

The Impact of a Teacher Training Program on Mathematics Teaching Methodologies: Using Student-centered Learning

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Abstract This study aimed at investigating the impact of a teacher training program on mathematics teaching methodologies using student-centered learning. This study identified the teaching methods that math teachers used to implement learner-centered approach. To answer the research questions, the researcher chose a sample of ten teachers. The researcher employed several tools in order to triangulate the data to bring it to a degree of credibility. Classroom observation, videotaping, interviews and teachers' and students' reflection analysis were all used to gather the research data. The results of the study revealed that some teaching methods were used more than others and teachers attributed this to the LTD program. The program helped them choose suitable methods that could match their students' different learning styles and different learning interests. The study results also showed the satisfaction of most of the students on the teaching methods used by teachers.

Keywords: *mathematic, student centered learning, training program, teaching methods*

Cite This Article: Buad Khales, "The Impact of a Teacher Training Program on Mathematics Teaching Methodologies: Using Student-centered Learning." *American Journal of Educational Research*, vol. 4, no. 14 (2016): 992-998. doi: 10.12691/education-4-14-2.

1. Introduction

Jubran [6] indicates that students often have the knowledge but fail to use it when it is required and this knowledge remains mainly passive. Most often students do not transfer their knowledge to contexts that are different from the context in which they had learned it, for example, outside class or in everyday life. This may be attributed to the traditional methods of teaching in which the teacher's role is simply to convey information to the learners, who receive it passively and most often do not relate it in any way to their lives.

In mathematics there is also a need for strategies and teaching approaches which can enhance the students' understanding of mathematical concepts, develop mathematical thinking and improve their attitude towards learning. These strategies are also expected to stimulate the students' motivation to learn how to learn more effectively and successfully, and to activate the interaction between the teacher and students to discuss the instructional materials effectively and with great confidence. The strategies should also focus on the students' positive attitudes towards learning and to activate their role through research, experimentation, and dependence on themselves in locating and evaluating information and acquiring skills and formulating values and attitudes [19].

Concomitantly, adopting such strategies should help students to pass TIMSS and achieve the international

standards of learning mathematics. TIMSS has revealed the effects of usage times and handling of instructional methods and has shown a need to employ different methods (e.g. inquiry-based learning, teaching through games, and active learning) which vary in their level of effectiveness.

The first time Palestine participated in TIMSS (Trends in Mathematics and Science Study) was in the third cycle (2003). Then it participated in the fourth and fifth cycles, 2007 and 2011 respectively. The analysis of the effectiveness of teaching practices used in schools and its impact on student achievement showed that Palestinian students' scores in science were better than in mathematics for the three TIMSS cycles Palestine participated in. However, the progress the Palestinian students achieved in mathematics from 2007 to 2011 was quite remarkable as they achieved an average increase of 37 points on the international scale of scores, which was the highest among the participating countries and educational systems (Palestinian Ministry of Education, 2012).

In order to develop the teaching of mathematics in its schools, the Palestine Ministry of Education devised a strategic plan to allow math teachers to develop professionally. The strategy aimed to empower them with general and specialized knowledge, skills, values and attitudes to become effective teachers who are committed to their students, career and society. The plan also aimed to create teachers with a good mastery of their subject matter and who are resourceful and can use a variety of effective teaching methods and techniques that respect the

students and guide them to learn for understanding and application and develop their different life skills, as well as their analytical and critical thinking and problem-solving skills. The Ministry also called for the creation of a national body whose main aim would be to develop teaching as a career by devising professional standards for teacher qualification and certification. (Palestinian Ministry of Education, 2008, 2008)

Professional standards are statements about a teacher's professional attributes, knowledge, understanding and skills. They specify the professional characteristics that a teacher is expected to maintain and to build on at throughout his/her teaching career. Standards will support teachers in identifying their professional development needs and support them in identifying ways to broaden their expertise within their current career stages. (Palestinian Ministry of Education, 2012)

The Conference on Quality Teachers for Quality Education – Towards Quality Teachers through Innovation, Reflection, and Leadership (2013) held in partnership between with the Palestine Ministry of Education and (UNESCO) and (EU) investigated the development of in-service teacher education programs based on Palestinian teachers' professional standards and needs, with an aim at linking these to actual practices. It also focused on the supportive and facilitative roles of educational leaders. It was suggested that the new vision for school leadership (management), derived from teachers' professional standards, would support innovative practices of reflective teaching (Palestinian Ministry of Education, 2013).

