# THE EFFECTIVENESS OF A TRAINING PROGRAM BASED ON STEM APPROACHES IN DEVELOPING IMPLEMENTATION COMPETENCIES FOR MATHEMATICS TEACHERS

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**Abstract**

The research aims to identify (the effectiveness of a training program based on (STEM) orientations in developing the competencies of implementation among teachers of mathematics, and its teachers. And middle school for the academic year 2021/2022 AD, and the number is (656) teachers and schools in the General Directorate of Education in Salah al-Din Governorate. As for the research sample, the intentional method was used in selecting it, which consisted of (25) teachers and schools from the schools of the Education Department. The researchers used the program The training program in the light of (STEM) trends and to measure the dependent variable used ((implementation competencies)) and it consisted of (40) items, and to make sure of its validity and stability, the appropriate statistical methods were used, and the researchers concluded that there are statistically significant differences at the level of significance (0.05). Between the pre-application and the post-application in the competencies of implementation and in favor of the post application

**Keywords**: post-application, validity, competencies, implementation

## THE FIRST CHAPTER INTRODUCES THE RESEARCH

### FIRST: THE RESEARCH PROBLEM

The prevailing trend in teaching the mathematics curriculum is the use of the traditional method that focuses on memorization and memorization by teachers, in which the teacher teaches information, facts and concepts to students and explains the ambiguous ones, and the role of the student is limited in activity and effectiveness, which may prevent the development of his mathematical level and his ability to innovate and participate seriously in the lesson. Which led to the teaching of mathematics facing difficulties that limit the ability to achieve the desired educational goals in teaching, and among these difficulties is the weak ability of teachers to implement the lesson in the light of modern teaching strategies. Information settled in their minds, and it is not surprising because they learned about it and got used to it, and this is due to the shortcomings of the methods and methods in which they studied and the methods of evaluation that they are accustomed to, which were and are still emphasizing memorization and indoctrination, which made the role of the student negative and his participation in the lesson almost non-existent. From the mistake that the old methods of education made, Piaget indicates that it is wrong for the student to get used to accepting knowledge as it is, and it is correct for the teacher to organize meanings and information within schemes (schemas) in the process of research and organized investigation.

The future represents one of the powers that distinguish man from all other beings, as all societies were very fond of knowing their future, and what fate had in store for their members, so they had their simple means through which they knew that unknown future, which are now considered naive means such as: astrology, magic, Fortune-telling, palm reading and divination, predicting the unknown and other means that are not consistent with modern objective science, but are considered in the eyes of their owners a kind of science, especially since some of the predictions reached by the use of these means may actually be achieved at the level of reality, while he sees Many people believe that anxiety resulting from a lack of clarity in the future leads to a significant

impact on the psychological and social compatibility of individuals, which increases the individual's feeling of despair and despondency, and invites him to isolation, just as the individual who cannot achieve his vision of the future will make him feel dissatisfaction, despair, loss of hope and lack of Harmony with life, and from this standpoint, the research problem was identified in the following main question:

What is the effectiveness of a training program based on (STEM) approaches in developing implementation competencies for male and female mathematics teachers?

**SECOND: THE IMPORTANCE OF RESEARCH**

The curricula have witnessed tangible developments and rapid changes in recent times in all countries of the world, and mathematics has had a large share of these developments, as many countries have reconsidered their curricula, methods and models of teaching, to be in line with the needs of their societies and the aspirations of their members to move forward towards progress and progress to meet the requirements XXI century. (Maddah, 2009: 23).

The teacher must urge his students to study mathematics as a practical subject and not as a purely theoretical subject, so he should not make them feel alienated between them and this science. Therefore, the problem-solving process in mathematics must employ issues of life content or a relationship with other sciences, and mathematics has passed its form School in multiple stages, it was in its entirety focused on characterizing mathematics as a formal conceptual formula that led to the formation of many misconceptions about teaching mathematics and its importance, and it resulted in the students' reluctance from the scientific departments related to mathematics, and perhaps this is due to the great separation between mathematics as a science that went through many stages as methodology and logic Through it, we can explain various social and natural phenomena. (Obaidah, 2002: 23)

Through the foregoing, the researchers see the importance of the role of the mathematics teacher in the teaching process, who can effectively employ the mathematics curriculum in providing students with mathematical skills and different thinking patterns. This is the importance of mathematics, so it must be taken care of and taken care of in the methods and models of teaching and learning it in order for it to play its desired role, which is the development of thinking among learners so that they can face life in all its fields. It responds to the data of development and takes off its traditional dress. Learners need more useful mathematics in their lives, and learning it contributes to preparing them to face future challenges. The most important thing is that we teach students how to justify and explain their ideas and how to solve the problem. We teach students to make them think on their own mathematically so that they can participate in acquiring knowledge, which is practical and not productive.

