Research the Cognitive Processes of Junior High School Students in Solving Algebraic Counting Problems in Story Problems; a Phenomenological Study

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Abstract

This research aims to analyze the cognitive processes of Al Hidayah Integrated Middle School students in solving arithmetic problems related to algebra in story problems. This research was conducted qualitatively with a phenomenological design using 2 high category students and 2 low category students to achieve data saturation. Supporting instruments include student answers and interview results related to algebra. This research concludes that students' cognitive processes in solving numeracy problems related to algebra in word problems in the high and low categories have different images. This difference in intelligence has an impact on solving mathematical problems. This research can help enrich understanding of students' cognitive processes and contribute to the development of better mathematics learning strategies and curricula.

Keywords: *Cognitive processes; Algebra; and Phenomenological Studies.*

Abstrak

Penelitian ini bertujuan untuk menganalisis proses kognitif siswa smp terpadu al hidayah dalam menyelesaikan soal-soal berhitung yang berkaitan dengan aljabar dalam soal cerita. Penelitian ini dilakukan secara kualitatif dengan desain fenomenologi menggunakan 2 siswa kategori tinggi dan 2 siswa kategori rendah untuk mencapai kejenuhan data. Instrumen pendukung berupa jawaban siswa dan hasil wawancara terkait aljabar. Penelitian ini menyimpulkan bahwa proses kognitif siswa dalam memecahkan masalah berhitung yang terkait dengan aljabar dalam soal cerita pada kategori tinggi dan rendah memiliki gambaran yang berbeda. Perbedaan kecerdasan ini berdampak pada saat menyelesaikan masalah matematika. Penelitian ini dapat membantu memperkaya pemahaman tentang proses kognitif siswa dan berkontribusi dalam pengembangan strategi dan kurikulum pembelajaran matematika yang lebih baik.

Kata Kunci: Proses Kognitif; Aljabar; and Studi Fenomenologi.

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INTRODUCTION

Mathematics learning plays an important role in developing science and technology (Ministry of Education and Culture, 2017). Mathematics learning is closely related to problem solving in the form of abstract questions and questions. According to Hudojo (Rif'atul & Kurniasari, 2016), problem solving itself is a process carried out by students to solve algebraic calculation problems in the story problems they are facing until the problem is no longer a problem for students. Sumargiyani and Hibatallah (2015) stated that problem solving is not only a form of ability to apply information that is already known through learning activities, but more than that, it is a process of obtaining information that is proven to be applicable according to the situation at hand. Mathematical problem solving is a cognitive activity used in the process of overcoming a problem that a person is facing by requiring several strategies (Harahap & Surya, 2017).

Problem solving can help students to develop the ability to think, solve problems, and develop their intellectual skills (Safrida, Susanto, & Kurniati, 2015). In line with that, Adhar (2012) stated that problem-solving abilities are very important in mathematics lessons. Not only for those who want to study mathematics, but it is useful for someone who will apply it in other subject areas and in everyday life. This is reinforced by the opinion of Yarmayani (2016) who states that mathematical problem solving ability is the ability where students try to find a way out to achieve the goal of solving a problem. So, problem solving is a basic skill that everyone must have.

Cognitive refers to a known process, including knowing as defined by Pantsar (2019). These processes involve leveraging existing knowledge, integrating it with new knowledge, and using the resulting capabilities to make decisions, as described by Basir et al. (2022) Furthermore, cognitive processes relate to individual mental processes, specifically regarding the view that the mind has internal mental states such as beliefs, desires, and intentions, which can be understood through information processing.

According to Ferri (2006), the six components of the cognitive process are mathematical communication, forms of representation, mathematical problem

solving, mathematical argumentation, modeling, and technical abilities and skills. Cognitive processes are needed by each student to receive, store, retrieve and process data about the process of solving mathematical problems (Fauziyah et al., 2022). Cognitive processes and mathematical problem solving are interrelated, so that problem solving can be understood as a cognitive process where students know facts, processes, concepts and procedures and then apply this knowledge to solve problems in the context of real situations (Kuncoro et al., 2022).

