A DESCRIPTION FOR MATH PROBLEM-SOLVING PRACTICUM FOR (5-7)TH GRADE MATH TEACHERS AND ITS EFFECT ON THEIR TEACHING AND ON THEIR STUDENTS' LEARNING

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ABSTRACT

The purpose of this study is to introduce a description for practicum for (5-7) grade math teachers, and to investigate the effect of (5-7) grade teachers participating in mathematical problem solving workshops on their teaching and on their students' learning. This study was conducted on nineteen public school teachers who teach (5-7) grade and their students. Five workshops were done with teachers using problem-solving activities with open-ended tasks, math investigation, games, and critical thinking as new methods of teaching. Each workshop had educational and mathematical activities. Also, I focused on: group work, sharing activities instead of lecturing, open-ended tasks and questions, open discussions, listening to each other's' ideas, and thinking in different ways. Teachers carried these new things to their classes and used them while teaching several topics in mathematics. Data was collected from different resources: teachers' survey, classroom observations, teacher interviews before and after the workshops, teachers' assignments, students' interviews and short exams, mathematical activities for both teachers and students, teachers' and students' reflections. Then these data were analyzed to answer the research questions. The results of analyzing the data show that participating teachers in problem-solving workshops using several and different strategies changed teachers' strategies for the better, and their knowledge in measurement increased. Moreover this affected their students' motivation and understanding in measurement lessons.

THE PROBLEM

The practicum program for teachers teaching the elementary stage proved its ability to help teachers in changing their traditional ways of teaching. Some universities have started to use (or thinking seriously in using) the same program with teachers teaching (5-7) grads. The two stages are linked but different; teachers in the second stage need to use more developed strategies in problem-solving. Surly we don't need just educated students, but we need problem-solvers.

Mathematics is a very complicated topic to be learned by students and most of the time their achievement is low in it. Last year we did a math exam for 7^{th} grade students in Nablus directorate in the end of the year. It was obvious that there were troubles in math. we had many phone calls from teachers to talk about the high level question about the cone and some of them asked about the solution. When I analyzed the exam this question had the lowest achievement for the students. In fact math in this grade depends on analyzing and understanding deeply the concepts which will finally help the students to solve problems. On the other hand,. Schifter and Szymaszek wrote "As teachers learn mathematics to develop a rich network of connections among ideas, they are able to identify when a student broaches an important concept. And as they identify conceptual challenges to their students, they also learn how to call on their students' reasoning as a resource for learning." (2003, P155).

So, we think a solution for the previous problems is to train math teachers on using and then building several problem-solving activities "that suit their classes" while teaching math. "Students' responses to open ended tasks give teachers evidence of their problem-solving and communication skills". (Moskal, 2000, p.501). Teachers will be facilitators and students will be more motivated and they will achieve more understanding; activities will be used to lead to a good discussion that strengthens the students' conceptual understanding in a math topic. Moskal in his article wrote "Problem-solving activities give students opportunities to select their own approaches for both solving problems and expressing mathematical ideas."(2000, p.500). . Teaching math using problem-solving activities will motivate students to participate in math classes; because they will be convinced of their need to this knowledge, and this will (we think) raise their understanding.

Schools everywhere are full of equipment (balls, trees, schoolyards, windows, doors……) that can be used for manipulating and help in building many math tasks. For example, the math teacher can use the classroom environment to do some math. The school, trees and balls can be used to solve problems with numbers, algebra, probability, and Geometry. He can use any available stuff. If he believes in that, his class will be better. Teachers should encourage students to think critically. Encourage the students to discover formulas that they need to solve the problem, find other solutions and compare them, to analyze complex problems, and to increase their accuracy and skills. Encourage the students to create problems and suggest solutions. Teachers themselves should think and learn from their students' thoughts to encourage students to learn. Encourage the students to Apply what they learned to real life problems. Help the students learn how to construct shapes and diagrams to explain a problem. Use critical thinking in their subject delivery, classroom discussions, assignments and tests. What is the challenge in math classes? we always ask ourselves. We think that it is how far the teacher can go with students' understandings. The students vary in the classes; in their cognitive thinking and in their responses to what they are learning. It is the challenge for math teachers to understand that their students differ in their understanding of math so that they can deal with these differences.

