The Impact of Using the Mathematical Modeling in Communication and Mathematical Achievement in Preparatory School Students

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ABSTRACT

The research aims to know the impact of using Mathematical Modeling in achievement and developing mathematical communication skills. The research sample consists of 42 prep school students in Arab schools in Israel in the academic year 2019-2020. The researcher follows the experimental curriculum. The students were divided into two experimental and control groups; the two groups were equalized in the pre-mathematical achievement. The research concludes that there is efficiency for mathematical modelling in mathematical communication and achievement favoring the experimental group. The researcher introduces recommendations and suggestions that contribute to achieving mathematical communication and developing its mathematical ability.

Keywords
Mathematical Modelling, Mathematical Communication Skills, Mathematical Achievement, Preparatory Stage
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Introduction

Mathematics plays an essential role in our scientific and practical life, especially in the enormous technological development. Playing this significant and crucial role must be based on teaching strategies that make the learner the center of the teaching process and allow him/her to participate effectively. Most mathematics' teachers offer basic topics that indoctrinated and exist in the educational books, without depending on strategies that motivate the students. This makes mathematics hard, complex and not close to the student world, which makes most students complain about the difficulty of mathematics, as well as their low academic achievement. Besides the sequencing and connecting subjects becomes meaningless which naturally leads to an imbalance in the development of students' creative thinking and mathematical communication skills and low achievement.

Mathematical Modeling strategy motivates students to strive with their ideas, develop their mental abilities and raise their achievement level. Moreover, it contributes to connecting mathematics with life to make the mathematics subject more fun and take it out of the context of complexity so that it contributes to overcoming common mistakes and misconceptions in mathematics. Mathematical modelling strategy is derived from the constructivist theory of education. Its content is that the individual is active in the construction of thinking patterns due to the interaction of his/her innate abilities and teaching style. It is one of the modern teaching theories that educators have turned to form students' ideas (Abd Algani, 2018; 2019, Edwards, 1979).

The mathematical modelling strategy takes students ' ideas, motivation, willingness to learn, and individual differences into account while planning for the lesson. It also shows a graphic representation of real-life and that the mathematical problem is the basis of mathematical effectiveness, which raises a lot of questions and stimulates students' thinking. The mathematical modelling strategy's importance is to motivate students to discuss their ideas, which helps the teacher assess students' level and contributes to the development of students' mathematical communication skills. It will develop mathematical communication among the students (Abd Algani & Eshan, 2019).

Literature Review

Mathematical Communication

Mathematical communication is an essential component of mathematical power that enables the student to use the mathematical language while confronting written, read, an audible or concrete situation, and interpreted and understood it through oral or written mathematical discussions between the student and the teacher or between the students themselves (Letwinsky & Karim, 2017).

Mathematical communication aims to make learners aware of mathematical language and express his/her mathematical ideas through reading, talking and listening. Communication is one of the mathematical criteria mentioned in the document of the National Council of mathematics teachers, which states that the ability of the learner to use the mathematical language with its symbols, terms, forms and relations to express mathematical ideas and references to understand it and to be able to explain to others (Tinungki & Georgina, 2015).

Mathematical Communication Definition

Letwinsky and Karim (2017) define mathematical communication as the student's ability to understand mathematical expressions, express contained mathematical ideas, solve mathematical problems and communicate with others through written sentences incorrect mathematical language.

Veloo, Arsaythamby; Md-Ali, Ruzlan; Chairany and Sitie, (2016) defines mathematical communication as the learner's ability to use mathematical language with its symbols, terminology, forms and relations to express mathematical concerns and ideas to understand it and to be able to clarify to others. Fennell (1995) and National Center for Education Statistics (2014) define mathematical communication as exchanging ideas, information or mathematical reviews between the teacher and his/her students and between the students themselves through discussion, listening, reading, acting and writing.