The Palestinian National Institute for Education and Training (NIET) in Ramallah and AMIDEAST organized a program under the title of "Leadership and Teacher Development Program" (henceforth LTD) to train teachers of government schools. Teacher professional development is defined as giving teachers the authority to make professional decisions concerning student learning process [1].

In an attempt to achieve the goals set by the Teacher Training Strategy, the Ministry of Education, represented by the National Institute for Education and Training, and Amideast, adopted a program for teacher training. The *Leadership and Teacher Development Program*, launched in May 2012, was a comprehensive education reform initiative focused on improving the quality of education in the West Bank and Gaza. It aimed at the comprehensive professional development of in-service teachers based on action research and a review of the current teaching practices in addition to empowering teachers with teaching and evaluation strategies [9].

Teacher empowerment is characterized as reaching a psychological state where teachers feel that they have more responsibility and control over their work. The empowerment of teachers develops by enhancing their motivation and professionalism, self-confidence, independence and exchange of experiences with others. [7].

In this regard, Eric [3] defined teacher empowerment as the process of providing teachers with the power and authority to make professional decisions concerning student learning/ teaching. In a student-centered teaching approach, empowering teachers means the active occupation of teachers in the actual student learning

process and affording them the opportunity to express their opinions and to be tolerant towards their mistakes in an atmosphere of comfort and tranquility in order to stimulate their motivation to think, learn, reflect, and innovate so that they can develop an integrated personality and also to try to develop their thinking and intelligence through providing integrated activities in an environment that stimulates learning. This allows learner to become thinkers, analysts and critics instead of merely being carriers of knowledge.

The philosophy of the student-centered approach is based on enhancing the learning process, through its active role in encouraging learners to acquire new information, knowledge, skills, and raise the level of their abilities as part of the educational process in an educational environment where learners participate actively. This can be achieved by avoiding dealing with learners with the logic of negative receptors [17,21,22].

Often enough, students may have the knowledge, but tend not to use it when required; that is, they leave their knowledge inactivate. What students learn within the school context does not always apply or can't be transferred to other contexts of everyday life. This is due to the fact that traditional education is generally teacher-centered, where teachers are considered as a source of knowledge and information givers and where learners are considered blank pages awaiting to be filled. Learning needs to be developed to help learners best acquire knowledge [4].

For this reason, there is a need for pedagogical strategies and methods to contribute to the understanding of mathematical concepts and the development of mathematical thinking skills. Student-centered teaching methodologies encourage the interaction between the teacher and the learner, both inside and outside the classroom, and encourage cooperation among learners, making the learner active in the learning process, and focusing on building learners' inquiry skills instead of merely collecting and memorizing any type of knowledge.

Student-centered learning refers to learning that is based on the active involvement of students in the learning situation, allowing the learners to enjoy their own learning process and to utilize their capabilities. Teachers should then be facilitators, guides and should stimulate the student learning process. Learning here is a constructive process with strong interaction between teachers and learners in order to explore new ideas that work to connect learners' previous knowledge with a new knowledge based teaching methods, such as dialogue and discussion, cooperative learning, role-playing, brainstorming, problem-solving, cognitive maps, and visual [2,8,15].

In this regard, Pang [16] investigated the methods of teaching mathematics in Korean schools, and how to transform teacher-centered into learner-centered education. The study, which applied classroom observation and interviews with mathematics teachers, showed that mathematics teaching in Korean schools requires fundamental reform to become truly student-centered so as to provide the students with the opportunity-for active involvement in the learning process and the implementation of strategies that motivate thinking.

Toptas [20], on the other hand, aimed to determine the perspectives of 34 Turkish elementary school teachers on the instructional methods used in mathematics classes.

Open-ended interviews were utilized to collect the data, content analysis was used to analyze the data. The results showed that “Question-Answer”, “Problem Solving”, “Direct Instruction” were the most commonly used methods in Mathematics classes by the participants. When selecting a teaching method to use, the participants looked for “enabling permanent learning” the most

Using a variety of teaching methods in the student-centered approach helps the learner to think mathematically, use mathematical thinking and reasoning, solve problems, use mathematics for life, make connections, and think critically [5].

An integral part of learning math is developing the learners’ mathematical thinking. The students should be able to solve problem, to connect, and to do analogical reasoning they must draw on their knowledge, experience, and skills [14].

