the deliberate method, and the sample was divided into two groups, one of them is experimental consisting of (32) students who studied Ali according to the method Mathematical modeling, and the other was a control unit consisting of (30) students who studied on the basis of the traditional method. There was parity between the

two study groups in variables (chronological age, previous mathematical achievement, level of intelligence). For the purpose of collecting data for the experiment, the applied problem-solving test in mathematics was built, and in its final form it may have (10) essay-type test items, through which the research sample can measure the solution applied. Math problems. Appropriate statistical analyzes were carried out to calculate the difficulty factor and discrimination for the test items, and after using statistical tools to analyze the results of the test application, such as the second test for two independent samples, the Pearson correlation coefficient, the Seberman - Brown equation, and the Cronbach Alpha equation. The results indicated that there are statistically significant differences at the level of significance (0.05) between the average grades of students who study according to the mathematical modeling method and those who study according to the traditional method of solving applied problems in mathematics. Benefit students who study according to the mathematical modeling method.
Key words: mathematical modeling, solving applied problems, Experimental group , Control group

المستخلص

هدفت هذه الدراسة إلى معرفة أثر أسلوب النمذجة الرياضية في حل المشكلات التطبيقية لطلاب جامعة السودان في الرياضيات، ولتحقيق أهداف البحث اعتمدت الباحثة المنهج التجريبي، واستخدمت التصميم التجريبي مع المجموعتين التجريبية والضابطة باختبار لاحق. أضع الفرضية الصفرية التالية: "لا يوجد فرق ذو دلالة إحصائية عند مستوى دلالة (0.05) بين متوسط درجات الطلاب الذين درسوا علي وفق أسلوب النمذجة الرياضية وأولئك الذين يدرسون وفق الطريقة التقليدية للحل المطبق. مشاكل في الرياضيات". بعد تحديد المجتمع البحثي الذي يمثل جامعة السودان، تم اختيار عينة البحث من (62) طالباً وطالبة في المستوى الثالث من جامعة السودان تم

اختيارهم من قبل الطريقة المتعمدة، وتم تقسيم العينة إلى مجموعتين ، إحداهما تجريبية تتكون من (31) طالبًا درس علي وفق أسلوب النمذجة الرياضية ، والأخرى كانت ضابطة مكونة من (31) طالبًا درسوا على أساس الطريقة التقليدية. وتم التكافؤ بين مجموعتي الدراسة في متغيرات (العمر الزمني، التحصيل الرياضي السابق، مستوى الذكاء). لغرض جمع البيانات للتجربة، تم بناء اختبار حل المشكلات التطبيقية في الرياضيات، وقد يكون في شكله النهائي (10) عناصر اختبار من نوع المقالة، والتي من خلالها يمكن لعينة البحث قياس حل المطبقة. مشاكل في الرياضيات. أجريت التحليلات الإحصائية المناسبة لحساب عامل الصعوبة والتمييز لعناصر الاختبار، وبعد استخدام الأدوات الإحصائية لتحليل نتائج تطبيق الاختبار، مثل الاختبار الثاني لعينتين مستقلتين، ومعامل ارتباط بيرسون، ومعادلة سيبرمان - براون، ومعادلة كرونباخ ألفا. أشارت النتائج إلى وجود فروق ذات دلالة إحصائية عند مستوى الدلالة (0.05) بين متوسط درجات الطلاب الذين يدرسون وفق أسلوب النمذجة الرياضية وأولئك الذين يدرسون وفق الطريقة التقليدية لحل المشكلات التطبيقية في الرياضيات. يستفيد الطلاب الذين يدرسون وفق أسلوب النمذجة الرياضية.

