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Identification of Students' Mathematical Creative Thinking Ability in Number Pattern Problems Solving

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Abstract

Improving the learning mathematics process in the classroom requires creative thinking skills. In learning mathematics, creative thinking skill is one of the critical mathematical skills to be mastered and developed by students. Creative thinking adds support to students so that students are more enthusiastic about problem-solving. Creative thinking is exploring different, quality, and task-appropriate ideas. The research aims to describe students' mathematical creative thinking skills in number patterns for the eighth grade of MTs Mamba'ul Ulum Pandaan. This research approach was qualitative. The qualitative design was descriptive qualitative. The data collection process was carried out at MTs Mamba'ul Ulum Pandaan. Data collection techniques were carried out in three ways: observation, tests, and interviews. After the data was obtained, qualitative data analysis was then carried out, which consisted of pre-field analysis and field analysis. Field analysis consisted of data reduction, data presentation, and conclusion. Then, the validity of the data was tested. The study results indicated that students with high mathematical creative thinking skills met four indicators. Students with moderate creative thinking skills met two indicators, while those with low creative thinking skills did not meet any predetermined indicators.

INTRODUCTION

The national education system in Indonesia is regulated by Law Number 20 of 2003, which regulates the curriculum. Article 36 of Law Number 20 of 2003 states that curriculum development refers to national education standards to achieve national education goals. Curriculums at all levels and types of education are developed with the principle of diversification according to academic units, regional potential, and students [1]. To understand there are two views of the curriculum. First is the objective, content, planning, and placement of teaching materials; second is the method for conducting learning [2].

Based on the experience of researchers in the field, the results of conversations with the mathematics teacher at MTs Mamba'ul Ulum Pandaan conveyed that the learning objectives to be formed were students' mathematical creative thinking skills. Nevertheless, most students did not understand the meaning of the problems; thus, they had difficulty completing it or even cheating on the work of the theme.

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Students also tended to find what was known in problem-solving using the right strategy. However, they could not find the best solution. If students can get used to thinking creatively, then students can get used to finding new ideas to solve problems and even get used to new ways as the best solution.

Through learning mathematics, students can practice logical, analytical, abstract, critical, and creative thinking [3]–[6]. Hence, improving the process of learning mathematics in the classroom requires creative thinking skills. In learning mathematics, creative thinking is one of the critical mathematical skills students master and develop. Creative thinking supports students so that students are more enthusiastic about problem-solving. McGregor [7] states that creative thinking leads to the acquisition of new insights, new approaches, new perspectives, or new ways of understanding something.

Creative thinking is the skill of generating many possible solutions or ways to solve a given problem [8]. Kurniasih & Sani [9] reveal that creative thinking is the skill to explore different, quality, and task-appropriate ideas. It implies that creative thinking can increase the power of thought, including insights with a broad scope. Indicators in creative thinking as researchers' references are fluency, flexibility, originality, and elaboration [10]–[12].

According to national education and learning mathematics objectives, creative thinking skills are vital to be improved at schools. Students' creative thinking can develop ideas and make decisions and generalizations [13]. However, reality in the field discovered that students' mathematical creative thinking skills were still low. The Trend International Mathematics and Science Study (TIMMS) results strengthened the lack of students' mathematical creative thinking skills. In addition, it was in line with the results of previous research that students' mathematical creative thinking skills were deficient. Lestari and Zanthy [14] revealed that students' mathematical creative thinking skills at a vocational high school in Cimahi City were still low. Ismara and Suratman [15] stated that the level of students' mathematical thinking skills in Indonesia was low because only 2% of Indonesian students could solve problems that required the skill to think creatively.

The research objective was to describe the mathematical creative thinking skill in eighth grade at MTs Mamba'ul Ulum Pandaan in number pattern problem-solving.

