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Development of the constructionist concept in conjunction with the Bar model for a mathematics course

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ABSTRACT

This research aims to find out the effectiveness of the plan to organize the mathematics course in the first grade according to the constructivist concept in conjunction with the Bar model. The results of the study found that the effectiveness of the plan to organize the mathematics was most suitable level. The results of the first grade mathematics course based on the constructivist concept and the Bar model. It has an average assessment result of 4.65, the most appropriate level. Ability to solve math problems of students before the activity, the student passes the criteria. 70% of 2 students out of 4 students (50%) had an average of 66.25% and a standard deviation of 2.55%. 70% of people, or 100%, have an average of 78.33% and a standard deviation of 1.63%.

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1. INTRODUCTION

Although mathematics is important, in reality, mathematics in Thai schools has experienced significant regression. When considering the scores of the Basic National Educational Test (O-NET), it was found that the average was low in all subject groups, and the scores from the PISA test were lower than in many other countries with similar development levels. These problems are caused by limitations in the curriculum and teaching system that emphasize content and memory rather than skill development and competency, resulting in a lack of creativity in solving problems, which is a challenge in the current Thai education system (Changthong et.al., 2020).

In terms of learning management goals, mathematics subject groups Ban Thonglang Noi School Academic Year 2019. Students have learning achievement in the mathematics subject group by 31.25 percent in 2020 has 65 percent and 57.14 percent in 2021 can be seen as below the 70 percent threshold set by the school. The researchers analyzed the classroom and found that 50 percent of Grade 1 students. Understanding and using the properties of equality and properties of numbers to analyze and solve problems using single-variable linear equations, falling below the 70% threshold, which is the basis for solving other mathematical

problems. Most problems arise from students not being able to create sentences, symbols, or equations from the problem.

Learning mathematics for students is becoming very problematic when a problem is found, it is not possible to analyze what it wants to do, and it cannot find the desired value. Because it requires knowledge, reading, and interpretation to find words and mathematical calculations (Verschaffel et.al., 2020). Students must have a background in mathematics and be able to analyze math problems very well. Transforming the learning process to develop Thai people into complete human beings in the 21st century focuses on the 3Rs and 8Cs skills (Prachagool & Nuangchalerm, 2021). Mathematical problem-solving skills are process skills at the heart of mathematics instruction, and students should be trained to develop problem-solving skills. In order to be able to apply knowledge, one must learn things that will bring knowledge and apply it in life (Hasibuan & Fauzi, 2019; Ergen, 2020; Nur et.al., 2020; Pambudi et.al., 2020).

In addition, classroom instruction often focuses solely on building numerical skills. Emphasis is placed on children practicing skills over and over again, even if they have quick numeracy skills. But it is not enough because students will lack the skills to interpret problems. The use of mathematics to solve problems increases as children learn mathematics in higher grades, which is more complicated to understand (Genc & Erbas, 2019; Yayuk & As' ari, 2020). It requires more logic to solve problems, children will begin to learn mathematics but will not understand it. This is in line with Piaget's theory of intellectual development, which emphasizes the importance of understanding nature and children's development rather than stimulating them to develop faster (Fuady & Rahardjo, 2019; Sugianto et.al., 2022).

Organizing learning activities based on the concept of constructivism, problems that generate intellectual conflicts, that is, prior knowledge and new perceptions that are inconsistent. To allow students to observe information, compare it with previous knowledge, and search for answers to reduce intellectual conflict through planning, action, and social constructivism. The opportunity to build their own knowledge based on the concept of knowledge creation is a concept that can be used in student-centered teaching and learning. By allowing students to think and build knowledge on their own using important processes. 1) Allowing students to revise their previous knowledge; 2) Allowing students to acquire/seek/collect/experiential information by themselves using process skills; 3) Allowing students to study, think critically, and create meaningful information or experiences by themselves using various process skills; 4) Allowing students to summarize and organize knowledge or information or structuring knowledge as well; and 5) Allowing students to express what they learn in a variety of ways. In the field of pedagogical evaluation (Jonassen, 1992).

