IMPROVING STUDENTS PERFORMANCE IN SOLVING PROBLEMS ON EQUATION OF CONIC SECTIONS THROUGH POLYA'S APPROACH

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ABSTRACT: According to the National Mathematics Advisory Panel (2008), the main purpose for teaching and learning mathematics is to develop the ability of the learner to solve wide variety of both simple and complex mathematics in their daily lives. The study focused in improving the competency of conic sections which is taught in Grade 11 Science Technology Engineering and Mathematics (STEM) strand, Academic Track. The basis of the researcher in choosing the competency is based on the low performance for the past years. This action research utilized the Pretest – Posttest Research Design. The pretest was administered to the Grade 11 STEM (Pythagoras) to determine their prior knowledge while the posttest was used to measure the effectiveness of Polya's Problem Solving Approach. This study was conducted for the First Quarter, Week 1, Day 2 for school year 2019-2020 at Linao National High School particularly in the students of Grade 11 STEM (Pythagoras). The learners are given 20 items teacher made test which was based from the constructed table of specification as a pretest and parallel teacher made test as posttest. The test was checked and the results were interpreted. The results were utilized to determine if the approach is effective in improving the performance of Grade 11 STEM (Pythagoras) in solving problems on equation of conic sections.

KEYWORDS: *performance, solving problems, equation, conic sections, Polya's approach, Pythagoras, competency*

INTRODUCTION

Development in almost all areas in life is based on effective knowledge of science and mathematics. There simply cannot be any meaningful development in virtually any area of life without knowledge of science and mathematics, (Sherrod et. al. 2011). It is for this reason that the educational system of countries that are concerned about their development put great deal of emphasis on the study of mathematics (Ministry of

Education, Ghana 2012). Mathematics is also widely regarded as one of the most important school subjects and a central aspect of the school curriculum in every society. Oyedeji (2000), also supported this idea by saying that, Mathematics is an extremely advantageous in almost all spheres of human life.

According to the National Mathematics Advisory Panel (2008), the main purpose for teaching and learning mathematics is to develop the ability of the learner to solve wide variety of both simple and complex mathematics in their daily lives. The study of mathematics is therefore seen as a means of sharpening the mind, shaping the reasoning abilities, and developing the personality of the individual to become a more scientifically and technologically minded person in the society. This is why most countries put great emphasis on the study of a well-planned and effectively implemented mathematics education program especially those that are concerned about their scientific and technological development. Furthermore, constructivist Sap Cova (2011), viewed that teachers in particular and educational planners in general are implored by society to design practical method of teaching and learning that are applicable to learner's environment and our everyday life situation. This is because, learners possess a natural curiosity and interest in mathematics, and come to school with an understanding of mathematical concept and problem solving strategies they have discovered through the exploration of the world around them.

According to Polya (1957) solving problem is a practical skill. Students will learn problems when they observe and imitate what other people do when solving problems. The main conception of the problem is getting different when there is shifting of point of view in the problem. Krulik and Rudnick (1996) on their book about teaching, reasoning and problem solving, found that the ability of the students to recognize words is fundamental to reading and being able to visualize the problem can lead to a successful problem solving. Students entering the Senior High School who opt to take Science Technology Engineering and Mathematics (STEM) are faced with tremendous challenge most especially in the field of mathematics. One of the mathematics subjects that they have to embrace is Pre-Calculus.

The first lesson as stated in the curriculum guide is a competency in Analytic Geometry particularly the Conic Sections of Apolonuis of Perga.

When introducing conics, a particular class of curves which oftentimes appear in nature and which have applications in other fields. One of the first shapes learned is a circle, is a conic. When a ball is thrown, the trajectory it takes is a parabola. The orbit taken by each planet around the sun is an ellipse. Properties of hyperbolas have been used in the design of certain telescopes and navigation systems, Pre-Calculus First Edition (2016). Though the lessons in conic sections is a very interesting one, students find difficulties in understanding the concepts of conic sections. The very systematic presentation of the lessons in Pre-Calculus issued by the Department of Education is still faced with problems because of the difficulty of the learners to cope with the lesson.

The mathematics teachers are still looking for the best strategies suited to the level of the learners so that they can grasp immediately the lessons in which for them, is very abstract. This is the very reason why the researcher prompted this action research to be conducted.

According to George Polya there are four steps to follow to effectively solve a problem in mathematics. First, understand the problem, sometimes the problem lies in understanding the problem. If a learner is unclear as to what needs to be solved, then the learner is probably going to get the wrong result. In order to show an understanding of the problem, one must need to read the problem carefully. Sounds simple enough, but some people jump the gun and try to start solving the problem before they have read the whole problem. Once the problem is read, list all the components and data that are involved. Second, device a plan, you come up with a way to solve the problem. Setting up an equation, drawing a diagram and making a chart are all ways that one can go about solving a problem. Third, carry out the plan, this is where one will solve the problem and come up with a “devise a plan” step. Fourth, look back, check and interpret to see if all information was used and that the answer makes sense. If the answer does check out, write the answer with correct labeling. In the context of this action research, the students will be given set of problems on conics and strictly apply the four steps of Polya until they arrive with the correct answer. The questions in the practice test include:

