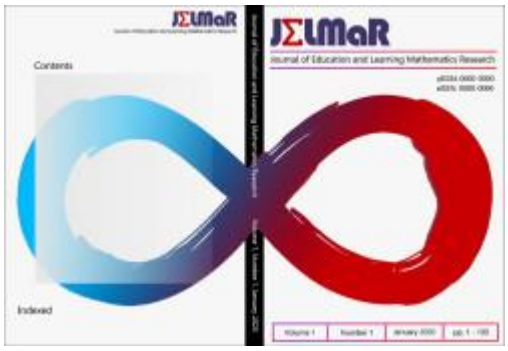

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Awareness About Mathematical Patterns in MI Muhammadiyah 3 Jogoroto Jombang Students

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Abstract: *Awareness of patterns in this study is closely related to generalization. This awareness is the condition of someone who can know there is an order in the pattern, can mention the structure of the given pattern and can determine the next pattern. One of the basic skills in learning mathematics is generalization. This research is a descriptive quantitative research that aims to describe awareness of mathematical patterns in grades 4, 5 and 6 of MI Muhammadiyah 3 Jogoroto Jombang. The sample of this research was 89 students in grades 4, 5 and 6 of MI Muhammadiyah 3 Jogoroto Jombang. All students were given questions about number patterns and figure patterns and then conducted interviews. The results showed that students' awareness of number patterns was 80,65% for 4th grade , 95,83% for 5th grade and 97,06% for 6th grade . Meanwhile, students' awareness of figure patterns was 87,09% for 4th grade, 95,83% for 5th grade and 100% for 6th grade. Based on the results of this study, it can be seen that students in grades 4, 5 and 6 of MI Muhammadiyah 3 Jogoroto Jombang are already able to recognize pattern regularity, can mention the pattern structure and can determine the next pattern, which is limited in number. Students have not been able to determine the number of elements (structures) in the n-th pattern.*

Keyword: Awareness, Generalization, Mathematical Pattern

INTRODUCTION

Based on the 2013 curriculum, number patterns and arithmetic sequences are one of the important materials. This is because the concept of number patterns is very applicable in everyday life, starting from patterns deliberately made by humans, such as house numbers, to patterns that exist in nature, such as Fibonacci number patterns in flowers and animals (Lessy, 2021). Even though new pattern material is taught to junior high school students in mathematics. But in elementary schools there is also pattern recognition, although not as extensive as material for junior high schools. Generalization of mathematical patterns is one part of algebraic thinking. Instilling algebraic thinking in elementary schools will reduce the problems faced when students are faced with formal algebra lessons in secondary schools (Payne, 2012). Generalization is a high-level thinking process in mathematics (Yuni & Fisa, 2020). Generalization is also important to support various topics in mathematics learning (Setiawan et al., 2020; Chua & Hoyles, 2014; Afriansyah et al, 2019). So that generalization becomes an important part of learning mathematics.

Permendiknas Number 22 of 2006 which states the purpose of studying mathematics: to use reasoning on patterns and properties, perform mathematical manipulations in making generalizations, compile evidence, or explain mathematical ideas and statements. Reasoning plays an important role in the success of students. Students with good reasoning are expected to have good mathematics learning achievements as well. One of the important reasoning mastered by students is generalization. Generalization or

concluding is the stage for understanding the essence of the subject matter that has been presented (Yuni & Fisa, 2020).

Generalization is a discovery by reflecting on several cases, a general description that can be applied to all cases (Rivera, 2011). Mathematical generalization is a statement that some properties or techniques apply to a set of mathematical objects or broader conditions (Carraher et al., 2008). Awareness of mathematical patterns in this study is related to generalization because students observe patterns and determine the next term of a pattern. According to Marzano there are four stages in the generalization process, namely (1) perception of generality, namely the process of perceiving or identifying patterns; (2) expression of generality, namely determining the structure or data or picture or next term from findings or pattern identification; (3) symbolic expression of generality, namely formulating generality symbolically; (4) manipulation of generality, namely solving problems using the results of generalizations (Yuni & Fisa, 2020).