Hayuningrat and Listiawan (2018) described students' thinking processes using a reflective cognitive style in solving algebraic problems in story problems. Based on several studies on cognitive processes that have been carried out previously, there is still a need to discuss students' cognitive processes related to algebra problem solving in story problems. Analyzing the cognitive processes involved in solving mathematical problems can provide insight into students' basic abilities in solving algebraic problems in word problems.

The cognitive processes in this research are focused on the cognitive process of knowing, the cognitive process of applying, and the cognitive process of reasoning. This research focuses on algebra in word problems. because based on the opinion of Sujadi et al. (2022), one of the most challenging questions in numeracy is the content of changes and relationships related to algebraic material. This research aims to analyze students' cognitive processes in solving numeracy problems related to algebra.

RESEARCH METHODS

Qualitative research was chosen as an alternative approach to conducting this research. Qualitative research aims to understand and analyze social and human behavior experienced by those involved in a particular social context (Ary et al., 2010). Qualitative methods allow researchers to understand the cognitive processes in solving algebraic calculation problems in more depth. A phenomenological design was chosen because it allows researchers to explore students' experiences in solving algebraic numeracy problems in word problems. The researcher, as the key instrument, has full control over the entire research

process. Apart from that, researchers also used auxiliary instruments in the form of student answers and interview results related to algebraic calculation questions in story problems.

RESULTS AND DISCUSSION

This research contributes to a deeper understanding of the cognitive processes involved in algebra in story problems in 7 th grade students at Alhidayah Integrated Middle School and provides valuable implications for teaching and learning strategies in mathematics education. Numeracy questions consist of one stimulus with one question representing different cognitive processes. The numeracy questions used in this research are structured based on the cognitive process, namely the cognitive process of knowing. In a question describing the cognitive process of knowing, students are asked to find a circumference. The results of cognitive analysis of students in the high and low categories in solving questions about algebra in story problems/

1. In the high category

The high category consists of two subjects, namely S1 and S2. The results of the high category cognitive process analysis are based on data from each high category subject obtained from the subject's answers and interviews.

The cognitive process of knowing

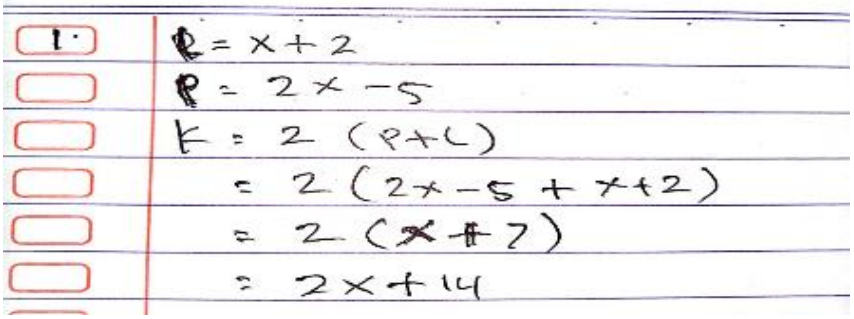

Figure 1. Process Student Answers to Number 1

Q: "Which formula do you use?"

S: "Circumference formula, sis."

Q: "What does the formula deck look like?"