Why do our students find math difficult? The problem of poor understanding in math is considered the most important one; the motivation of students in math classes is very low, and our math classes are teacher focused. Most of our teachers are traditional in their ways of teaching. Teachers usually teach students math formulas and solve problems as examples, and students do the same. Many teachers don't want to change their way, simply because this is easier for them and what they are used to. Most of the teachers focus on the good students in the class and neglect the others, so shy and underperforming students are oppressed in these classes. These problems make math difficult for students; students don't have the chance to think and ask questions, they only perform as their teachers want.

Research purpose

The main purpose of this research is to build a training program for math teachers teaching (5-7) grads through participating them in problem-solving workshops. The second purpose of our research is to evaluate the effect that using different strategies in problem-solving strategies (open-ended tasks, games, math investigation, and critical thinking) in teaching math has on teachers' solving-problems' strategy and students' learning. In this inquiry I'm trying to have a better understanding of my own work as a math supervisor. I want to know whether and how my efforts to enhance teachers' strategies in math classes (Geometry,

Algebra, Numbers, and probability), and also to enhance student's mathematical reasoning, judgment and thinking in diverse ways has any positive effects on their learning mathematics.

As we seek to understand using problem-solving strategies and the effect of good questions in math classrooms, me and the teachers will have students' reflections and explanations of the concepts they are learning in mathematics, to help us to improve and build the students' reasoning and judgment skills. We believe that this research will be beneficial not only to me as an educator, but will help my teachers to understand the importance of having students communicate their mathematical thinking to increase their conceptual understanding of mathematics.

We're looking to make the sense out of the use of problem-solving activities and sharing through some activities "performance tasks, projects, games…." which will affect students' conceptual understanding and reasoning. I want to learn how we can effectively share with teachers and their students that using problem-solving activities and good questions will help those teachers in their problem-solving strategies and their students will be more efficient of learning and give them more control on their own understanding. Also we want to learn more effective methods in teaching mathematics. We want to learn how to find new material and other things that we can provide teachers in the workshops; to help them more in their learning and also affect immediately math classrooms, and help them to reach their students' conceptual thinking.

The Educational Assumptions

1-Working with (5-7)th grade teachers in mathematical problem solving workshops about several topics in math (geometry, algebra, numbers, and probability) will develop teachers' teaching strategies.
2- Working with (5-7)th grade teachers in mathematical problem solving workshops about several topics in math will develop teachers' knowledge.
3- Working with (5-7)th grade teachers in mathematical problem solving workshops about several topics in math will increase students' motivation.
4- Working with (5-7)th grade teachers in mathematical problem solving workshops about geometrical math will raise students' understanding in several topics in math and consequently their achievement.

Research questions

1- What is the suggested program for practicum program in the Palestinian universities for (5-7) grade math teachers as the program's second stage?
2- What is the effect of (5-7)th grade teachers participating in mathematical problem solving workshops about geometry, algebra, numbers, and probability on their teaching and on their students' learning?

We believe that teachers' strategies and knowledge in mathematics affects students' motivation and understanding. So, to understand math well and to increase students' achievement we have to develop students' motivation in math classes, which is connected to achievement. This can be done and achieved through training teachers using good tasks, open ended questions, games, and math investigation through arranged workshops while teaching math, which help teachers to promote their students' understanding and motivation. Teachers

ask many questions during math classes, and try to engage students in activities but these are not well arranged and these questions are not open-ended so they limit students' thinking.

From our experience as a teacher's we can say that, students develop their mathematical understanding though listening to peers, explaining something to someone else, talking in groups, exploring their own thinking, and thus developing the necessary problem-solving skills. Also, students can share their reasoning with each other since it is important to give students the opportunity to communicate with each other in this way. So, we prepared problem-solving activities for the $(5\text{-}7)^{th}$ grade students in geometry, algebra, numbers, and probability dealt with concentrating conceptual thinking.

