



A Training Program to Develop Strategies for Solving a Mathematical Problem and Mathematical self-Esteem Among Students in Terms of the Trends of International Examinations

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Keywords:

*Mathematical Problem-Solving Strategies,
Mathematical Self-Esteem, Training
Program, International Examinations*

The study aimed to examine the effectiveness of a training program that is built in terms of the trends of international examinations to develop strategies for solving mathematical problems and mathematical self-esteem among 8th, 9th and 10th graders. The students were selected from two schools in KhanYunis city in Palestine. The experimental research utilized a one-group design, using a test of mathematical problem-solving strategies and a mathematical self-esteem Scale as instrumentation. The results of the study revealed an improvement among the students taught by the strategies of mathematical problem-solving and mathematical self-esteem. In addition, the program revealed the effectiveness and effect of the strategies of solving mathematical problems, while the strategies of mathematical self-esteem showed only an effect, but not effectiveness. The results also showed a moderate positive relationship between students' possession of problem-solving strategies and mathematical self-esteem. The results obtained were discussed in detail in the section of findings and discussion.

Introduction

The specialists in teaching mathematics have agreed that solving a mathematical problem is a mental process that prerequisites an ability to perceive the relationships among the internal elements of a problem in order to explore the strategies for an appropriate solution. The strategies for solving problems require adequate time to be possessed. Solving a problem is a dynamic and interactive process that began with the understanding of the problem and ends up with the review of a solution. Al-Khatib and Al-Khatib (2008) reviewed eighteen studies on solving mathematical problems, and found twenty strategies to solve the problem as follows: Finding a simpler solution for a similar problem, inferential evidence, classifying data, approximation, using the computer, defining the characteristics of things, specification, generalization, examining the extremes in the field, visual display of a diagram or table, drawing, intelligent guessing, and selection, defining necessary and sufficient situations and conditions, sequencing, identifying without prejudicing generality the arrangement, categorization, or the organization of calculations, working in reverse, finding a model, and adopting a different point of view. In this context, a group of researchers indicated that problem-solving strategies are not the steps followed by individuals to reach the solution, but rather the methods they utilize to solve the problem. Malouff (2018) stated that the stages of problem-solving are not the same as the strategies for problem-solving; the stages of a solution can be termed as a set of sub-abilities that represent the general ability to solve the problem. Their efficiency is different based on the selection of appropriate strategies within each stage.

The reasons why the students are weak in solving a mathematical problem are overwhelmingly due to the following reasons: (1) Their misunderstanding of the problem, (2) their inability to distinguish and explore the principles of the problem, (3) their failure to choose and organize the solution steps, (4) their lack of mastering the basic concepts, laws, processes and main skills; (5) their failure to recall basic information and their misuse of thinking skills, (6) their weak ability to guess, estimate and use mathematical sense to reach the solution, (7) the teachers do not encourage students to appropriately solve the problem and resort to the rule of habit in solving and following up on the solution. Additionally, part of this weakness is also due to the teacher's lack of interest in problem-solving strategies in the classroom. It was indicated that most teachers tend to obtain memorial responses, which reinforce familiar thinking among students, except for (5%) of them who use the most effective problem-solving strategies (Avcu and Avcu,

2010; Epulveda, 2006; Poetzl, 2007). After reviewing research in the field of problem-solving (Avcu and Avcu, 2010; Breyfogle and Wilburne, 2011; Erbas and Okur, 2012), it was concluded that the most prominent challenges students face in solving problems are teachers' teaching methods; they apply direct spoon-feeding and application to the rules in teaching problem-solving. Hence, the students' role is limited to simulating the method used by their teacher and applying the explained rules and steps to reach the solution.

Self-esteem is a desirable goal for students as it represents one of the important dimensions of personality; it makes students rate themselves positively. Additionally, it contributes to developing students' skills and abilities in all areas, which subsequently leads to further efficiency and effectiveness in dealing with life problems. Self-esteem is important as it is mentioned at the top of the Maslow Hierarchy Pyramid (Al-Murad, 2007). In this context, Omar (2018) indicated that mathematical self-esteem reflects the students' desire to follow and interact with mathematical ideas, the ability to complete mathematical tasks, and their confidence in their ability to learn new topics in mathematics. This is also confirmed by Abd-Rabbo (2018) who reported that mathematical self-esteem is formed by the student's belief about his/her performance in mathematics.

