

THE CREATION OF CONSTRUCTIVE LEARNING MODEL-BASED MATHEMATICAL ACTIVITIES FOR LEARNING AND POLYA'S PROBLEM-SOLVING METHODS WITH AN EMPHASIS ON ANALYTICAL THINKING FOR FOUNDATIONAL CALCULUS FOR GRADE 12 STUDENTS, THE DEMONSTRATION SCHOOL OF SUAN SUNANDHA RAJABHAT UNIVERSITY

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ABSTRACT

The present study aims to: 1) create educational materials on mathematics that highlight analytical thinking abilities, drawing from constructivist theory and Polya's approach to problem-solving with a focus on the basics of fundamental calculus. 2) Encourage success in acquiring mathematical knowledge for At least 70% of pupils have achieved academically on average, and at least 70% of all students have done so. Own a 70 percent or higher academic success rating. 3) Learn how to think, examine, and analyze; and 4) research learning satisfaction. Students in high school are the intended audience, which is the grade 12 students' demonstration school of Suan Sunandha Rajabhat University in the first semester of the academic year 2023.

The findings demonstrated that the students could use constructivist theory and Polya's method of problem-solving to answer mathematical problems on fundamental calculus after learning, with 42 students scoring better than 70% (95.45%), and 2 student (4.45%) scoring more than 60% but less than 70%.

Keywords: Constructivist theory, Polya's problem, Problem-solving, Analytical-thinking skills

INTRODUCTION

Constructivism is a theory of learning that places a strong emphasis on how actively students construct their own understanding. Learners don't just absorb information; instead, they process it through reflection, build mental images, and add new information to existing schemas. Deeper comprehension and learning are encouraged by this. Per Elliott et al. (2000), p. 256, constructivism is defined as "an approach to learning that holds that people actively construct or make their own knowledge and that reality is determined by the experiences of the learner." Arends (1998) elaborates on the theories of constructivism, stating that constructivism holds that meaning is created by the learner on a personal level via experience and that meaning is shaped by the interplay of new information with existing knowledge. Paisal K (2018) Donko's teaching method involves six steps: creating interest, teaching important content, practicing, summarizing, expanding knowledge, and evaluating understanding. Students work together to answer questions, fill in gaps, study new content, and evaluate their understanding. We use all about knowledge to develop a teaching

Problem-solving is a critical skill in education, and George Pólya's Four-Stage Method has demonstrated efficacy in improving students' problem-solving abilities. This study aims to explore the impact of incorporating Polya's method into the teaching process, with a

particular focus on the progression from simple to complex problems. Math issues it is a scenario or query with procedural material or information that the student has never encountered before and is unable to quickly locate. It will take expertise and understanding in mathematics and other areas to find the solution. In addition to analytical skills, synthesis, and judgment, teaching problem-solving techniques Rather than giving pupils the answers to issues, it is an effective technique to teach them how to deal with problems. By putting an emphasis on the capacity of learners to think critically and allowing them to identify patterns or solutions to a variety of issues on their own.

Because critical thinking abilities are so important, they must be constantly developed. Where teachers play a significant role. As a result, teachers should employ the analytical thinking process. Montree Wongsaphan (2013, p. 130) identified hurdles in problem resolution as a result of students' lack of comprehension of the process and technique of the problem. So, guess at random to obtain the solution show students will develop their problem-solving abilities if teachers employ a systematic procedure and step-by-step solution in learning management better when simply the mathematical problem-solving aspect is considered.

OBJECTIVES OF THE RESEARCH

1) To develop mathematics learning activities using learning management based on the concept of constructivist theory and Polya's problem-solving process that emphasizes analytical thinking skills on the Fundamental Calculus for Grade 12.

2) To develop mathematics achievement for students to have an average academic achievement of not less than 70 percent and a number of students not less than 70 percent of all students. Have an academic achievement of 70 percent or more.

3) To study the analytical thinking skills of students learned from organizing mathematics learning activities using learning management according to the concept of constructivist theory and Polya's problem-solving process that emphasizes analytical thinking skills based on the Fundamental Calculus for Grade 12.

METHODOLOGY

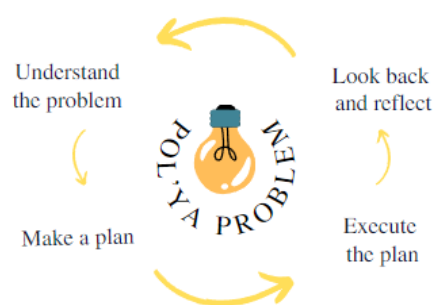


Figure1. George Polya's 4-step problem-solving process.

1. Learning activities in mathematics employing a learning management approach based on constructivism's theoretical notions and Polya's problem-solving process that promotes analytical thinking abilities are referred to as learning activities. 5. Among the steps are:

Step 1 is the introduction to the lesson. Students are aware of the goal. Play games, go over prior information, and respond to inquiries.

Step 2: The teaching step, which consists of sub-steps:

- The process of confronting and resolving challenges on one's own. Students examine issues. To address difficulties, acquire information. Solve puzzles and verify solutions on your own.
- The brainstorming process occurs in small groups. Students share their original concepts. Discuss concerning and share information in small groups.
- At the large group level, there is a consideration stage. In front of the class, students give small group presentations of their responses. Their friends give their thoughts and double-check them.

Step 3: Synopsis. Students summarize the ideas, approaches, and procedures for problem-solving during group discussions.