In addition to the four stages of the generalization process, what must also be considered is the generalization requirements. According to Soekadijo, a proposition can be said to be generalized if it fulfills three conditions, namely: (1) Generalization must not be limited numerically. That is, generalizations are not tied to a certain amount. If it says "all P is Q", then the proposition must be true, regardless of the value of P. In other words, the proposition applies to all subjects that meet P. (2) Generalization is not limited in space and time, meaning it is not limited spatio-temporally, it must apply anywhere and anytime. (3) Generalizations must be used as a basis for assumptions (Yuni & Fisa, 2020). Giving assignments about generalizing figure patterns can develop and improve problem solving abilities, algebraic thinking and understanding of geometric and spatial relationships (Kilic, 2016; Mulyani, Indah & Satria, 2018). Apart from that, it can also increase student creativity through assignment of figure patterns (Vale, Pimentel, Cabrita & Barbosa, 2021). Giving repeated exercises to find relationships in patterns and making generalizations will enable students to understand problems in real life (Faturohman & Afriansyah, 2020).

Patterns are an important part of mathematics because the basic principles of mathematics in schools are built from generalizing patterns to numbers (Fyfe et al, 2017). A mathematical pattern is any predictable regularity, usually involving numerical, spatial or logical relationships (Mulligan & Mitchelmore, 2009). Patterns can be described as systematic arrangements of numbers or shapes that follow certain rules (Smith et al., 2018). Patterns consist of three types, namely simple repeating patterns, growing (developing) patterns and symmetrical patterns (Smith et al., 2018). In addition, there are two types of pattern assignments, namely number and figure (Somasundrum et al., 2019). The patterns to be used in this study are number patterns and figure. For figure patterns using repeating patterns and growing (development) patterns. Within the pattern there is a structure that forms it. The structure can be observed in the pattern of figure and numbers (numeric). In order to understand patterns, children must be able to identify similarities and differences between objects and their order i.e. what came before, what came after. Attributes that vary in pattern include: color, shape, size, texture, position and amount (Smith et al., 2018). Sometimes to make a pattern you can use a combination of several of these attributes. The results of the research show that the task of figure patterns can lead to figure and numerical strategies. Whereas the number pattern assignment only raises numerical strategies (Lie, Zhi & Sean, 2017).

There are several strategies that can be used to generalize numbers including calculation, recursion, whole-object, contextual, guess and check, rate-adjust. In the calculation strategy there are activities to construct a model that represents the situation and calculate based on the properties requested. In the recursion strategy, the previous rule is formed in the sequence to determine the next rule (to determine the value obtained

from the previous value). The whole-object strategy uses parts of a unit to construct a larger unit using unit multiplication. Contextual strategies, constructing formulas on the basis of relationships that are determined from a problem. Guess and check strategy, guessing a rule without paying attention to the reasons. In the rate-adjust strategy, using the change in value as a multiplier. Adjustments are then made by adding or subtracting these values to achieve a certain value (Lannin, 2003).

Students who recognize the structure of mathematical processes and representations show good mathematical understanding (Mulligan & Mitchelmore, 2009). Awareness of patterns is the state of a person who can recognize pattern structures, can identify patterns and can determine the structure or description of the next pattern. Indicators of awareness about mathematical patterns in this study are that the subject knows there is regularity in the pattern, can mention the structure of the pattern given and can continue the pattern given. The results of pattern exploration research on elementary school students showed that elementary school students in grades 1 and 2 were able to solve simple pattern problems. Students are able to continue and identify simple pattern rules (Rusdiana, 2020). The results of another study showed that grade 5 students were better at working on number pattern problems than figure patterns. Many students have not been able to determine the nth term (n is more than or equal to twenty) which is determined by the problem (Somasundrum et al., 2019). Based on the background of the problems that have been stated above, the formulation of the problem in this study is how is the awareness of mathematical patterns in grades 4, 5 and 6 of MI Muhammadiyah 3 Jogoroto Jombang?

METHOD

This research is a descriptive quantitative research. This study aims to describe awareness of mathematical patterns in grades 4, 5 and 6 of MI Muhammadiyah 3 Jogoroto Jombang. The results of the study are described using descriptive statistics based on indicators of awareness of the mathematical patterns used. In addition, it also describes how students' awareness of number and figure patterns. Descriptive research is a description designed to describe symptoms, facts or events in a systematic and accurate manner, mapping facts based on perspective (a particular frame of mind at the time the research was conducted) (Abdullah, 2018).