S: "This is the formula, sis. k=2(p+l)"

P: "That means you already understand the circumference material"

S: "Yes, bro, I have"

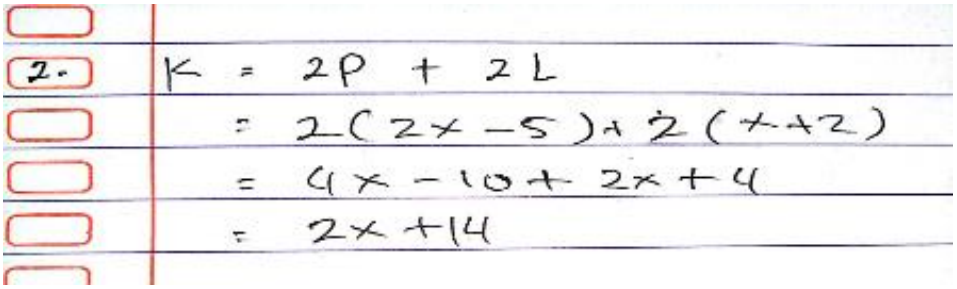

Figure 2. Process Student Answers to Number 2

Q: "Which formula do you use?"

S: "Circumference formula, sis."

Q: "Why is the circumference formula not the same as this one k=2(p+l)?"

S: "I use the formula k=2p+2l"

P: "Oohh...yes the deck is the same if you multiply it by 2, the length is the same as the width"

S: "Yes sis"

Two subjects in the high category knew that the counting questions were related to circumference. Clear subject when asked why the material is a circumference. Two subjects in the high category knew that length had the symbol p, and width had the symbol l. calculate circumference. S1 uses the formula k= 2 (p+l) S2 uses the non-formula approach k = 2p + 2l.

2. Low category cognitive processes

The low category consists of two subjects, namely S1 and S2. The results of the low category cognitive process analysis are based on data from each low

category subject obtained from the subject's answers and interviews. The results of the analysis presented are the results of the overall analysis according to each cognitive process.

The cognitive process of knowing

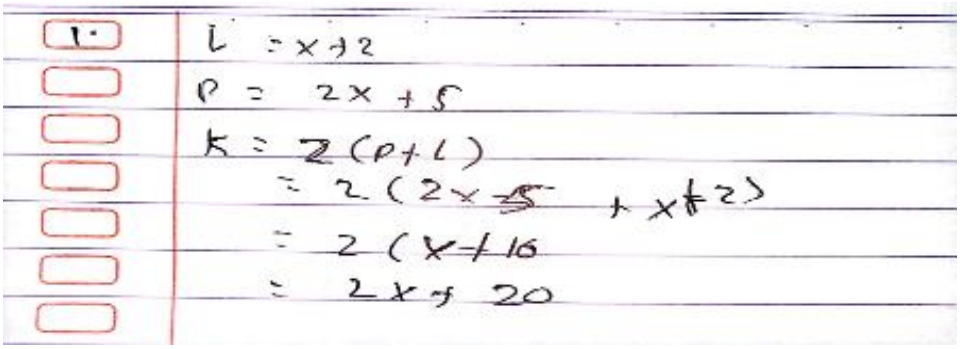

Figure 3. Process Student Answers to Number 1

Q: "Where do the 2x+5 and x+2 decks come from?"

S: "Sis...that's the length and width."

Q: "The results are wrong, right?"

S: "I don't know, sis.."

Q: "Is this the correct deck with a result of 4x+20?"

S: "That means I'll just multiply it, sis..."

P: "Yes sir"

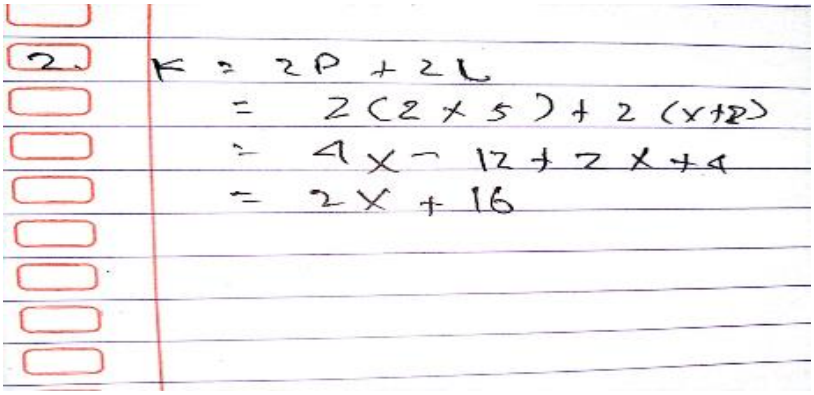

Figure 4. Process Student Answers to Number 2

Q: “Where does this 4x-12+2x+4 deck come from?