Most countries seek to participate in international examinations; if they pass them, the countries will gain confidence in their educational system and determine their status on the global educational map, which is reflected in the management of human resources in a respective country where human competencies are recruited. These examinations are also a significant indicator to measure the level of education in a country.

The Program for International Student Assessment (PISA) is one of the international examinations administered by the Organization for Economic Cooperation and Development (OECD), and it represents the main criterion for measuring the quality of educational systems in many countries. The OECD aims to monitor the results of educational systems in terms of students' educational attainment within an internationally agreed framework. The promotion of studies would improve societies' economic and social situation around the world. PISA also represents an exam that is considered the most comprehensive and accurate international program in evaluating students, collecting data about them and their families, and institutional factors that help explain the differences in performance among students (Gurra, 2012; Al-Mannai & Abdelhafeez, 2017).

Mathematics is the main field-tested in the (PISA2022), and represented the main field in the (PISA2003,

PISA2012). Is also indicated that the goal of designing the cognitive framework for (PISA2022) is that mathematics is clearly closely contacted with 15-year-old students. Consequently, these questions kept developing in real and meaningful contexts. The course of mathematical modeling that was used in earlier frameworks to describe the stages individuals go through in solving contextual problems remains a key feature of the cognitive framework for (PISA2022); it is used to help identify the mathematical operations students participate in to solve problems; those operations, along with inference, provide the basic dimensions of students' level of mathematical knowledge (OECD, 2018).

As (PISA) is important in evaluating and guiding educational systems, Palestine was keen for the first time to participate in the (PISA2022) cycle to get benefit from the results of participation in guiding the educational system in Palestine. Accordingly, the Palestinian Ministry of Education (PMoE) has prepared for this exam by forming technical committees in order to devise a plan for preparing the examination and follow up on its implementation. The PMoE started applying (PISA) tools to an experimental sample of eleven governmental schools encompassing (560) tenth graders in April 2021. The PMoE has prepared the school laboratories, trained the teaching staff, and circulated instructions for students and parents to make the implementation of the study successful. In January 2022, the PMoE through teachers began training tenth graders in all schools to train models that mimic tests of PISA. In April and May 2022, PISA tools were applied to a surveying sample representing the study community in Palestine (Palestinian Ministry of Education, 2021).

In the same vein, the educational system in most countries is interested in academic achievement and the factors affecting it; this is why we witness the country's eagerness to take part (TIMSS), which includes various goals and levels of thinking. Each country analyzes and discusses its results at the state level, and searches for ways to address shortcomings and supporting strengths. Mullis et. al. (2021) mentioned that (TIMSS) exams are implemented every four years starting from 1995, and are controlled by the International Association for the Evaluation of Education Achievement (IEA). TIMSS uses a set of tools: Achievement test booklets and questionnaires for teachers, students, schools, environment, curriculum, and home questionnaire for the fourth grades. TIMSS aims to identify students' performance and compare them in various educational systems to explore the gap between performance in achievement levels, if any, and to identify the factors affecting the outcomes of these systems. In addition, to let several countries participate to evaluate the

effectiveness of teaching and learning mathematics and science, measure the level of performance and trends of change in their various environments, provide reference data for analysis, compare the performance of participating countries, and evaluate teaching methods. In this context, (IEA, 2021) has explained that (TIMSS2023) represents the eighth cycle of the international assessment of mathematics and science that contained 67 countries, including the State of Palestine. In previous cycles, (TIMSS2023) collected detailed information about curricula, their implementation, educational practices, and school resources. However, (TIMSS2023) has a new feature of creating a collective design that allows for better alignment of assessment with students of the participating countries. In conjunction with TIMSS, it also presents a unique opportunity for countries to also participate in the International Computer and Information Literacy Study (ICILS). TIMSS2023 will be implemented from early to mid-2023 in Northern Hemisphere countries, and during the second half of 2023, it will be implemented in Southern Hemisphere countries, while TIMSS2023 results will be published in December 2024.

