THE EFFECTS OF POLYA'S PROBLEM SOLVING PROCESS ON MATHEMATICS PROBLEM SOLVING SKILLS AND ACHIEVEMENT OF MATHEMATICS STUDENT TEACHERS

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Abstract - The research objectives to study and compare mathematics problem solving skills and mathematics achievement before and after using Polya's Problem Solving Process of mathematics student teachers. This study was conducted by one-group Pretest-Posttest Design. The samples consisted of 30 mathematics student teachers who were studying in the second semester, the academic year 2016 at UdonThaniRajabhat University, UdonThani, Thailand that selected by cluster random sampling. The research instruments consisted of 1) lesson plan Polya's Problem Solving Process on Statistics for teacher, 2) the mathematics problem solving skills test and 3) the mathematics achievement test. The data were analyzed for mean, standard deviation, percentage, and t-test for dependent samples. The results were as follows: 1. Mathematics problem solving skills of mathematics student teachers who were taught by Polya's Problem Solving Process had mean score pretest 10.43 (34.76%) and posttest 23.63 (78.77%) the result show that posttest mean score higher than 75% and posttest higher that pretest. 2. Mathematics achievement of mathematics student teachers who were taught by Polya's Problem Solving Process had mean score pretest 11.50 (38.33%) and posttest 24.03 (80.10%) the result show that posttest mean score higher than 75% and posttest higher that pretest

Keywords - Polya's Problem Solving Process, Mathematics problem solving skills, Mathematics achievement.

I. INTRODUCTION

Mathematics is about pattern and structure; it is about logical analysis, deduction, calculation within these patterns and structures. When patterns are found, often in widely different areas of science and technology, the mathematics of these patterns can be used to explain and control natural happenings and situations. Mathematics has a pervasive influence on our everyday lives, and contributes to the wealth of the country [1]. Mathematics is a methodical application of matter. It is so said because the subject makes a man methodical or systematic. Mathematics makes our life orderly and prevents chaos. Certain qualities that are nurtured by mathematics are power of reasoning, creativity, abstract or spatial thinking, critical thinking, problem-solving ability and even effective communication skills [2]. Mathematics is the cradle of all creations, without the world cannot move an inch. Be it a cook or a farmer, a carpenter of a mechanic, a shopkeeper or a doctor, an engineer or a scientist, a musician or a magician, everyone needs mathematics in their day-to-day life [3]. Therefore, mathematics is one of the most important subjects of our life. No matter to which field or profession you belong to, its use is everywhere. That is why it is necessary to have good understood of the subject. The most important learning of mathematics is to train a sort of individual who can be self-confident, curious, creative, critical thinking, problem-solving ability, innovative, and also capable of knowledge understanding the differences.From the 20th century to today, problem solving has never lost its importance in the teaching-learning process. Problem solving is the cornerstone of school mathematics. The main reason of learning mathematics is to be able to solve problems. Mathematics is a powerful tool that can be used to solve a vast variety of problems in technology, science, business and finance, medicine, and daily life. It is strongly believed that the most efficient way for learning mathematics concepts is thought problem solving [4]. Many students believe that school is about learning basic facts and simple skills. In reality, most courses require students to think through problems presented and give thoughtful answers. In mathematics, problems-solving skills help students apply principles to scenarios found in the real world [5]. So, the conviction is that children need to learn to think about quantitative situation in insightful and imaginative ways, and that mere memorization of rules for computation is largely unproductive. Of course children are to learn problem solving; their teachers must themselves be competent problem solvers and teacher of problem solving. Therefore, problem solving can be a problem. Any problem is solved easier with an action plan. There are four basic steps in solving a problem of Polya's Problem-Solving Process [6], 1) defining the problem/understand the problem, 2) generating alternatives/ devise a plan, 3) evaluating and selecting alternatives/ carry out the plan, and 4) implementing solutions/ look back. The techniques discussed in this and that coming sections should help students to become a better problem solver and should show students how to help others develop their problem solving skills. Therefore, in order to spread the problem solving ability and mathematics achievement among students in the university environment, teaching and learning environment should be arranged in such a way for the students to improve their problem solving ability and mathematics achievement in these areas. Appropriate teaching

strategies, method and techniques should be used to achieve this. In today's teaching-learning process, choosing appropriate media is so important.