The sample of this research was all students in grades 4, 5 and 6 of MI Muhammadiyah 3 Jogoroto Jombang as many as 89 students. All these students will be given questions about number patterns and figure patterns, then interviews will be conducted with these students. So the instruments for this research are test questions and interview guidelines. Methods of data collection through tests and interviews. After students work on questions and interviews, they will be analyzed according to indicators of awareness about mathematical patterns. The research results are presented using descriptive statistics based on indicators of awareness about mathematical patterns (number patterns and figure patterns). This research was conducted in the even semester of the 2022/2023 school year.

The research procedure begins with formulating the problem, identifying information through literature review, formulating research objectives, determining data sources, making instruments and validating instruments, giving tests and interviews to samples, analyzing data.

RESULT AND DISCUSSION

The following are the questions given to students in grades 4,5 and 6 of MI Muhammadiyah 3 Jogoroto Jombang. Problem number 1 (figure 1) is a number pattern and number 2 (figure 2) is an figure pattern. After students work on the questions, the student answers are checked and students are grouped based on correct and incorrect answers. In the group of students with correct answers, 4 students from each class will be selected to be interviewed. So there were 12 students who were interviewed, these students were selected by the mathematics teacher based on their communication skills. The results of this study will present written work and the results of interviews with one student to represent.

