

How to Develop Teachers' Mathematical Modeling Teaching Skills

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Abstract

This study aimed at developing some of the mathematical modelling skills necessary for the student teachers in mathematics education College. Modeling involves making genuine choices, modeling problems have many possible justifiable answers, modeling problems matter to the end-user who needs to understand something or make a decision. modeling presents problem solving as a creative, iterative process. and it is inherently a team sport. To achieve this aim, the following main question was answered: How can we develop the mathematical modelling skills for the student teacher. The sample of the study consisted of 35 students in the fourth-year in the department of mathematics education The researcher used a mathematical modelling scale which consisted of: evaluating test for students' mathematical modelling skills. measuring student's attitude towards suggested program of mathematical modelling which consisted of four units Using mathematical modelling to solving some problems. Modelling the data. Mathematical modelling and operation research. Mathematical modelling using "Mathematica software Program" . After Applying the designed mathematical modelling, comparing the pretest and the post tests, the outcomes showed that there was lack of the student teachers' competence in the ' mathematical modelling in the pre- test. In the post- application the test showed that there was improvement in the student teachers' mathematical modelling skills. The statistical analysis verified the effectiveness of the suggested program in developing student teachers' mathematical modelling skills in the department of mathematics and teaching mathematical modeling in a regular basis in the department is not applicable ,since many of the professors do not prefer a mathematical modeling so there should be more studies to be conducted in the field of mathematical modelling, focusing on higher-order thinking skills and a continuous developing of student preparation Programs in the Faculty of Education.

Keywords: Mathematical Modeling ,Mathematical model

Introduction:

Students need math to benefit from it in real their life and learning mathematics preparing them to the future challenges and the ability to analyze events, forecasting and decision-making, to mathematics in relative terms, Rogerson. (1986).

The main goal of teaching math to learn how students are doing math and solve real problems, not to learn and memorize formal theories trained them to solve problems similar to the examples in the text book

(Ivan Melnik 2012) described the mathematical modeling as a pillar in the teaching of mathematics, pointed out: that the importance of mathematical modeling is how to apply the mathematical theories in life is one of the basic math goals, also contribute to the development of thinking, which is the most important points in the teaching and learning of mathematics

(Lesh & Doerr, 2003) Mathematical Thinking and Learning describes models and modeling perspectives toward mathematics problem solving, learning, and teaching

Mathematical Models are purposeful interpretations, descriptions, explanations or symbols that are used to construct and manipulate, or predict the systems that are being modeled. Mathematical models are used to interpret real-world situations or non-mathematical situations in mathematical formats.

teacher-level tools have included: Observation forms to gather information about the roles and processes that contribute to students' success, Ways of thinking sheets to identify strengths and weaknesses of products that students produce—to help teachers provide appropriate feedback and directions for improvement, Quality assessment guides for assessing the quality of alternative products that students produce, Guidelines for conducting mock job interviews based on students' portfolio

Models are inherently provisional and modeling usually involves a series iterative testing and revision cycles. In a modeling cycle, competing interpretations are gradually sorted out or integrated or both— and in which promising trial descriptions and explanations are gradually revised, refined, or rejected.

(Abrams, J. (2001),Kang, 2010; NCTM, 1989;), Steps of mathematical modeling process: Examining the situation or the problem. Setting up the goals to be accomplished. Identifying variables in and determine the ones that represent the main features. Formulating the suitable model by selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between all variables. Analyzing and performing operations on these relationships conclusions; if the implementation of the performed operations cannot be complete, then revise the selection of the variables used to formulate the model, Interpreting the results of the mathematics in terms of the original situation. Validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable. Applying the model to similar situations for

evaluation.

A model should be: Accurate if the output of the model is correct or very near to correct. Descriptively realistic if it is based on assumptions which are correct and related. Precise if its predictions are definite numbers and acceptable. Robust if it is relatively immune to errors in the input data. General if it applies to a wide variety of situations. Fruitful if its conclusions inspire or points the way to other models and situations.

(NCTM, 1989, 2000). In *Principles and Standards for School Mathematics* (2000) it is recommended that high school students should be able to develop, identify and find the best fitting model for real-world data by drawing on their own knowledge of ideas and methods that they have developed. They should also be able to explain why that model seems reasonable. Because a teacher makes choices of which problems to engage students in, a teacher's capacity to use and appreciate the importance of the concept in varying contexts is critical.

Kim and her colleagues (2010) a mathematical modeling problem as a non-routine problem that involves real-world applications and mathematical concepts that lead to the creation of a mathematical model.

Kim (2011) examined the effect of modeling activities on a group of middle school students' uses and conceptions of graphical and symbolic representations of the absolute value.

