THE DEVELOPMENT OF MATHEMATIC PROBLEM SOLVING ABILITY ON THE SEQUENCE AND SERIES USING THE PROBLEM-SOLVING PROCESS BASED ON THE CONCEPT OF GEORGE POLYA FOR GRADE 11 STUDENTS DEMONSTRATION SCHOOL OF SUAN SUNANDHA RAJABHAT UNIVERSITY BY ONLINE SYSTEM

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ABSTRACT

The purpose of this research was to develop the ability to solve mathematical problems on sequences and series by using the problem-solving process based on the concept of George Pólya for grade 11 student demonstration school of suan sunandha rajabhat university by online system. The sample is a group of 17 students in the medical aptitude program for grade 11 demonstration school of suan sunandha rajabhat university academic year 2021. The research instruments were 3 lesson plans and an online mathematical problem solving ability test. The statistics used in data analysis were mean $(\bar{X})$, percentage $(\%)$, standard deviation $(S.D.)$. Comparison of scores on problem solving ability with mathematics achievement level according to the criteria of road map for mathematics demonstration school of suan sunandha rajabhat university, 70%.

The results showed that after learning, the students had the ability to solve mathematical problems on sequence and series by using the problem-solving process based on the concept of George Pólya through an online system 7 students higher than 70% (41.18%), 8 students (47.06%) higher than 50% but less than 70%, and 2 students less than 50% (11.76%).

Keywords: Problem Solving Ability, Mathematic Problem, Problem – Solving Process Based on The concept of George Pólya

INTRODUCTION

From the results of ordinary national educational test (O-Net) of the demonstration school of suan sunandha rajabhat university for grade 12 students. It was found that in 2019, mathematics scores 2019 has an average score of 39.25, a standard deviation of 21.66, and the year 2020 has an average score of 35.03, a standard deviation of 18.48, which, when compared to the national level in 2019, has an average score of 25.41, a standard deviation of 18.01 (National Institute for Educational Testing, 2019) and year 2020 with an average score of 26.04, standard deviation of 16.83 (National Institute for Educational Testing, 2020). It can be seen that the average score of suan sunandha rajabhat university demonstration school students scores higher than the national average. But the standard deviation at the school level was higher than the national level. That shows the degree of difference between high-scoring students and low-scoring students is large. And from the statistical values separated by indicator standards, it was found that the standard strand 1, indicators, standard 5/2, understood

and applied the knowledge of serial sequences. which the content of this course is related with solving mathematical problems Requires a variety of knowledge to analyze and connect to find answers to students Must have an understanding of the content and be able to apply it to solve problems. Students will need to think analytically that What do you want to know? What is given and what methods must be used to find the answer? Must be able to connect old knowledge and new knowledge. which has a multi-step process shows that The content and content that must be corrected are related to the process of analyzing problem-solving. Problems from the problems that arise, students need to be developed to solve the process of thinking, analyzing, solving problems. One of the reasons is that students are unable to take exams that require thinking process to solve problems. The students saw the problem and did not understand what the problem had to do. because students cannot use the procedure or the analytical thinking process to find the answer In other words, students lacking a systematic analytical thinking process, students will not be able to solve problems. which affects the learning outcome scores For the reasons mentioned above, it is the reason why researchers are interested in doing research on this topic.

Due to the cause of the spread of COVID-1 9 As a result, the teaching and learning management in the academic year 2020 - 2021 cannot manage the teaching and learning in the normal way that students must come to study at school. For this reason, almost all schools across the country, including the demonstration school of suan sunandha rajabhat university, have to adapt to the use of technology in various operations. in management to continue Therefore, in conducting research to develop the ability to solve mathematical problems on sequences and series. By using the problem-solving process based on the concept of George Pólya for grade 11 student demonstration school of suan sunandha rajabhat university by online system. Therefore, the author uses technology to help manage teaching and learning through online systems.