The PMoE decided to participate in the study of the international trends in mathematics and science (TIMSS2023). This is the fourth time Palestine has participated. This participation reflects the developmental plan of the Ministry to put the Palestinian educational system in comparative global contexts, and after a break-in (TIMSS 2015, and TIMSS2019). Palestine's last participation was in the cycle of (TIMSS2011) (Palestine News Network, 2021).

Despite the interest in solving mathematical problems as a primary goal for learning and teaching mathematics, the teaching of solving mathematical problems in our schools is still unclear. It is not taught in the correct sense and needs more focus. There is a focus on the results regardless of the procedures and methods used in solving problems. These results are in alignment with the following studies (Khalil, 2016; Al-Salami, 2013; Al-Salahi, 2019; Al-Qarni, 2019) which revealed the low level of teachers' interest in problem-solving strategies, and they limit their use to one method for solving; therefore, solving the mathematical problem represents a great challenge for students, especially students of the upper basic stage; from whom are selected to take part in international exams (i.e. TIMSS). The eighth-graders participate in TIMSS, while tenth graders participate in (PISA) test. This is due to the multiplicity of skills and cognitive processes that require students when solve mathematical problems, and their need to practice various strategies to solve them.

For the following reasons: (1) The students' low level in mathematics, (2) the researcher's observation that students' ability to solve mathematical problems is below the required level, (3) the results of the previous studies (Abdul-Qader, 2017; Al-Ghosun et al., 2020) which revealed a weak level in solving mathematical problems, (4) the students' need to be trained on modern strategies that help them in that skill, (5) due to the fact that the ability to use strategies during the solution is an integral part of solving mathematical problems, (6) the significant role of these skills in learning mathematics, (7) based on the results of Palestine in (TIMSS), (8) considering the state's preparation to participate in the (PISA), (8) due to teachers' complaints about students' poor attainment in mathematics in general and their weakness to solve mathematical problems in particular, and (9) the students' low level of self-esteem and low confidence in their ability to deal with mathematical problems, which was confirmed by studies (Al-Jundi and Khalil, 2019; Qutina and Al-Shara, 2021). Therefore, there is a need arises for therapeutic intervention by training students on various strategies for solving problems and improving their mathematical self-esteem.

Research Questions

The research aims to build a training program in terms of the trends of international examinations; (PISA, TIMSS). The program is useful for arranging learning situations and training students to choose and employ effective strategies to solve mathematical problems to improve their performance and raise their mathematical self-esteem. Accordingly, the main question of this research is: **"What is the training program that could be utilized for developing students' strategies for solving mathematical problems and mathematical self-esteem in terms of the trends of international examinations?"** The following questions stemmed from it:

- 1) What is the effectiveness of the training program to develop students' mathematical problem-solving strategies?
- 2) What is the effectiveness of the training program to develop students' mathematics self-esteem?
- 3) What is the kind and degree of the relationship between students' possession of mathematical problem-solving strategies and their mathematical self-esteem?

Methodology

This part reviews the research procedures; the research design, the research population, the training program, the data collection tools (the exam of mathematical

problem-solving strategies, and the Mathematical Self-Esteem Scale), and data analysis methods.

Research Design

This research is experimental research that uses a one-group design; a pre-post measurement. The subjects were randomly treated (Rusefendi, 2005), as well as the random selection of the sample, and the creation of a new group of students.

Research Population and Sample

The population represents all the students of the upper basic stage in the governmental schools in Gaza during the year 2021/2022. The sample randomly included (42) eighth, ninth, and tenth graders in Al-Qararah Area Basic Schools for Boys and Al-Qararah Area Secondary Schools for Boys.

The training program

The training program was built based on the main and sub-domains of the international examinations (PISA, TIMSS), which were utilized to formulate the training sessions. The program was reviewed by specialists whose percentage of agreement was not less than (85%). The program was composed of a number of (13) training sessions; each session lasted (120 minutes) per day and for three weeks.

