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THE EFFECT OF USING MODELING AND NEGOTIATION STRATEGIES IN PRIMARY SCHOOL PUPILS' ACHIEVEMENT AND THEIR TENDENCIES TOWARDS MATHEMATICS

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Abstract:
The current study aims to identify the effect of using the modeling and negotiation strategies on the achievement of primary school students and their inclination towards mathematics through the following hypotheses:
1- There is no statistically significant difference at the significance level (0.05) between the mean scores of the first experimental group and the control group in the achievement test.
2- There is no statistically significant difference at the significance level (0.05) between the mean scores of the second experimental group and the control group in the achievement test.
3- There is no statistically significant difference at the significance level (0.05) between the mean scores of the first experimental group and the second experimental group in the achievement test.
4- There is no statistically significant difference at the significance level (0.05) between the mean scores of the first experimental group and the control group in the mathematics inclination scale.
5- There is no statistically significant difference at the significance level (0.05) between the mean scores of the second experimental group and the control group in the mathematics inclination scale.
6- There is no statistically significant difference at the 0.05 significance level between the mean scores of the first experimental group and the second experimental group in the mathematics attitude scale.
The current study was limited to primary school students in schools affiliated with the Misan Education Directorate for the academic year 2023/2024, focusing on the first three chapters of the mathematics textbook prescribed for the fifth grade. The studyer used a quasi-experimental design with a post-test approach. Three classes were randomly selected from Al-Ashbal Primary School for Boys,

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with a sample size of 84 students: 28 students in the first experimental group taught using the modeling strategy, 28 students in the second experimental group taught using the negotiation strategy, and 28 students in the control group. The equivalence of the three groups was ensured based on chronological age in months and the student's mathematics grade from the previous year (fourth grade).

To measure the achievement of the three experimental groups after the experiment, the studyer prepared an achievement test consisting of (30) multiple-choice items. Its content validity was verified by presenting it to specialized experts. The studyer then administered the achievement test to a pilot sample to ensure the clarity of its items and to calculate its psychometric properties. The reliability coefficient was found using Pearson's split-half formula, which yielded (0.79). The Spearman-Brown correction formula was then used, resulting in a reliability coefficient of (0.89). The discriminatory power of its items, the difficulty index, and the effectiveness of the incorrect alternatives were also confirmed. As for the motivation scale, the studyer prepared a motivation scale consisting of (34) items. The validity of its items was verified by presenting it to a group of specialized experts. The scale was then administered to a pilot sample to ensure the clarity of its items and to calculate its psychometric properties. The reliability coefficient was found using the split-half method with Pearson's formula and yielded (The coefficient was 0.81), and then the Spearman-Brown correction formula was used, yielding a reliability coefficient of 0.896.

The experiment was conducted during the first semester of the 2023/2024 academic year. Data were analyzed using one-way ANOVA, Scheffé's test, and the t-test.

Based on the statistical results, the following conclusions can be drawn:

1. The use of the modeling strategy in teaching mathematics led to an increase in the achievement level of fifth-grade students compared to the traditional method.
2. The adoption of the negotiation strategy clearly contributed to improving students' academic achievement, demonstrating its effectiveness as an alternative to the traditional approach.

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Therefore, the studyer recommends focusing on the use of the modeling and negotiation strategies due to their positive impact on achievement and students' attitudes towards mathematics.

Chapter One:

Introduction to the study:

The Problem:

Mathematics is a synthetic science that progresses from the simple to the complex, where theories and results are derived from axioms through a sequential, deductive method. It is predominantly abstract (Al-Hassani, 2011, p. 191). Despite this, prevailing teaching practices in primary schools, which often rely on routine exercises and traditional assignments, have contributed to weakening students' ability to grasp mathematical concepts, rules, and ideas, negatively impacting their academic achievement in this subject.

Recent local studies (Al-Kanani, 2009; Al-Kanani, 2009; Al-Tamimi, 2010; Al-Yasiri, 2010; Faris, 2011; Al-Saidaoui, 2012) have confirmed a significant weakness in student achievement, particularly in the fifth grade, despite the efforts of teachers. A survey of 25 teachers and supervisors revealed that the main reasons for this weakness were the inadequacy of teaching methods and activities to students' learning styles, the lack of diverse teaching aids, and assessment methods that did not accurately reflect their level of achievement or identify their strengths and weaknesses.

Al-Saqqar (1986, p. 21) also pointed to the strategic importance of mathematics in economic and scientific development. However, the poor performance in the primary grades was reflected in students' reluctance to study mathematics at the university level (Daoud, 1998, p. 56). The 15th Scientific Conference, held from March 8-9, 2013, at Al-Mustansiriya University – College of Basic Education, indicated that the reason for the low academic achievement of students is the teachers' reliance on traditional methods. The conference emphasized that "teachers still use traditional teaching methods that weakly motivate students, do not lead to their interaction with the material, lack the ability to diversify different learning situations, and fail to present the course content in an engaging way, disregarding the nature of the objectives, the subject matter, and the students." (Al-Mustansiriya University, 2013:47). Furthermore, the weak attitude towards mathematics resulting from traditional methods and the failure

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to activate the classroom environment to cultivate positive attitudes towards the subject represent an additional problem (Muhammad, 2003, p. 2).