LITERATURE REVIEWS

From such importance, it is necessary to continuously develop critical thinking skills for students. where teachers play an important role Therefore, teachers should apply the analytical thinking process to Learning activities for students such as Montree Wongsaphan (2013, p. 130) discussed obstacles in solving problems that It is because the students lack understanding of the process and method of the problem. So find the answer by guessing at random. show If teachers use a systematic process and step-by-step solution in learning management, students will understand the process and method of problem solving, resulting in students developing their ability to solve problems. better when considering only the mathematical problem-solving part One process that will help us succeed in solving problems is The problem-solving process based on George Pólya's ideas was published in the book "How to Solve it" Pólya, G. (1957, pp. 16 - 27) and is widely regarded as a step-by-step process. systematic problem-solving thinking from the importance of analytical thinking in mathematics The researcher is therefore interested in applying George Polyya's problem-solving process methodology to develop for grade 11 students at suan sunandha rajabhat university demonstration school. Have the ability to solve problems Know how to think, analyze and plan to find the correct answer to the problem of sequences and series. The researcher therefore conducts this research. in order to lead to the development of problem-solving abilities and learning mathematics effectively for

students to use in their daily lives and is the basis for learning mathematics and other subjects in the future.

Problem Solving Process

When only considering the problem solving in mathematics, the problem-solving process based on the concept of George Pólya is one of process that helps us solve problems successfully. This concept was published in the book "How to Solve it" in 1957 and widely accepted which the process consists of the following **four steps**;

Step 1: Understand the Problem Clearly

Person who do not understand the problem clearly will not be able to solve the problem. Therefore, understanding problem is very important in problem solving process then it was organized as the first step. It can summarize by the quote **"Well begun is half done"**. At this stage, concentrate well, read the problem carefully, and analyze important issues include in this step to help you understanding the problem deeply and clearly.

Step 2: Devise a Plan

There are many strategies you can choose to solve problems. To select strategy, it depends on the information you have in hands such as what is given in the problem, what the problem needs to know, what is the relation between message given in the problem and what the problem needs to know, have you ever solved the similar problems before, and how do you solve that problem as well as which theories that are expected to be related to problems. You will take those listed above into consideration in which strategy will bring what the problem needs.

Step 3: Carry Out the Plan

This step is the process that you will proceed as planned in the previous step with caution and careful to avoid mistakes in getting correct and accurate answer. Sometimes you may encounter or face with problems or barriers that obstruct you from solving the problems. It may because you have not tried enough on the plan or strategy you have selected in the previous step or you have selected inappropriate strategy. Thus, you have to consider carefully what the cause is. Initially, you may think that you have not tried enough so take a rest for a moment and clear your head then comeback to try the existing strategy. If you spent too much time and still not successful, you must recognize the truth and dare to go back to the previous step for choosing new appropriate strategy.

Step 4: Look Back and Check

This step is the process of checking if the answer is correct and relate to the problems. If a variety of strategies is used, you have to check whether you get the same answer from each strategy. If the answer is still not correct or match, you have to go back to step 2 and 3 again.
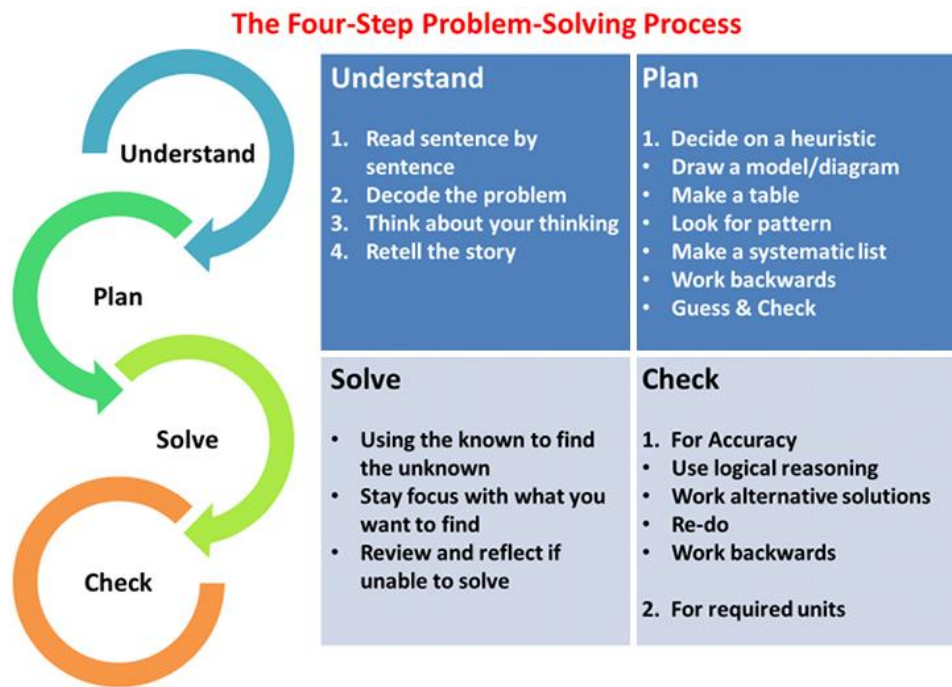
Figure 1. George Polya's 4-step problem-solving process.