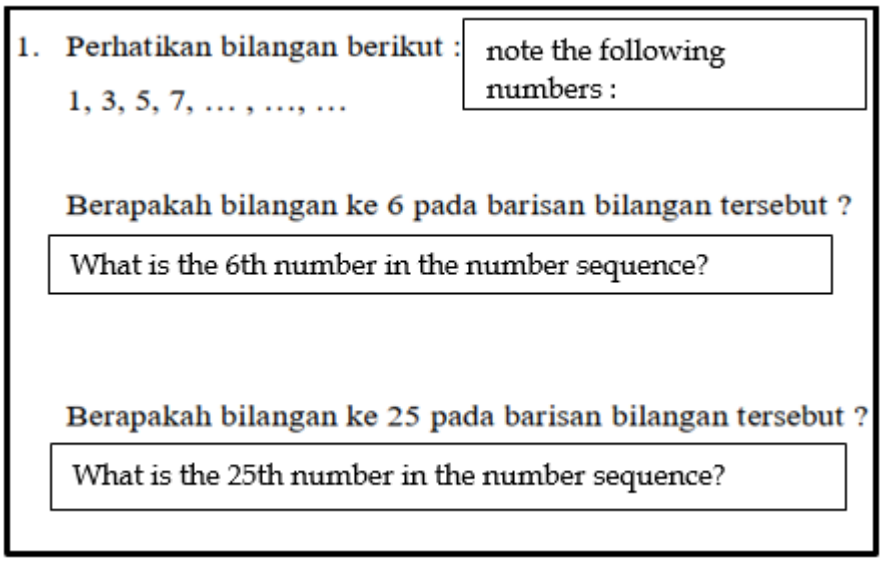


Figure 1. Test Question Number 1

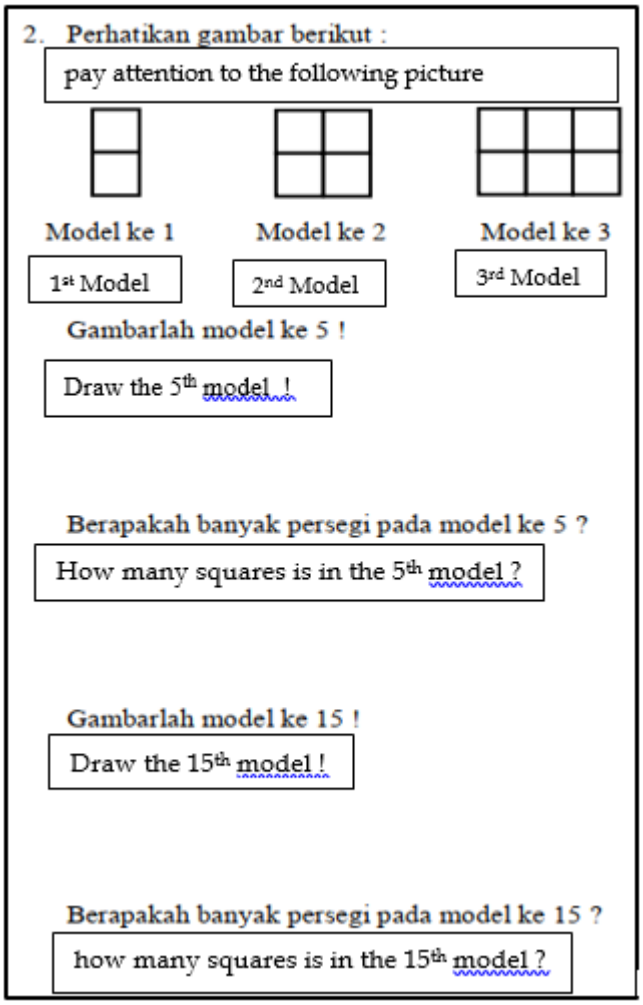
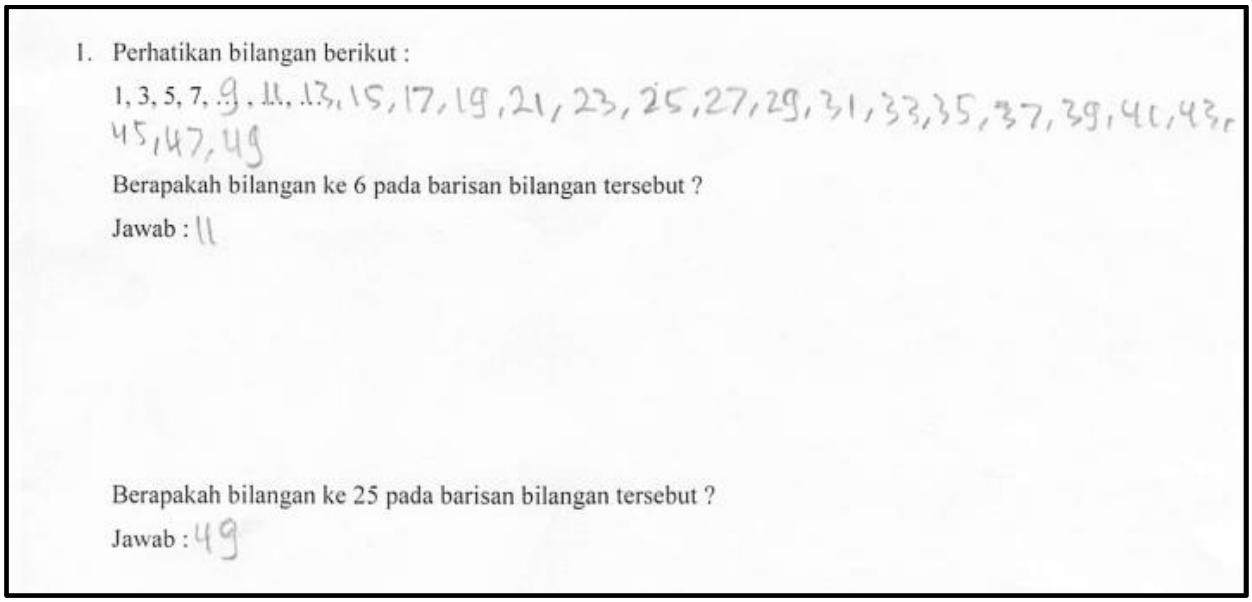


Figure 2. Test Question Number 2

The questions were given to 31 grade 4 students, 24 grade 5 students and 34 grade 6 students. Then the students' work was checked and interviews were conducted with students. The results of tests and interviews can be seen students' awareness of mathematical patterns. The following are the results of student work as shown in Figure 3 and excerpts of the interview for number patterns.


1. Perhatikan bilangan berikut :

1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49

Berapakah bilangan ke 6 pada barisan bilangan tersebut ?

Jawab : 11

Berapakah bilangan ke 25 pada barisan bilangan tersebut ?