الكلمات المفتاحية : النمذجة الرياضية ، حل المشكلات التطبيقية ، المجموعة التجريبية ، المجموعة الضابطة

1.0 Introduction:

Technological developments have created new problems that former generations had never encountered. As a consequence, there is an increasing demand for individuals who set a high value on mathematics, who have a high level of mathematical thinking and who can use mathematics in problem solving [1]. Therefore, developing students' mathematical thinking and problem solving skills has become one of the major purposes of mathematics education[2].the importance of establishing relationship between mathematics and other disciplines; and reported that one of the major purposes of mathematics education is to get students acquire knowledge and skills of applying mathematics to different fields. Similarly, Brans ford [3], pointed out that most of the mathematical concepts should be given together in different contexts to get stu-

dents make sense of them. mathematics education aims to create individuals who can generate effective solutions for problem situations in real life, and who can apply mathematics into real life by understanding the strong connection between mathematics and real life, and consequently create ones who enjoy mathematics instead of being afraid of mathematics.

that traditional verbal problems fail to show students the applications of mathematics in real life, since they do not encourage students to use mathematics effectively in real life, and to establish a relationship between mathematics, real life and other disciplines [4].For this purpose, real life problems which help students to understand the importance of mathematics should be included in curriculum in order to change the negative opinions of students towards mathematics[5].

In view of the importance of using mathematical modeling method, the matter calls for a scientific study dealing with the use of mathematical modeling method in solving applied problems in mathematics among students of the University of Sudan, and the researcher returned to previous studies, and noticed the scarcity of Arab studies that dealt with the subject of mathematical modeling, and from here the idea appeared study.

1.1 Statement of the problem.

The problem of this study lies in several aspects, the most important to answer the following question:

What is the effect of the mathematical modeling method on solving the applied problems of students of the University of Sudan in mathematics?

1.2- Objectives of the Study

This study aims to fulfill the following objective:
Identifying the effect of mathematical modeling method on solving applied problems of Sudan University students in mathematics.

1.3 Hypotheses of the study

There is no statistically significant difference at the level of significance (0.05) between the average grades of students who study according to the mathematical modeling method and those who study according to the traditional method of solving applied problems in mathematics.

1.5 The importance of the study:

Education curricula are by their nature, or must be sensitive to contemporary changes in science and in the methodology of research in it, and science has witnessed rapid changes whose beginnings can be traced back to about the thirties of the last century, not limited to the volume of knowledge, but rather to the methodology of science, i.e. the methods of dealing With knowledge. In light of all contemporary scientific developments and the increasing volume of human knowledge, it is assumed that this knowledge is addressed as an integrated one, without barriers related to different fields of study, and this is also confirmed by the nature of the different practical life situations.

The practical importance of the study is determined in:

1. Highlight the applications of mathematics in solving some problems from the real world.
2. Identifying some practical problems suitable for students of the University of Sudan and developing a list of these problems may benefit mathematics curriculum planners.

3. Providing an application form to test for solving applied problems, which benefits mathematics professors in evaluating Sudan University students.
4. Using the mathematical modeling method helps the student to relate mathematics as an abstract science with the problems of daily life that it faces.

2.1 Literature Review:

2.1.1 Mathematical model:

The term "model" generally refers to a representation of reality, and a model is a simplified picture of the most important features of a realistic situation to clarify it, with the elimination of some complications or minor things to enable us to clearly understand the situation. (6) and believes that the mathematical model is a representative pattern of reality or practical life, and depending on its fundamentals as mathematical equations, they are solved and interpreted in a template that allows inferring solutions to the problem in reality(7). Mathematical models are based on the use of mathematical relationships and concepts in their structure to describe problems in terms of their variables and their various inputs and the causal relationships between them, and this is expressed in the form of mathematical relationships in which each symbol represents one of the variables of interest, and the mathematical model often takes the form of a mathematical equation, matrix or graph Or any other forms(8). And indicates that there are basic requirements for building any mathematical model, namely:

1. Define the variables that describe the phenomenon.
2. Determine the relationships between the variables.
3. Account for the transactions that govern relationships.