Perhaps the most prominent of these changes is the use of technology in all aspects of knowledge, and in order to keep pace with this change, teaching methods must be developed in order to achieve unity of knowledge. The objectives of the entrance to the integration between science, mathematics and technology is to prepare students to play a constructive and practical role in a technical society, as students are able to use science, mathematics and technology to improve their lives and the lives of others in society, so the integration of science, mathematics and technology helps students to work in a good educational environment in the twenty-first century Accordingly, the need of science for mathematics is evident, as the laws of science are mostly quantitative, and with the complexity and progress of science, their connection with mathematics becomes stronger, meaning that it is difficult to understand science without comprehending and understanding mathematics, and that any progress in science depends on a broader understanding of mathematics, and perhaps this is what strengthens The call for integration between science, mathematics, technology and engineering. (Ambou Saidi and Abed, 2002: 65)

Among these contemporary educational trends is the science, technology, engineering and mathematics (STEM) curriculum, which has contributed since its inception to transforming traditional classrooms into creative classrooms, and transforming the role of the teacher from a

prompter to a mentor and facilitator; It also helped prepare a student capable of discovery, creative thinking, solving problems and facing challenges, and providing educational information and experiences in a functional and more beneficial manner to students, in which the impact of rapid engineering and technological developments is evident in consolidating complementary relations between science and mathematics. The STEM approach also helps in instilling values. The integrated conceptual experiences of students, and the preparation of generations capable of keeping pace with the changing requirements of the times, which increases their possession of more applied and creative skills; Therefore, specialists in the field of science education and the field of teaching mathematics have recommended the need to include it in many relevant educational and applied programs. (Youssef, 2018:41)

The (STEM) entrance is like other entrances that include objectives, content, activities and innovative teaching strategies that help to implement it in a manner that is consistent with the goals and evaluation methods through which the quality of the outputs is ensured and the strengths and weaknesses of the curriculum are identified. Therefore, the (STEM) entrance It is considered one of the most important and most modern trends related to science and mathematics curricula, as the design of curricula based on this approach depends on the integrated conceptual experience between science, mathematics, engineering and technology, and problem-solving through the implementation of various activities that develop scientific, critical and creative thinking and decision-making skills. STEM) contributes to the development of science and mathematics curricula through the application of modern technology, and encourages interaction between the content of mathematics and science curricula. (Al-Saidi and Al-Azab, 210: 2021)

Future directions help people to define clear ways to achieve their goals instead of losing the required vision and perception. It can be said that human existence is a continuous struggle that the individual pursues in his attempt to deal with the problems of life and progress towards the future, and that everything that befalls us in terms of success or failure depends on the extent of our feelings. With our perception of the future, the availability of capabilities alone is not sufficient to achieve future goals and achieve success in life. Therefore, the importance of implementation competencies lies in the fact that they include the individual's pursuit of achieving his desires, goals and aspirations, and trying to face the obstacles that impede their realization. Individuals who have a good level of clarity in future orientation will have an increase in Clear in the field of academic success. (Crowson, 2001: 324)

Some may understand that implementation competencies take place as a matter of luxury and entertainment, because they talk about something that did not happen, but rather something that may happen in the future, but what needs to be emphasized is that implementation competencies prepare future scenarios based on accurate data and correct information. The burdens of the past, to define the features of tomorrow, in addition to that it works to develop human capabilities and community development, so we see the dependence of many developed countries in building developmental and political plans on implementation competencies that are based on a strategic thinking pattern that is expected from radical changes in the present and the future over time periods specific. (Mansoor, 2016: 84).