Math problem solving strategies

The exam aims to investigate the students' mathematical problem-solving strategies by addressing eight problems; at the end of each problem, there are questions about identifying the main problem and the appropriate strategy for solving it. The validity of the exam was confirmed using the validity of arbitrators and (Lawshe's) method. According to the equation $CVR = \frac{n_e - (N/2)}{N/2}$, (n_e) represents the number of experts who agree that the question is essential in the measurement, while (n) signifies the total number of panel members (Ayre & Scally, 2013). The statistical treatment revealed the arbitrators' validity percentage for all questions and for the test as a whole is (1.00). The discriminatory ability of the questions was also confirmed after applying the test to a pilot sample using Pearson's correlation. The correlation between each question and the overall sum of questions ranged from (698 to 0.882), which is bigger than (0.300); therefore, it is an acceptable correlation for the discriminatory ability (Pal, 2013). The reliability of the test was met by the following equation: $KR_{21} = \frac{n}{n-1} \left(1 - \frac{M - \frac{M^2}{n}}{(SD)^2} \right)$. (N) is the number of test items, (m)

is the mean of the total test scores, and $((SD)^2)$ is the variance of the total test scores. (Webster, 1960). The value of the reliability coefficient is (0.718), which is greater than (0.700), and thus it expresses an acceptable validity (Cortina, 1993). Finally, the test in its final composition consisted of eight questions, each question has ten points, and the overall degree is (80) degrees.

The scale of mathematical self-esteem

The scale aims to (1) identify the level of students' self-esteem of their ability to employ the mathematical problem-solving strategies, (2) their willingness to help their peers to employ such strategies to solve mathematical problems, (3) and their future perspective toward learning mathematics. Initially, the scale contained (27) items according to the five-point Likert scale, distributed over three areas; the student's self-esteem, the student's estimation of his/her friends, and the student's estimation of his/her teacher through his/her teaching). The validity of the scale was met using the arbitrators' validity and Lawshe's method. The statistical treatment revealed the percentage of arbitrators' validity for the items ranged between (0.82 - 1.00), and for the whole scale is (0.97). The discriminatory ability of the items was also confirmed after the scale had been applied to a pilot sample using Pearson's correlation to calculate the correlation between the degree of each item and the total degree of their factors. Four items were deleted as their correlation is less than (0.300), while the correlation coefficient of the other items ranged from (0.62 to 0.887) and was greater than (0.300). The correlation between the degree of each factor and the total score of the scale was also found (0.593 - 0.627), which is greater than (0.300). To ensure the reliability of the scale, Cronbach's alpha coefficient was used for the factors of the scale using the following equation: $\alpha = \frac{n}{n-1} \left(1 - \frac{\sum_i \sigma_{x_i}^2}{\sigma_c^2} \right)$,

(n) signifies the number of items, ($\sigma_{x_i}^2$) represents the items variance, and (σ_c^2): represents the whole scale (Cronbach, 2004). The stratified alpha for the whole scale was adopted using the following equation: $r_{STRAR,\alpha} = 1 - \frac{\sum_{i=1}^n \sigma_i^2 (1-r_i)}{\sigma_c^2}$, (r_i): is the reliability estimates of the factor, (σ_i^2) is the variance of the factor, and (σ_c^2): is the total score variance of the test (Cronbach & at. el., 1965). The reliabilities showed (- , ٨٠٤) ٠,٩٢٠ for the factors and (0.917) for the whole scale; a very good result which is greater than (0.700). Hence, the final scale was composed of (23) items, and the overall grade is (115).

Data analysis methods

The two tools of the study; the exam of mathematical problem-solving strategies and the scale of self-esteem, were quantitatively analyzed to: (1) Find out the significance of the difference between the mean scores of the pre and post measurements for the two tools using the paired sample t-test, (2) verify the relationship between the level of students' possession of mathematical problem-solving strategies and their level of mathematical self-esteem using the Pearson correlation coefficient, and (3) investigate the significance of the correlation value using the t-ratio according to the following equation: $t_{obs} = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}}$. (r)

represents correlations coefficient, (n), signifies the sample size, and ($n - 2$) is the degree of freedom (LaMorte, 2021). To explore the variance harmony and normality of both measurements, Cohen's equation was used: $d_{cohen's} = \frac{\mu_1 - \mu_2}{\sigma}$, (μ_1) represents the means of the first scores, (μ_2) denotes the means of the second scores, while (σ) is the standard deviation for the differences between means. (D) values are interpreted as follows: (0.20 < 0.50) is small, (0.50: < 0.80) is medium, while (≥ 0.80) is large (Cohen, 1988). For verifying the effectiveness of the program to develop the two dependent variables, Black's gain equation was used: $E.SB = \frac{y-x}{z-x} + \frac{y-x}{z}$, (y) is the mean of post-measurement, (x) is the mean of pre-measurement, while (z): is the total score of the measuring instrument (AlWahaibi, at. el., 2020).