METHOD

This research employed a qualitative approach, which was applied to examine the state of natural objects, where the main instrument were the researcher, samples, and data taken purposively, namely with special considerations and purposes. Triangulation was used to validate data by collecting various sources or data techniques and analysis. This research was inductive. Furthermore, the results of qualitative research were more generalization meaning [16].

This research was included in the qualitative descriptive research design, i.e., research that applied or explained ongoing events in the field [17]. The data sources of this research were eighth-grade students at MTs Mambaul Ulum Pandaan who had received number pattern material. The data used in this research was qualitative in the form of mathematical creative thinking skill test results and interview results.

The data was obtained by giving test problems to three students with high, moderate, and low problem-solving skills. In detail, there was one student with high problem-solving skills, one

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with moderate problem-solving skills, and one with low problem-solving skills. Checking the data validity used model triangulation, testing data from several sources, techniques, and much time [16].

The triangulation employed in this research was method triangulation to test the credibility or validity of the data by comparing and verifying the difficulty of understanding the concept with the method of test and interview techniques [16]. The data analysis used was the analysis of Miles [18], suggesting that qualitative data processing techniques or methods can be carried out in three stages: data reduction, data presentation, and conclusions.

RESULTS AND DISCUSSION

Results

Qualitative data analysis used descriptive qualitative analysis with test data collection techniques, field notes, and interviews. The data validity test used triangulation techniques. According to Moleong [19], the triangulation technique is a data validity checking technique that utilizes something other than the data for checking purposes or as a data comparison.

In this research, the researchers gave test problems for the mathematical creative thinking skill to 24 students for further analysis. Analysis of mathematical creative thinking skills employed the test and interview results. The results of the tests and interviews would then be used as a reference for grouping students into skill levels. Therefore, the researchers described several ways students solved problems through mathematical creative thinking skills. Based on the explanation of several methods students use in answering problems on mathematical creative thinking skills tests, the researcher would describe descriptively how students answered test problems. In this case, the researcher took three subjects based on categories of high, moderate, and low skills in mathematical creative thinking.

Table 1. Research Subjects

Research Subjects	Results of Mathematical Creative Thinking Skill Test	Research Subjects
HMB	91	High
FAA	73	Moderate
AAA	60	Low

1. HMB Subject

Triangulation of test results and interviews of the HMB Subject on mathematical creative thinking skills.

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Table 2. Comparison of Test Result Data and HMB Subject Interview Data

Indicator of Mathematical Creative Thinking Skill Test	Data on Mathematical Creative Thinking Skill Test Results	Data on Mathematical Creative Thinking Skill Test Results
1. Presenting steps and ideas in working on problems fluently.	HMB Subject was able to present ideas as solutions to work on problems by presenting the steps to work on by observing patterns in a sequence of numbers in the problem.	HMB Subject was able to state ideas as a solution to work on the problem by presenting the working steps by observing the pattern of a sequence of numbers in the problem.
2. Changing the approach way and mindset.	HMB Subject changed their approach using his mindset to determine the next term of a sequence of numbers.	HMB Subject explained the approach to solving the problem using his mindset to determine the next term of a sequence of numbers.
3. Multiplying and developing a product idea.	HMB Subject developed an idea to solve the problem by learning the various patterns of number sequences.	HMB Subject explained the idea as a solution to the problem by mentioning the kinds of number sequence patterns in the problem.
4. Creating an extraordinary coherence of an element.	HMB Subject created coherences according to his thinking by applying the number pattern rules in the problems.	HMB Subject was able to explain the pattern of his way of thinking to solve the problem by applying the number pattern rules in the problems.

Based on Table 2, it can be concluded that there was suitability and consistency of the HMB subject data seen from the results of tests of mathematical creative thinking skills and interview results. It indicated that the HMB subject's data was valid; thus, it could be analyzed to answer research problems (problem formulation).

2. FAA Subject

Triangulation of test results and interviews of the FAA Subject on mathematical creative thinking skills.