MEDTHODS

The purpose of this research was to develop the ability to solve mathematical problems on sequences and series by using the problem-solving process based on the concept of George Pólya for grade 11 student demonstration school of suan sunandha rajabhat university by online system. The sample is a group of 17 students in the medical aptitude program for grade 11 demonstration school of suan sunandha rajabhat university academic year 2021.

1. Research Hypothesis

After, grade 11 students managed to learn sequences and series using the problem-solving process based on the concept of George Pólya by online system have the ability to solve mathematical problems the learning outcome was 70% higher than the criteria of the road map for mathematics of the demonstration school of suan sunandha rajabhat university.

2. Research Tools

2.1. Learning and Teaching Activities

2.1.1. 3 online lesson plans

2.1.2. Assign the student to prepare themselves for activities/experiments of each topic

2.1.3. Lecture in the online class

2.1.4. Discuss about the lectures

2.1.5. Practice and check with teacher

2.2. Resources

2.2.1. Workbook, Worksheet and Exercise

2.2.2. Computer Software such as Google Meet; Google Applications of Education; Adobe Flash Player; Wolfram Alpha

2.3. Online Mathematical Problem Solving Ability Test (30 points 90 minutes)

    2.3.1. Subjective test, show that the solution of 1 problem by using the problem-solving process based on the concept of George Pólya 4 steps (10 points)

    2.3.2. Multiple Choice Test (10 problems 20 points)

3. Data Collection

    3.1. The researcher plans to collect data by teaching all 3 weeks, 2 hours per week.

    3.2. Implement the learning management plan on sequence and series using the problem-solving process based on the concept of George Polya, 3 plans for 6 hours via online system.

    3.3. After completing all learning plans The researcher had all students take a test to measure their ability to solve mathematical problems by online system.

    3.4. Analyze the obtained data to draw conclusions.

4. Data Analysis

    4.1. Take the data which is the score obtained from the test to measure the ability to solve mathematical problems on the subject of sequences and series. Quantitative data were analyzed using basic statistics, percentage, mean ($\overline{X}$) and standard deviation (S.D.)

    4.2. Use the results of the assessment to interpret the data. By considering the evaluation criteria that the researcher has set up. It is an evaluation criteria applied by the researcher from the criteria used to measure the learning outcomes at the basic education level 8 show the follows below.

80 - 100	percent means excellent
75 - 79	percent means very good
70 - 74	percent means good
65 - 69	percent means pretty good
60 - 64	percent means moderate
55 - 59	percent means fair
50 - 54	percent means passing the minimum criteria
0 - 49	percent means below the criteria

    4.3. Take the scores of each student to find the mean percentage to compare with the criteria of the road map for mathematics of suan sunandha rajabhat university demonstration school, 70%

RESULTS

    1. The grade 11 students learned about sequence and series using the problem-solving process based on the concept of George Pólya by online system for 3 weeks, the ability to solve mathematical problems was measured. by using an online test to measure ability after class shown in Table 1.

Table 1 Results of developing mathematical problem solving abilities

Student Number	Test Score		Academic Grade	Outcome
	Score	Percentage		
1	11	36.67	0	below the criteria
2	22	73.33	3	good
3	16	53.33	1	passing the minimum criteria
4	22	73.33	3	good
5	14	47.78	0	below the criteria
6	22	73.33	3	good
7	16	53.33	1	passing the minimum criteria
8	22	73.33	3	good
9	24	80	4	excellent
10	18	60	2	moderate
11	28	93.33	4	excellent
12	20	66.67	2.5	pretty good
13	18	60	2	moderate
14	20	66.67	2.5	pretty good
15	20	66.67	2.5	pretty good
16	22	73.33	3	good
17	20	66.67	2.5	pretty good

From Table 1, it was found that the ability to solve mathematical problems of students in grade 11, the number of students was 7, representing 41.18 percent with a score higher than 70.00 percent (good level) of the full score. When considering the grade level, it was found that There were 2 students with excellent ability, representing 11.76%, with good ability of 5 people, representing 29.41%, while students with abilities below 70.00% of the full score had relatively good ability, 4 people, representing 29.41%. 23.53 moderate level 2 people representing 11.76%, minimum passing level 2 people representing 11.76% and low level 2 people representing 11.76%

2. The results of data analysis when comparing the mathematical problem solving ability scores of each student with the criteria of the road map for mathematics of the demonstration school of suan sunandha rajabhat university was 70 percent. There were 7 students with scores higher than 70 percent, categorized as good, very good and excellent. The data analysis results are presented in Table 2.