Since learning according to this constructivist theory depends on the interests and the creation of different meanings of individuals. The resulting learning outcomes are therefore varied in nature. Therefore, evaluation requires a variety of approaches. Mathematics instruction has a specific characteristic in its content. There is only one answer to the problem. In order to achieve the accuracy of mathematical problem solving, problem-solving strategies are needed to support learning activities. The Bar model has been used to improve mathematics learning since 2007 (Osma et.al., 2018; Lowrie et.al., 2019; Rosé et.al., 2019). Teachers approve of it, and it originated in Singapore. Because it has been used to solve math problems for a long time. It is a learning management materials that are explained using diagrams to accompany problems. In the United States, bar models are used to solve counting problems by training students to draw rectangles or model bars representing quantities and the relationship between quantities in the problem (Morin et.al., 2017; Sevinc & Lizano, 2022).

Drawing bar models improves mathematical problem-solving abilities and develops mathematical thinking abilities as they are concrete solutions to explain abstract data

relationships. It is presented through rectangular models to allow students to visualize and better understand the relationship between what the problem assigns. It is also a way to encourage students to develop their knowledge in solving advanced problems (Baysal, & Sevinc, 2022). This makes it possible to see the relationship between all the given information and can link to the answer to the question that the problem wants to know clearly. Students can analyze problems. It is linked to students' mathematical analysis and drawn into a bar model, which allows students to solve problems easily and accurately. For that reason, the importance of applying learning activities based on constructivist theory with bar models to adapt learning activities at all grade levels in accordance with 21st century learning management and to guide learning activities to help students develop their ability to solve math problems.

2. METHOD

This research employed an action research, the procedure can be drawn as following.

Plan: The research plan consists of creating a plan for learning activities and preparing research tools.

1.1 Survey students with math problem-solving abilities using the mathematical problem-solving ability assessment. The exponential numbe), which is the content that students have already learned in the first semester of the academic year 2022, only explored the first practical cycle. In the next practice cycle, the results of the analysis and problems from the end of the practice cycle will be used to plan the next learning activity.

1.2 Study the core curriculum of basic education B.E. 2008 (Revised Version 2017), curriculum of the Ban Thonglang Noi School, and study literature and research related to the organization of learning activities using the learning management model based on constructivist theory together with bar models that promote the ability to solve mathematical problems. Analyze learning standards, indicators, and study time using one-variable linear equations. Grade 1 Prepare 10 learning units and 10 learning activity plans. Course designed 1 hour per plan, including 10 hours of class time Present the written learning activity plan to five experts. The acceptable assessment criteria must be from 3.51 to 5.00 or higher, with an average assessment result of 4.63. In addition, experts give advice on how to adapt the example scenario to real-life situations. To encourage meaningful learning

1.3 Study literature and research related to the organization of learning activities using the learning management model based on constructivist theory together with bar models that promote the ability to solve mathematical problems. The criteria for evaluating learning activities from five experts that are acceptable must have an average of 3.51–5.00 or higher, which has an average assessment result of 4.65. Organizing learning activities based on constructivist theory together with bar models consists of 5 steps. as follows

1. Preparing is an introductory step to the lesson. It is an interest-building step to encourage students to be ready to review their previous knowledge. The purpose of each lesson is to inform the students of their learning objectives in order to link them to new knowledge creation.
2. Construct is the stage where students will face the problem situation and solve it on their own. The teacher presents the problem in the form of an activity sheet. Students use their knowledge, experience, and understanding. Plan a solution by drawing a model bar. Determine how to perform mathematical operations. Write one-variable linear equations. Systematically execute the plan. The answers obtained by searching for answers are summarized manually.
3. Interaction: Divide students into small groups. Groups of 2 Discuss ways to solve each other's problems. Exchange ideas in small groups, help each other

investigate, and select appropriate solutions to problems. Facilitated by teachers Encourage the exchange of learning in groups.