Teaching mathematics is an important process as it entails the formation of learners’ mathematical insight, deep understanding, and mathematical, critical, creative and reflective and inductive thinking. It also involves developing the students’ inclination towards learning mathematics and motivates them to confront the problems they face and seek to solve them. This is achieved by the employment of a variety of teaching methods that can make learning mathematics an interesting process, which will reflect positively on the desire of students to learn mathematics and not ward them off. This course of action also requires shaking off the teachers’ traditional beliefs and practices to encourage them to develop their methods of teaching mathematics springing from their new belief in the active role of learners in constructing and personalizing knowledge. The teachers would then come up with new products designed on the new knowledge acquired by the learner so that learning would become more meaningful to the learner. In contrast, using traditional methods of mathematics teaching hinders the learning process as it limits the understanding of mathematical concepts and their employment in different life contexts.

1.1. The Purpose of the Study

This study sought to investigate the impact of a teacher training program on mathematics teaching methodologies using student-centered based learning. It aimed to answer the following questions:

1. What are the different student-centered methods teachers use in their classes?
2. How much does LTD help math teachers use the methods of a student-centered learning approach?
3. How did the new teaching methodologies used by the teachers reflect/impact on the students’ attitudes towards learning mathematics?

1.2. Limitations of the Study

The present study is limited to mathematics teachers from one single city district who had joined the Leadership and Teacher Development program. The study sample consists of 10 teachers participating in the LTD program since it is a qualitative study that involves classroom observation, analysis of reflective writing, and interviews. The study lasted for eight, months.

2. Methodology

2.1. Participants

The researcher trained 26 male and female teachers in the LTD program but only 10 of them showed the desire to participate in this study. As a measure of ensuring confidentiality, each participating teacher was given a special code consisting of the letter T and a number from 1 to 10.

The participants were given a

Table 1. Teachers’ professional profile

Teacher’s Code	Major	Years of Experience	Classes taught
Teacher 1	Bachelor in Math	12	3, 4, 5, 6, 7, 9
Teacher 2	Bachelor in Math	7	3, 4, 5, 6, 7, 8, 9
Teacher 3	Bachelor in Math	7	5, 6, 7, 8, 9
Teacher 4	Bachelor in Math	8	5, 6, 7, 8, 9
Teacher 5	Bachelor in Math	8	5, 6, 7, 8, 9
Teacher 6	Bachelor in Math	6	5, 6, 7, 8, 9
Teacher 7	Bachelor in Math	9	5, 6, 8, 9
Teacher 8	Bachelor in Math	7	6, 7, 8, 9
Teacher 9	Bachelor in Math	8	4,5,6
Teacher 10	Bachelor in Math	7	4,5,6

Table 1 shows the professional profiles of the teachers participating in the study in terms of degree attained, years of teaching experience and classes that each teacher was teaching at the time of the study.

2.2. Study Ethics

All personal information about the participant teachers was kept confidential. Each teacher was given a special code to guarantee confidentiality and ethical professionalism.

2.2.1. The Researcher

Since the LTD program aimed at establishing a national cadre of training and leadership educators that meet MOHE standards. The researcher, who had been trained by international experts, was actively involved in the LTD program from which the sample of ten teachers participated; in other words, the—researcher played a twofold role of trainer as well as researcher.

2.3. Study Instruments

This study utilized the qualitative research method and employed four tools: class observation, interviews, and teacher and student reflective journals.

2.3.1. Classroom Observation

Observation is considered the primary tool used in qualitative research. It allows the researcher to get involved in taking notes as things fold out. In addition to observation, the present researcher video-taped the class lessons for later analysis and review. Each participant was observed twice; all classes were videotaped and notes were taken during each class, resulting in a total of 20 observations for all teachers.

Through the observations, the research sought to study the effectiveness of the LTD program in empowering the participant math teachers (G 3-9) in a variety of student-centered teaching strategies. It also aimed to explore the various teaching strategies used by the teachers in this

study and how they used them and the students' reflections about these strategies. For this purpose, the researcher observed the teacher at a close distance and noted their teaching practices and strategies and recorded notes and videotaped the classes after obtaining the teachers' consent. A fellow researcher (an independent observer) was asked to analyze the classes independently. The reliability between the researcher and the independent observer was very high.