Stephens and Hyde wrote that "knowing the possibilities presented by a task allows the teacher to prepare suitable scaffolding for learners"(2013, p.37), which insures how important it is for teachers to know how to build problem-solving activities for their students. Also Moskal wrote "Students' responses to these tasks give teachers evidence of their students' problem-solving and communication skills" (2000, p.500). Also Strutchens, Martin and Kenney write that "students' initial experiences with area are often limited to the use of formula. Although one can determine the area of enclosed regions by tiling it with congruent regions serving as the units of measure" (2003, p.200). So, problem-solving activities are very important in teaching because they have the ability to help teachers in raising their students' knowledge and thoughts.

Maida and Maida also emphasize that: "Students construction of such strategies is facilitated, not by 'giving' those formulas, but by encouraging students to invent, reflect on, test, and discuss enumeration strategies in a spirit of inquiry and problem solving". (2012, p.214). Also, Carmody in her article wrote "Teachers know that students arrive in class with a wide range of insights and abilities; they also struggle differently and exhibit different needs. One method of incorporating this diversity is the development of problem-solving mathematical projects, which offer the opportunity for differentiation high levels of engagement that go beyond solving a set of pre-determined problems" (2011,P. 272). She also emphasizes things to develop an open ended task: open ended questions, a topic essential to curriculum, meaningful real-world applications, including mathematical notation, choices of product terms, resources, time, creativity students' needs and deep understanding.

LITERATURE REVIEW

"Mathematics is a living subject which seeks to understand patterns that permeate both the world around us and the mind within us. Although the language of mathematics is based on rules that must be learned, it is important for motivation that students move beyond rules to be able to express things in the language of mathematics. This transformation suggests changes both in curricular content and instructional style" (Schoenfeld, 1772, p.335). Schoenfeld then gives categories of goals for courses in problem solving: train students to think creatively, prepare students for problem competitions, provide instruction in heuristic strategies, learn standard techniques in particular modeling, and provide a new approach to remedial mathematics. Then Schoenfeld adds Webster's two definitions of math problem solving: anything required to be done, and a question which is perplexing or difficult.

In the article "Mathematics in the Streets and in Schools" the authors talk about the difference between solving mathematical problems using algorithms learned in school and out of schools (in the streets). In other words, it might be the case that the same person succeeds out

of school in solving a problem but does not succeed in school, and they explained this by students' needs in streets to solve such problems. (Carraher, Carraher, & Schliemann, 1785). Herbst wrote " To teach mathematics, a teacher must enable and put part to work between students and mathematical ideas; in so doing, problems and questions can be useful instruments to this end" (2006, p.313). Herbst insures that students' engagement in problem-solving can motivate the development of their mathematical knowledge.

In the article "Understanding Geometry and Math through Service-Learning" Gillmor and Rabinowicz (2013) wrote that their objectives, that they shared with their students before beginning any task, were :students will solve real-life and mathematical problems involving angle measure, area, surface area, and volume in which students will make sense in solving them and will construct arguments and critique the reasoning of others, model with math and use appropriate tools strategically. In their activity they combined the concepts of volume and surface area: from several canned food items, students' assignment was to classify each can, measure its radius and height, calculate the area of the base, and compute its volume, then their problem was to determine the dimensions of the box that they are going to build so that their cans can be packaged in the most efficient way possible. Gillmor and Rabinowicz wrote that "Students took the tasks more seriously because they knew they were going to have to apply the knowledge in a meaningful, real-world situation" (2013, p.56) . At the end of their lesson they concluded that this problem was good for students for several reasons: strong link to curriculum, progress monitoring, and opportunities for reflection. They wrote about the good engagement for their students with the content in a meaningful way.