In light of what was mentioned, we define mathematical communication as the student's ability to use the vocabulary of mathematical language (forms and symbols), express mathematical ideas, relations and solutions and explain them to others. Besides, it is the ability to justify a particular situation or solve mathematical problems and employ the language skills of reading, writing, speaking and listening, and mathematical representation skills, which may help to understand mathematics and increase their ability to use them in mathematical and life situation.

The National Council of Mathematics Teachers (NCTM) (1989; 2000) classified the forms of mathematical communication into**:**

1. Mathematical Reading Skill

Mathematical reading is an important area in mathematical communication skills, especially in self-learning or when pupil uses it while doing homework or assessment tests.

Fikri (1995: 222) defines mathematical reading as a psycho-linguistic process that includes the perception of words, mathematical symbols or forms, linking literal meaning to terms, analyzing relationships and formulating problems in a verbal form.

While Fennell and Rowan (2001) define mathematical reading as a pupil's ability to pronounce mathematical vocabulary correctly, identify verbal meanings of mathematical terminology, analyze relationships between mathematical language and solve questions. It can be defined as the student's ability to understand, analyze and evaluate readable mathematical texts, including concepts, symbols, equations and problems. In addition to identifying the verbal meanings of mathematical vocabulary, analyze the relations between them and solve mathematical issues.

Mathematical reading differs from other types of reading skills that are used in study subjects, as it has its patterns and levels that the researchers point out as follows:

- Mathematics as a language includes two basic patterns: the first is the language of words and terms that unique vocabulary related to the mathematical system, the second is symbols. To read Mathematics correctly, students must read both of these mathematical language patterns and transform one to the other. The efficiency in using both practices is an essential requirement (Isaksen & Treffinger, 1985). It requires teachers' effort and learners' skills so that the mathematical language has its particularity. Besides, reading increases students' motivation to learn mathematics by increasing their participation in mathematics classes which results from their mathematical task.

- To succeed at each stage, the student must be able to read the question, understand the symbols in the question's formulation, link the literal meaning to each character, analyze the relations between the signs, and then be able to solve them.

Mathematics reading skill focuses on the reliability of the student's pronunciation of mathematical symbols, phrases, concepts and instructions, and requires the ability to understand the verbal function of the mathematical symbols and rules s/he reads; to achieve this, the math teacher must (Fennell & Rowan, 2001):

- Listen well to the student to provide them with appropriate feedback to determine his/her mathematical reading.

- Design teaching aids and boards which have key symbols and basic concepts.

- Instruct explanatory questions during class help to achieve student's understanding of mathematical symbols and phrases.

- Encourage students to read aloud what they have written and what the teacher has written on the board.

- Encourage students to read representations, shapes and graphs correctly.

- Design educational activities that involve students reading cards and boards that contain mathematical language.

There are four levels of mathematical reading:

Symbols' Perception

The symbol is defined as a character, relationship or abbreviation that represents a mathematical process or expression. The symbol is often used instead of the name. Symbolic thinking is thinking through symbols and abstractions, not through data senses; for example, the thought used in the case of geometry and algebra issues, for example, is a symbol of belonging and read (belongs to) and $\notin$ is the symbol of non-belonging and read (not belong to) (Fennell & Rowan, 2001).

Symbols Verbal Meanings' Determination

Linking literal meaning to symbols means the ability to give an appropriate definition, conclusion, examples of what the term, character or form mean, for example, the process of the intersection of two sets A and B denoted (B⋂A), and the result is a new set containing shared elements from A and B (Brousseau & Otte, 1991; Davis, 1981).

Analysis of the Relationships between Symbols

It means the ability to process symbolic facts, ideas, terms, express the final position with symbols, and exclude unrelated information, for example, Note the adjacent figure 1:

$$B \cap C = \{\dots\dots\dots\dots.\}$$
$$B \cup C = \{\dots\dots\dots\dots.\}$$

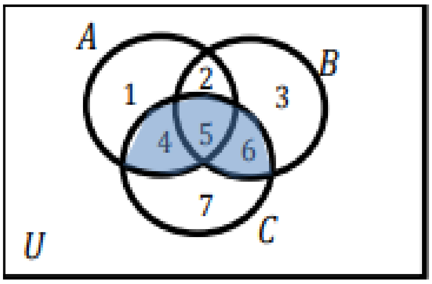

Figure 1

Solving Mathematical Exercises Formulated in the Form of Verbal Questions

It means finding the mathematical relationships between variables and expressing them with the appropriate symbols and forms. It is defined as the exercises that require the student to perform activities that including the perception of words and symbols, linking the literal meaning to words and characters, and analyzing the relationships between words and symbols, for **example,** the law of the outer surface area of the sphere is: If: **Find**? Define the radius of the sphere R by P? (Goldin, 2000).