Third: Research Objective The current research aims to (build a training program based on STEM approaches in developing implementation competencies for male and female mathematics teachers).

## FOURTH: RESEARCH HYPOTHESES

Based on the research objective, the researchers formulated the following hypotheses:

1. There are no statistically significant differences between the mean scores of the experimental group who were trained in the light of STEM trends in the pre and post applications of the future perceptions scale.
2. There are no statistically significant differences between the average scores of the experimental group who were trained in the light of STEM trends in the pre and post applications of the Execution Competencies Scale due to the gender variable (males).

3. There are no statistically significant differences between the mean scores of the experimental group who were trained in the light of STEM trends in the pre and post applications of the Execution Competencies Scale due to the gender variable (females).
4. There are no statistically significant differences between the mean scores of the experimental group members who were trained in the light of STEM trends in the post application of the executive competencies scale due to the gender variable (male and female).

**FIFTH: RESEARCH LIMITS**

The current research is limited to:
- Human limits: Mathematics teachers in the General Directorate of Education of Salah al-Din Governorate - Education Department of the Education District - and those who are regular in day-time middle and high schools.
- Spatial boundaries: The training program was applied to male and female mathematics teachers in the Science Education Department of the General Directorate of Education in Salah al-Din.
- Temporal limits: The research experiment was applied in the academic year 2021-2022.
- Cognitive limits: a training program based on STEM trends, a measure of future perceptions.

Sixth: define terms

1. Training Program: Get to know him
• Al-Shahrani (2013): “A comprehensive plan with specific objectives, structured content, and sequential procedural steps, represented in a set of targeted, planned, organized and intended methods and activities to develop teaching performance skills.” (Al-Shahrani, 2013: 7)
• The two researchers know it: a well-thought-out process that requires prior planning according to the teachers' needs. It is a targeted behavioral process concerned with changing teachers' behavior so that they grow professionally, raise their performance competencies, and clarify their future perceptions.

2. STEM Trends: Define it
Shawaheen (2016): “An approach in which science, technology, engineering, and mathematics disciplines are integrated, and learning takes place in a project-based way by integrating curricula with scientific experiments through which learners apply science, technology, engineering, and mathematics in contexts linking study, work, and society.” (Shawahin, 2016: 3 )
Definition of the theoretical researchers: Employing integration between the disciplines of science, technology, engineering and mathematics in teaching mathematical content and training teachers to provide solutions to mathematical problems through employing exploration and searching for relationships in the surrounding world and space, providing explanations and producing ideas, studying quantities, sizes, solids and transformations in the form of designs, structures, tools and devices digital.
• The definition of the two procedural researchers: Employing STEM approaches based on the integration of science, technology, engineering and mathematics in training mathematics teachers for the purpose of developing their professional competencies and their future perceptions.

3. Future perceptions: Define them
• Ahmed (2011): “Expectations revolving around the individual’s future plans and goals aimed at self-realization and success or the state of perfection that he wishes to be in.” (Ahmed, 2011: 17)
• The theoretical definition of the two researchers: an emotional guess of a future event based on the needs of the present.
• The definition of the procedural researchers: the responses of the mathematics teacher to the situations included in the scale of implementation competencies prepared for the purposes of this study, expressed in the total degree obtained by the teacher through his answers on the scale.

4. Mathematics teachers: the definition of the two researchers: They are the teachers who teach the mathematics curriculum to middle and preparatory school students, who are graduates of the colleges of education in Iraq and have a bachelor's degree or higher.

The second chapter is a theoretical background and previous studies
The first axis: (STEM) orientations: the foundations of applying the (STEM) approach

The application of the STEM approach depends on a set of foundations summarized by (Hamdi, 2017) as follows:

1. Interest in mastering computer programs.
2. Apply laboratory activities and practices in physics, biology, earth, space, engineering and technology.
3. Conducting studies and research in the four fields of STEM education.
4. The application takes place in the form of real programs, projects and problems related to the real world.
5. Linking the student's scientific and engineering experiences and practices with the challenges and problems surrounding his environment and his local and global community.
6. Establishing distinguished relationships between the student and his fellow participants, and with his teachers, experts and scholars interested in the fields of (STEM).
7. Conducting intensive workshops and training to develop scientific and engineering skills and practices. (Hamdi, 2017: 162)

The second axis: future perceptions: throughout the life of time, man looks towards the future and prepares for it for fear of disasters and lean years. 12) Some of those interested in future affairs believe that scientific thinking about the future began at the end of the nineteenth century, when a group of writers and thinkers emerged and were described as futurists and are not content with merely understanding and assimilating what happened in the past. And that the value of the past lies in the possibility of using it to stir up the future. (Abdul Rahman, 1988: 15).