Findings

This part presents the procedures for investigating the conditions of the methods of data analysis, and the presentation and discussion of the research results.

Investigating the conditions of data analysis methods

To choose the methods of analysis that fit the nature of the data, homogeneity of data variance was verified for the research tools using (Levene's test) for comparing the post and pre-means of measurements. It revealed (3.181) at the level of (0.079) for the exam of strategies for solving a mathematical problem, and (0.897) at the level of (0.899) for the mathematical self-esteem scale. The values indicated the homogeneity of variance of the pre-post measurements for both tools. As the sample is less than 50, Shapiro-Wilk Test was adopted to investigate the homogeneity of the pre-post measurements (Leslie, Stephens & Fotopoulos, 1986). The value of (SW) for the degrees of the pre-post

measurements of the test of mathematical problem-solving strategies respectively was (0.939, 0.941) at two levels of significance (0.253, 0.283). The (SW) value of the two measurements of the mathematical self-esteem scale respectively was (0.942, 0.946) at two levels of significance (0.288, 0.316), which indicates the homogeneity of the degrees of the pre and post measurements.

Research Results

Table1. Illustrates the results of the paired sample to determine the difference between the mean scores of the pre-post measurements for testing a mathematical problem solving strategies

	Test	N	\bar{X}	SD	DF	T	P
Mathematical Problems Solving Strategies	Pre	42	22.29	3.039	41	-50.893	0.001
	Post	42	66.33	4.626			

According to the scores obtained by the mathematics problem-solving strategies test, the table showed a statistically significant difference between the means of the pre-post measurements [T = -50.893, P < 0.05]. Differences are in favor of the post-measurement as its arithmetic mean is greater than the arithmetic means of the pre-measurement.

Table2. The results of the effect size of the training program on the level of students' employment of mathematical problem-solving strategies.

	\bar{X}_1	\bar{X}_2	σ	Cohen's d	Effect Size
Mathematical Problems Solving Strategies	22.29	66.33	44.048	7.853	Large

The results of table two shows a big effect of the programme [d = 7.853 > 0.80].

The effectiveness of the training program to develop the level of employing mathematical problem-solving strategies

Table 3. The results of the effectiveness of the training program to develop the level of employing mathematical problem-solving strategies

	T	X	Y	Z	E.SB
Mathematical Problems Solving Strategies	-50.893	22.29	66.33	80	1.31

The results of table three an acceptable level in the effectiveness of the training program to develop the students' level of employing mathematical problem-solving strategies.(E.SB = 1.31 > 1.2).

2.2.4 Results related to the second sub-question

The results of the second question "What is the effectiveness of the training program to develop students' mathematics self-esteem?" are displayed as follows:

1.2.4 Results related to the first sub-question

The results of the analysis of the sub-question "What is the effectiveness of the training program to develop students' mathematical problem-solving strategies?" are displayed as follows:

The difference between the mean scores of the pre-post measurements of the mathematical problem-solving strategies test

Table (1) shows the results of the paired sample t-test

The effect size of the training program on the level of employing mathematical problem-solving strategies

Table (2) shows the results of the effect size using the "Cohen's d" equation to examine the effect of the training program on the level of students' employment of mathematical problem-solving strategies.

Table (3) shows the results of the Black Modified Gain Ratio to examine the effectiveness of the training program to develop the level of employing mathematical problem-solving strategies.