2.3.2. Semi-structured Interviews

Following class observations, the researcher conducted semi-structured interviews with the participant teachers. The interview comprised 6 main questions and aimed at identifying the teaching methods used by teachers in the LTD program and at determining the reasons behind applying such methods in addition to exploring all the obstacles that faced teachers when they chose such methods. (Appendix 1)

2.3.3. Learning Circles

The researcher participated in 5 learning circles, which were conducted every two weeks. The learning circles were held to provide the participants with the opportunity to discuss the teaching methods, planning and type of tasks required from them. The role of the researcher was limited to observing and recording the teachers' discussions while performing the activities.

2.3.4. Students' Reflective Journals

The students were asked to keep their reflections about their learning mathematics and the teaching methods used by their teachers during the lessons that were observed by the researcher and videotaped. The students wrote about the opinions, feelings and impressions about the classes they had attended, and their attitudes about learning mathematics and suggestions for development.

2.4. Triangulation

Credibility is a crucial aspect in qualitative research, through which data validity is processed. Triangulation is a process that ensures research validity. It includes relying on expert opinion, depending on various resources in collecting data, and asking the study sample to give their opinions and explanations. In the present study, several tools were used to collect the required data: class observations, reflection journals, focus groups, and portfolios.

2.5. Data Analysis

The researcher analyzed the observation notes and videotaped of the classes using a qualitative analysis thematic analysis and frequency of using the various teaching methods that were used by the teachers in the LTD program.

3. Findings

3.1. Results of the First Study Question

What are the different student-centered methods teachers use in their classes?

To answer the first study question, the researcher analyzed the class observation notes (N=20) using the descriptive method and calculated the frequency and frequency percentage of each teaching method used by the teachers during the LTD program. The results are shown in [Table 2](#) below.

Table 2. Teaching strategies/methods used by teachers in LTD ranked by frequency

Method	Number	Percentage
Cooperative learning	18	23
Direct learning	14	18
Learning through dialogue	10	13
Problem-solving	8	10
Visualization	7	9
E-learning	6	7
Learning through stories	5	6
Learning through trips	3	4
Lifelong learning	3	4
Web quests	2	3
Learning through games and play	2	3
TOTAL	78	

The results from [Table 2](#) show that the teaching methods used in LTD can be ranked as follows (from most to least used): cooperative learning, direct learning, learning by dialogue, problem-solving, learning through visualization, E-learning, learning through stories, learning through trips, lifelong learning, Web quests, and learning through games and play.

Cooperative learning was used by T (3), who related it to visualization in a class about rectangles; while T (10) used it in a class on lesson algebraic term .and T (5) used it in a class on triangle congruence and algebraic terms. On the other hand, learning by dialogue was applied in a variety of classes: T (6) utilized it at the beginning of the class, while (T7) used it at the start of her class in brainstorming about triangle congruency, which led the students to start on a thinking, analysis and problem solving track.

E-learning was utilized by T (4), who applied through an educational game in a G 4 class about fractions; it was also used by T (8) in a class about algebraic terms through the use of a power point presentation. T (3) applied it in a class on functions while (T 1) used it in a class on solids .

Games were used by two teachers only. In contrast, life learning was utilized by three teachers: T (8) took her student to the market to apply verbal word problems, while T (9) created a small vegetables stall to teach them algebra

In other words, T (9) believed that mathematics teaching can be implemented through discussion between the students and the teacher within an active social environment, and allowing students to develop their understanding by allowing them to express their ideas. T (8) also implemented life learning in two classes believing that learners are thought generators and knowledge producers since they became involved in constructing their mathematical thinking within a life context. Teacher (8) applied this method life learning in two classes and acted as a thought generator and knowledge producer while learners focused on building their mathematical capacity in the life context.

As regards the use of web quests, T (10) divided his students into groups and asked them to design a web quest about congruent triangles. The first group provided a definition of triangles and gave examples of the different types of triangles; the second group classified triangles based on side length (e.g. equilateral, isosceles, and scalene) and gave an example of each type. On the other hand, students in the third group talked about the types of angles (e.g. right, obtuse, acute) and gave examples of each while the fourth group presented the composition of triangles and explained how the sides can be calculated. Following the presentations by all four groups, a discussion took place between the students and the teacher. At the end of the class, the teacher asked the students about their opinion about the class and gave his instructions for the next one.