The third axis: Studies dealing with STEM orientations.

1. Al-Najjar Study, 2019: The Effectiveness of a Proposed Program Based on Hybrid Education in Developing Creative Teaching Competencies According to the (STEM) Curriculum for Student Science and Mathematics Teachers at the College of Education.

The study was conducted in the Kingdom of Saudi Arabia, and the study aimed to identify the effectiveness of training packages based on the (STEM) curriculum in scientific centers in developing academic achievement, habits of mind, and attitudes towards science among sixth grade female students in Jeddah Governorate. My achievement, the measure of attitude towards science and the attitude towards science teacher, and the statistical methods used were (t-test for two correlated samples, Pearson correlation coefficient, Cronbach's alpha equation). The results showed a statistically significant difference between the mean scores of female students in the pre and post applications of the achievement test in favor of the post application, as well as the presence of a statistically significant difference between the mean scores of female students in the pre and post applications. For the measure of attitude towards science, for each dimension of the scale and for the scale as a whole, and the difference came in favor of the post application.

2. Al-Saedi and Al-Azab Study, 2021: A proposed program in light of the requirements of the STEM curriculum to develop the professional and academic performance of science and mathematics teachers at the secondary level.

The study was held in Egypt, and the study aimed to identify the effectiveness of a proposed program to develop the professional and academic performance of science and mathematics teachers in the light of the integration approach (STEM). The t-test for two independent samples, Pearson's correlation coefficient, Cronbach's alpha equation, Eta square, Cooper's equation). The professional and academic performance of the research sample group in favor of the post application.

Aspects of benefiting from previous studies:

1. The presentation of previous studies benefited the two researchers in identifying the studies that were conducted in the field of the variables of their research and provided them with ideas and explanations that helped them define the dimensions of the problem, define goals, choose the type of design, sample size and appropriate statistical methods, which helped to achieve the requirements of the current research as well as helping them in interpreting the results.

2. The previous studies made it possible to identify the theoretical frameworks, which helped the researchers to crystallize the research problem, highlight its importance, and start from where the others ended.
The third chapter discusses the research methodology and procedures
Descriptive approach to building the training program:
And since the first objective of this research is to build a training program, and to achieve this goal, the researchers looked at a number of educational literature and previous studies that included building training programs, and came to a vision of the training program, and this perception included defining the steps for building, implementing and evaluating the program. The program building process follows the following steps

Stages of building the training program: The process of building the training program proceeds in three stages:
First: Implementation stage: This stage includes two basic steps:
1. Analysis: These are basic procedures on which the training program is based. It is the main step in the process of building the training program, as it determines the basic needs and paths that the program should focus on and follow, including:
a. Determine teachers' needs and characteristics.
B. Analysis of the educational environment: The educational environment is a fundamental and influential factor in the outcomes of education and teaching, and the interaction between teachers' needs and the conditions of the surrounding environment is an important factor in explaining their educational behavior.
c. Determine the target group
2. Building the objectives and building the program: Building the program means setting the basic and structural formula in which the elements of the training program are organized in a series of steps, namely:
A- Determine the objectives of the program:
▫ General objectives:
▫ Behavioral purposes:
B. Choose program content.
c. Determine teaching strategies.
D- Educational activities and means.
Second: Lesson design and implementation (training sessions).
Third: the evaluation stage.
The researchers used two evaluation methods in the training program, namely the formative (structural) evaluation, and the final (final) evaluation, as follows:

1. The formative calendar.
2. Closing calendar (final)
Verifying the validity of the training program: One of the important things that should be available in the program is (honesty), and the validity of the program means the contribution of all its elements to achieving the educational goals represented by (content, teaching methods and methods, teaching aids, activities, and evaluation). The program was validated by presenting it to a group of experts specialized in teaching curricula and methods and psychology to express their opinions and suggestions.