In Lee's study (2006) involving high school students, modeling activities appeared to be helpful in improving problem solving skills. Mathematical modeling and applications which require the skills necessary to become mathematics teachers to present a new thing in the teaching and learning of mathematics, mathematics teachers often deal with problems in textbooks assuming ideal conditions, and giving similar exercises while the truth in fact more than that.

If we take a look at most of the existing applications in the textbooks, we find that they represent exercises similar to the Examples are given by the teacher, which does not represent real applications of mathematics required by mathematical modeling to reflect the mathematical model of the real life problems. There are many reasons for teaching mathematics from realistic situations familiar to students, one of them that this strengthens their motivation when students know that what they are learning can be applied in life. You cannot have introduced mathematical modeling in the education curriculum before they train math teacher on the basics and theories, so that he can train his students to do so.

2. Mathematical Modeling steps:

Defining the problem, build a mathematical model., Solving the model. Testing the Model Validity by Applying the model, predict, interpret the results, determine the best behavior., If it is not valid to go back and make sure of the actual results of observations. Mathematical modeling reducing the gap between what is the problems of real life problem and what is the application, Teaching Physical model in many countries and has proved wildly a successful and a positive impact on the students sense of the value of what they learn. "There are many studies on the subject of mathematical modeling, but most of those studies focused on the development of mathematics in the light of the decisions of mathematical modeling, for example:

- Understanding, structuring, simplifying interpreting the content
- Assuming, Formulating, mathematising
- Working mathematically
- Interpreting mathematical out put
- Comparing, critiquing, Validating
- Communicating, justifying
- Revising the modelling process

3. The Problem of the study:

Despite the importance of mathematical modeling skills, but there are serious shortcomings in the application by the student teachers of mathematics and educational math in Jordanian universities, particularly the Arab and universities generally, and inadequate training. One indicator of this shortcoming is observed by a researcher in the pilot study on a group of students of the Faculty of Education Mathematics Division, as the researcher to submit test includes non-traditional problems requires modeled mathematically and solved, the results showed that 80% of respondents have dealt with these problems speculation without access to the solution in a systematic manor, and 20% they modeled mathematically and then tried to solve the problem, but have been unable to develop appropriate connection of the model and the solution for those models conditions, noted the researcher as well as the speed required respondents to obtain solutions, without giving themselves a chance to think about them, and this suggests that there is a weakness of the student teacher in possession of some mathematical modeling skills. And need to focus on mathematical modeling and applied mathematics topics in the scientific, economic and other fields.

There are deficiencies in student teacher in their translation performance of the skills, Among the most important requirements of Mathematical modeling the skills to be managed by a student teacher, deep

understanding of the relationships between mathematical concepts and the ability to employ mathematical relationships with each other out of new knowledge, which should have a math teacher who can sense of what's behind the math .The adoption of mathematical modeling and solving realistic problems, and natural issues research is an essential component of the math curriculum .and conduct an intensive training courses for mathematics teachers to renew their knowledge. The necessity of inclusion of teacher preparation for decisions on applications of mathematics in different sciences such programs (economy, education, population, and natural sciences ...) educational innovation in mathematics education research indicated that most of the research focused on solving school math problems, and links between mathematics and its applications in society, so the need for attention different applications of mathematics. Given the importance of mathematical modeling skills, and referred to the results of the studies referred to the situation calls for conducting a scientific study for the development of mathematical modeling skills of students teachers at the Faculty of Education. the problem of this study determined from the presence of failure among student teacher in the practice of mathematical modeling skills, which requires scientific study of the development of these skills

4. The study questions:

The study stems from the problem of the main question as follows:

- 1) How mathematical modeling skills can be developed among students Teachers of Mathematics Faculty of Education?
- 2) What are the mathematical modeling skills necessary for student teacher of mathematics?
- 3) what is the level of the student's math teachers in that skill?
- 4) What is the type of proposed program for the development of some mathematical modeling skills?
- 5) What is the effectiveness of the proposed program in the development of those skills?

5. The Study limitations

This study is limited to:

- 1 – The students of the final year at the Faculty of Education in Teaching Mathematics.
- 2 – The Best mathematical modeling suited for students of the Faculty of Education allocates math skills,

6. The study importance

The importance of this study due to the subject studied which aim to,

- 1 - Improve the programs of mathematics teacher's preparation
- 2 - Provide methods that contribute to the development of mathematical modeling skills.
- 3 -Taking care of mathematics application in solving problems of the real world.
- 4- Identify some mathematical modeling skills necessary for student teacher who is teaching mathematics,
5. Develop a list of those skills, according to the Education administrators the directors of mathematics, in-service training centers to develop these skills.