2. Mathematical Writing Skill

Hasnes and Zard (1994) define writing as an essential science tool in general and mathematics in particular. Also, it helps to facilitate the process of thinking, understanding, and the ability to express mathematical ideas, concepts and relationships and transfer that to others. And Usiskin (1996) believes that teaching mathematics involves accustoming students to the correct mathematics writing; when solving problems or issues, the student should learn how to express the solution accurately and organized—for example, arranging arithmetic operations, putting numerical and algebraic symbols, writing proofs, and writing the distinction between mathematical issues and the location of the equal sign since writing skill includes using the mathematical vocabulary and terms to express ideas in written or figured away. Dibble (1995) also mentions that mathematical writing expression uses language and knowledge of mathematics and terminology to express mathematical arguments in written or calculated form. Besides using it regularly to access writing communication within math class activities to provide teachers with sources of information about pupils' thinking about mathematics and evaluation of their learning (Austin, 1998; Austin, Ministry of Education).

Training students to write the steps of solving a question and write its numbers and letters leads to developing the skills to solve mathematical problems because writing question gives the best chance for thinking about the solution and extends the writing skills, spelling, expressive and written.

Signs for Mathematical Writing Skills (RAMA, 2017):
- Writes solutions to questions correctly.
-Write an explanation for solving a problem.
-Writes a description for the characteristics of the given form.

For example, Jawad wants to travel from "Karam" town to "Al Rumman" town.
He confuses which route of travel to choose. Does he travel through route number 1, where he has to pay fees, or route number 2, where he does not have to pay fees (as shown in figure 2)?

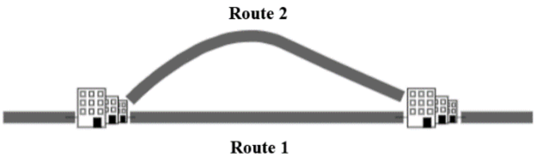

Figure 2

The following table (1) provides information about travel from "Karam" town to "Al Rumman" town in both routes

	Road length	payment fee per kilometer	fuel consumption
Travel on Route No. 1	30km	0.7 NIS	one liter of fuel per 15 km
Travel on Route No. 2	40km	without charge	one liter of fuel per 10 km

Table 1
- The price of one liter of fuel is 6 NIS.

How much does it cost to travel from "Karam" town to "Al Rumman" town in both routes? Show the solution method. The solution (as shown in table 2):

Traveling on Route 1	Traveling on Route 2
The length of the Route 30 km	The length of the road is 40km.
It consumes 2 liters of fuel to cross Route No. 1	It consumes 4 liters of fuel to cross Route No. 2
Fuel consumption Payment =2 * 6=12 shekel	Fuel consumption payment = 4*6=24 NIS
Payment fees = 0.7 *30=21 shekels	Payment fees 0

Table 2: The solution
(Rama, 2017).

3. Mathematical Representation Skill
The mathematical representation can transform a mathematical question or idea into a new formula. The student expresses the belief in an alternative template that is more completed, acceptable and exciting to others. Circle circumference – in a circular form, wrap a thread around in one roll, so the thread's length is the circle's circumference and supposes it is 15.7 cm. We can measure the diameter and consider that it is 5 cm; when we multiply the diameter in the fixed percentage, we'll find it the same as the length of thread we measured). Mathematical representation is also the transformation of the represented image in figures into mathematical symbols and words. Represent numbers by different images (cubes, beams, coins) or transform the other pictures of

numbers into numerical characters, transform verbal questions into figures, tables or equations, or transform graphic problems into mathematical symbols and words (Torrance, 1996).