The second axis: the experimental approach to know the effectiveness of the training program:
First: The experimental design The researchers adopted the one-group design with a pre and post test, due to its suitability to the conditions of this research, and the following scheme illustrates this:

| Post-test | dependent variable | the independent variable | Pretest | the group |
|---|---|---|---|---|
| Implementation competency measure | Implementation efficiencies | training program | Implementation competency measure | Experimental |

**striped (1)**
**The experimental design with one group with pre and post test is shown in this research**

Second: the research community and its sample
1. Research community The community of this research consisted of male and female mathematics teachers in the General Directorate of Salah al-Din Education Department of Science Education for the academic year (2021/2022) and they numbered (656) teachers, according to the statistics of the Planning Department of the General Directorate of Salah al-Din Soil / Tikrit Education Department .
2. Research sample: Because the research community is small, so the research sample was represented by all (25) members of the research community, male and female teachers in the specialty of mathematics, and from those appointed to the owners only, and from non-lecturers from all schools of the science district and for the academic year 2021/2022.
Third: Controlling extraneous variables: The researchers tried as much as possible to control the factors or variables that may affect the course of the experiment, and then its results. Here are a number of extraneous variables and how to control them:
1- Experimental circumstances and accompanying accidents: They mean natural accidents such as wars, disasters, earthquakes, floods, and the like, which may occur during the experiment, which impedes the course of the experiment, and during the duration of the experiment, when none of them occurred.
2- Experimental extinction: Throughout the course of its conducting, the experiment is exposed to these cases, whether it is leakage, interruption, or abandonment.
3- Processes related to maturity: These processes had no effect on the experiment because of the relatively large ages of male and female teachers.
4- Measurement tool: The researchers used a tool to measure the dependent variable prepared by the researchers and applied before the start of the experiment and after its completion.
Fourth - The effect of experimental procedures: The researchers made an attempt to reduce the impact of this factor during the experiment, in which it means fixing a number of characteristics related to the research, which may appear during the study of the relationship between the independent variable and the dependent variable, so the researchers were keen to adjust a number of variables to ensure the progress of The experiment, its safety, and the accuracy of its results.
Fifth: The research tool: One of the current research requirements is a scale that measures the competencies of implementation among teachers of mathematics, both male and female, after the end of the training program. The previous scales of perceptions, the researchers did not find the scale that fits the current research, so they decided to prepare the scale of future perceptions, and the following clarifies the procedures for preparing the scale.
Determining the objective of the scale The researchers prepared a scale aimed at measuring the level of implementation competencies for teachers of mathematics, male and female, the research sample.
Preparing the items of the scale: The two researchers prepared a scale of implementation competencies consisting of four domains (the social domain, the cognitive domain, the electronic domain, and the psychological domain) and each domain consisted of ten paragraphs, and thus the scale became in its initial form consisting of (40), and the scale was graded threefold. Alternatives (always, sometimes, rarely).
Formulation of the scale instructions: The two researchers prepared the instructions for answering the scale items, which are commensurate with the level of mathematics teachers, as it was shown to them that the scale includes three alternatives (always, sometimes, rarely), as there is no right or wrong answer, and they were asked to answer all the paragraphs. And frankly, for each paragraph of the scale one answer and not to leave any paragraph unanswered.
Virtual honesty: For the purpose of verifying the validity of the scale, the researchers relied on virtual honesty, and for this reason, the implementation competency scale was presented in its initial form to a group of experts and specialists in education, psychology, and teaching methods, in order to verify its validity and investigate its validity as a tool for research and to express their

opinions on its paragraphs. 80% or more of expert opinions, and the percentage of validity is considered acceptable if it reaches (80%) or more (Samarah et al., 1989: 120).
The exploratory application of the scale in order for the researchers to verify the accuracy and clarity of the instructions attached to the scale and the clarity of the content of the paragraphs, as well as determining the time it takes to answer the scale. To the researcher, the scale instructions were clearly clear, and the time required to answer this scale ranged between (20-30) minutes, with an average time of (25) minutes.
Statistical analysis of the items of the scale The aim of this application was to analyze the questions of the scale in order to delete the non-distinguished items and keep the distinctive items, and therefore the scale was applied to an exploratory sample consisting of (100) male and female teachers other than the basic research sample who were randomly selected from teachers Mathematics and its teachers in the General Directorate of Education of Salah al-Din, and in order to identify the discriminatory power of the paragraphs of the scale of future perceptions, each of the following two methods has been used:
- The peripheral comparison method (the method of the two extreme groups) After collecting the answers, the researchers analyzed their responses and arranged them in descending order, and they were divided into two equal categories (27%), upper and lower, with (27) male and female teachers in each group.