4. Determine the appropriate methods to solve the model.

The mathematical model means a mathematical representation of the elements and relationships in an ideal form of a complex phenomenon, and mathematical models can be used to explain, interpret and solve some problems by using equations, tables and graphs to represent and analyze those relationships, models are often designed as for the impossibility of seeing near phenomena and real processes, and therefore the model provides us with a good service in clarifying processes and phenomena, especially complex ones, and facilitating their images, and thus contributes to studying the thing that came to conceive and examining the theory on which it is based. Due to the gap between reality and theory, the models are considered as bridges that allow crossing over these during the procedural research. Models work on expressing and depicting concepts interacting with reality, and representing it as a simplified part of reality that helps in better understanding and controlling the studied phenomena [9].

Mathematical models help the student to use mathematics in solving many problems that they encounter in life. From the above it can be concluded that: 1. The mathematical model includes one or more aspects of a phenomenon. Whenever the mathematical model includes more aspects of the phenomenon, that is closer to representing reality.

2. The mathematical model is a simplified picture of the most important properties of the situation and the real.

We cannot make it, however precise, to include all the complexities of the natural situation, but the elimination of some of the

surrounding factors of little importance may not affect the expression of the mathematical model on a phenomenon. Accordingly, the mathematical model is a mathematical relationship, usually an equation or inequality or a table or graph between the problem of its application and the factors associated with it.

2.1.2 The concept of mathematical modeling:

Mathematical modeling is the process of transforming the situation under study into a mathematical problem (problem), then solving this problem, testing the correctness of the solution in the situation, and then coming up with new predictions, generalizations and concepts, which is the main field for applying mathematics in life and other sciences(10).

A common feature that combines mathematical applications (11).indicates that mathematical modeling translates a problem from the real world into a representation that is mathematical, then solves this mathematical formulation, and then translates the mathematical solution in the context of the real world (12). 2. The importance of mathematical modeling states that in order for mathematics education to keep pace with the current cognitive developments, knowledge must be addressed in an integrated manner and focus on solving problems and that knowledge applications form a central aspect of the curriculum, and this can be translated into that mathematical modeling will become an essential part of mathematics curricula at all stages Educational.

The use of models included many life problems such as industrial, intellectual exchange, describing the environment, pollution of its components, predicting storms and waves in the bays

... etc., and other life issues that the individual and society are exposed to [13]. teaching and learning mathematics in the twenty-first century requires several elements, the most important of which are:

1- Including mathematics curricula with statistics for global economic projects, with analyzing and interpreting these statistics to benefit from them and predict future events.
2- Interest in teaching mathematical modeling and making mathematical models of applied life situations related to environmental and population problems, lack of food resources and water shortage.
3- Paying attention to the use of technology in teaching and learning mathematics, and emphasizing the development of the use of computers and the information network in obtaining and organizing data in preparation for its analysis and utilization.
4- Paying attention to using teaching methods that develop the spirit of cooperation among students, such as cooperative learning, group learning, and peer learning.
5- Mathematics curricula include some concepts related to the population explosion, its relationship to economic growth, environmental issues, food shortages, and how to address them [14]. It is clear that the use of mathematical modeling works to link information with society's issues and problems, and helps students to deal with the situations they face in contemporary life.

2.2 previous studies

2.2.1 STUDENTS' MATHEMATICAL MODELING IN ALGEBRA, BY: JASON DEAL THESIS, 2015:

Mathematical modeling and algebraic reasoning are two important components of mathematics education. In this study, I

taught a mathematical modeling lesson to high school Algebra I students. My goal was to understand how mathematical modeling and algebraic reasoning are related. To analyze students' modeling and reasoning, I adapted a coding scheme for identifying observable actions in mathematical modeling and created a coding scheme for identifying observable actions in algebraic reasoning. Using these coding templates, I analyzed three groups. I found that two groups followed iterative, non-linear modeling routes and used more algebraic reasoning, while one group followed a highly linear modeling route and did not use as much algebraic reasoning. In addition, I found that the later steps in the modeling cycleled to more algebraic reasoning than the early steps. The findings suggest that mathematical modeling does encourage algebraic reasoning, but not in all circumstances. In addition, the findings provide insight into tensions in teaching mathematical modeling and suggestions for the design of modeling lessons. To further understand how students learn algebra through mathematical modeling, I recommend further study in developing the coding template foridentifying algebraic reasoning, studying the modeling behavior of more groups of students to understand other possible student modeling routes, and studying how students' modeling and reasoning changes over time[15].