Mathematical representation is the expression of mathematical ideas or concepts through various tools such as words, tables, drawings or concrete materials, for examples of mathematical representation skills (Phillips & Crespo, 1995; Fennell, 1995; Kosko & Wilkins, 2011).

- Recognizes equivalent formulas for the same mathematical text, for example**,** you have 8 equations. Match each one with its equivalent equation.

|x| = 1	**x – 1 = 0**
x + 7 = 13	(x + 1)(x – 1) = 0
x = 0	3x = 18
4x + 9 = 13	3x = 2(x – 3) +6

- Transform what drawings and figures represent into numerical symbols or algebraic symbols.
- Transforming verbal questions into drawings, figures, images, information tables, sensory models, or algebraic symbols and equations.
- Transforming imaged questions into mathematical symbols and words.
- Transforming verbal questions into algebraic equations.
- Transforming the mathematical forms into mathematical words.

4. Mathematical Listening Skill

Mathematical listening skills are necessary for the pupil to begin absorbing the initial and straightforward concepts to form complex ones and mathematical generalizations. Listening is considered a mathematical communication skill for teacher and pupil, where the pupils benefit from listening to the others' ideas in developing strategies for dealing with math activities.
Besides, listening to correct spoken mathematical words leads to practical development, discussion (Fennell & Rowan, 2001). It can be said that listening in situations of mathematical communication needs attention to content, words and relationships since communication in mathematics takes place effectively only if the pupils are prepared and trained well to play both roles: listen attentively to the thoughts of others and talk about their mathematical understanding (Fikri, 1995; Kosko & Miyazaki 2012).

(Fikri 1995; Larnell & Smith, (2011) defines it as the pupil's ability to listen intelligently and attentively to the mathematical terms, mathematical interpretations relations, description models and forms. Then, s/he can clearly express what s/he has heard and interpret what others have said mathematically correctly. Mathematical listening is one of the essential structures of learning mathematical communication, listening to the verbal and rightly spoken mathematical language, and drawing on others' opinions and ideas in developing strategies for dealing with mathematics fragments (Goldin, 2000).
Crouse and Sloyer (1987) state mathematical listening skill as follows:
Analyze and evaluate mathematical issues, solutions, and discussions presented by others, respond to them correctly and read mathematical statements coherently and precisely.

Skill indicators

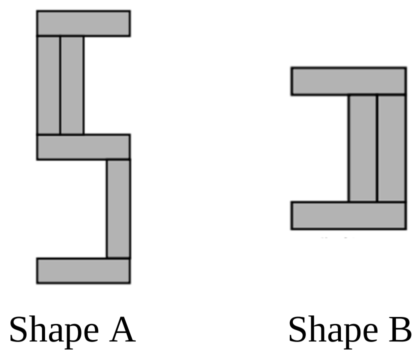

Figure 3

Student can realize a mathematical relationship he heard.

Two different shapes (Fig. 3) were built by many of tiles, which
are similar to the following shape.
The area of Shape A is larger than the area of Shape B by 32 cm^2.
Find the value of x. show the solution method.
The answer: x = ……….. cm

Student can complete a mathematical sentence which s/he had heard part of it, for example (Hoffman, 1998; Karl Duncker, 1945)**:**

- Given the following number series:
- $\frac{1}{2}$, 1, $1\frac{1}{2}$ ....
- a. Write the following three boundaries in the series: 2, $2\frac{1}{2}$, 3
- b. Describe the series in allowed words.

c. What will the ninth boundary in the series be? Explain.
Student can listen to the peer's performances and interpret them correctly. What was your preceding colleague's answer, and is it right or wrong?