The results showed that the t-value calculated for all paragraphs was more than the tabular t-value (2.00) at the level of significance (0.05) and the degree of freedom (52), which means that these paragraphs are distinct.

- The method of internal consistency to calculate the correlation coefficient between the scores of the sample members on each paragraph of the scale and their total scores. The researchers adopted the same analysis sample that was used to calculate the discriminatory power of the paragraphs in the manner of the two extreme groups of (100) male and female teachers. The Pearson correlation coefficient equation was used to extract the relationship between The degree of each paragraph and the total score, and for the purpose of knowing the significance of the correlation coefficient for accepting or rejecting the paragraph, the significance of the correlation coefficients was chosen, and it was shown that all correlation coefficients are statistically significant when balanced by the tabular value (0.19) and with a degree of freedom (98).
Scale stability Stability means the degree of stability of tests and scales and consistency between their parts. To verify the stability of the scale in its final form, the researchers decided to adopt two methods in that:
1. Method of re-testing: The idea of re-testing is based on conducting the test on a group of teachers and then re-taking the same test on the same teachers after a period of time. After that, the scale was re-applied on the first survey application sample of (20) teachers and schools under similar circumstances. It is consistent with what was indicated by Daoud and Abdel-Rahman (1990) that the interval between the two applications usually ranges between one and two weeks, as the shorter period than that provides an opportunity for remembering, and the length of the period may provide an opportunity for teachers to grow, and then change their performance (Daoud and Abdel-Rahman 1990: 122), then the researchers applied the Pearson correlation coefficient for the two times, and it reached (0.83), and such a ratio is considered good and acceptable.
2. The method of variance analysis using Cronbach's alpha equation: To estimate the internal consistency of the scale, the responses of the first application sample were used in calculating the re-test of (20) male and female teachers, and the stability coefficient reached (0.87), which is a good stability coefficient for internal consistency between the items of the scale Allam, 2000: 166).
Scale correction instructions

The researchers prepared the instructions for correcting the scale. The total score was calculated by adding the scores of all the items, and the distribution of scores on the items of the scale is as follows:

Always (3) degrees, sometimes (2) degrees, rarely (1) degrees, and thus the highest score for the scale is (120) and the lowest score (40) with a theoretical mean of (80) degrees. A good level of future perception, but if the respondent's total score is lower than the theoretical average, this indicates that the respondent's level of perception is weak, i.e. he does not have a future vision.
The fourth chapter presents and interprets the results
1. The results of the first hypothesis: (There are no statistically significant differences between the average scores of the experimental group who were trained in the light of STEM trends in the pre and post applications of the future perceptions scale) to find the effectiveness of the training program in developing the implementation competencies of mathematics teachers, male and

female. The comparison between the results of the research group in the pre and post measures, and the value of "t-Tese" was calculated for the difference between the average scores of the teachers in the pre and post applications of the implementation competencies scale prepared for this purpose, and Table (1) shows this.

**Table (1) The arithmetic mean, standard deviation, and the t-value of the scores of the experimental group in the scale of pre and post implementation competencies**

| the sample | standard deviation | SMA | average arithmetic of the differences | deviation of variances | t values | | **theoretical mean** | **Significance at level (0,05)** |
|---|---|---|---|---|---|---|---|---|
| | | | | | **calculated** | **Tabular** | | |
| **Tribal** | **9,55** | **58,00** | **49,40** | **9,72** | **25,39** | **2,06** | **80** | **Statistically significant** |
| **after me** | **9,34** | **107,40** | | | | | | |

It is clear from the previous table that the arithmetic mean of the experimental group before the experiment is equal to (58.00) with a standard deviation of (9.55), while the arithmetic mean of the experimental group after the experiment is equal to (107.40) with a standard deviation of (9.34), and that The calculated t-value is (25.39), which is more than the tabular t-value of (2.06) at the level of significance (0.05) and a degree of freedom (24), and this confirms the positivity of the training program in developing the implementation competencies of mathematics teachers.