Jawab : 49

Figure 3. Student Work On Number Patterns

Snippets of interviews with students:
P: From the sequence of numbers, what can you observe?
S : em..the numbers are sequential but skip two
P: What do you mean by two jumps?
S: after 1 it's 3, after 3 it's 5 so you add two more
P : how do you determine the 6th number from the number pattern?
S: yes, plus two, after 7 it's 9 after that it's 11. So the sixth number is 11
P : how do you determine the 25th number from the number pattern?
S : I did the same as before, I counted to the 25th number. So I found 49
P: What is the nth number in the number sequence?
S : em to n, yes count a b c d to n

Based on the results of student work and interviews it is known that students know there is regularity in number patterns. This can be seen from the students' answers during the interview which mentioned skipping two and adding two all the time. Students can mention the structure of the pattern given. This can be seen from interviews with students who stated that the sequence of numbers is sequential. Students can continue the pattern given. This can be seen from the students' written work, which shows that students can determine the 6^{th} and 25^{th} numbers from the given number sequence. However, students have not been able to determine the nth term of a given sequence of numbers. The following are the results of student work as shown in Figure 4 and excerpts of the interview for the figure pattern.

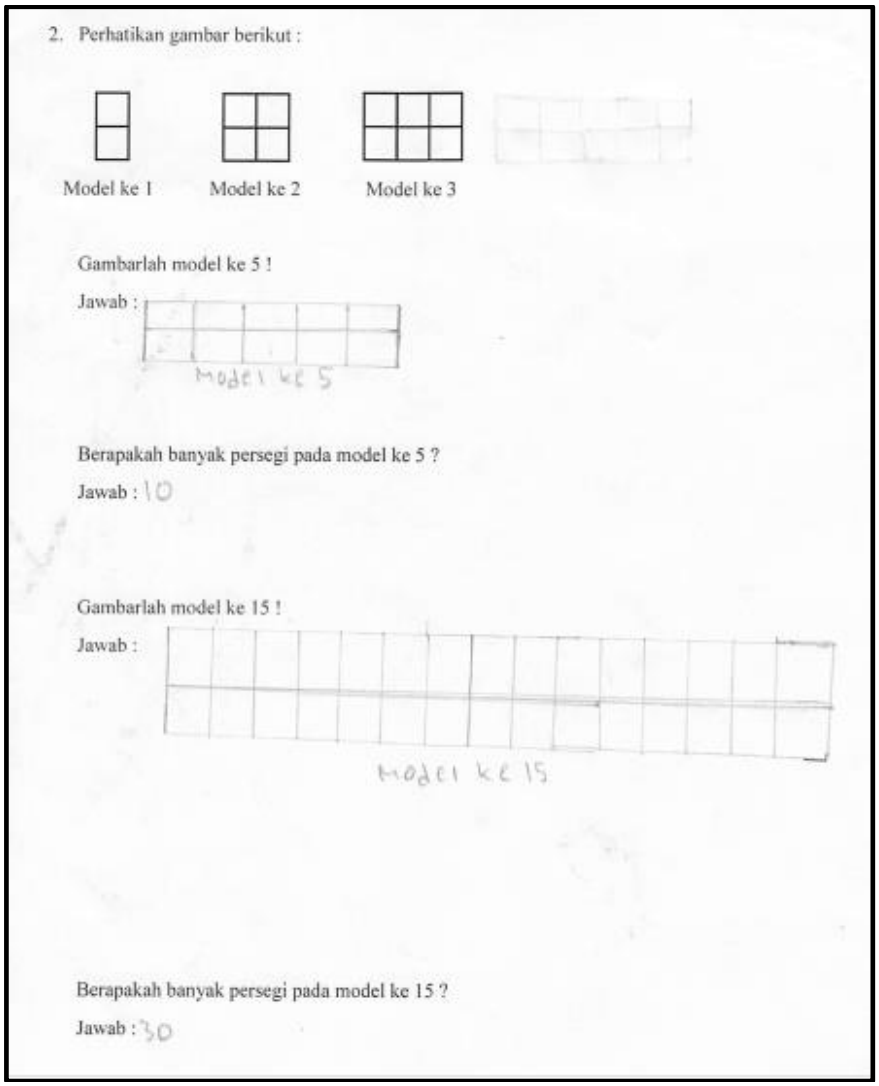


Figure 4. Student Work On Figure Patterns

Snippets of interviews with students:

P: From the pictures of the 1st model, 2nd model and 3rd model, what can you observe?

S : from the picture, the 1st model has 2 squares, the 2nd model has 4 squares, the 3rd model has 6 squares

P : how do you draw the 5th model?