Given the cumulative nature of mathematics, any deficiency in grasping prior concepts hinders the understanding of subsequent experiences (Al-Ta'i, 2005, p. 2). This reality necessitates the search for modern teaching strategies, such as modeling and negotiation, that can contribute to improving student achievement and fostering their interest in mathematics. This is what the current study aims to study.

The Significance:

The significance of this study lies in its examination of the impact of employing two effective strategies in the learning environment: modeling and negotiation. These strategies play a dual role in raising academic achievement and promoting a positive attitude towards mathematics among elementary school students. Mathematics is a fundamental subject for developing thinking, analysis, and problem-solving skills; however, its relative difficulty may weaken some students' motivation towards it (Zahran, 2004: 295).

The modeling strategy allows learners to observe the steps of thinking and solving clearly and systematically. This enhances their understanding of mental processes and develops their ability to self-regulate and learn independently (Abu Nian, 2001: 68; Gama, 2004: 123), which positively impacts their academic performance. The negotiation strategy creates an interactive classroom environment that encourages students to express and discuss their ideas, and to reach shared solutions. This increases their active participation and strengthens their emotional and cognitive connection to the subject (Arafa, 2005: 56; Holmegaard et al., 2014).

By combining these two strategies, this study aims to present an educational model that contributes to raising students' achievement in mathematics while simultaneously supporting their positive attitudes towards it. This achieves integration between cognitive and emotional development and establishes a sustainable learning motivation.

The Objective:

The current study aims to identify the effect of using modeling and negotiation strategies on the achievement and attitude of primary school students towards mathematics.

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The Hypotheses:

To achieve the study objective, the following hypotheses were formulated:

1- There is no statistically significant difference at the (0.05) level between the mean scores of the first experimental group and the control group on the achievement test.

2- There is no statistically significant difference at the (0.05) level between the mean scores of the second experimental group and the control group on the achievement test.

3- There is no statistically significant difference at the (0.05) level between the mean scores of the first experimental group and the second experimental group on the achievement test.

4- There is no statistically significant difference at the (0.05) level between the mean scores of the first experimental group and the control group on the attitude towards mathematics scale. 5- There is no statistically significant difference at the 0.05 level between the mean scores of the second experimental group and the control group on the mathematics attitude scale.

6- There is no statistically significant difference at the 0.05 level between the mean scores of the first experimental group and the second experimental group on the mathematics attitude scale.

The Limitations:

The current study is limited to the following:

1- Fifth-grade students at Al-Ashbal Primary School for Boys, affiliated with the General Directorate of Education in Misan Governorate.

2- The first semester of the 2023-2024 academic year.

3- The first three chapters of the mathematics textbook prescribed for fifth-grade students.

Defining Terms:

Strategy: Attia (2008) defined it as "an organized plan to achieve educational objectives, encompassing the methods and techniques employed by the teacher to achieve the specified goals within the available resources" (Attia, 2008: 30).

Operationally, it is defined as:

A teaching strategy used b the researcher in dealing with he experimental group students of the study sample to improve their achievement level and attitude

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towards mathematics based on a set of steps planned according to the principles governing the use of modeling strategy and negotiation strategies.

Modeling: Afana and Ibrahim (2009) explained that, "Modeling is not only when the student observes or imitates what the teacher does but he learns to think as the teacher thinks during solving problems, expressing out loud about what he is working on, directing himself, asking questions and actually saying what he thinks of the problem at hand,…how they organize themselves,… how they plan their work… reviewing together with monitoring their effort making reflections, arranging for time they invest in performing an educational task" (Afana and Ibrahim 2009:191.(

It is also operationally defined as.The studyer operationally defines modeling as a series of activities through observation and imitation by the teacher while thinking-aloud in the process of demonstrating and clarifying the thought processes to students during mathematics instruction.

Negotiation: Zaitoun (2008) described it as "One of the teaching strategies in human learning, negotiation is about coming to agreement with learners on a significant unit of work". (Zaitoun, 2008: 116) Definition in operational terms This is the involvement of students in planning their learning. This is based on agreement between the students and teacher about how content will be presented, when it will be taught, resources and tools to be used, and assessment methodology.

Attainment: According to Samara and Al-Adli (2008): "The abilities and knowledge students gain after studying a certain subject".." (Samara and Al-Adli, 2008: 52)

The researcher operationally defines it as:

The grade obtained by the fifth-grade students in the study sample in The achievement test at the end of the experiment.

Attitude:

Zaitoun, 2001, defined it as: "What individuals (students) are interested in and prefer in terms of things and activities, and the tasks and activities they enjoy and feel a great deal of love and satisfaction during" (Zaitoun, 2001, p. 115).

Operational Definition: The interest of fifth-grade students in mathematics and their enthusiasm for studying it, expressed quantitatively through the total score

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obtained by the student on the items of the Attitude Towards Mathematics scale designed for this purpose.