- Student can listen to a description of a real model or geometric figure and apply it correctly, for example (Letwinsky & Karim, 2017):

Before starting the cinema show, two types of tickets were sold: regular tickets, which price is 60 shekels per ticket, and V.I.P tickets which cost is 80 shekels per ticket. The total of all sold tickets was 120 tickets. At the end of the show, it turned out that the price of all sold tickets is 7400 shekels. How many tickets were sold for each type?

- Student can listen to an oral description of a mathematical task to perform it correctly.
- Students can listen to his/her colleagues' opinions, help them understand what they are expressing and reflect his/her respect for their views.

Which opinion of your colleagues' views do you think is correct and why?

- Read mathematical phrases coherently and clearly: To read a diagram correctly.
- To read the graph and explain its content to colleagues.
- To read written mathematical relationships.
- To read Students ' written performances and interpret them correctly
- To read and explain what your friend wrote, mentioned the reasons if right or wrong.
- To read a description of a mathematical model or form and do it correctly.

5- Mathematical Speaking Skill
The studies vary in defining this skill. Some describe it as "talking skill" like Guilford (1967) and Abd Algani (2018; 2019). Moreover, Hoffman (1998) use to call it "mathematical discussion". Abd Algani and Al-haj (2020) define the mathematical, verbal expression skill as pupils' ability to display and present their mathematical knowledge by expressing it orally while speaking with a teacher or other pupils in a free environment and to encourage participation based on the opinions and suggestions of others.

Abd Ghani and Eshan (2019; 2020) state the mathematical oral expression skills in the following: Student can introduce a summary of what s/he understands about ideas, solutions and procedures, express the characteristics of a mathematical form orally correctly, ask questions that reflect his/her understanding of the situation, say a geometric shape orally in a proper way, correctly mention mathematical law, use his/her language to demonstrate mathematical concepts, ask his/her colleague a question about the topics s/he studied, provide oral descriptions of numerical or geometric patterns, provide a verbal description daily life situation that requires a mathematical operation, dialogue the teacher or his/her colleagues in a right and expressive manner.
The teacher gives students a working sheet that includes decorative geometric figures and presents a sheet that consists of a set of questions about the decorative models.

Research Questions:
In light of the current search, a question can be formulated as follows:
What is the impact of using mathematical modelling on the achievement and communication skills in Arab middle school students' mathematics in Israel?
The importance of research underlies in knowing the possibilities and strategies of modelling in developing new teaching strategies.

Methodology

The Curriculum of the Study
In this chapter, the researcher mentions the procedures that he followed in implementing the

study through the study curriculum, community, sample, and the preparation of the study tool, and ensures its truthfulness, stability, and statistical methods followed.

1) Study Approach: the researcher uses the experimental method, where the researcher designs the equivalent groups with the pre-test and post-test for the first experimental group that learn according to the mathematical modelling method, and the other is a control group that know according to the usual method used in school.

The researcher subjects the independent variable in the study, "mathematical modeling", to applying its impact on the dependent variable," that is the mathematical communication skills", to the students of the preparatory stage.

(2) Study community: it consists of all 8,800 ninth-grade students in the preparatory school in the Arab schools in northern Israel (the academic year 2019-2020).

(3) Study sample: it is selected from various Arab preparatory schools from northern Israel during the first semester of 2019-2020. The researcher distributes the study sample to two groups, the first experimental group and the other represents a control group, where the sample members totalled 55 students and the following table (3) shows this:

School	Class	Experimental / Control	Number of the students
Eighth grade classes of	E	Experimental	27
Arab Middle schools from northern Israel	C	Control	28
Total			55

Table 3: The distribution of the sample

Equivalence of two study groups:

The researcher ascertains the equivalence of the two groups, experimental and controlled, according to the following variables:

1) Mathematical achievement: that is through the student's achievement in previous exams according to the following table (4):

Group	No.	Mean	St.	T(85)
Experimental	27	71.23	14.1	0.4
Control	28	69.5	16.32	

Table 4: The equivalence of the two groups

2) Cultural, economic and social level of the parents: selecting students is done with the help of the school counsellor, where the experimental and control samples are chosen from the same schools and an immediate socio-economic, cultural environment.