Doyle defines "A task is the universe of possible operations that an individual might or might not take while working on a problem, toward a certain product, with certain resources, the feedback that the problem can provide on those operations, and the operations adapted to the feedback that may ensue" (quoted in Herbst, 2006, P315). Also Herbst wrote "Students' engagement with a particular problem might precipitate the task of building a reason conjecture," (2006, p.315). According to Small, "tasks need to be created with variations that allow struggling students to be successful and proficient students to be challenged"(2007,p.12) . Also, in her book "Good Questions Great ways to Differentiate Mathematics Instruction" (2007), Small presents strategies for creating parallel tasks, fostering effective follow-up discussion, managing issues in choice situations, putting theory into practice, and creating a math talk community in different topics of math and for different grades. Moskal (2000) wrote that responses of open ended tasks showed that sixth grade students are capable of providing detailed written explanations that reflect their mathematical reasoning. Moskal showed that it is very important to use problem-solving activities in teaching math concepts that provide immediate feed- back-by discussing each stage in the task in order to continue-upon students' work because this keeps students engaged and motivated toward their work with deep concepts. Immediate feed-back discussion is highly successful in class and helps students to develop their knowledge about the math topic.

Ameis (2005) wrote that tasks that involve spatial thinking are well suited to helping students relate to mathematics in a more positive way. He argues that engaging mathematically reticent students in appropriately designed spatial thinking tasks can be a useful strategy for middle years' teachers, which offers hope in helping these students become more successful learners. Stephens and Hyde (2013) wrote that good tasks need to provide a challenging and sufficient opportunity for extended time to be spent on them. Students enjoy problems that appear initially 'unsolvable', because tasks provide the necessary challenge "mathematics

elegant solution" which students describe a 'trick'. Carmody (2010) wrote "These long term projects invite creativity into math class".

So, from the previous we conclude that, tasks are valuable for understanding in mathematics. Tasks provide opportunities for students' engagement which helps them to become confident in their "challenging" solutions. Also tasks connect between different math topics and thus develop the conceptual thinking of students.

Critical thinking means the use of reasoning, judgment and thinking in different ways. Critical thinking is an individual skill, every student needs to have this skill. We can never go to an end in developing critical thinking, but we can start teaching our students how to reason about their solutions and how to start thinking about their work, how to judge their answers and their colleague's answers and how to think in different ways to solve their problems. On the other hand. "Math games can increase student engagement in the classroom, provide ample opportunities for cooperative learning "(Allen , 2010) . All students have to participate in math lessons with interest and fun without feeling worried that Math is difficult. Students also have to understand "the meaning of the math concepts such as fractions, algebra…… than procedures for manipulating them" (Clarke ,Roche and Mitchell ,2008.p, 3(5-7)4) . In addition to that, teachers are to be provided with new methods of teaching math's such as using games.

From the previous we conclude that problem-solving strategies (math investigation, open-ended tasks, games, and critical thinking) are very important strategies for teaching mathematics; also they let teachers know how students think. Even when teachers want to use diverse methods in teaching, they still need to know what problems to present, and how to present these problems in classes in order to engage all students and achieve their purpose.

The research Methodology

This chapter describes the methodological approach adopted in this study; it includes the research design, the participants in the study and the tools used for collecting data,

The research Design

In this study we did action research on the effect of participating $(5\text{-}7)^{th}$ grade teachers on problem-solving workshops on their teaching. Pre-interviews were done with one group of teachers before the workshops, and post-interviews were given to the same teachers after the end of the workshops, surveys were done with all teachers (see Appendix 13A, 13B). Five workshops (see Appendix 14A, 14B, 14C, 14D, and12E) were done. Every week (and sometimes two weeks) there was one workshop with an assignment to be done in the teacher's class with her/ his students in order to train them on using effective and open-ended questions. These they practiced while they were teaching math (circle sector, cone and prism: nets, surface area and volume) in $(5\text{-}7)^{th}$ grade classroom. Every workshop was two hours long. Classroom observations were done before the workshops, and after the workshops.

One short exam and a worksheet were given to students. The exam was in the middle of the unit about circle sector and its properties, and the worksheet was at the end of the unit and was about surface area and volume (see appendices 13D, 13E). Teachers in groups of four prepared lessons about: circle sectors, cones, and prisms. Teachers analyzed students' mistakes in math according to the example of Hershkowitz (1787) in geometry. Also

mathematical activities about geometrical math were given for both teachers and students (see Appendix 1, 2, 3, 4, 5, 7, 8, 7, and 10). Workshops were held before teachers started teaching the math unit, and I attended their classes after finishing the five workshops.