The difference between the mean scores of the pre-post measurements of the mathematical self-esteem scale

Table (4) shows the results of the paired sample t-test

Table 3. Shows the results of the paired sample to determine the difference between the mean scores of the pre-post measurements of the mathematical self-esteem

	Test	N	\bar{X}	SD	DF	T	P
Mathematical Self-esteem	Pre	42	71.05	10.174	41	-20.321	0.001
	Post	42	103.69	6.565			

The table revealed a statistically significant difference between the mean scores of the pre-post measurements according to the scores obtained by the mathematical self-esteem scale [T = -20.321, P < 0.05], and that the difference is in favor of the post-measurement as its arithmetic mean is greater than the arithmetic means of the pre-measurement.

The effect size of the training program on mathematical self-esteem

Table (6) shows the results of the effect size using the "Cohen's d" equation to examine the effect of the training program on the level of students' mathematical self-esteem

Table 4. The results of the effect size of the training program on the students' mathematical self-esteem

	\bar{X}_1	\bar{X}_2	σ	Cohen's d	Effect Size
Mathematical Self-esteem	71.05	103.69	32.643	3.136	Large

The results of table five shows a big effect of the programme [d = 3.136 > 0.80].

Table (6) shows the results of the Black Modified Gain Ratio to examine the effectiveness of the training program to develop the level of mathematical self-esteem

The effectiveness of the training program to develop the level of mathematical self-esteem

Table 6. The results of the effectiveness of the training program to develop the level of mathematical self-esteem

	T	X	Y	Z	E.SB
Mathematical Self-esteem	-20.321	71.05	103.69	115	1.03

The results of table six shows that the porgramme did not make effectiveness to develop the level of mathematical self-esteem (E.SB = 1.03 < 1.2).

Results related to the third sub-question

To analyze the results of the third sub-question "What is the kind and degree of the relationship between students' possession of mathematical problem-solving strategies and their mathematical self-esteem?". Table (7) shows the results of the Pearson correlation coefficient between the level of students' possession of mathematical problem-solving strategies and their level of mathematical self-esteem.

Table 7. The results of the relationship between students' possession of mathematical problem-solving strategies and their mathematical self-esteem

	N	\bar{X}	SD	r	P	t_{obs}	$t_{(40,0.05)}$
Mathematical Problems Solving Strategies	42	66.33	4.626	0.357	0.020	2.417	2.021
Mathematical Self-esteem		103.69	6.565				

It revealed the relationship between the level of students' possession of mathematical problem-solving strategies and the level of their mathematical self-esteem was statistically significant [r = 0.357, P < 0.05]; a positive relationship. It also showed that the correlation

coefficient between the two variables differs from zero at the significance level of 0.05; which means that it is significant in the population [$t_{obs} = 2.417 > t_{(40,0.05)} = 2.021$].

Discussion

This study is the first, to the best researcher's knowledge, that seeks to develop students' abilities to employ strategies for solving mathematical problems and mathematical self-esteem collectively in one study. Some studies have attempted to develop the two variables, but each of them individually (i.e. Al-Ghabashy & Mahmoud, 2017; Hendriana, Johanto & Sumarmo, 2018; Khalil & Al-Omari, 2019; Al-Jundi & Khalil, 2019). Additionally, this study is one of the first studies to use the trends of international exams to construct a training program for students.

It is found that there is a significant difference between the mean of the pre-post measurements of the mathematical problem-solving strategies test in favor of the post-measurement. This difference was essential indicating that the scientific significance of the difference is big and that the difference does not occur randomly, but it is a real difference due to the effect of the training program. Moreover, it was found there is acceptable effectiveness of the training program to develop strategies for solving mathematical problems among students. The difference obtained is due to: (1) the researcher's reliance on training workshops and multiple training methods throughout posing problems that simulate the international exams (PISA and TIMSS), (2) the researcher's training of students on problem-solving strategies, (3) the researcher's assigning of students to try to answer strategy questions within each problem at the three levels of interaction (individual, pair, or group), and then generalizing this answer to other mathematical problems, and (5) the researcher's diversifying of problem-solving strategies that suit the students' individual differences that commensurate with the nature of their thinking (geometric or algebraic), and match their abilities, tendencies and trends so that they use the strategy they tend to, especially since they have been trained to use more than one strategy to solve the mathematical problem. Consequently, the students have a diverse collection of problem-solving strategies.