Research Program:

Teacher guide is considered a mentor and assistant in the implementation of lessons without problems and flops. It also provides directions and guidance that can help the teacher to facilitate the educational process and its progress in the right direction. The teacher guide has been prepared according to the following steps:

Program objective: to provide a comprehensive presentation of the teachers' role in applying mathematical modelling steps to achieve the purposes of the academic unit.

According to the Israeli Ministry of Knowledge curriculum, it also contributes to helping the teacher develop mathematical communication skills and in the quadratic function unit of the ninth grade, especially among middle school students.

Content of the guide: the guide consists of the quadratic function unit and mathematical modeling of the preparatory stage according to the Israeli Ministry of education curriculum in mathematics as shown in the following table (5):

No.	Subject
1	quadratic function of the image $y = x^2$
2	the quadratic function of the image $y = a \cdot x^2$
3	the quadratic function of the image $y = x^2 + k$
4	the quadratic function of the image $y = (x - p)^2$
5	the quadratic function of the image $y = (x - p)^2 + k$
6	the quadratic function of the image $y = a \cdot (x - p)^2 + k$
7	the quadratic function of the image $y = a \cdot x^2 + b \cdot x + c$

Table 5: The matirial

The guide has been built according to the following:
1) The objectives of each subject are formulated in a behavioral way that the teacher can measure class goals and student performance.
2) Educational tools and means: the researcher prepares the standards that suit the educational situation's nature according to students' needs.
3) Evaluation and assessment: It means to assess students ' understanding of educational materials.

Study Tool - Mathematical Communication Test:

1) The purpose of the test is to measure to what extend preparatory school students possess mathematical communication skills.
2) Identify the mathematical communication skills that the test measure

Mathematical communication test: the paragraphs of the mathematical communication test were drafted as the final form. It consisted of 40 items (8 items in each mathematical communication field), and the researcher prepared the test items according to previous studies.

To examine the test credibility, it was applied on a group of 35 students, then, the weak items were deleted after the calculation of Alpha Cronbach through the SPSS program, and two weeks later, it was applied for the second time on the previous sample, the analysis of Alpha Cronbach was 81.1%.

Mathematical Achievement Test:

The study tool of the mathematical achievement test was prepared in its final draft where it consisted of 18 questions (6 questions based on knowledge, six questions based on understanding and six questions based on application according to Bloom's taxonomy)

The test was written in its final draft with its instructions. Then, it was submitted to a competent committee in the field of mathematics, teachers, and experts in assessment and languages to be written in the test was applied on a reconnaissance sample to determine the level, the time required to solve and difficulties, where it was determined that the time needed for the test is 120 minutes and the researcher checked it and assess the fastness of the test using Alpha Cronbach equation which resulted in 81.0%, this is an index on the validity of the test in the study, and it can be applied on the students.

Results

Post-achievement results:

The research results show that no differences between average of mathematical achievement scores between the experimental group students who study using mathematical modeling and the control group who study in the usual way, as shown in the following table (6):

Group	Number	Mean	St.	t (54)
Control	28	56.44	20.22	2.72
Experimental	27	44.18	15.23	

Table 6: The Post Achievement

Measuring the size of the independent groups' effect by calculating the square of ETA η^2 by Cohen's way:

$$\frac{56.44 - 44.18}{4.496} = 2.726$$

ETA Form:

$$\eta^2 = \frac{7.3984}{53 + 7.3984} = 0.122$$

Here is the significant impact of using the mathematical modeling on students' achievement.

Results related to the mathematical communication test:

The search results show that no differences between the average test scores of mathematical communication test between the students of the experimental group who study using the mathematical modeling and the control group who study using the usual way, as shown in the following table (7):

Group	Number	Mean	St.	t (54)
Control	28	37.04	8.8	3.12
Experimental	27	43.12	11.24	

Table 7: Mathematical Communication

Measuring the size of the independent groups' effect by calculating the square of ETA)(η^2 Cohen's way:

$$\frac{43.12 - 37.04}{2.96} = 2.054$$

ETA form:

$$\eta^2 = \frac{9.73}{53 + 9.73} = 0.155$$

Here is the significant impact of using the mathematical modeling in students' mathematical communication.