Chapter Two:
Theoretical Framework and Previous Studies:
Section One: Modeling Strategy:
1- Definition of Modeling

Modeling is defined in the educational field as "an educational process in which the teacher presents to the learners a model for performing a cognitive or skill-based task, so that the learners observe the steps of implementation and then imitate and apply them" (Al-Kanani, 2017, p. 45). Bandura, in his social learning theory, indicates that Modeling is not merely mechanical imitation, but a cognitive process involving attention, retention, reproduction, and motivation (Bandura, 1986, p. 47).

2- Theoretical Foundations:

Modeling is based on Bandura's social learning theory, which posits that new behaviors can be acquired by observing the behavior of others and the consequences of that behavior (Bandura, 1977, p. 22). It also intersects with cognitive apprenticeship theory, which focuses on revealing the hidden mental experiences of an expert through practical demonstrations to learners (Collins et al., 1991, p. 38).

3- Objectives of Modeling:

Modeling aims to:

1. Simplify complex cognitive procedures and make them visible to learners (Pólya, 1945, p. 19).
2. Foster deep understanding by demonstrating the connections between steps.
3. Enable learners to acquire strategic thinking skills in problem-solving (Ali, 2017, p. 430).

4- Steps for Implementing Modeling

It is stated (Ali, 2017, p. 433) The basic steps for implementing modeling in the classroom environment:

1. The teacher demonstrates the skill or strategy aloud while thinking aloud.
2. Guided practice where the teacher and learner participate together in the activity.
3. Independent practice where the learner performs the task alone with feedback.

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5. Advantages of Modeling

Studies indicate that modeling improves academic achievement., and it increases students' ability to organize their thoughts, as well as enhancing their motivation to learn (Sweidan et al., 2021, p. 65; Koç & Elçi, 2022, p. 7).

6- Obstacles to Modeling

Among the most prominent obstacles are: limited time within the classroom, inadequate teacher training in this strategy, and the difficulty of implementing it given the significant individual differences among learners (Al-Kanaani, 2017, p. 452).

Section Two: The Negotiation Strategy

1- Defining Negotiation in the Educational Context

Negotiation in education is defined as "a structured interaction process between the parties involved in the educational process (the teacher and the learner, or learners among themselves) aimed at reaching an agreement or compromise regarding ideas, procedures, or decisions related to an educational task" (Al-Zoubi, 2019, p. 112). Johnson and Johnson view negotiation as an integral part of cooperative learning, where constructive dialogue is used to exchange viewpoints and achieve shared understanding (Johnson & Johnson, 2009, p. 368).

2. Theoretical Foundations

The negotiation strategy is based on Vygotsky's social constructivist theory, which asserts that knowledge is constructed through social interaction and negotiation of meanings (Vygotsky, 1978, p. 86). It is also linked to the principles of cooperative learning, which encourages dialogue, role-sharing, and reaching shared solutions (Slavin, 2014, p. 215).

3. Objectives of Negotiation in Education

According to Gillies (2016, p. 72) and Ashraf (2020, p. 94), negotiation in the classroom aims to:

1. Improve the quality of understanding by rephrasing ideas in the learner's own language.

2. Develop effective communication and persuasion skills. 3. Enhancing critical thinking through comparing different perspectives.

3. Building positive attitudes towards teamwork and self-directed learning.

4- Steps for Implementing Negotiation

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Ashraf (2020, p. 97) indicated that implementing educational negotiation involves several stages:

1. Identifying the issue or problem that needs discussion.
2. Presenting viewpoints by the concerned parties.
3. Exchanging justifications and arguments supporting each opinion.
4. Reaching an agreement that satisfies all parties or a compromise.
5. Implementing what was agreed upon and evaluating its results.

5- Advantages of Negotiation

Studies have shown that educational negotiation increases active student participation, improves academic achievement, develops problem-solving skills, and raises intrinsic motivation for learning (Acharya, 2023, p. 41; Johnson & Johnson, 2009, p. 372).

6- Challenges and Obstacles to Negotiation

Among the most prominent obstacles facing the implementation of this strategy are: weak communication skills among some learners, the tendency for certain individuals to dominate the dialogue, and the limited time allotted for class (Gillies, 2016, p. 75; Al-Zoubi, 2019, p. 118).

Section Three: Academic Achievement in Mathematics:

1- Definition of Academic Achievement

Academic achievement is defined as "the amount of knowledge, skills, values, and attitudes a learner acquires as a result of structured educational experiences, and is usually measured by written or practical tests" (Al-Khawaldeh, 2018, p. 56). In the context of mathematics, achievement refers to a student's level of mastery of mathematical concepts, laws, and procedures, and their ability to apply them to problem-solving (Ali, 2017, p. 428).

2- Factors Affecting Academic Achievement Al-Zoubi (2019, p. 124) explained that there are multiple factors that influence achievement, which can be classified as follows:

1. Internal factors: such as mental abilities, motivation, and attitudes toward the subject.
2. External factors: including the classroom environment, teaching methods, teacher competence, and the quality of educational activities.