The plan for my Workshops

What is the suggested program for practicum program in the Palestinian universities for (5-7) grade math teachers as the program's second stage?

The first workshop (see Appendix 14.A):

The first workshop was about Measurement and Geometry, area, circle sector, and good questions. twenty teachers attended the workshop. All the activities in the first workshop were done by teachers. At the end of the workshop an assignment was given to teachers to be done in their classes and to prepare it for the next workshop in the next week.

The second workshop (see Appendix 14.B)

The second workshop was about Pyramid, Cone, Good listening, and Group work.. All twenty teachers attended the workshop, and all the activities designed for this workshop were done. In addition the assignment given to them last week was discussed and a new assignment was given to them for next week.

The third workshop (see Appendix 14.C)

The third workshop was about algebra, critical thinking, math investigation, and shifting toward proficiency. This workshop seventeen teachers attended. Then there was a discussion about how to change the class to a workshop.

The fourth workshop (see Appendix 14.D)

The fourth workshop was numbers, challenge problems, doughnut activity. Then discussing the rubric, then the activity of combining two surface areas for two shapes and finding the new one.

The fifth workshop (see Appendix 14.E)

The fifth workshop was How to deal with misconceptions in math?, using the strategy of free writing, then by pairs discussing students' mistakes and then how to deal with them. The second activity was discussing their prepared lessons and problem-solving activities, and then the last survey.

The participants

I worked with 20 teachers; 12 males and 8 females who teach math for $(5\text{-}7)^{th}$ grade. All of them work in public schools. Nine of the male teachers have a bachelor's degree of math and the tenth is with bachelor's degree in physics but he teaches math for $(5\text{-}7)^{th}$ grade since he was hired 20 years. Another teacher has a computer science bachelor's and he is teaching math for 9 years ago. The other two teachers have masters' degrees in math and are in their first year in teaching. Their performance ranges from good to very good. Each teacher has 5

lessons per week for the $(5\text{-}7)^{th}$ grade, and the number of students in their classrooms ranges from 30 to 40 students.

All female teachers have been in teaching for 3 to 15 years; one is for 15 years three are for 13 years, one is for 10 years, two are for 7 years, the last two are in their 3rd year. Their classes are crowded with girls. Four of them have bachelor's degree in math, only one has a math diploma. Their performance is very good. All of them have 5 lessons per week for the $(5\text{-}7)^{th}$ grade. Only one school is co-education school otherwise the males work in boys' schools and the females work in girls' schools.

Tools for gathering data

Classroom observations (before and after) in which I focused on teachers` questions during the tasks and on students` responses.
Pre and post survey for teachers. (See Appendix 13A).
Interviews with teachers (before and after). (See Appendix 13 B).
Students' interviews (see Appendix 13C).
Quiz for students before teaching the unit and after. (See Appendix 13 D).
Worksheet for students. (see Appendix 13 E).
Collect teachers' plans and student work.
Teachers' assignments: teachers will be given assignments during the workshops to observe their problem solving development.
Collect teachers' questions and projects work.
Write down which of the problem-solving activities is the most effective in eliciting strong responses from students.
Write about how the group-work will provide students with the opportunity to process information.

Research process

- We interviewed with teachers before We told them that these questions are for research.
- We observed classrooms before the workshop to observe students responses and to record teachers' performance. We told teachers that this observation was for normality not for evaluation.
- We gave five workshops for teachers. During the workshops We visited teachers` classrooms to observe their performance and students` responses while doing math. Besides that, I visited the classes after finishing the workshops during which quizzes were given to students to reveal their understanding in the concepts and used exit slips to collect more information about their understandings.
- After all the workshops were over, teachers' interviews and the post-surveys were done.

DISCUSSION & CONCLUSIONS
For my first question in this research

What is the suggested program for practicum program in the Palestinian universities for (5-7) grade math teachers as the program's second stage?