A significant difference between the mean of the pre-post-measurements of the mathematical self-esteem scale was found in favor of the post-measurement. The result confirms the following studies (Hendriana, Johanto & Sumarmo, 2018; Al-Jundi & Khalil, 2019, Khalil & Al-Omari, 2019). No acceptable effectiveness of the program to develop students' mathematical self-esteem is revealed. The difference obtained is due to the reliance on some specific techniques during the program sessions; the techniques of active training. Furthermore, the researcher trained students on how to monitor and express their feelings within those situations, and how they can take problem-solving strategies to reach the best

way. There is a sharp focus on preventing the student from behaving negatively (i.e. frustration, and feeling of inability to complete the mathematical task).

Furthermore, the program topics are organized and formulated in a way that makes the mathematical ideas linked to non-curricula life problems and enhances the students' self-confidence, and contributed greatly to stimulating their desire to learn mathematics. The results also show a positive and statistically significant correlation between the level of students' possession of mathematical problem-solving strategies and their level of mathematical self-esteem. The correlation obtained is average indicating that there is an average relationship between the results of the two tools, which means a high level of students' mathematical self-esteem goes in parallel with an increase in the level of their adoption of mathematical problem-solving strategies. This may be due to implanting confidence in students by allowing them to participate in choosing the appropriate solution strategy, and their sense of the functionality of mathematics, which prompted positive effects on their mathematical self-esteem.

The results in tables one and four show the agreement of a statistically significant difference between the mean of the pre-post measurement of the test of problem-solving strategies and the mathematical self-esteem scale. This significance does not occur coincidentally, but rather as a result of the relationship between them, which is confirmed by the results of table (7), which shows that there is a positive significant correlation between the two variables. It means that the change in them occurs in the same direction although the correlation is moderate; it means that the improvement of one leads to the improvement of the other, and vice versa.

Conclusion

This research investigates the effectiveness of a training program in terms of the trends of international exams to develop strategies for solving mathematical problems and mathematical self-esteem among students of the upper basic stage (eighth, ninth, and tenth). To achieve this, the training program sessions are applied to the research sample, as well as the application of the pre-post mathematical problem-solving strategies and the mathematical self-esteem scale. The results are analyzed at the level of significance ($p < 0.05$). The difference between the mean of the pre-post measurements for testing mathematical problem-solving strategies was found significant ($T = -50.893$ at $P = 0.001$) in favor of the post-measurement. The difference was significant specifying the scientific significance of the difference ($d = 7.853$). It is shown that there is acceptable effectiveness of the training program to develop students'

mathematical problem-solving strategies ($E.SB=1.31$); this result is explained. Although this paper has begun to answer the effectiveness of the training program to develop mathematical problem-solving strategies, more studies are needed. First, it is necessary to conduct a more comprehensive investigation, for example, examining the effect of training on mathematical problem-solving strategies to develop different thinking styles or other academic variables. Second, replicate this research in other training content and classrooms (particularly fourth grade) and look for other strategies that may be effective to solve other types of mathematical problems. Third, this part could be the most important part; there should be more research targeting the training of students on international examination skills and consequently, Palestine's participation in such exams will be improved.

The difference between the mean of the pre-post measurement of the mathematical self-esteem scale was also found significant ($T=-20.321$ at $P=0.001$); in favor of the post measurement. This difference is significant ($d=3.136$), while no acceptable effectiveness of the training program to develop students' mathematical self-esteem ($E.SB=1.03$) is revealed. This result was explained. Although this paper explains the effectiveness of the training program to develop mathematical self-esteem, more studies are needed. First, it is necessary to replicate this research using a different sample with different training content, especially since this research did not show the effectiveness of the training program to develop mathematical self-esteem. Second, replicating this research on students in the lower basic stage, specifically the fourth grade. The students' scores in the two variables were also analyzed using Pearson's correlation coefficient (r) at ($p<0.05$); a medium positive correlation ($r=0.357$ at $P=0.020$) is found. This correlation value is explained. Although this paper answers why there is an average correlation between the two variables, more studies are needed; a more thorough investigation of the relationship between employing mathematical problem-solving strategies and mathematical self-esteem is needed. Further, examining this relationship among students in the lower basic stage, specifically the fourth grade, and determining the relationship, if any, is necessary.

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