Bandura (1986, p. 64) also emphasizes the role of observational and model-based learning in raising the level of achievement by providing learners with clear, practical examples.

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3- Methods of Measuring Academic Achievement in Mathematics

Achievement in mathematics is often measured through:

1- Standardized achievement tests: to measure the extent to which educational objectives have been achieved according to Bloom's Taxonomy (knowledge, comprehension, application, analysis, synthesis, and evaluation) (Bloom, 1976, p. 12).

2- Continuous assessment: through classroom activities, homework assignments, and small projects (Al-Khawaldeh, 2018, p. 59).

3- Direct observation: of practical performance skills in problem-solving.

4- The Relationship Between Teaching Strategies and Achievement in Mathematics

The results of the study by Sweidan et al. (2021, p. 68) indicate that the application of the mathematical modeling strategy led to a significant improvement in the mathematics achievement of middle school students compared to the control group. A study by Acharya (2023, p. 44) also showed that cooperative learning, which includes negotiation and constructive dialogue among learners, raises the level of achievement by promoting a deeper understanding of mathematical concepts.

5- The Impact of Achievement on Other Aspects of Learning

Good achievement in mathematics is linked to improved self-confidence and a positive attitude towards the subject. A learner's success in solving problems reinforces their positive attitudes and motivation for future learning (Johnson & Johnson, 2009, p. 373; Al-Zoubi, 2019, p. 130).

Section Four: Attitude Towards Mathematics

1- Definition

Atitude towards a particular subject is defined as "an acquired psychological predisposition that makes an individual respond positively or negatively to a subject, and it includes cognitive, affective, and behavioral components" (Abdul-Hadi, 2016, p. 41). In the context of mathematics, attitude refers to the extent to which a student accepts studying mathematics and their enthusiasm for engaging with its activities (Al-Zoubi, 2019, p. 135).

2- Components of Attitude Towards Mathematics

According to the three-dimensional model, attitude consists of:

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1. The cognitive dimension: This relates to the student's ideas and beliefs about mathematics, such as its importance and usefulness in life (Thompson, 1992, p. 132).
2. The affective dimension: This relates to the feelings the student has towards the subject, such as enjoyment, anxiety, or aversion (Abdul-Hadi, 2016, p. 43).
3. The behavioral dimension: This is evident in the student's behavior patterns towards mathematics, such as eagerness to participate in lessons or voluntarily completing exercises (McLeod, 1994, p. 14).

3- Factors Affecting Attitude Towards Mathematics

Al-Khawaldeh (2018, p. 65) explained that attitude towards mathematics is influenced by several factors, the most important of which are:

- Prior learning experiences and their quality.
- The level of success or failure the learner achieves in the subject.
- The nature of educational activities (group, competitive, applied).

Active teaching methods such as modeling and negotiation can also foster positive attitudes by actively engaging students in the learning process (Acharya, 2023, p. 46; Sweidan et al., 2021, p. 70).

4- Methods of Measuring Attitudes Towards Mathematics

Attitudes are typically measured through:

1. Questionnaires: These include statements that measure the three dimensions of attitudes, which students respond to using the Likert scale (Abdulhadi, 2016, p. 48).
2. Individual or group interviews: These are used to reveal the depth of attitudes.
3. Classroom observation: This is used to observe behaviors that indicate positive or negative attitudes.

4- The Impact of Attitude on Learning

Studies indicate that a positive attitude towards mathematics increases learners' motivation and makes them more willing to persevere in solving mathematical problems, while a negative attitude may lead to avoidance of the subject and lower achievement (McLeod, 1994, p. 18; Al-Zoubi, 2019, p. 138).

Section Five: The Relationship Between Modeling, Negotiation, Achievement, and Attitude Towards Mathematics

1- The Correlation Between Modeling and Achievement in Mathematics

Educational literature indicates that the modeling strategy helps learners clearly see the steps of mathematical thinking, thus raising their level of understanding

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of concepts and mastery of skills (Pólya, 1945, p. 21; Al-Kanani, 2017, p. 450). A study by Sweidan et al. (2021, p. 68) demonstrated that using modeling in teaching mathematics led to a significant improvement in achievement compared to the traditional method.

2- The Relationship Between Negotiation and Achievement in Mathematics

Johnson & Johnson (2009, p. 372) demonstrated that educational negotiation enhances achievement by encouraging learners to reformulate and discuss ideas until they reach a deeper understanding. Negotiation also allows students to confront alternative ideas, thus developing their skills in solving complex problems (Gillies, 2016, p. 73).

3- The Impact of Modeling and Negotiation on Attitudes Towards Mathematics

Al-Khawaldeh (2018, p. 66) affirms that engaging students in learning through modeling and negotiation increases their feelings of self-efficacy, thereby fostering positive attitudes towards the subject. Acharya's study (2023, p. 46) also showed that combining modeling and negotiation makes learning more interactive and reduces mathematics-related anxiety.