Strategy/educational objects	Activities
Math investigation, good listening.	Math Object: Algebra, Numbers 1- The activity of the frogs 2-Why do use this strategy? How do you think? Write an example? 3-How can we use this strategy in our workshops with teachers? Then the teachers in their classes? 4-Worksheets having open-ended questions.
Open-ended tasks, turning classes to workshops, rubric.	Math Object: Geometry, Measurement, and Numbers 1- A task (suggest a water bottle different than the usual one to convince the water bottle company to take your water bottle instead of their usual model) 2-Why do use this strategy? How do you think? Write an example? 3-How to build open-ended task? 4-Discussion of their tasks. 5-Pizza activity.
Games, and good questions, reflecting the change in classes.	Math Object: Algebra, Numbers 1-The game of Turn-over. 2-Different worksheets and homework. 3-Why do use this strategy? How do you think? Write an example? 4-Discussion about features good games (I can use your Arabic article about games)
Critical thinking, analyzing students' mistakes, writing reports.	Math Object: Algebra, Probability, and Numbers 1-Do you think the following activities can help teachers in developing students' critical thinking? A-Hand-shaking problem. 2-Why do use this strategy? How do you think? Write an example? 3-Do you Think this is a good strategy? How? 4-How can we help teachers to develop their students' critical thinking?

For our second question in this research

- What is the effect of $(5\text{-}7)^{th}$ grade teachers participating in mathematical problem solving workshops about geometry, algebra, numbers, and probability on their teaching and on their students' learning?

We found that through teachers' surveys, interviews and through workshops and classroom observation using problem-solving activities in teaching math changed the performance of math teachers in teaching geometrical math for the seventh grade classes. They tried to avoid using lectures and tried many activities they learned in the workshops. Also they wrote about the good results they have in their classes with their students' participation. The teachers said and wrote that they will use critical open-questions in other topics of math and for other grades. Teachers began to use different strategies of problem-solving activities in their classes. They began to change their role from a lecturer to a facilitator, and began to decide which strategy is suitable to their students and which is not.

Teachers really changed their methods in introducing activities for calculating surface area and volume as they used to focus on the algorithm in doing calculations and asking students to memorize them. Now, however, they stared to focus on the strategies of concluding formulas of volume and surface area from students' knowledge. In general, students doing activities to discover the formulas of the new concept were able to come up with the algorithm needed for solving the mathematical problems. In addition, teachers now give students suitable wait-time to prepare the correct answer for.

Moreover, teachers were very interested in the workshops, and they learned many new things which were very clear from the examples they presented. They said that using and preparing effective and problem-solving activities affected students' motivation and achievements and now they`ve become much more convinced about the fact that problem-solving activities can affect students` motivation and understanding positively. Also their ability in talking with students has increased and they avoided focusing on teaching math by just giving examples for students memorize.

The crucial thing is that teachers showed development on their ways of preparing lessons. They started to write all the activities with the needed questions during and after the activity. Moreover, they started to determine teachers' role and students' role for each activity which makes teachers to manage the time for each activity and to be more confident in them. They avoided lecturing and started to focus on teaching for understanding, not teaching for memorizing.

Furthermore, in traditional classrooms, teachers were talking most of the time of the lesson and they had some activities during math class. These activities included closed-questions which focus on students' knowledge and memorizing the algorithm. In addition, teachers were using questions just to evaluate students' ability in memorizing knowledge and information. Also when using group work, it was by giving groups worksheet to be solved from each group and sometimes teachers helped students to find the correct answer. While now, teachers' strategies in geometrical math have changed; they now start the lesson with an activity or a question to motivate students, focus on teaching by doing and understanding, and they start using open-ended tasks. Moreover, they encouraged students to share their ideas through opening discussion to the whole class. In addition, teachers now don't depend on themselves only in math lessons, they started to focus on giving students opportunities to share and discuss their own ideas. Teachers' role began to change from lecturing for the most time to facilitator for the interactions needed in the classroom.

All this information shows that teachers` roles have changed in the classroom from lecturing to facilitating. After the workshops, teachers' knowledge in geometrical math has improved. In response to math questions for them during the workshops in the worksheets and in the activities (see Appendix), teachers` answers were getting better through the discussion, as no one of them didn't try to solve the question. Teachers were able to analyze, and construct their thinking.