Step 4: Practice your abilities. Students work on their skills. From the training in skills.

Step 5: Step of assessment Students apply Polya's problem-solving approach, which integrates analytical thinking abilities, to identify information or parts into parts in each of the instructional phase's sub-steps 1), 2), and 3. Then look over or arrange the structure to identify connections between different parts.

2. Academic achievement is defined as students' capacity for learning as determined by their performance on the mathematical achievement test that the researcher developed for Grade 12 students. The test covers basic knowledge about fundamental calculus. There are two subjective questions for ten points each and ten objective questions worth one point each, for a total of twenty points on this four-choice objective type test.

RESEARCH RESULTS

This research's technique: It involves the creation of instructional materials for mathematics in the style of action research. There is a four-step procedure for fixing problems: planning, implementing, and reviewing. Examining and contemplating in order to apply the findings to enhance or adjust the work in order to make it more effective and come to conclusions that genuinely address the issue. The target audience target population for this study at The Demonstration School of Suan Sunandha Rajabhat University, Semester 1, Academic Year 2023, there are 44 students enrolled in Grade 12. Research tools there are

- 1) Twelve mathematics learning plans were utilized as tools in the practical experiment.
- 2) Behavior observation recordings are one of the tools used to reflect on practice results. Form for documenting outcomes following learning and cycle-ending assessments.
- 3) Learning accomplishments Exams are one tool used to assess the efficacy of learning management. And a test to gauge one's capacity for analytical thought.

Data collection: Student orientation and knowledge sharing were provided by the researcher to the research assistant. Following that, learning activities were organized utilizing 12 hours of teaching time according to the researcher's learning management strategy. The researcher and research assistants collected data from each learning management plan. The information acquired from practice reflection is then analyzed, criticized, improved, and flaws are remedied using a practice reflection tool.

Data examination: Basic statistics are applied quantitatively, such as calculating averages and qualitative percentage values. Practice-based reflection outcomes are examined and talked about. To provide useful suggestions or practice models, the findings are distilled into study results.

DISCUSSION

1. **Organizing learning** around the constructivist theory notion and Polya's problem-solving approach, which focuses on analytical thinking abilities in the context of fundamental calculus. The five steps of the grade 12 students' teaching model are as follows:

- The lesson's introductory paragraph the learning objectives are informed by it and assess knowledge through a range of instructional resources.
- The instructional phase comprises:

1.1 individual problem-solving and coping stages. This step involves the individual study of the problem scenario by the students using Polya's four-step problem-solving process:

Step 1: Acknowledge the problem. Students understand the difficulties after reading them. By outlining the issue or objective and the desired level of analysis.

Step 2: Make a plan for the fix. Students organize or come up with solutions to challenges, then select the best one.

Step 3: Execute the strategy. Students demonstrate how to locate the predetermined answers.

Step 4: Review and ensure that the responses you received were reasonable and accurate. Verify the accuracy and logic of the responses you received.

1.2 Brainstorming in small groups It is a procedure in which students work in groups to solve problems, utilizing Polya's problem-solving processes.

1.3 Reflection stage at the large group level at this point, students stand up and give their presentations in front of the class. Discuss Polya's methods for tackling problems. In order to keep things interesting, the researcher poses questions and offers alternatives to the answers the students have offered.

2. **The summary stage** is a summary of learning and understanding about concepts.

3. **Skills training stage:** Students practice skills from skill exercises with problem situations similar to the original situation.

4. **Evaluation stage:** Use observation of participation in classroom activities and performance inspection after the end of each lesson plan.

5. **The average score** for basic calculus knowledge is 88.89 percent, and 95.45 percent of all students have a score of 70 percent or higher.

6. **Students have analytical thinking abilities.** Taking the analytical thinking abilities test. Students were shown to have superior classification skills: connecting skills, using skills, summarizing skills, and classifying skills representing, in that order, 94.79, 95.57, 88.64 and 65.59 percent. That is shown in Table 1 below:

Table 1 shows the results of Polya's problem-solving processes.

Evaluation list	Analysis results
1. Connecting skills	94.78%
2. Using skills	95.57%
3. Summarizing skills	88.64%
4. Classifying skills	65.59%

CONCLUSION

The researcher developed mathematics learning activities that fostered students' analytical thinking skills and academic achievement. These activities, based on constructivist theory and Polya's problem-solving approach, encouraged students to actively engage in tasks and analyze data. This approach not only improved students' analytical thinking abilities but also contributed to higher academic achievement.

ACKNOWLEDGEMENTS

The author expresses gratitude to specialists for their time and financial assistance from Sunandha Rajabhat University for contributing to the research's success.

FUTURE WORK

1. Learning activities should be arranged in accordance with constructivist theory concepts and Polya's problem-solving approach, which prioritizes analytical thinking abilities. to employ in additional mathematics learning courses by selecting relevant content.

2. Using Polya's problem-solving techniques, guidelines for structuring learning activities based on constructivist theory should be followed, with a focus on supplying students with additional abilities. By selecting appropriate abilities

3. This model should be used with the same set of pupils over and over again. To investigate the outcomes in other areas, such as students' attitudes and tenacity in learning.

SUGGESTION

1. The time should be set for each activity at each step for pupils to know. It will energize pupils and enable them to successfully complete activities in accordance with their objectives.

2. Teachers should examine past knowledge connected to this as basic knowledge so that students can build new knowledge on their own.

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