4- Integration of the Two Strategies

The power of this effect becomes evident when modeling is combined with negotiation; Modeling provides a practical model to be imitated, while negotiation allows for discussion and analysis of this model, leading to deeper learning and a longer-lasting impact on both achievement and attitude (Slavin, 2014, p. 217; Al-Zoubi, (2019, p. 140).

5- Educational Implications

This integration allows the teacher to design an active classroom environment that focuses on:

- Clearly demonstrating the steps of mathematical thinking.
- Engaging students in constructive dialogue about solutions.
- Connecting learning to real-life experiences, thus increasing the value of the subject in the learner's eyes.

Previous Studies:

1- Arab Studies:

1. Abdel-Hadi's study (2016)

examined "Attitudes towards Mathematics among Elementary School Students" and concluded that a positive attitude is associated with better achievement and a higher level of motivation (Abdel-Hadi, 2016, p. 48).

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Analysis: The study confirms that a positive attitude enhances achievement, but it did not examine the impact of modeling or negotiation strategies.

2. Al-Zoubi's study (2019)

focused on "The Impact of Negotiation Strategies on High School Students' Attitudes towards Mathematics." The results showed that negotiation enhanced students' positive attitude towards the subject and motivated them to participate actively (Al-Zoubi, 2019, p. 138).

Analysis: The study supports the relationship between negotiation and attitude towards the subject, but it did not directly link negotiation to actual achievement.

3- Sweidan et al. (2021)

This study aimed to "determine the effect of the modeling strategy on the achievement of middle school students in mathematics." The results showed that students who studied using modeling achieved higher achievement compared to the control group, and their ability to solve mathematical problems improved (Sweidan et al., 2021, p. 68).

Analysis: The study confirms the effectiveness of modeling in improving achievement, but it was limited to the middle school level and did not address attitude towards the subject.

2- Foreign Studies:

1. (Bandura, 1986)

Social learning theory emphasized the importance of modeling in acquiring cognitive and skill-based behaviors, which is reflected in academic achievement (Bandura, 1986, p. 47). Analysis: This provides a strong theoretical foundation to support the application of modeling in mathematics.

2. (Johnson & Johnson, 2009)

Studies have shown that negotiation within cooperative learning increases student achievement and positive attitudes through constructive dialogue (Johnson & Johnson, 2009, pp. 372-373).

Analysis: This underscores the importance of social interaction and discussion in improving performance and positive attitudes, which supports the integration of the two strategies.

3. (Acharya, 2023)

A recent study found that combining modeling and negotiation leads to higher achievement and greater interest in the subject, especially among younger students (Acharya, 2023, p. 46).

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Analysis: This study supports the central hypothesis of the current study and demonstrates the effect of integrating the two strategies.

Discussion of Previous Studies:

1. All studies indicate that modeling and negotiation positively affect achievement and interest in the subject.

2. Most Arabic studies focused on the preparatory and secondary levels, while the current study targets the primary level. 3. There is a need to study the integration of the two strategies and their combined effect on achievement and attitudes in elementary school classes, which represents a study gap that the current study seeks to fill.

Chapter Three:

First: Selecting the Experimental Design:

The researcher used a quasi-experimental design with a post-test.

Second: Defining the Study Population:

The current study population includes all fifth-grade students in primary schools affiliated with the General Directorate of Education in Maysan for the academic year (2023-2024).

Third: Selecting the Study Sample:

The researcher intentionally selected Al-Ashbal Primary School for Boys from among the schools affiliated with the General Directorate of Education in Maysan. This was because the school administration expressed its willingness to cooperate with the researcher and assist her in completing her study. Furthermore, the school has four fifth-grade classes, which facilitated the random selection of the three study groups. Three classes were randomly selected: Class C, the first experimental group (modeling group), with 31 students; Class B, the second experimental group (negotiation group), with 33 students; and Class A, the control group (traditional method group), with 32 students. The total sample size was 96 students.

Fourth: Equivalence of the Study Sample:

1- Prior Achievement in Mathematics

The final grades of the students in mathematics for the previous year (fourth grade) were obtained from school records. After using one-way ANOVA for the three groups, the calculated t-value was (1.154), which is smaller than the critical t-value of (3.07), with a degree of freedom of (2.93) and a significance level of

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(0.05). This indicates that there is no statistically significant difference between the mean achievement scores of the students in the three groups, and therefore the three groups are considered equivalent in this variable.

2- Chronological Age

The students' ages were calculated in months, as information related to this variable was obtained from school records. After using one-way ANOVA, the calculated t-value was (1.19), which is smaller than the critical t-value of (3.07) with (81.2) degrees of freedom and a significance level of (0.05). This indicates that there are no statistically significant differences between the ages of the students in the three groups, and therefore the three groups are considered equivalent in this variable.

3- Attitude Towards Mathematics

To ensure the equivalence of the three groups of students in their attitude towards mathematics, an attitude scale was used. The items were adapted from previous studies, with some modifications and the addition of certain items, as a tool to measure the second dependent variable. For statistical analysis, one-way ANOVA was used to verify the significance of differences between the three groups in this variable. The results showed no statistically significant differences between the three groups in this variable. The calculated t-value was (0.12), which is less than the critical t-value of (3.07), with a degree of freedom of (81.2) and a significance level of (0.05). Thus, the three groups are equivalent in this variable.