S : yes, look at the model that was drawn, from model 1 to model 2 it increased by 2 squares... then from model 2 to model 3 it also increased by 2 so model 4 must have 8 squares and model 5 has 10 squares

P: increase by 2 squares which do you mean?

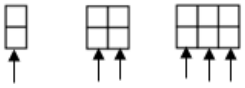
S : this (while pointing at the picture)…adding next to it

P : how do you draw model 15?

S: model 1 right 1 arrangement of a square (1 arrangement there are 2 squares), model 2 has 2 arrangements, model 3 has 3 arrangements so model 15 has 15 arrangements

P: Which arrangement do you mean?

S : this one (while pointing at the picture)



P : how do you calculate the number of squares?
S : yes, you can see that according to the model, for model 5, there are 5 square arrangements, then times 2, it becomes 10, for model 15, the arrangement is 15, then multiplied by two, it becomes 30.
P : how many squares are there in the nth model?
S : emm..don't know..

Based on the results of student work and interviews it is known that students know there is regularity in the pattern of figure. This can be seen from the students' answers during the interview which mentioned an increase of two squares. Students can mention the structure of the pattern given. This can be seen from interviews with students who say that the number of squares in each model. Students can continue the pattern given. This can be seen from the students' written work, which shows that students can determine the figure and determine the number of squares in the 5th and 15th models. However, students have not been able to determine the number of squares in the nth model from a given figure pattern.

Based on the results of written work and interviews with one of the students to represent the sample, it can be seen that students have an awareness of mathematical patterns. Based on the results of the work of 89 students and interviews, it was found that the percentage of awareness of grade 4 MI Muhammadiyah 3 Jogoroto Jombang students towards number patterns was 80,65% of 31 students. Grade 5 awareness of number patterns was 95,83% of 24 students and grade 6 was 97,06% of 34 students. This percentage can be seen in the graph of Figure 5.

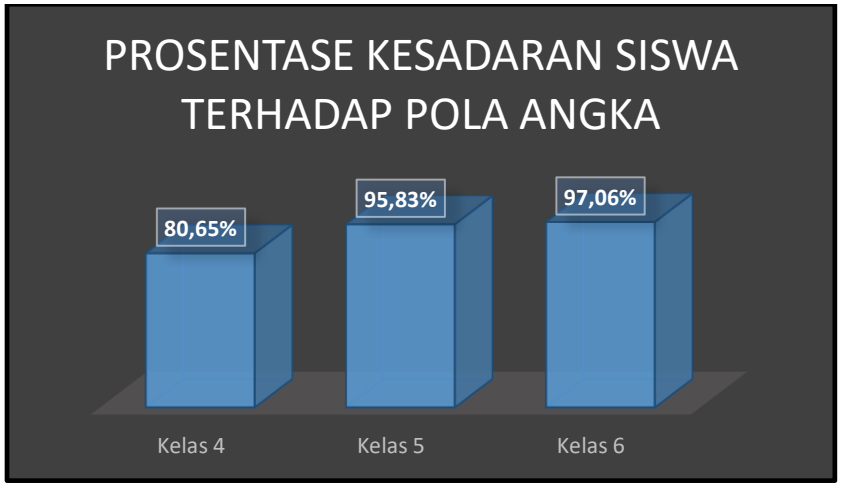


Figure 5. Percentage of Students' Awareness of Number Patterns

Meanwhile, the awareness of grade 4 students about figure patterns was 87,09% of 31 students. Grade 5 students' awareness of figure patterns was 95,83% of 24 students and grade 6 was 100% of 31 students. This percentage can be seen in the graph of Figure 6.