The results on above, this study was conducted to explore the effects of Polya's Problem-Solving Process as an alternative instructional strategy which could be introduced to mathematics student teachers classroom in the teaching and learning of Mathematics. Students taught in traditional mathematics education environments are preoccupied by exercises rules, and equations that need to be learned, but are limited use in unfamiliar situations such as solving real life mathematics projects [7, 8]. In contrast to conventional mathematics classroom environments, a Polya's Problem-Solving Process provides students with opportunities to develop their abilities to adapt and change methods to fit new situations. Further, students participating learn mathematical process associated with communication, representation, modeling and reasoning. The Polya's Problem Solving Process is show in Figure 1.

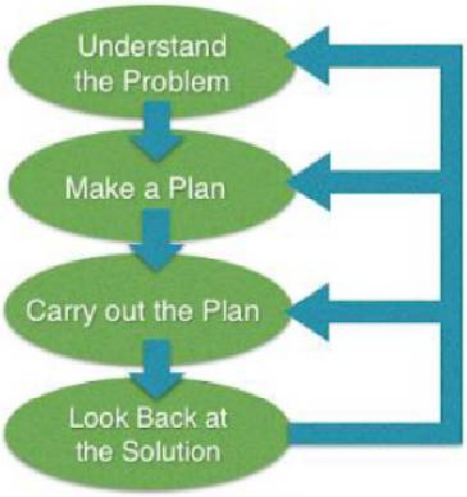

Fig. 1.Polya's Problem Solving Model testing [9]

II. OBJECTIIVES OF THIS STUDY

To study and compare mathematics problem solving skills and mathematics achievement before and after using Polya's Problem-Solving Process of mathematics student teachers.

III. HYPOTHESIS OF THE STUDY

1. Mathematics problem solving skills of mathematics student teachers who study with Polya's Problem-Solving Process are posttest score higher than 75% and posttest higher that pretest.
2. Mathematics achievement of mathematics student teachers who study with Polya's Problem-Solving Process are posttest score higher than 75% and posttest higher that pretest.

IV. METHODOLOGY

4.1 Design of the study

This research was a pre-experimental design. Research design used is one group pretest and posttest design [10].

Pretest	Treatment	Posttest
O_1	X	O_2

4.2 Sample

The sample of this study were 1st year mathematics student teachers in Faculty of Education at UdonThaniRajabhat University, UdonThani, Thailand, utilizing 30 students who were studying in the second semester, the academic year 2016.

4.3 Variable

This study were two variables, the dependent variable was teaching mathematics by using the Polya's Problem-Solving Process and the independent variable were mathematics problem solving skills and mathematics achievement of mathematics student teachers.

4.4 Instrument

1. Four lesson plans using the Polya's Problem-Solving Process for use in teaching mathematics student teachers. Each lesson plan was for 4 hours that required 16 hours in total. The teaching content on Statistics for teacher that contents covered four topics including

- Measures of Average and Variability,
- Measures of Confidence,
- 3)Significance Testing and Comparing Averages, and
- Analyzing Frequencies, Correlations and Linear Regression

2. The mathematics problem solving skills test, the test was writing to mathematics problem solving as the Polya's Problem-Solving Process.

3. The mathematics achievement test on statistics for teacher, the test was multiple-choice.

4.5 Procedures

In this research taught by using Polya's Problem-Solving Process of Statistics for teacher , before staring the experimental research the sample group have been applied a scale of pretest of the mathematics problem solving skills test and the mathematics achievement test. The teacher was informed about the objectives of the study and Polya's Problem-Solving Process then taught by using Polya's Problem-Solving Process of 4 lesson plan. During the process teacher was observed the interaction between teacher-students and students-students; participation and contribution of students into learning environment and teacher as well as the physical conditions and material availability of the classroom. Students in the sample group were

instructed with Polya's Problem-Solving Process. In instruction teaching and learning activities and lesson plan were designed to maximize student's active involvement in the learning process. Teacher only provided questions suggested approaches, gave feedbacks, and assesse understanding. After finished using instruction base on Polya's Problem-Solving Process the sample group have been applied a scale of posttest the test same pretest. So the study tool 6 weeks, 4 weeks for the instruction, 2 weeks for the application of the pretest and posttest.