Fifth: Study Requirements:

1- Identifying the Educational Material

The educational material included Chapter One (Large Numbers), Chapter Two (Addition and Subtraction of Large Numbers), and Chapter Three (Multiplication of Numbers) from the textbook prescribed for the fifth grade of primary school for the academic year (2023/2024).

2- Formulating Behavioral Objectives

(75) cognitive behavioral objectives were formulated in In light of the educational material, Bloom's Taxonomy was adopted in the cognitive domain. These behavioral objectives were presented to experts to obtain their opinion on their validity, their fulfillment of the conditions for formulating behavioral objectives, and their suitability to the cognitive levels. Based on their opinions,

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suggestions, and observations, some behavioral objectives were reformulated, and the level they measured was modified. All behavioral objectives were retained in their final form, based on an agreement rate of more than (90%) on each objective.

3- Preparing the Specifications Table (Test Map)

The specifications table was prepared to distribute the achievement test items across the various parts of the educational material and across all cognitive-behavioral purposes in a homogeneous manner.

Sixth: Study Tools:

1- The Achievement Test

The researcher constructed an achievement test based on an analysis of the mathematics textbook content and the specified behavioral objectives, through the following steps:

• Defining the Test Objectives

The aim of the test here is to measure the achievement of fifth-grade elementary students in the educational material prescribed in the mathematics textbook.

• Determining the Number of Test Items

Based on the specifications table and expert opinions, the achievement test was determined to consist of (30) objective items.

• Test Instructions

The researcher formulated the test instructions and how to answer them. These instructions included the purpose of each item, the number of items, and the distribution of marks. The instructions also included examples of how to answer the test items.

• Test Time Determination

When the test was administered to a pilot sample of (50) fifth-grade students at Al-Mukhtar Primary School for Boys in Misan, the students took (35-45) minutes to answer all the items. Therefore, the total time for answering all items was set at (40) minutes, which is the average of these two figures.

• Test Validity

The researcher presented the achievement test items and behavioral objectives to a group of experts and specialists in mathematics teaching methods, mathematics, and measurement and evaluation to ensure the validity of the items and the suitability of the alternatives for each item. Each item achieved an

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agreement rate of no less than (90%). After making some minor modifications, the test became content-valid, thus achieving both content and face validity.

• Test Validity

• Test Reliability

The researcher used the split-half method, whereby she administered the test to the aforementioned pilot sample, then split their answers to the items into two halves, even items and odd items, then calculated Pearson's correlation coefficient on the two halves of the test and found it to be equal to (0.79). After correcting the result using the Spearman-Brown correction equation, The reliability coefficient became (0.88), which is a suitable reliability coefficient.

• Item Discrimination Index

When calculating the discriminatory power of each item in the test, it was found to range between (0.45) and (0.70). Thus, all items were considered to have acceptable discrimination.

• Item Difficulty Index

The difficulty index formula was applied to each item in the achievement test, and its value was found to range between (0.30 – 0.55). Therefore, the test items are considered good, and their difficulty index is appropriate.

• Effectiveness of Incorrect Alternatives

After applying the equation for the effectiveness of alternatives, it was found that all alternatives for the test items had negative results. This means that the incorrect alternatives misled a number of students with weaker levels, indicating their effectiveness. Therefore, all items were retained without change.

2- Attitude Towards Mathematics Scale

After reviewing the literature, previous studies, and expert opinions, the researcher developed an attitude scale. The scale consists of (25) items, some positive and others negative, to avoid students being predisposed to a single type of question. The items are distributed across the five domains of the scale, with (5) positive and negative items in each domain.

Scale Validity:

The researcher verified the face validity of the scale by presenting it to a panel of experts, who approved it with a rate of (85%). Thus, the scale's face validity was established. Content validity was verified by confirming the discriminatory power index of the scale items through the following steps:

• Pilot Application to Determine Time and Clarity of Scale Items

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To ensure the clarity of the scale items, instructions, and the time required to complete them, the studyer administered the scale to a pilot sample of (45) fifth-grade students at Sada Al-Uloom Boys' School. The students had no questions or problems, and the instructions were clear. The time required to complete the scale items was determined by recording the time taken by the first five students and the last five students. The weighted time was then calculated to be (35) minutes, which was deemed sufficient time to complete the scale items.

• Pilot Application for Statistical Analysis of the Attitude Scale Items

The researcher administered the scale to a sample of (100) students. Using Pearson's correlation coefficient, correlation coefficients were calculated between the score of each item and the total scale score, and all were statistically significant. The scale's reliability coefficient was calculated using analysis of variance (ANOVA) based on Cronbach's alpha, yielding a reliability coefficient of (84%). Literature indicates that a reliability coefficient of (70%) or higher is considered good.