T (8) informed her students that the lesson would take place in the market to learn mathematics through verbal ability questions. The teacher then introduced the verbal questions before going to the market and then headed to a glass shop in the market.

To justify their choice of teaching methods, the teachers gave the following reasons:

1. The goals teachers seek to achieve

Eight teachers said that the goals they seek to achieve are those that push them to choose teaching methods. This comes from teachers' pursuit to achieve the development of analysis, conclusion, application and understanding in students.

2. The nature of the subject being taught

Six teachers expressed the importance of the direct relation between the teaching method chosen and the subject being taught.

3. Student specifications

Nine teachers asserted that student specifications, particularly their age, play an important role in the teacher's choice of a suitable teaching method, ensuring that it fits their interests. They believed that this has a great effect on student acceptance of the new teaching styles.

4. School resources

Eight teachers said that certain teaching methods, such as E-learning, require financial resources as well as technical support such as a projecting system and a computer.

To conclude, during the interviews, all ten teachers participating in the present study expressed their satisfaction with their individual choice of teaching method. However, one teacher complained that the tools required by the E-learning method were not available and remarked that she needed further training in using this method.

3.2. Results of the Second Study Question

How much does LTD help math teachers use the methods of a student-centered learning approach?

To answer this question, the researcher analyzed the interviews conducted with teachers regarding their views on how the LTD program affected their choice of methods in their teaching. The analysis shows a variety of responses. Seven teachers described the LTD program as a compass that sets them out on the direct direction and guides them to make the choice of the teaching method

that most suits their students' features and learning styles. Furthermore, eight teachers considered the program to be an opportunity to share experiences with colleagues regarding the teaching methods they use in their classes, yet they also expressed the need for more face-to-face meetings to exchange experiences about their teaching methods in a more detailed fashion.

Following are some remarks made by the teachers about LTD. T (6) remarked: "The LTD program gave us the opportunity to talk about our experiences with the teaching methods we learned from other colleagues and with new methods that I had never heard of before" For T (1) and T (10), the LTD program satisfied their search for new teaching methods. T (9) pointed out that the program made her think how to link mathematics teaching to life and how to get lessons from daily life to use in teaching. T (5) said the LTD program made her teaching style more organized and that she had learned new teaching methods. On the other hand, T (8) said that the program provided her with the opportunity to reflect on her previous teaching experience and practices hoping she would benefit from this. T (4) made the following comment, "I got to know how to apply different teaching methods and I now know a variety of new methods that I had not known before. The program taught me how to choose the teaching method which is most appropriate for my students based on how they respond to it. And even though this is my eighth year teaching, this is the first time I feel that my teaching has become better than ever before".

T (1) pointed out, "It was the first time I had used computers in a class on fractions for fifth graders; in fact it made my students more active and interactive at the same time. The program made me use better teaching methods but not all of them due to the big number of students in my classes and the school's inability to provide trips or games or visual tools that help foster teaching". Teacher (2) asserted that: "the LTD program is important and has a huge impact on teachers but some of the methods the program discussed are hard to apply in classes due to the large number of students in classes the lack of basic needs.

3.3. Results of the Third Research Question

How did the new teaching methodologies used by the teachers reflect/impact on the students' attitudes towards learning mathematics?

In order to answer this question, the research analyzed the students' reflections, with a total of 50 journals. Five students from each class were chosen randomly to write their reflections. The researcher asked students to write their reflections after the classes she observed. The results of the analysis are shown in [Table 3](#).

The analysis of the students' reflection shows a general positive attitude. This is clearly reflected the answers to statements (4, 7, 9, 14, and 15) toward learning mathematics after their teachers started using new student-centered methods of teaching.

The results show that students like math classes, statements (1, 6, and 11) particularly with T 8, T 10, T 4, and T5 and appreciated the teaching methods used by T 8 and; while they said they felt bored in T1's, T2's and T 3's classes especially when using the direct teaching method.

Table 3. Frequency and percentage of student's reflections

Number	Statement	Frequency	Percentage
1	I like to learn mathematics.	40	14
2	Math syllabus is difficult.	5	2
3	Math classes are boring.	4	2
4	Learning math is interesting.	45	16
5	Math is difficult to understand.	4	2
6	I wait impatiently for math classes.	37	14
7	Math is very important to us.	41	15
8	I hate math classes.	0	
9	Math should be made optional.	2	1
10	Math classes are not enough.	20	7
11	I like to become a math teacher in the future.	29	10
12	I feel that math classes are a problem for me.	2	1
13	I wish they cancel math from school	2	1
14	I think math is very complicated.	2	1
15	I think that math classes attract our attention.	44	16
16	TOTAL	277	100

To illustrate, following are some remarks made by the students in their reflective writing.