Problem	Answer
1. What is the equation of the circle with center at the origin and radius 6?	$X^2 + y^2 = 36$
2. What is the equation of the circle with a diameter whose endpoints A(-3,2) and B(7,4)?	$(x – 2)^2 - (y- 3)^2 = 26$
3. What is the vertex of the parabola with the equation $y^2 – 5x + 12y = -16$?	(-4, -6)
4. What is the focus of the parabola with the equation $x^2 = -4y$?	(0,-1)
5. What is the directrix of the parabola if the equation is $3y^2 = 24x$?	X = -2
6. What the coordinates of the center of an ellipse if the equation is $x^2/169 + y^2/169 = 1$?	(0,0)
7. What is the equation of an ellipse with foci (-7,6) and (-1,6), the sum of the distances of any point from the foci is 14?	$(x + 4)^2/49 + (y – 6)^2 = 1$
8. What is the coordinates of the center of the hyperbola if the equation is $x^2/36 – y^2/ 64 = 1$?	(0,0)
9. What is the equation of a hyperbola having a foci (-4,-3) and (-4,13), the absolute value of the difference of the distances of any point from the foci is 15?	$(y – 5)^2/49 – (x + 4)^2/15 = 1$

STATEMENT OF THE PROBLEM

The study focused in improving the competency of conic sections which is taught in Grade 11 Science Technology Engineering and Mathematics (STEM) strand, Academic Track. The basis of the researcher in choosing the competency is based on the low performance for the past years.

Thus, this action research aimed to improve the performance of Grade 11 STEM (Pythagoras) students using the Polya's approach in problem solving. Specifically, it aimed to answer the following questions:

1. What is the mean score of the grade 11 STEM (Pythagoras) students before the implementation of the Polya's problem solving approach?
2. What is the mean score of the grade 11 STEM (Pythagoras) students after the implementation of the Polya's problem solving approach?
3. Is there a significant increase in the mean score of the students from the Pretest to the Posttest?
4. What is the effect-size of the Polya's Problem Solving Approach in improving the performance of Grade 11 STEM (Pyhtagoras) students in solving problems on equation of Conic Sections?

RESEARCH METHODOLOGY

This action research utilized the Pretest – Posttest Research Design. The pretest was administered to the Grade 11 STEM (Pythagoras) to determine their prior knowledge while the posttest was used to measure the effectiveness of Polya's Problem Solving Approach.This study was conducted for the First Quarter, Week 1, Day 2 for school year 2019-2020 at Linao National High School particularly in the students of Grade 11 STEM (Pythagoras). The learners are given 20 items teacher made test which was based from the constructed table of specification as a pretest and parallel teacher made test as posttest. The test was checked and the results were interpreted. The results were utilized to determine if the approach is effective in improving the performance of Grade 11 STEM (Pythagoras) in solving problems on equation of conic sections.

The pretest was administered on the First Quarter, Week 1, Day 3 to Grade 11 STEM (Pythagoras) students to determine their stock knowledge about the topics. The result was checked and recorded. The posttest was administered immediately after the implementation of the intervention. The posttest was administered to compare the results taken during the pretest.

The gathered data was analyzed to determine if there is a significant change between the mean score in the pretest and posttest of the Grade 11 STEM (Pythagoras) students.

To determine the scores of the students in solving problems on conic sections before and after the implementation of the Polya's Approach, Mean and Standard deviation was employed. To test whether there is significant change in the pretest and posttest scores of the respondents, paired samples t-test was utilized. To test the significant change between the scores, independent sample t-test was used. The Cohen's d was used to determine the effect size of Polya'sApproach on the performance of students in solving problems on conic sections.

RESULTS AND DISCUSSIONS

Table 1: Paired Sample Statistics

Test	Mean	N	Std. Deviation	Std. Error Mean
Pretest	9.52	31	2.014	.362
Posttest	15.68	31	2.135	.385

The above table shows the result of the Pretest and Posttest mean scores of thirty-one (31) STEM 11-Phytagoras students. As revealed in the table, the mean score in the Pretest is 9.52 which is lower than the mean score in the Posttest which is 15.68. This implies that the students have limited knowledge prior to the teaching of the competency being tested. The result of the Posttest mean score further manifest great improvement in their knowledge after implementing the Polya's Problem Solving Approach.

Table 2: Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	*Upper*			
Pretest-Posttest	-6.161	2.919	.535	-7.254	-5.069	-11.516	30	0.00

Table 2 shows the paired sample test between the pretest and the posttest mean score. The two mean scores have a difference of 6.61 and the increase is significant as reflected in the probability value of 0.00. This means that the significant increase in the mean scores can be regarded to Polya's problem solving approach, hence an effective way in teaching the competency in solving problems involving equation of conic section

Table 3: Effect –size of Polya's Problem Solving

Mean	Std. Deviation	Cohen's d Value	Verbal Interpretation
6.161	2.973	2.07	Large Effect

The above table shows the effect size of Polya's Problem Solving Approach. Using the Cohen's d scale, it can be seen that Polya's problem solving approach has a large effect on students' gained knowledge on problem solving involving the equation of conic sections. It is therefore recommended that this approach can be an alternative to the usual way of teaching problem solving involving the equation of conic sections.

CONCLUSION

To solve a word problem in Mathematics, have a lot of techniques but the main objective was to

come up with the correct final answer. Sometimes students are not certain if the answer they arrived at is the correct one. The approach introduced by George Polya has been proven to be very effective in solving word problems that even word problems in Conic Sections can be solved systematically using the approach. Great improvement in the performance of learners if the systematic approach in solving conic sections is adapted.

RECOMMENDATIONS.

Based from the conclusion formulated, the following are being recommended.

1. Learning Action Cell Session with the SHS and JHS teachers of Linao National High School through the permission of the Head Teacher and the school Principal should be conducted to disseminate the findings of the study
2. The findings should be disseminated during In-Service Trainings in the Division of Tuguegarao City with the approval of the Schools Division Superintendent.
3. The same study should be conducted using different year levels in the Basic and Higher education.
4. More seminars and workshop should be conducted about action research.

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