4. Guidelines: The representative of the subgroup will propose solutions to the whole class. Discuss, question, propose group guidelines, and verify accuracy and reasonableness. The teacher presents an approach that the student has not yet presented and compiles a reasonable, correct solution that the whole class accepts. Discussion the advantages and limitations of each option and then summarize the best approach.
5. Predicate is the stage where students work together to summarize the concepts and principles and ideas for the subject learned. The teacher provides additional briefing so that students can examine their ideas and correct their principles.

1.4 Study the school curriculum and analyze the content. Mathematics Fundamental Mathematics Units C21102 Grade 1 Subject: One-variable linear equations analyze the relationships between material strands to serve as a framework for constructing subjective mathematical problem-solving capabilities. Establish a scoring measure of subjective mathematical problem-solving abilities (Institute for the Promotion of Teaching Science and Technology, 2012: 130). Conduct the creation of mathematical problem-solving ability assessments. subjective model in accordance with a total of 20 learning objectives. The assessment of the ability to solve the created mathematical problems was presented to five experts to determine the consistency of the content with the learning outcomes as a guideline for improvement to be more appropriate.Select items with an index value from 0.5 to 1.00 that fall within the criteria of consistency between the question and learning objectives. We selected 10 questions that clearly meet the learning objectives and cover the most content for this research, divided into 5 questions per operating cycle.

Action: It is the process by which the researcher acted according to the plan of the learning activities created. Plans for learning activities based on constructivist theory in conjunction with Bar Model Re: One-variable linear equations of 1st graders that promote their ability to solve mathematical problems 10 plans Two operating circuits are defined according to the structure of the content of a single-variable linear equation.

Observation: This is the observation that occurs in the teaching action, and the researchers also make the observation.Record all events by observing the operation, listening to the results of the operation, and using the following tools. The student behavior observation model to observe the target students during the activities in each learning plan. Test the ability to solve mathematical problems with the target students after the end of each activity cycle.

Reflection: We evaluate the organization of learning activities based on constructivist theory in conjunction with the bar model. Promote the math problem-solving abilities of Math 1 students by analyzing all students' math problem-solving abilities compared to the 70% threshold. This will use the information obtained to help design the next operating circuit to be more efficient.

3. RESULT AND DISCUSSION

The students in the target group improved their ability to solve math problems after class a lot more than before class, and they were very chaotic. Through appropriate allocation of time to solve problems and behavioral observation, it is found that students have the behavior to show the ability to solve problems. According to the mathematical search of items that need to be observed for behavior, there is a higher incidence of behavior in each learning activity plan (Figure 1).