7. Research Methodology

The current study biased on

7.1 Mathematical modeling skills that require high thinking. The development of mathematical modeling skills which is a basic objective in the teaching of mathematics. Development of teacher preparation programs, faculties of education an important need for education achieve all of the above the study went through the following steps and stages to identify some of the mathematical modeling skills necessary for student teachers in math department ,and educational math Education college this done by:

- 1) Study of mathematical modeling (what they are important steps.)
- 2) Development of mathematical modeling skills necessary for student teacher
- 3) Interviewed the experts in the fields of education and academia.
- 4) Study of the nature of mathematics program.
- 5) Reviewed previous studies in this area.

7.2 Study tools:

This is done by:

Examining the situation or the problem, setting up the goals to be accomplished. Identifying variables in that represent the main features. Formulating the suitable model by selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the all variables, Analyzing and performing operations on these relationships conclusions; if the implementation of the performed operations cannot be complete, then revise variables selection used to formulate the model. Interpreting the results of the mathematics in terms of the original situation, Validating the conclusions by comparing them with the situation, and then

either improving the model or apply it if it is acceptable. and Applying the model to similar situations for evaluation.

Six principles considered for good a model: Accuracy, descriptive realism, precision, robustness, generality, and fruitfulness. A model should be: Accurate if the output of the model is correct or very near to correct. Descriptively realistic if it is based on assumptions which are correct. Precise if its predictions are definite numbers Robust if it is relatively immune to errors in the input data. General if it applies to a wide variety of situations. Fruitful if its conclusions inspire or points the way to other models. The fruitfulness principle can often be evaluated often before any of the details of the model.

(NCTM, 1989, 2000). In Principles and Standards for School Mathematics (2000) it is recommended that high school students should be able to develop, identify and find the best fitting model for real-world data by drawing on their own knowledge of ideas and methods that they have developed. They should also be able to explain why that model seems reasonable. Because a teacher makes choices of which problems to engage students in, a teacher's ability to use and appreciate the importance of the concept in varying contexts is critical to formulate recommendations and proposals in the light of the results of the study.

8. Terms definition

8.1 Program: The organization of a set of modules designed to develop mathematical modeling skills necessary for student teacher of the Division of Mathematics, Faculty of Education

8.2 The mathematical model: mathematical expression of the reality of the problem after simplify the complexity and the complexity of influencing and affected by variables in the problem, so the focus is on the main variables, which may be the mathematical model is equations or inequalities or matrices, geometric or graphical forms, ..., and configure in mathematical form of basic skills in mathematical modeling process.

8.3 Mathematical Modelling: Mathematics applied in the treatment of real life problems or problems in the same math or problems in other sciences, so by transforming life problem into a math problem and then deal with this issue , solve it, choose the best solutions ,corresponding with the nature of the problem we are dealing with it , generalize and predict if possible.

9 Findings

9.1 There was a slight improvement in the student teacher in the ability of mathematic molding and testing the Model

9.2 The researcher found this percentage is satisfactory to judge the improvements of the student teacher ability in mathematical modeling this is due to:

- The low level of student teacher in pure mathematics in the first place.
- For the student to do not have a math ability and mathematical modeling ability should be trained on these skills starting from the kindergarten
- The teacher students fear from trying the new skill they didn't have the ability to test and judge the model
- The rejection of solving word math problem using mathematical modeling, most of the students prefer the like examples problem
- The un-seriousness of their responses to the test

10. Recommendations

1. Use the mathematical modeling in mathematical curricula to introduce the mathematical knowledge in solving problems considering a life issues
2. Use the mathematical modeling in mathematical curricula to introduce the mathematical knowledge in solving problems considering a life issues
3. Rewriting text books to help students in treating mathematics in new a revolutionary point view serves the new trend in teaching mathematics
4. Train the students teacher and teachers in education colleges and mathematic department on how to use the mathematical modeling in solving real life problems
5. Train the students teacher and teachers in education colleges and mathematic department on how to use the mathematical modeling in solving real life problems.
6. For curricula designers and editors, they have to direct and show the teachers the importance of the mathematical modeling to increase the students' motivation toward math learning.
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9. There should be specialists team to set up and arrange the problems, situations and activities that helps in developing the innovation and creation in math curriculum putting into consideration the students' individual differences.
10. Classifying the math problems in the curriculum in order to help students to use different methods of solving to develop their skills.
11. The math curriculum content should be reorganized according to the math modeling,
12. Prepare a guidelines and tips for mathematics teachers to teach the curriculum using the math modeling.

From all of the above the researcher suggests for further researches in the insinuations for future teachers' teaching practices to make it significant, and introduce an efficient and powerful means of gaining regular access to their students' thinking ability and modeling which can be done by modifying the curricula and training the teacher to be more capable to apply modeling process in their teaching .

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