4.6 Data Analysis

Mean, percentage, and standard deviations of measured quantities were determine and t-test for one samples and t-test for dependent samples done for hypothesis testing.

V. RESEARCH FINDING

Improvement in mathematics problem solving skills and mathematics achievement after using Polya's Problem-Solving Process, the means of the pretest and posttest of mathematics student teachers have been compared. Generally, research data of this can be summarized in Table 1 and 2 below.

Table 1: The comparison of the mathematics problem solving skills of pretest and posttest of the Polya's Problem-Solving Process

N	Test	Mean	S.D.	%	t-test	P
30	Pre	10.43	2.47	34.76	43.86**	.000
	Post	23.63	4.76	78.77		

Note.**p<.01

Table 2: The comparison of the mathematics achievement of pretest and posttest of the Polya's Problem-Solving Process.

N	Test	Mean	S.D.	%	t-test	P
30	Pre	11.50	2.27	38.330	34.11**	.000
	Post	24.03	2.17	80.10		

Note.**p<.01

According to Table 1, it is know that mathematics problem solving skills pretest mean score obtain by mathematics student teachers is 10.43 (34.76%) after learning through the Polya's Problem-Solving Process their posttest mean score is 23.63 (78.77%). The results show that the posttest mean score was higher than 75% and it was also higher than the pretest. Similarly in Table 2 show the mathematics achievement pretest mean score is 11.50 (38.33%) after learning their posttest mean score 24.03 (80.10%). The results show that posttest score was higher than 75% and it was also higher than the pretest.

CONCLUSION AND DISCUSSION

Based on the findings obtained in the study, it can be conclude the following points:

1. The mathematics student teachers who have been instruction with the Polya's Problem-Solving Process have mathematics problem solving skills mean score 10.43 (34.76%) after learning their posttest mean score is 23.63 (78.77%).The results show that the posttest mean score was higher than 75% and it was also higher than the pretest.
2. The mathematics student teachers who have been instruction with the Polya's Problem-Solving Process have mathematics achievement mean score 11.50 (38.33%) after learning their posttest mean score is 24.03 (80.10%).The results show that the posttest mean score was higher than 75% and it was also higher than the pretest.

From the research result could be discussion as; it was found that the Polya's Problem-Solving Process can contribute significantly to the outcome of mathematics education. Not only is it a vehicle for developing logical thinking, it can provide students with a context for learning mathematical knowledge, it can enhance transfer of skills to unfamiliar situations and it is an aesthetic form in itself. Moreover, four step process of Polya's for problem solving helps students keep in mind the common sense nature of math and mathematical problem solving. With them, students were able to use the reasoning abilities they already have to leap hurdles they might have previously thought insurmountable [11, 12]. At four step of Polya's it can concluded that:

1) The understand problem let the students to explain and identify the information that obtain from the problem by taught teachers to ask students question such as Do you understand all the words used in stating the problem? What are you asked to find or show? Can you restate the problem in your own words?
2) The make a plan let the student have an active role in the solving of mathematical problems. Student will find choosing a strategy increasingly easy,
3) do the plan let them develop self confidence in capacities and skills for learning and thinking by themselves, and
4) Look back let them taking the time to reflect and look back at what you have done, what worked, and what didn't. Doing this will enable you to predict what strategy to use to solve future problem [13, 14]. However effective the mathematics teachers needs to understand the role of problem solving in students everyday lives, as well as the importance of problem solving in the mathematics classroom. By incorporating problem solving in their classrooms, teachers will enable students not only to attain one of the general aims of mathematics curriculum namely to identify and solving problems and make decisions, using critical and creative thinking, but also to attain a specific aim for school mathematics, namely to

apply mathematics to solve problems, using acquired knowledge and skills.

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