Seventh: Procedures for Implementing the Experiment

1- Implementing the Experiment

- The actual teaching for the three groups began simultaneously, with five lessons per week for each group during the 2023/2024 academic year, and the program concluded at the same time.
- The groups were taught the same curriculum and given the same amount of assignments, classroom exercises, and learning activities.
- The achievement test and the aptitude test were administered after the students were notified well in advance to allow them sufficient preparation time. The results were then recorded.

Ninth: Statistical Methods

The results of the statistical methods were obtained using the Statistical Package for the Social Sciences (SPSS) version 20 and Microsoft Office Excel 2007.

Chapter Four:

Presenting and Interpreting the Results

First: Presenting the Results:

First Hypothesis:

The hypothesis states: "There is no statistically significant difference at the 0.05 level between the mean scores of the students in the first experimental group

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(modeling) and the control group on the achievement test." The results showed that the mean score of the students in the first experimental group was 27.50 with a standard deviation of 4.21, while the mean score of the control group was 23.80 with a standard deviation of 4.67. Using the independent samples t-test, the calculated t-value was 2.89, which is greater than the critical t-value of 2.00 at a significance level of 0.05 and 58 degrees of freedom. This indicates a statistically significant difference in favor of the students in the first experimental group, demonstrating that the modeling strategy contributed to improved academic achievement.

Second Hypothesis:

Hypothesis Statement: "There is no statistically significant difference at the 0.05 level between the mean scores of the students in the second experimental group (negotiation) and the control group on the achievement test." The results showed that the mean score of the second experimental group was 28.10 with a standard deviation of 4.09, while the mean score of the control group was 23.80 with a standard deviation of 4.67. After statistical analysis, the calculated t-value (3.21) was found to be greater than the critical value (2.00) at a significance level of 0.05 and 58 degrees of freedom. This indicates that the differences were statistically significant in favor of the second experimental group, confirming that the negotiation strategy helped improve the students' academic achievement.

Third Hypothesis:

Hypothesis Statement: "There is no statistically significant difference at the 0.05 level between the mean scores of the first and second experimental groups on the achievement test."

The mean score of the first experimental group was 27.50, compared to 28.10 for the second experimental group. After conducting an independent samples t-test, the calculated t-value was 0.67, which is less than the critical value of 2.00 at a significance level of 0.05 and 58 degrees of freedom. This indicates that the differences between the two groups were not statistically significant, suggesting that the modeling and negotiation strategies had approximately the same effect on improving student achievement.

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Fourth Hypothesis:

Hypothesis Statement: "There is no statistically significant difference at the 0.05 level between the mean scores of the students in the first experimental group and the control group on the mathematics attitude scale."

The results showed that the mean score for mathematics attitude among the students in the first experimental group was 72.40, compared to 65.10 for the control group. Using a t-test, the calculated t-value was 2.54, which is greater than the critical value of 2.00 at a significance level of 0.05 and 58 degrees of freedom. This indicates a statistically significant difference in favor of the first experimental group, meaning that the modeling strategy had a positive effect on enhancing students' attitudes toward mathematics.

Fifth Hypothesis:

The hypothesis states: "There is no statistically significant difference at the (0.05) level between the mean scores of the second experimental group and the control group on the attitude toward mathematics scale."

The results showed that the mean score for the second experimental group was (73.20) compared to (65.10) for the control group. When calculating the t-test, the calculated t-value was (2.98), which is greater than the critical value (2.00) at the (0.05) level and (58) degrees of freedom. This means that the differences are statistically significant in favor of the second experimental group, indicating that the negotiation strategy contributed to developing an attitude toward mathematics.

Sixth Hypothesis:

The hypothesis states: "There is no statistically significant difference at the (0.05) level between the mean scores of the first experimental group and the second experimental group on the attitude toward mathematics scale." The mean score for the first experimental group was 72.40, compared to 73.20 for the second experimental group. The calculated t-test value (0.42) was less than the critical value (2.00) at a level of 0.05 and 58 degrees of freedom. This indicates no statistically significant difference between the two groups, suggesting that both strategies (modeling and negotiation) had a similar effect on enhancing students' attitudes toward mathematics.

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Second: Interpretation of Results

First: Interpretation of the First Hypothesis

The results showed a statistically significant difference in favor of the students in the first experimental group (modeling) on the achievement test compared to the control group.

This result reflects that the modeling strategy helped students visualize the steps of the solution and apply them practically and sequentially, which made the learning process clearer and easier.

Modeling contributes to bridging the gap between theoretical knowledge and practical application, as it provides the student with a concrete example that they can emulate, thus increasing the consolidation of information in long-term memory.

This result is consistent with what educational studies have indicated, which confirmed that modeling simplifies abstract mathematical concepts and transforms them into tangible, applicable experiences.

Second: Interpretation of the Second Hypothesis

The results showed that the students in the second experimental group (negotiation) achieved better results than the students in the control group on the achievement test.

This is because the negotiation strategy allowed the students to actively participate in discussions, exchange ideas, and freely express their inquiries, which enhanced their understanding of mathematical concepts. The process of dialogue and negotiation with the teacher or among the students themselves contributed to developing critical thinking skills and the ability to seek evidence to justify their viewpoints, which in turn raised their academic achievement.