Discussions and Conclusions

The research's results found an impact for using mathematical modelling in improving mathematical communication skills and educational achievement between the students' average results of the experimental group and the students' average of the control group in favor of the experimental group; these results are consistent with the results of the studies of (Larnell & Smith, (2011), (Letwinsky and Karim, (2017), (Abd Algani, 2018), (Abd Algani & Eshan, 2019), in the use of some strategies that develop the creative thinking skills in the mathematics field.
The following reasons can explain this:
1) The variety of activities and life problems has led to a rise in creativity among students.
2) Mathematical modelling solution with its multiple, progressive and interrelated steps have worked in each of its actions to expand student perception and integrate them into steps that help students to develop their creative thinking.
3) Mathematical modelling solution increases students ' understanding of the problems posed, which develop their fluency of solutions, the flexibility of entrances and originality of explanation, which grew students creative thinking.

Interpretation of results related to the mathematical communication test

The current study aims to reveal the impact of using mathematical modelling on developing mathematical communication skills in preparatory school students in Arab schools in northern Israel. To achieve the goal, the researcher's mathematical communication test was applied to the study's students. After the application was completed, the data was collected and counted to validate the study hypothesizes.

The results show statistically significant differences, where the experimental group studied by mathematical modelling strategy excellence over the control group studied by the usual method, in mathematics, and this can be attributed to:

The organization of educational content and its presentation to students using mathematical modelling, which contains several skills that increased the students' motivation and achievement. Mathematical modeling has led to the provision of the appropriate classroom environment to students' communication within the classroom, contributing to motivating students to think, participate actively, interact, and give solutions to different mathematical problems in many different ways. Also, mathematical modelling contributes to students who have understood the basics of mathematics away from indoctrination. Besides, feedback helps to solve mathematical questions and guide students towards a deep understanding of the material and change teacher understanding of students' mathematical thinking ways.

All this led students to use the mathematical language to describe objects and relationships and use symbols and geometric shapes in their written communication. The application of mathematical communication within working in groups has helped to increase the inter-student dialogue, which helps to build collaborative groups supporting the learner's understanding, and the student's search for information by him/herself helps to keep the information in his/her memory for a more extended period. Moreover, students ' ability to perceive and use the mathematical language increased and developed reading, speaking and listening skills.

In conclusion, mathematical modelling actively contributes to developing mathematical communication skills for students and enhancing their understanding of the learning subject. Thus they have developed creative thinking in solving problems and scientific achievement.

Recommendations
In light of the study's results, the researcher recommends:
1) Using mathematical modelling in mathematics curricula to show the role of mathematical knowledge in solving real-life problems.

2) Training students-teachers in education on using the modelling and mathematical problem-solving in solving life problems.
3) Teachers should discover students ' abilities and inclinations, develop their curiosity and improve these abilities in the right direction.
4) The curriculum designers should pay teachers attention to the importance of mathematical problem solving to increase students' motivation in studying mathematics.
5) There should be a specialized team to select problems and activities that develop creativity and include them in the math curriculum in an appropriate manner that takes into account students' differences.
6) The gradation of problems in the curriculum is necessary so that there are problems solved mentally, others need paper and pen, and others need calculators to develop students' creativity.

Proposals for Future Research:
In light of the current study objectives and results, these subsequent studies and research can be proposed:
1) Study the impact of using mathematical modelling in teaching other subjects and educational stages.
2) Study the impact of using mathematical modelling on developing visual thinking skills in primary school students.
3) Study the effectiveness of training programs for teachers to use mathematical modelling in teaching different school subjects.
4) Study that aims to identify the teaching staff's awareness of mathematical modelling importance.

7) Focusing on organizing the mathematics curriculum content in the preparatory stage according to solving mathematical problems.
8) Designing guides books for teachers to teach the mathematics curriculum at the preparatory stage using mathematical problems.

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