2.2.2 Research Trends in Digital Technologies and Modeling in Mathematics EducationJuan Fernando Molina-Toro , Paula Andrea Rendón-Mesa , Jhony Alexander Villa-Ochoa 2019:

This document presents a literature review that analyzes the articulation of modeling and digital technologies in the field of

Mathematics Education. The review aims to find evidence of the use of digital technologies in modeling processes and how these practices can change some ways of working with students in the classroom. The results show, on the one hand, different roles that technology plays when it is articulated to a modeling process (as a resource in the process or as a means that reorganizes the process) and the uses given to diverse technological tools in the empirical studies analyzed. The findings present a new category that extends the classification of technologies and suggest the need to expand both theoretical and empirical research to get a better understanding of the impact of digital tools in modeling processes. In addition, the findings draw attention to the inclusion of mobile devices in future[16].

3.1 Study methodology:

3.1.1Experimental Design:

The experimental design was chosen for two equal independent groups, the first group represented the experimental group and the second group represented the control group, and as in the following table:

Groups	Equalization of groups	Independent variable	Dependent variable
Experimental group		Mathematical modeling style	Solve applied problems
Control group		The traditional way	

3.1.2The Study population:

The Sudan University of Science and Technology, College of Education, Department of Mathematics, was deliberately chosen as a field to conduct the experiment, and thus the student community would be all students of Sudan University in the College of Education, Department of Mathematics in the 2018-2019 academic year.

3.1.3The study sample:

After the Sudan University of Science and Technology identified a field for conducting the study experiment, a group of three-level students from the University of Sudan was randomly chosen, which numbered four groups. Two groups (B and C) were also randomly selected. B) represents the control group, and the number of students in the two groups was (62) students, as the number of students in the experimental groups was (31) and the control group was (31) students.

3.1.4 Adjustment procedures:

To be reassured of the internal integrity of the experimental design, some of the variables that are believed to affect the dependent variables with the independent variable were identified by performing statistical equivalence between the two experimental groups such as (chronological age, previous mathematics achievement, level of intelligence) and the results were as in Table (2) All of which indicate that there are no statistically significant differences between the two groups of experiment in these variables,

which confirms their equivalence, in addition to checking external safety and giving them the same amount of study material and the equal number of teaching lectures between them throughout the duration of the experiment and not allowing students to move from one group to another.

Table (2) The significance of the differences between the mean scores of the students of the experimental and control groups in a number of variables to test their equivalence

Item	Experimental group		Control group		calculated (t) value	Tabular (t) value	sig
	mean	St.d deviation	mean	St.d deviation			
Previous achievement in mathematics	76.21	11.59	72.21	10.26	1.76	1.980	Not Significance at 0.05
Chronological age	195.52	5.67	196.83	7.72	0.94		
IQ level	44.79	7.58	44.31	7.84	0.35		

Source: Prepared by SPSS

3.1.5 Tools of data collection:

One of the requirements of the study is to build a test for solving applied problems consistent with the content of the prescribed study material and the behavioral goals that were prepared to measure the achievement of the experimental and control groups.

3.1.6 Reliability and validity of the test:

3.1.6.1 validity:

The presentation of the test paragraphs in its initial form and the answer instructions as well as the behavioral objectives, their levels, the content of the study material and the analysis of their content to a group of experts who agreed to represent the test paragraphs of the academic content with an agreement of no less than (80%) in any paragraph means that the test enjoys the outward validity and validity of the content In addition, building the test map and verifying the factors of difficulty, ease and discrimination coefficients is an indication of validity of construction and discriminatory honesty, which can be reassured that this test enjoys the outward and content validity in addition to the validity of construction and discriminatory honesty.