Our 1st question was "What effect does the training of teachers of (5-7)th grade in using problem-solving activities in math have on teachers' performance in teaching math?" All the teachers showed that they can use problem-solving activities and questions in teaching math. And they will use it in other classes; one teacher talked in the third workshop about her experience in doing the straw activity and some of the worksheets of nets in 6th grade in doing 3-D shapes. She was fond of the engagement and the ability of her students to deal with

high level activities. All the teachers showed that they prefer using problem-solving activities and questions in teaching geometrical math, and they will use it in other topics. They said that they will always look for learning new strategies in teaching " and they asked me when will be other workshops.

For my 2nd question "What effect does the training of teachers of (5-7)th grade in using problem-solving activities in math have on their students' learning?" All students in the classes that I attended were able to answer open-ended questions that are related to open-ended tasks. All of them were engaged to in tasks and their answers showed their deep-understanding for several topics in math. From the interviews students s liked the new activities for teachers and said that they began to like math lessons more than before, they said that each class they wait for the new activities the teacher will give them. They also increased their involvement in the lesson with comfort; they are not afraid whether their thinking of the solution is right or wrong which helps them to see that math can be fun and interesting .Beside that using problem-solving activities lead to cooperative learning between students themselves while doing the task, I noticed many connections between different student levels.

Giving students opportunities to learn and discuss in the class enhanced students to learn more. As when they participate in the class, their knowledge, skills and attitude in math will be developed. This means that students` efforts have risen, as they now try hard to do math in the class. In addition, student start to use discovery learning and using this new method of teaching give students opportunity to investigate the new math concepts, also students now have the ability to discuss with their teachers math concepts. Moreover, students now spend more time on doing mathematics and their results seemed to be much better after the study.

As teachers start to give students enough wait-time to answer the questions, students' answer became much better than before and have fuller answers. Furthermore, Students' scores on the exam have increased which shows that nearly all students achieved a conceptual understanding in geometrical-math. Students' reflective thinking has developed, as they started to ask and discuss questions with their peers in the class. Students also show positive interactions while doing these activities and this was clear from their discussion with groups and with whole class. Besides this, some students asked their teachers for more math activities which can enhance their understanding in math.

CONCLUSIONS

After completing my research one thing was evident: using problem-solving activities in teaching math curricula had an effect on teachers' performance in math classes. The other thing was using problem-solving activities and open- questions in teaching math curricula also has an effect on student's participation and attitude in math classes.

The most beneficial data I collected was from teacher and student interviews; because I was able to judge using problem-solving activities and questions through their feelings and reflections. From the classroom observation I was able to see the difference between the teachers' performance before and after using critical thinking activities, also it was very interesting for me to see that how much the participation of the same students have changed; before starting there were many bored students (in some classes there were sleepy ones). Using problem-solving activities has affected the participation of many of these students; they became attracted to what teacher says and does. Pre and post survey showed me how the

teachers thought about problem-solving activities and questions and its practice in their classes before and after the study. I sometimes used video tapes to get a better idea about students' participation in the class.

The answers I found for my research questions through the research were that using open ended-tasks and questions in teaching geometrical math was useful to the students, teachers and me. The students said this strictly in their interviews that it helped the ideas to be much clearer in their heads. It was a way for the students to assess their answers and understanding. Students began to understand the importance of really understanding math concept and not only memorizing how to perform math procedures. For teachers, I asked myself sometimes" is that the same teacher whom I ordinary attend his classes?" Through classroom observation teachers really changed their performance and get linked to the new activities as if they were waiting for me to train them. I'll always look for new strategies to give to teachers to help them use different methods in their classes.

Overall, teachers had much ability to use problem-solving activities such as problem-solving activities and questions in their classes. Students were able to ask and answer why questions, to work together and judge their thinking in different ways.

RECOMMENDATIONS

-Conclusion of training courses and workshops on the subject of teaching aids to teachers of mathematics for the second phase of the core in Palestine.
- Teachers positive development trends toward the use of problem-solving strategies.
-Further studies in all phases about problem-solving strategies in math classes.
- Further studies at all stages about the reality of problem-solving strategies in math classes.
- Activate the link between the authors of the curriculum and teachers, through regular meetings held.
- Enhancing the role of the student in the classroom share.

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