- S 1: I like math because during class we work together in groups. We like our teacher because she explains well and makes us understand well. My group is good and we are all friends. The class on lateral area was very interesting and all the classes were simple and easy.
- S 2: I liked the way that the teacher taught us drawing in geometry and I like to make posters about geometry. The teacher asked us to draw and I wish we can draw in every math class. In some classes we feel bored and we start entertaining each other; that's why classes are very difficult for me and wish that the teacher would repeat the lesson more than one time.
- S 3: I like math because it requires intelligence, but sometimes the classes are boring.
- S 4: Our class today on cubes was very interesting. Math classes are interesting and we like math even though it's difficult – but our teacher teaches us in a very beautiful way. I like to do more activities and to go to entertainment places and I like to thank my teacher because she is great and knows how to teach us.
- S5: I like this class with my friends and the professor. She taught us how to make a cube using rectangles. We can also learn math at work like the carpenter and blacksmith.
- S 6: I like to be successful and to be a smart student and obtain a high score but at the same time I don't like to study math. Sometimes I memorize the laws but then forget them and start to cry. The syllabus is very difficult. Why don't they design a simpler syllabus?

The remarks made by students (1, 2, 3, 5 and 6), regarding statement (1, 4, 6, 7, 9, 11, 14, and 15), indicate that student-centered teaching methods lead students to have a positive attitude towards learning math and also impact their perspective about it.

This conclusion is supported by Sriraman [19], who indicated that student-centered strategies depend on the positivity of the learners in the learning situation and in activating their role in research, work, and experimentation in their attempt to acquire knowledge.

This leads to the learners to have positive attitudes towards learning mathematics. This is also in agreement with Mvdudu [15]'s opinion that student-centered methods/strategies depend on the students' active involvement and positivity in the learning situation, which in turn makes them enjoy their learning and use of their capabilities to learn.

4. Discussion

The findings of the present study show that the teachers used a variety of teaching methods in their mathematics classes. The teachers also appreciated the role their students played in the learning/teaching process, which was clearly evident in the practices of those teachers who made the teaching process both interesting and fun. They also allowed the students to think and express their opinions as well as create verbal word problems. Despite the final results, the researcher faced a lot of difficulty at the beginning convincing some teachers to try various teaching methods instead of depending solely on direct teaching. This process required that the training program put more emphasis on applying the new methods of teaching, simulating them during training and critique each method and start a dialogue about how to put it into practice. It was through the learning circles that the researcher was able to convince the teachers to apply these methods, which in fact presented a golden opportunity for all of them to showcase their experiences and talk about them.

The teachers became more cognizant of the importance of learning mathematics in life through creating math problems about different life situations and accompanying students to the market so they can practice the selling and buying process in real life situations. The LTD program also helped the teachers to utilize the web quest and games and play in teaching mathematics.

This finding could be attributed to the fact that during the LTD program the learners were exposed to a variety of student-centered teaching methods/strategies which allowed them to achieve a good degree of mastery of these methods. However, taking a more conservative perspective, it appears that, although there has been some progress in the use of new teaching methods, not all

teachers attempted to apply them. This finding can be ascribed to the fact that teaching mathematics is quite difficult and requires a lot of effort and time. This conclusion is in agreement with Pang [16], who claimed that mathematics teaching requires essential reform of the educational system so that teaching becomes truly student-centered.

The process of developing mathematics teaching and the introduction of new student-centered teacher methods/strategies will very likely enhance the students' learning of mathematics and allows them to think and analyze. And since the students' success in TIMSS requires them to think critically and analytically, solve problems and use inductive thinking. This means that teaching should concentrate more on student-centered strategies.

Based on this, the researcher recommends that teachers be given more opportunities to utilize their capabilities and potentials. Emphasis in teacher training and professional development should be given to training in student-centered strategies. More directed research should be conducted about the efficacy of student-centered strategies and about the learner especially in regard to mathematics.

Based on the results of the present study, and in order to advance the teaching of mathematics in Palestinian schools, it is recommended that mathematics teachers receive extensive training in the various student-centered learning methods.

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