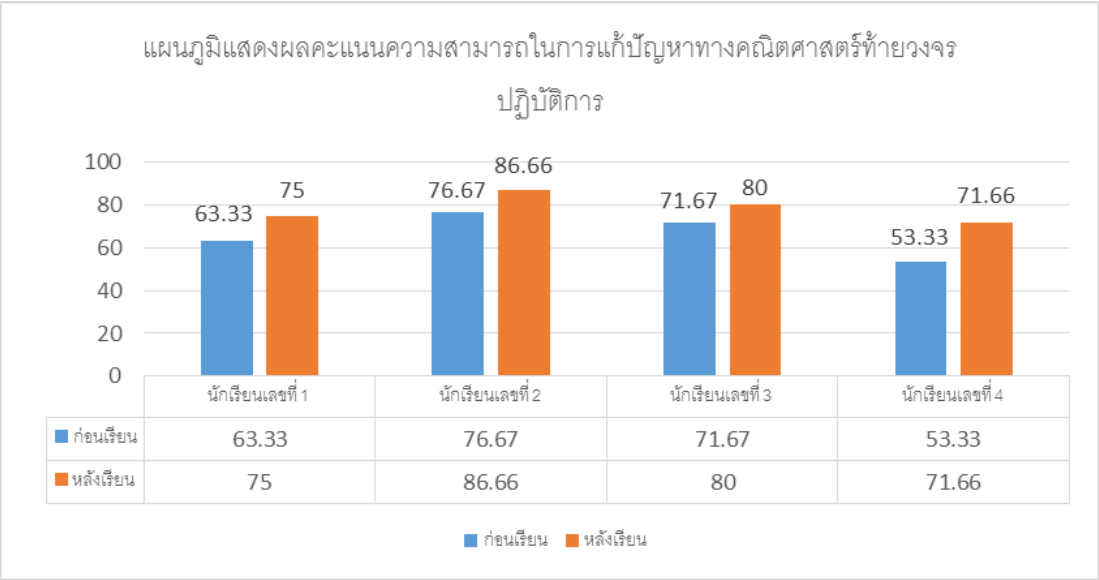

Figure 1 Comparison of students' mathematical problem solving ability

Figure 1 shows that students have the ability to solve mathematical problems according to the items they want to observe, and the rate of behavior increases with every learning management plan. Identify what the problem is and what you want to know. Plan a solution by drawing a model bar. Display each variable with the appropriate symbols. Performing mathematical operations and write one-variable linear equations. It can proceed according to the laid-down guidelines by showing how to systematically perform mathematical operations, finding the result of a single-variable linear equation. It also summarize the results of the solution according to what you want to know (Willyarto et.al., 2015; Osman et.al., 2018; Ramasamy & Puteh, 2018). Bar models are drawn to see concretely, easier to look at solutions It was also a mutual aid for friends to practice presenting in front of the class.

The ability to solve math problems of 1st graders was learned by organizing learning activities based on constructivist theory in conjunction with model bars. It was found that 70 percent of all students had the ability to solve math problems. This is due to the plan of learning activities based on constructivist theory in conjunction with effective model bars. focusing on solving mathematical problems that aim for students to create new knowledge by applying experience, knowledge, understanding, and ideas to solve math problems. The key steps are:

- A preliminary step to the lesson (Preparation) to generate interest To encourage students to be prepared. Review previous knowledge and inform students of the objectives of learning each hour so that they can relate to the creation of new knowledge.
- Construct is the stage where students will face problems and solve them on their own. The teacher presents the problem in the form of an activity sheet. Students use their knowledge, experience, and understanding. Plan a solution by drawing a model bar. Determine how to perform mathematical operations. Write one-variable linear equations. Systematically execute the plan. The answers obtained by searching for answers are summarized on their own.
- Cognitive reflection in small groups (Interaction) divides students into small groups. Groups of 2 Discuss ways to solve each other's problems. Exchange ideas in small groups, help each other investigate, and select appropriate

solutions to problems. The teacher facilitates and encourages the exchange of learning in the group.

- Guidelines the representative of the small group will present the solution to the problem to the whole class. Discuss, question, propose group guidelines, and verify accuracy and reasonableness. The teacher presents an approach that the student has not yet presented and compiles a reasonable, correct solution that the whole class accepts. Discuss the advantages and limitations of each choice and then summarize the best approach.

The teacher provides additional conclusions so that students can examine their ideas and correct principles to measure their ability to solve mathematical problems, which can be measured by doing a mathematical problem-solving ability assessment created by the researcher that covers the students' abilities in four aspects: 1) Understanding the problem, i.e., the student analyzes the problem, 2) Problem-solving, planning students plan to solve problems by drawing bar model (Schoenfeld & Kilpatrick, 2008; Kho et.al., 2014; Olteanu, 2017). Display each variable with the appropriate symbols. Choose a mathematical operation method and write a one-variable linear equation, 3) Plan execution requires that students follow the guidelines laid down by showing how to systematically perform mathematical operations to find the result of a one-variable linear equation, and 4) Summary of answers: Students summarize the results obtained from solving problems in accordance with what they want to know.

4. CONCLUSION

The results of the first grade mathematics course based on the constructivist concept and the Bar model. It has an average assessment result of 4.65, the most appropriate level. Ability to solve math problems of students before the activity, the student passes the criteria. 70% of 2 students out of 4 students (50%) had an average of 66.25% and a standard deviation of 2.55%. 70% of people, or 100%, have an average of 78.33% and a standard deviation of 1.63%.

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