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Application of Jerome Bruner's Learning Theory in Learning Mathematics in Elementary School

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A B S T R A C T

The purpose of this study is to characterize how Bruner's Theory of Mathematics Learning is implemented in the 2023–2024 school year at the Tega Green School of Papua, located in the Wolo District of the Jayawijaya Regence, Papua Pegunungan Province. The success and challenges of applying Bruner's theory to learning are another objective of this study. Applying Bruner's Theory will make learning more dynamic, efficient, and proficient. The use of Bruner theory to first-grade mathematics instruction at Tega Green School in Papua has piqued the curiosity of researchers. This study is a qualitative descriptive study. The subject or object in the school is the focus of the researcher's investigation. The researcher uses documentation, observation, and interviews to discuss the data. The findings of this study indicate that teachers can apply Bruner's theory, which identifies three shapes—enactive, iconic, and symbolic—in the classroom. This approach is only effective for a year. As a result, teachers may help kids become more creative and increase their comprehension and counting skills

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INTRODUCTION

Mathematics learning aims to help students understand mathematical concepts, principles, and skills and apply them in everyday life. According to Kholid (Budiman & Trimurti, 2023), understanding numbers is the first step in learning mathematics for students in lower elementary schools. According to Heruman (Pramudita, Wahyudi, Joharman, 2019), the concrete operational phase is the development phase of elementary school children, according to Piaget's theory. Mathematics learning in Indonesia aims to develop students' abilities in using numbers conceptually and flexibly, as well as improve critical thinking, logic, and problem-solving skills. This is important to help students face challenges in everyday life. One of the characteristics of mathematics learning in Indonesia is as follows: (a) Concept-Based and Contextual Approach, which emphasizes understanding concepts rather than memorizing formulas. In order for mathematics to be easier for students to understand and use, teachers must use real-life examples. (b) Problem Solving and Critical Thinking: Learning is designed to challenge students to think critically, creatively, and logically as they face problem-solving-based tasks. This is in accordance with the demands of 21st-century education which emphasizes high-level thinking skills (HOTS). (c) Use of Technology and Learning Media: The development of technology encourages teachers in Indonesia to use technology in mathematics learning, such as learning applications, mathematics software, and digital media to demonstrate difficult concepts. (d) Basic Skills Challenges and Access Gap: Despite efforts to improve mathematics learning, basic skills and access to education are still a problem, especially in remote areas of Indonesia.

The importance of understanding ideas and structures from the concrete to the abstract level is emphasized by Jerome Bruner's learning theory. Bruner argues that cognitive structures are a common way for people to perceive and generalize the external physical world, and that learning is to form knowledge structures from all subjects in students' minds. According to Bruner, learning is the organization and reorganization of cognitive structures. The formation of cognitive structures is also an important internal component. This is the basis for learning and understanding new information, (Weng, 2018). In modern education, the theory of cognition is an approach that focuses on how individuals process, store, and manage information. This theory seeks to understand how the human mind processes information by emphasizing mental processes such as problem solving, memory, and attention, (Nasar, 2024).

Bruner's theory emphasizes three stages of learning involving three types of representation. The enactive stage involves direct experience with real objects or situations, the iconic stage involves visual representations or mental images of objects or situations, and the symbolic stage involves the use of symbols, such as numbers or mathematical symbols, to represent objects or situations in designing interesting and meaningful learning experiences for students, (Safari & Inayah, 2024). Students at the Green School Papua Elementary School in Wolo, Jayawijaya Regency, had difficulty understanding arithmetic operations such as addition, subtraction, multiplication, and division. Based on this data, the researcher conducted observations and taught in elementary schools, using

teaching aids such as oranges and drawing boxes on the computer and printing them on paper. The teachers who teach at the school are Rahel and Nike. This study discusses the importance of understanding and applying Bruner's theory in mathematics education, especially in terms of solving problems and solving problems. This study emphasizes the role of mathematical literacy, such as minus, add, take, and give again, in improving students' understanding and application of theory.