2. The results of the second hypothesis: There are no statistically significant differences between the mean scores of the experimental group members who were trained in the light of STEM orientations in the pre and post applications of the Execution Competencies Scale due to the gender variable (males). To test the validity of this hypothesis, the researchers applied a measure of implementation competencies on male mathematics teachers, before and after they passed the training program, and to address the results of the two applications, the researchers used the (t-Tese) test for two correlated samples to compare the average scores of mathematics teachers in the pre-application test of the observation card of professional competencies. And the average scores of the teachers themselves in the post-application of the same card, and the results were as shown in Table (2).

**Table (2) The arithmetic mean, standard deviation, and t-value of the scores of the experimental group of males on the pre and post implementation competency scale**

| males | **the number** | standard deviation | SMA | average arithmetic of the differences | deviation of variances | t values | | **theoretical mean** | **Significance at level (0,05)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **calculated** | **Tabular** | | |
| **Tribal** | **12** | **8,24** | **56,25** | **52,41** | **7,85** | **23,11** | **2,20** | **80** | **Statistically significant** |
| **after me** | **12** | **9,27** | **108,66** | | | | | | |

It appears from the above table that the arithmetic mean for males before the experiment is (56.25) with a standard deviation of (8.24), while the arithmetic mean after the experiment is (108.66) with a standard deviation of (9.27), and the calculated t-value (23.11), which is more than the tabular t-value of (2.20) at the level of significance (0.05) and degree of freedom (11), and this confirms that the differences in the averages are a function in favor of the post-application, which means that the training program was effective in Developing the implementation competencies of male mathematics teachers.

1. The results of the third hypothesis: There are no statistically significant differences between the average scores of the experimental group members who were trained in the light of STEM trends in the two pre-applications of the implementation competency scale due to the gender variable (females). of females, before and after they went through the training program, and to address the results of the two applications, the researchers used the (t-Tese) test for two related samples to compare between the average scores of mathematics teachers in the pre-application of the implementation competency scale, and the average scores of the teachers themselves in the post-application. The results were as shown in Table (3). ).

**Table (3) The arithmetic mean, standard deviation, and the t-value of the scores of the experimental group of females on the pre- and post-implementation competency scale**

| females | **the number** | standard deviation | SMA | average arithmetic of the differences | deviation of variances | t values | | **theoretical mean** | **Significance at level (0,05)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **calculated** | **Tabular** | | |
| **Tribal** | **13** | **10,69** | **59,61** | **46,61** | **10,72** | **15,66** | **2,18** | **80** | **Statistically significant** |
| **after me** | **13** | **9,61** | **106,23** | | | | | | |

It appears from the above table that the arithmetic mean for females before the experiment is (59.61) with a standard deviation of (10.69), while the arithmetic mean after the experiment is (106.23) with a standard deviation of (9.61), and the calculated t-value (15.66), which is more than the tabular t-value of (2.18) at the level of significance (0.05) and degree of freedom (12), and this confirms that the differences in the averages are a function in favor of the post-application, which means that the training program was effective in Developing implementation competencies among female mathematics teachers.

1. The results of the fourth hypothesis: There are no statistically significant differences between the mean scores of the experimental group members who were trained in the light of (STEM) orientations in the post application of the Execution Competencies Scale due to the gender variable (males and females).

To test the validity of this hypothesis, the two researchers applied a scale of implementation competencies on mathematics teachers, both male and female, after passing through the training program, and to address the results of the application, the researchers used the (t-Tese) test for two independent samples, and the results were as shown in Table (4).