Table 3. Comparison of Test Result Data and FAA Subject Interview Data

Indicator of Mathematical Creative Thinking Skill Test	Data on Mathematical Creative Thinking Skill Test Results	Data on Mathematical Creative Thinking Skill Test Results
1. Presenting steps and ideas in working on problems fluently.	FAA Subject could not present ideas as solutions to work on problems by presenting the steps to work on by observing patterns in a sequence of numbers in the problem.	FAA Subject was unable to mention the idea as a solution to work on the problem by presenting the working steps by observing the pattern of a sequence of numbers in the problem.
2. Changing the approach way and mindset.	FAA Subject changed the approach using his mindset to determine the next term of a sequence of numbers.	FAA Subject explained the approach to problem-solving by using his mindset to determine the next term of a sequence of numbers.
3. Multiplying and developing a product idea.	FAA Subject developed an idea to solve the problems by learning the various patterns of number	FAA Subject was able to explain ideas as a solution to the problems by mentioning the kinds of number

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Indicator of Mathematical Creative Thinking Skill Test	Data on Mathematical Creative Thinking Skill Test Results	Data on Mathematical Creative Thinking Skill Test Results
	sequences.	sequence patterns in the problems.
4. Creating an extraordinary coherence of an element	According to his thinking, FAA Subject could not create coherence by applying the number pattern rules to the problems.	FAA Subject could not explain the pattern of his way of thinking to solve the problem by applying the number pattern rules in the problems.

Based on Table 3, it can be concluded that there were suitability and consistency of the FAA subject data seen from the results of tests of mathematical creative thinking skills and the results of interviews. It implied that the FAA subject's data was valid; thus, it could be analyzed to answer research problems.

3. AAA Subject

Triangulation of test results and interviews of the AAA Subject on mathematical creative thinking skills.

Table 4. Comparison of Test Result Data and AAA Subject Interview Data

Indicator of Mathematical Creative Thinking Skill Test	Data on Mathematical Creative Thinking Skill Test Results	Data on Mathematical Creative Thinking Skill Test Results
1. Presenting steps and ideas in working on problems fluently.	AAA Subject could not present ideas as solutions to work on problems by presenting the working steps by observing patterns in a sequence of numbers in the problems.	AAA Subject could not mention the idea as a solution to work on the problem by presenting the working steps by observing the pattern of a sequence of numbers in the problems.
2. Changing the approach way and mindset.	AAA Subject could not change the approach using his mindset to determine the next term of a sequence of numbers.	AAA Subject could not explain the approach used to solve the problem of using his mindset to determine the next term of a sequence of numbers.
3. Multiplying and developing a product idea.	AAA Subject could not develop an idea to solve the problems by recognizing various number sequence patterns.	AAA Subject could not explain the idea as a solution to the problems by mentioning the kinds of number sequence patterns in the problem.
4. Creating an extraordinary coherence of an element.	AAA Subject could not create coherence according to his thinking by applying the number pattern rules in the problems.	AAA Subject could not explain his thinking patterns in problem-solving by applying the number pattern rules in the problems.

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Based on Table 4, it can be concluded that the AAA subject data was suitable and consistent, as seen from the results of the mathematical creative thinking skill test and the interviews. It implied that the AAA subject's data was valid; thus, it could be analyzed to answer research problems (problem formulation).

Discussion

In this segment, the researchers will discuss the description of students' mathematical creative thinking skills in the Number Patterns material for eighth grade at MTs Mamba'ul Ulum Pandaan. The data analysis and research results on HMB subject with high mathematical creative thinking skills indicated that he met the four indicators of mathematical creative thinking skills. The FAA Subject with the criteria of having moderate mathematical creative thinking skills could only meet two of the four indicators of mathematical creative thinking skills. Furthermore, the AAA Subject, with the category of having low mathematical creative thinking skills, could not meet the four indicators of mathematical creative thinking skills. The following discussion further explains the creative thinking skills achieved by the three subjects in completing the mathematical creative thinking skill test problems based on test results and interview results.