3.1.6.2 Reliability:

According to the reliability of the test using the Alpha Cronbach's equation, which is suitable for both the substantive and the essay paragraphs, it reached (0.86) by using the scores of the statistical analysis sample for the paragraphs of (62) students. This coefficient of stability is good, as the variance of the common stability in it reached (74%) and thus the coefficient of approximation in it is (36%), as the reliability coefficient, which is in fact a correlation coefficient, should exceed (70%) in order to be reliable More than (50%) and the coefficient of approach in it is less than (50%). Therefore, after verifying the validity and stability of the

applied problem-solving test and conducting the appropriate statistical analyzes, this test is ready to be applied in its final form to the research sample in the material of the experiment.

4.1 Results of the study

To find out the effect of the mathematical modeling method on solving the applied problems of the study sample, the validity of the hypothesis that indicates "There are no statistically significant differences at the level of significance (0.05) between the mean scores of students who study according to the method of mathematical modeling and those who study according to the traditional method of problem solving Applied Mathematics.

4.1.1 Testing the Hypothesis:

Null hypothesis:

There is no statistically significant difference at the level of significance (0.05) between the average grades of students who study according to the mathematical modeling method and those who study according to the traditional method of solving applied problems in mathematics.

Alternative hypothesis:

There is statistically significant difference at the level of significance (0.05) between the average grades of students who study according to the mathematical modeling method and those who study according to the traditional method of solving applied problems in mathematics.

Table (3) The find to significance of the difference between the mean scores of the experimental and control groups by use (T) test

Group	Students N	Mean of score	St.d deviation	calculated (t) value	Tabular (t) value
Experimental	31	35.281	8.641	5.915	2.000
Control	31	41.466	7.085		

Source: Prepared by SPSS

looking to table above the results:

The mean scores of the experimental group students on the applied problem solving test reached (35,281) a standard deviation score of (8.641), while the mean scores of the control group students that studied the same subject using the traditional method reached (41,466) a score with a standard deviation of (7,085) to find out the significance of the difference between The mean scores of the two groups To test the validity of the hypothesis, test (T) was used for two independent samples, and it became clear that the difference between them was significant at the level of significance (0.05), as the value of (T) drawn was (5.943), which is greater than the tabular value of (T) (2.000) with a degree of freedom (60) This result leads to the rejection of the null hypothesis and acceptance of the alternative hypothesis, meaning that there is a statistically significant difference between the two groups in the scores of the applied problem-solving test and that the difference in the average scores is in favor of the experimental group that studied the prescribed material using the mathematical modeling method.

4.1.2 Conclusions:

- From the results of the applied problem-solving test, the difference between the two groups and the control was statistically significant at the level of significance (0.05) using the T-test for two independent samples, meaning that the use of the mathematical modeling method in teaching contributed to solving students' applied problems better than the traditional method. The reason for this may be that, that is, the use of mathematical modeling in teaching contributed to helping students understand mathematical issues by moving from realistic situations in life to abstract mathematical models, and mathematical models help the student to use mathematics in solving many problems that describe him. In life.
- Through the method of mathematical modeling, students were able to implement activities and exercises easily and easily and organize their knowledge distinctively, while this was difficult for students of the control group who studied according to the traditional method.
- Using the mathematical modeling method that includes understanding and defining the problem and making the necessary hypotheses, then constructing the model, then solving the model and interpreting the solution, and then ensuring the correctness of the solution. This led to an increase in the performance of the students of the experimental group that studied according to the method of mathematical modeling from the control group students who studied according to the traditional method.

5.1 Recommendations:

In light of the findings and conclusions reached by the researcher, the following recommendations can be formulated:

1. Using the mathematical modeling method in teaching mathematics because of its great role in raising students' achievement.
2. Utilizing the results of the applied problem-solving test in determining the teaching strategy to suit their preference patterns.
3. Conducting training courses for mathematics teachers and training them in using the mathematical modeling method during teaching.

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