S: "That's from the results that are multiplied."

Q: "The results are wrong, right?"

S: "How is that possible sis?"

Q: "The result of 2 times 5 is 10, how come you get 12?"

S: "Sorry sis...I wasn't careful enough"

It is clear that two low category subjects already know that the material related to the question is circumference with S1 using the formula k=2(p+l) while S2 uses the formula k=2p+2l. Regarding facts about circumference such as length and width. Subjects already know how to look for differences that influence answers.

Based on low understanding and lack of accuracy in facts regarding perimeter, two subjects knew how to find perimeter but were wrong in S1 addition while S2 was multiplication. Subjects need to be given an understanding to be more careful in multiplying and adding numbers.

The results of the description of students' cognitive processes are in the high category, namely, in the cognitive process of knowing, students remember the surrounding material where the concepts explained are only in general terms. In the cognitive application process, students can create a model based on a counting task after being given a formula and then apply the model that has been created. In making the model, the subject did not experience difficulties so he could solve the problem. After being given the formula for finding the perimeter, two subjects can create a model and apply the model that has been created. The results of research on the cognitive reasoning process show that students already understand it well. Subjects are used to working on questions with formulas, so that when faced with questions with different formulas (with reasoning), subjects are able to do it.

The results of the student's cognitive process are in the low category, in the cognitive process of knowing, students have remembered the concept. Subjects in the low category had difficulty in stating facts in determining the

circumference and were simply not careful in addition and multiplication. Subjects are accustomed to changing contextual problems in length and width within a circumference but are not careful in the process of multiplication and addition. During the cognitive process of applying, students are required to retrieve formulas from memory, thus enabling them to apply them independently (Johns et al., 2022). When the subject is told the formula for finding the circumference using the process of addition and multiplication, the subject can continue with the next calculation process. Students can analyze the questions in the questions, so that the answers given are almost correct (Hutajulu et al., 2019). Subjects in the low category still need a companion to provide formulas in order to solve the questions. The results of research on the cognitive reasoning process show that students experience difficulties in the multiplication and addition process. This can be caused by students not being careful in the multiplication and addition process.

Based on the results of student work and interviews, it is known that several factors influence students' cognitive processes in solving numeracy problems in algebra, such as numeracy ability and learning motivation. Isnarto (2016) stated that problem solving requires understanding the problem, identifying concepts, finding generalizations, making plans, and organizing previous skills. This can help teachers develop effective learning strategies to help students overcome the difficulties faced in solving algebraic calculation problems. The implication of this research for mathematics learning in schools is that teachers can use this research to develop more effective learning strategies, such as providing more structured learning material and opportunities to practice solving numeracy problems in algebra. This research can help improve abilities. Students in solving counting problems in algebra in word problems and strengthening mathematics learning at school.

CONCLUSION

The results of the description of students' cognitive processes in the high category are, in the cognitive process of knowing, students remember the surrounding material where the concepts are clear and precise with the formulas k=2(p+l) and k=2p+2l. Students understand length and width using the process of multiplication and addition to identify how to find the circumference. In the cognitive applying process, students create and apply models according to the numeracy task after being told the formula. The results of students' cognitive processes are in the low category, namely in the cognitive process of knowing, students remember the concept of the circumference formula but are wrong in the process of addition and multiplication. Students mention and identify several facts in the perimeter formula. In the cognitive process of applying, students need to be told the formula, then students can apply it independently. Researchers can use the results of this research as a basis for conducting further research on students' cognitive processes in solving algebraic calculation problems, as well as exploring other factors that influence students' abilities in solving mathematical problems.

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