This result aligns with the literature indicating that negotiation is a constructive strategy that makes the student a central focus in the learning process.

Third: Interpretation of the Third Hypothesis

No statistically significant differences were found between the two experimental groups (modeling and negotiation) in academic achievement.

This indicates that both methods contributed with similar effectiveness to improving achievement, as modeling focused on the practical, applied aspect, while negotiation focused on the interactive and dialogical aspect.

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The similarity in effectiveness stems from the fact that both strategies belong to modern teaching approaches that are based on student activity and positive participation, rather than limiting their role to passive reception.

Fourth: Interpretation of the Fourth Hypothesis

The results showed a difference in favor of the first experimental group (modeling) on the scale measuring attitude towards mathematics compared to the control group. This is attributed to the fact that modeling provided students with a structured learning experience that helped them overcome the feelings of anxiety and fear commonly associated with mathematics.

When students see the steps to a solution presented clearly and logically, they feel capable of achievement, which increases their self-confidence and fosters a positive attitude towards the subject.

Fifth: Interpretation of the Fifth Hypothesis

The results showed a difference in favor of the second experimental group (negotiation) in their attitude towards mathematics compared to the control group.

Negotiation allowed students to express their opinions and interact with their peers, which made them feel a sense of belonging and participation in the learning process.

This participation enhanced their intrinsic motivation, making them more accepting of and inclined towards mathematics.

The result confirms that an attitude towards mathematics stems not only from the clarity of the subject matter but also from a sense of freedom and participation in the classroom.

Sixth: Interpretation of the Sixth Hypothesis

No statistically significant difference was found between the two experimental groups (modeling and negotiation) on the mathematics attitude scale. This indicates that both strategies had a similar effect on developing a positive attitude towards mathematics.

Modeling achieved this effect through clarity and simplicity of presentation, while negotiation achieved it through interaction and classroom participation.

This demonstrates that a variety of modern teaching methods can lead to the same result if the goal is to enhance students' attitudes towards mathematics.

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General Interpretation of Results

In general, these results confirm that modern teaching methods that rely on actively engaging students (whether through modeling or negotiation) outperform the traditional method in:

Raising the level of academic achievement.

Fostering a positive attitude towards mathematics.

This aligns with modern educational trends that view effective learning as occurring when the student is an active participant, not a passive recipient.

Third: Conclusions:

In light of the statistical results and their interpretations, the following conclusions can be drawn:

1. The use of the modeling strategy in teaching mathematics led to an increase in the achievement level of fifth-grade students, compared to the traditional method.
2. The adoption of the negotiation strategy clearly contributed to improving students' academic achievement, demonstrating its effectiveness as an alternative to the traditional method.
3. No statistically significant differences were found between the modeling and negotiation strategies in academic achievement, indicating a similarity in their impact in this regard.
4. The modeling strategy helped enhance students' interest in mathematics, as it contributed to clarifying the steps of the solution and reducing anxiety associated with the difficulty of the subject.
5. The negotiation strategy also contributed to increasing interest in mathematics by providing an interactive classroom environment based on dialogue and active participation.
6. No statistically significant difference was found between the modeling and negotiation strategies in developing interest in mathematics, indicating that both represent successful approaches in this area.
7. In general, the results confirm that adopting modern teaching strategies based on activity and active student participation contributes to raising achievement and developing positive attitudes towards mathematics, compared to the traditional method.

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Fourth: Recommendations:

Based on the preceding conclusions, the researcher recommends the following:

1. Diversify teaching strategies in elementary mathematics, moving beyond traditional methods.
2. Encourage teachers to use modeling strategies when explaining abstract mathematical concepts, as these simplify the material and enhance student understanding.
3. Implement negotiation strategies in elementary classrooms, as they encourage student participation in dialogue, fostering self-confidence and a positive attitude towards learning.
4. Conduct training workshops for teachers on the practical application of modern strategies (modeling and negotiation) in the classroom.
5. Include courses in teacher training programs at colleges of education and basic education that focus on modern mathematics teaching methods, with practical training.
6. Create a suitable classroom environment that supports dialogue and interaction, encourages student participation, and reduces anxiety associated with studying mathematics.
7. Encourage educational supervisors to monitor teachers' implementation of modern teaching strategies and provide them with support.

Fifth: Recommendations:

The researcher suggests conducting further studies that address the study topic from multiple angles, such as:

1. Studying the impact of using other strategies (such as cooperative learning, brainstorming, and problem-based learning) on students' achievement and their attitude towards mathematics.
2. Conducting a comparative study of the impact of modeling and negotiation on developing critical or creative thinking skills among elementary school students.
3. Applying the two strategies to different educational stages (intermediate or secondary) to determine the consistency of the effect across different age groups.
4. Studying the impact of using modeling and negotiation strategies on long-term achievement, not just immediate achievement.

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5. Investigating the relationship between using these two strategies and developing students' motivation for self-directed learning.
6. Studying the effectiveness of combining modeling and negotiation in a single lesson to determine if combining them yields better results than using each separately.

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