**Table (4) The arithmetic mean, standard deviation, and t-value of the scores of the experimental group (males and females) on the post observation card**

| sex | **the number** | standard deviation | SMA | t values | | **theoretical mean** | **Significance at level (0,05)** |
|---|---|---|---|---|---|---|---|
| | | | | **calculated** | **Tabular** | | |
| **males** | **12** | **9,27** | **108,66** | **0,64** | **2,06** | **80** | **Statistically significant** |
| **females** | **13** | **9,61** | **106,23** | | | | |

It can be seen from the above table that the mean for males is (108.66) with a standard deviation of (9.27), while the mean for the experimental group for females is (106.23) with a standard deviation of (9.61), and the calculated t-value is ( (0.64), which is less than the tabular t-value of (2.06) at the significance level (0.05) and the degree of freedom (24), and this confirms that there are no statistically significant differences in the post application of the implementation competence scale due to the gender variable (male and female). ).

Interpretation of the results The researchers attribute the positiveness of the training program in developing the competencies of implementation of mathematics teachers to the desire of the research sample to develop future perceptions through increasing thinking, creativity and continuing reading in the various fields of scientific knowledge and in the field of academic specialization in particular, due to the diversity of the different fields of mathematics sciences. As well as to the nature of the age stage of the research sample individuals, which works to discover everything that is new through the development of thinking and creativity and asking questions that will increase the continuation of reading in the various fields of scientific knowledge and in the field of academic specialization in particular to find solutions to these perceptions, as well as this result calls for optimism Because it is useful in predicting the safety of the psychological aspect in the lives of individuals of an important segment of Iraqi society, and they are the teachers who bear the responsibility of society, and that the competencies of implementation help them to be aware of understanding the task entrusted to them in understanding themselves first and then understanding their students, so they expect In the future, benign developments will occur in the field of science in general and mathematics in particular as a result of technological development and the massive information explosion, and that the trends that are working to change the world now are knowledge and science. And what is present in the present, there are individuals who seek to reach a high and distinguished degree in academic success, whether at the level of the educational stage, or to reach an academic or professional degree, or to a certain leadership position, and this does not come except through implementation, clarity of purpose and exerting more effort, This applies with what Kelly stated in his theory, which is (that the processes that the individual seeks to direct the individual in the ways in which the individual expects events), as I assume that the individual looks at his world, and organizes it in the same way that the world does, by formulating multiple hypotheses about the world And testing it against reality from his experience, and on this basis, the individual can imagine what will happen if in the future, based on his experiences in life, and this achieves the possibility of predicting events, and (Kelly) believes that the individual's expectations of events lead to the formation of his behavior, which is built These expectations naturally lead to the formation of certain patterns of behaviour. If the individual’s future expectations for a particular event are characterized by optimism, it is expected that patterns of behavior will emerge from it that are characterized by optimism and satisfaction in the present, i.e. the impact of the expectation will be direct on the individual’s behavior in the present. Thus, if these future expectations contain pessimism, it is expected that patterns of behavior will emerge from it, characterized by pessimism towards the facts and events that the individual is exposed to. (Hassan, 2001: 107)

Conclusions: In the light of the research results and within its limits, the researchers concluded the following:

1. The program has been prepared to suit the needs of teachers.
2. The clarity of the training programs and the knowledge of the sample members on the objectives that meet their training needs make the training more effective.
3. The high mental abilities of the research sample, in general, contribute to the formation of future perceptions.

Recommendations: In the light of the research results presented, the researchers recommend the following:

1. Conducting training programs before and during joining the job to train and qualify mathematics teachers in the Ministry of Education.

2. The need to expand the establishment of specialized STEM schools and compare them with educational institutions in Arab and foreign countries that apply the STEM approach in the Ministry of Higher Education.
3. The Ministry of Education should develop appropriate plans or improve existing plans to meet the multiple needs of teachers, their future aspirations, intellectual inclinations, and personal preparations, taking into account social, political and economic changes.
Suggestions: As a complement to the current research, and with the aim of opening future horizons for other research, the two researchers propose the following:
1. The effectiveness of a training program in the light of (STEM) approaches to evaluate the professional performance of mathematics teachers in the preparatory stage.
2. The effectiveness of a training program for in-service mathematics teachers to train them on the requirements of applying creative teaching according to the STEM curriculum and measuring its effectiveness in developing creative problem-solving skills among their students.
3. The effectiveness of a training program based on a STEM approach in developing technical problem-solving and innovative thinking for male and female mathematics teachers

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