LITERATURE REVIEW

Learning mathematics includes a deep understanding of concepts, logical thinking patterns, and problem-solving skills. Learning mathematics is not just memorizing formulas or procedures; it also includes a strong understanding of basic concepts, analytical thinking skills, and the ability to connect concepts to each other (Siagian, R, 2022: 37). According to Priatna (Febrianti & Purwaningrum, 2021) many students have difficulty learning mathematics. One of the difficulties is the low ability of students because in general students prefer to memorize rather than practice and analyze. In fact, mathematics is a formula that must be understood by students to know the meaning and purpose of the formula.

METHODOLOGY

This study uses qualitative methods by means of interviews, observations and documentation related to research problems, (Sugiyono, 2008). The selection of qualitative methods allows researchers to obtain accurate data according to the conditions of Green School Papua Elementary School students. The main object of this study is the application of Jerome Bruner's learning theory to overcome students' difficulties in understanding various arithmetic operations, especially addition, subtraction, multiplication, and division.

Jerome Bruner's learning theory is known as Cognitive learning theory, which emphasizes how important cognitive structures are in learning. Febrianti and Purwaningrum (2021) explain that Jerome Bruner's Theory uses student-centered learning, also known as discovery learning, to actively seek and obtain information about the experiences he has had. By teaching students to actively seek knowledge, students naturally seek answers to problems and produce results for themselves. independently to produce truly significant knowledge.

This study aims to explain the ways in which students learn mathematics in the classroom using Bruner's theory to teach addition and subtraction. Mathematics learning activities for addition and subtraction materials at SD Tega Green School Papua, located in Wolo District, Jayawijaya Regency, Papua Mountains.

RESULTS AND DISCUSSION

American developmental and cognitive psychologist Jerome Bruner. He combines classroom teaching with psychological research in his work. He conducted research to reawaken people's curiosity about "cognitive processes," namely the retrieval, storage, and communication of knowledge. Laboratory research on the issue of "cognitive processes" involving thinking and learning skills has been advocated by Bruner, (Tampubolon, 2018).

Bruner called cognitive structures "representations" and argued that representations can be divided into three types: action representations, image representations, and symbolic representations. The so-called behavioral characteristics mainly refer to relying on actions to understand the world, for example, two-year-old babies often rely on actions to understand the world. As children grow older, they begin to use visual and auditory representations or images in their minds to represent external things and try to solve problems through images. We call these representations image representations.

Starting from about six or seven years of age, individuals can use symbols such as language and numbers to represent experiences, while using these symbols to learn and gain experience. We call these representations symbolic representations. The three representations do not exist in isolation. As individuals develop to a certain stage, the three representations coexist in the individual's cognitive structure, complement each other, and work together in cognitive activities.

According to Bruner's discovery learning theory, learning is an active process that allows people to discover new things using existing information. Dewi (Dina, Lastari, Isna, 2023) explains that learning consists of three cognitive processes: obtaining new information, changing the information received, and evaluating the relevance and truth of knowledge. Learning mathematics means learning about mathematical concepts and structures that exist in the material being studied and looking for relationships between those mathematical concepts and structures. Sundari and Fauziati (2021) explain that Bruner describes learning as an activity in which students actively participate in problem solving and teachers encourage students to experience experiences that allow them to find and solve problems that are appropriate to their level of development.

Based on the findings from interviews conducted by researchers with mathematics teachers who teach mathematics subjects in elementary schools, the teachers have indeed used Bruner's theory in their learning, but not fully. The following figure shows the application of Bruner's theory of iconic and symbolic in mathematics learning, using a White Board.

Figure 1. Application of Bruner's Theory (Iconic and Symbolic)
Location: Tega Green School Papua

Figure 1 shows that this school has implemented Bruner's theory. Although not perfect, the theory can be applied well in schools. Figure 01 shows that educators have implemented Bruner's theory in mathematics learning. Children in this school are miles away from the district capital, but elementary school teachers have used Jerome Bruner's theory in their learning.