Table 2 Mathematical problem solving ability levels of grade 11 students compared with the criteria of the road map for mathematics of the demonstration school of suan sunandha rajabhat university, 70%

Sample	excellent	very good	good	pretty good	moderate	fair	passing the minimum criteria	below the criteria
17 students	2	0	5	4	2	0	2	2
percentage	11.76	0	29.41	23.53	11.76	0	11.76	11.76

From **Table 2**, it was found that grade 11 students had the most excellent abilities. Representing 11.76 percent and at the lowest level passing the minimum criteria accounted for 11.76 percent

The ability to solve mathematical problems of grade 11 students compared with the criteria of road map for mathematics of suan sunandha rajabhat university demonstration school, 70%, is shown in the following chart.
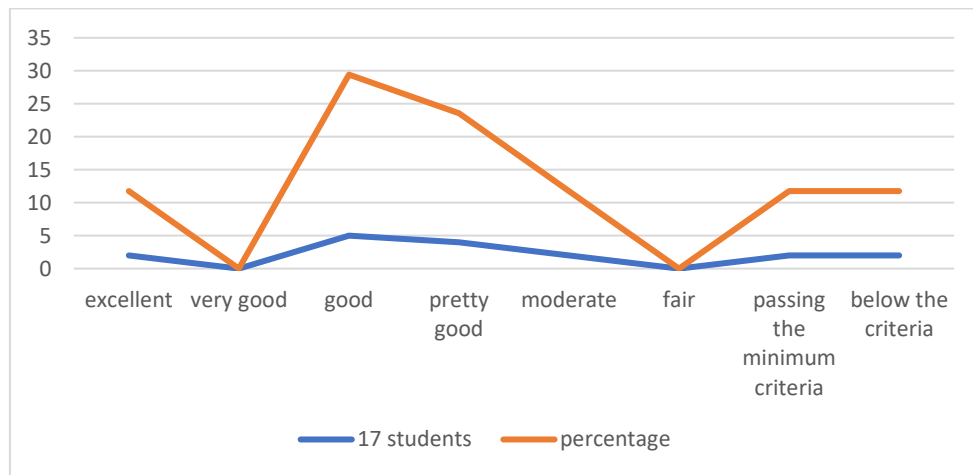
Figure 2 Mathematical problem-solving abilities of grade 11 students compared with the criteria of road map for mathematics of suan sunandha rajabhat university demonstration school, 70%

CONCLUTION AND FUTURE WORK

From the study of sequences and series using the problem-solving process based on the concept of George Pólya by online system for grade 11 students, it was found that the students had the ability to solve mathematical problems as follows: There were 7 students (41.78%) who received a score of more than 70% divided into 2 excellent levels (11.76%) and 5 good students (29.41%). There were 10 students (58.82%) who received a score less than 70 percent, divided into 4 students (23.53%) quite good, 2 moderate (11.76%), level 2 people pass the minimum criteria (11.76%) and 2 people below the criteria (11.76%), and if compared to the criteria of the road map for mathematics of suan sunandha rajabhat university demonstration school, 70% will have students who have problem solving abilities. mathematically higher than the threshold for 7 people (41.78%).

The future work was presented as follows:

Polya's problem-solving process should be experimented with solving mathematical problems on the point or other content besides the sequence and series.

SUGGESTION

1. According to the research results, the use of Polya's problem-solving process helps students to solve problems better. Therefore, in the course of teaching, the subject matter is problem-solving. Polya's problem-solving process should be used to train students to solve problems so that students can solve problems better.

2. For the study by Polya's problem-solving process. Should start with simple, uncomplicated problems first and then increase the difficulty level. Because in the process of Polya's process May have to bring the knowledge of the content that has been learned in the past to be linked to the knowledge that is currently learned. If the problem is too difficult for students to understand and unable to plan how to find the answer, it may cause students to become discouraged from practicing and dislike studying.

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