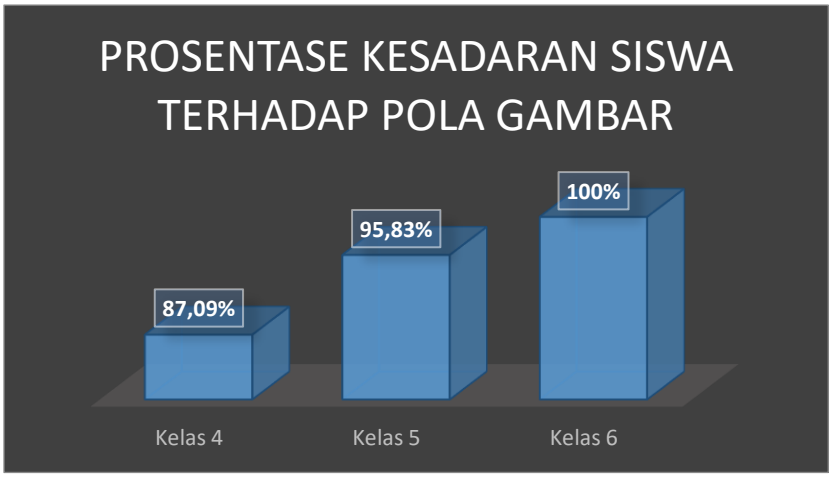


Figure 6. Percentage of Student Awareness of Figure Patterns

Awareness of the mathematical patterns of students in grades 4, 5 and 6 of MI Muhammdiyah 3 Jogoroto can be seen in the graph of figure 7. In this figure, it can be seen that the awareness of students in grades 4 and 6 about figure patterns is greater than number patterns. Grade 5 students' awareness of number patterns is the same as figure patterns. This also shows that grade 5 students in working on number pattern problems are as good as figure patterns. This is different from his research (Somasundrum et al., 2019) which shows that grade 5 students are better at working on number pattern problems than figure patterns. The equation students have not been able to determine nth model.

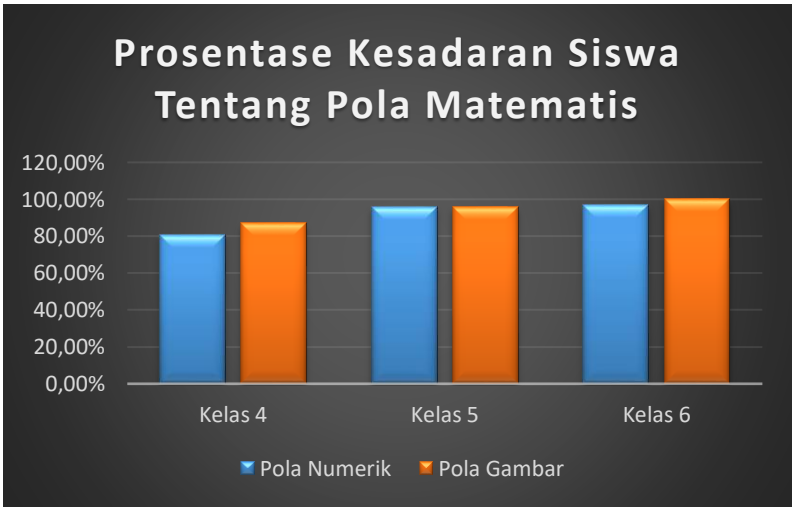


Figure 7. Comparison of Percentage of Students' Awareness About Mathematical Patterns

Based on student work and interviews, it can be seen that the strategies used by students all use the recursion strategy. This strategy is formed by the previous rule in the sequence to determine the next rule (to determine the next value derived from the previous value) (Lannin, 2003). To determine the 6th and 25th numbers in the number patterns, students observe the previous numbers which always increase by 2. Likewise in the figure patterns, to draw the 5th and 15th models students observe the previous model's figure which always increase by 2 squares.

Students in grades 4, 5 and 6 of MI Muhammadiyah 3 Jogoroto, who have an awareness of patterns in working on questions, carry out three generalizing actions, namely relating, searching and extending (Ellis, 2007). Relating the action seen by

students connecting the elements in the pattern. In the number pattern students connect numbers that are already known. The searching action shows that students are looking for order by finding that numbers always increase by two and figure increase by two squares. The extending action can be seen that students can continue the pattern requested by the problem.

CONCLUSION

Based on the results of the work of 89 students and interviews, it was found that the percentage of students' awareness of MI Muhammadiyah 3 Jogoroto Jombang towards the number pattern was as follows: grade 4 of 80,65%; grade 5 of 95,83% and class 6 of 97,06%. While students' awareness of figure patterns is as follows: grade 4 of 87,09%; grade 5 students at 95,83% and grade 6 at 100%. Students work on problems using the same strategy for number patterns and figure patterns, namely the recursion strategy.

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