The results of research conducted by Budiman and Trimurtini (2023) found that the results of Iconic Representation (pictures) and Symbolic Representation (numbers) based on Bruner's theory have been proven to help students in learning addition and subtraction because they help them visualize mathematical operations. The results of research conducted by Wen (2018) found that the application of Bruner's theory in mathematics learning can increase students' cognitive engagement by encouraging them to engage in the learning process with their own hands by manipulating real objects before moving on to visual and symbolic representations. This condition can increase students' cognitive engagement and help them associate mathematical concepts and real experiences.

Figure 2. Block Images Are Given to Children on Paper
Location: Papua Green School

Students enthusiastically hold Student Worksheets (LKS) containing blocks on paper, as shown in Figure 02. This LKS is a classic example of the addition calculation technique. Studies show that students here already know numbers from 1 to 10. They are also able to calculate additions that result from 1 to 5, and 1-10. Everything is done using a whiteboard: fingers, pawns (bamboo pieces), oranges, and blocks. Students can learn it if the image is printed on a computer and given as an LKS. as shown in the picture above.

The researcher found that 18 elementary school students were very enthusiastic about learning basic mathematics, especially the concept of addition and subtraction, when the teacher used concrete teaching aids. In learning using concrete teaching aids, such as pawns, pebbles, and oranges. This is the right place to contextualize mathematics learning. According to Bruner's theory, the use of concrete teaching aids such as fruit, pawns, and pebbles is called enactive. Therefore, the study shows that SD Tega Green School has implemented Bruner's theory in mathematics learning, especially with addition and subtraction material.

The children then do drills or exercises after being taught using Whiteboard. Furthermore, assignments are given using student worksheets (LKS), as shown in picture number 02. Students work alone. By counting blocks or boxes on paper, the teacher prepares boxes called iconic, and students also write numbers in the boxes to make it easier for them to count. For example, take numbers from 1 to 5, where the sum is below 5. For example, 1 + 1 = 2, 3 + 2 = 5, 2 + 2 = 4, and 4 + 1 = 5. This is a representation. while the enactive form, which is the actual form of something, such as two oranges plus three oranges will produce five oranges. Basically, it has been seen that at SD Tega Green School Papua, Jerome Bruner's theory has been applied in mathematics learning, especially in terms of addition and subtraction.

Research conducted by Febrianti and Purwaningrum (2021), in this study used the enactive, iconic and symbolic stages. At the enactive stage, students learn the concept of numbers, using real objects, such as marbles or blocks. In this concept, students not only gain knowledge about numbers, but also understand the quantitative relationship between objects. At the iconic stage, students use images. For example, they make a number line that shows operations such as addition or subtraction. This method helps students connect enactive activities with visual representations of the idea. The last is the symbolic stage, namely students use symbols or numbers abstractly without the help of concrete objects or visuals. They realize that numbers show deeper concepts. For example, the number "2" is not only a symbol, but also shows two real objects or one quantity in some situations

CONCLUSIONS AND RECOMMENDATIONS

This study reached several conclusions, such as that using Bruner's theory and implementing three stages of learning (enactive, iconic, and symbolic) will help students learn gradually. Students start with the manipulation of real objects (enactive), then move on to visual representations (iconic), and finally understand abstract mathematical notation (symbolic). Gain practical experience: Students can learn addition and subtraction directly by using real objects, such as marbles or pieces of paper, pictures of boxes, or pieces of bamboo. This makes the concept easier to understand and internalize. In addition, visualizing concepts helps students understand the relationship between numbers and operations. They can see the process of addition and subtraction through pictures of boxes and diagrams. Use of Symbols and Notations: Once students understand basic concepts through experience and visualization, they can move on to using mathematical symbols and notations. This prepares them for more complex operations in the future. Bruner's approach has been shown to encourage students to actively participate in the learning process. This method encourages students to not only be passive listeners but also to actively participate in researching and understanding mathematical concepts.

FURTHER STUDY

This research still has limitations, so it is necessary to carry out further research related to the topic of Application of Jerome Bruner's Learning Theory in Learning Mathematics in order to improve this research and add insight to readers.

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