The first indicator is fluency in presenting ideas as a way to work on the problems by presenting the working steps by observing a pattern in a number sequence in the problems. HMB Subject was only able to answer the problem correctly. HMB Subject could understand the intent of the problems and observe previous number patterns to answer the problems correctly.

It was also supported by the results of the interviews that the HMB Subject could explain the steps that were applied in finding solutions to the problems fluently. It indicated that the HMB Subject was fluent in answering problems because he could find possible solutions to solve the problems by observing the previous pattern, namely determining the number of pieces after being cut into eight patterned parts.

Munandar in Ghufron & Risnawati [20] reveals that fluency in thinking is the skill to find various ideas, answers, or solutions to problems, create various steps, and always look for more than one answer. Hence, it will be obtained that the fluency aspect is displayed by the skill of the three subjects in getting problem-solving in answering.

Furthermore, in the second indicator, namely being able to change the method of approach using his mindset to determine the next term of a number sequence, it can be considered that only HMB and FAA Subjects were able to find another way with a different approach from the answers that had been determined by previous researchers that had been discussed in the problems.

It was formed because the two subjects could create other ideas to find formulas to determine syllable patterns in different sequences but still gave the same result. Hence, the two subjects have shown a dimension of flexibility because of their skill to recognize two possible solutions to problems with other perspectives. It is in line with Olson's [21] research that flexibility refers to the skill to create various and extraordinary ideas to solve problems.

The third indicator explained that the skill to develop an idea as a solution to the problem in problem by recognizing various number sequence patterns could be seen from the answers given by the subjects that only HMB and FAA Subjects were able to meet the indicators. In their test results, the HMB and FAA Subjects could identify or recognize the number patterns in the

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problems and develop ideas to solve them, namely finding the following three numbers from the *Pascal* number.

Munandar [20] states that natural thinking is creating basic ideas. Actual means new, which in this research does not imply that something is new, but can be in the form of something that has existed before, "new" is a coherence of pre-existing components.

Meanwhile, the fourth indicator explained the skill to create coherence according to his thinking by applying the number pattern rules in the problems. HMB Subject could only meet indicator number four. HMB Subject could only coherently express a number into the sum of the odd numbers in the three numbers asked in the problems.

Munandar in Ghufron & Risnawati [20] states that the essence of elaboration thinking is the skill to develop or reproduce an idea. Therefore, it can be concluded that the elaboration aspect is shown by the subject's skill to form something into a related-new form.

Whereas AAA Subject was low because, in their test results, AAA Subject could not meet any of the skill indicators set out in this research. Subjects also could not explain how subjects answered these problems.

CONCLUSION

Under the formulation of the problem and research objectives that have been determined, the conclusion obtained from the results of data analysis and discussion were: (1) Students with high mathematical creative thinking skills in answering number patterns problems could be said to think creatively because he was able to meet the four indicators of fluency, flexibility, elaboration, and originality. (2) Student with moderate creative thinking skills in answering problems on number pattern material was said to think creatively because he has met two of the four indicators set, namely flexibility and elaboration. The student has not met the indicators of fluency and originality because he could not present ideas as solutions in working on problems and has not been able to take steps and ideas in working on problems fluently, and has not been able to create coherences according to their way of thinking by applying number pattern rules to problems. (3) Student with low creative thinking skills in answering problems on number pattern material was said to lack creative thinking because he could not meet any predetermined indicators, namely fluency, flexibility, elaboration, and originality. He had not met the indicators of fluency and flexibility because he has been unable to present ideas as a solution to problems and has been unable to change the approach through his mindset. Furthermore, he has not met the elaboration and originality indicators because he has not been able to develop an idea to solve the problems. He has been unable to create coherence according to his way of thinking by applying the number pattern rules to the problems.

The suggestions are: (1) Through this research, hopefully, mathematics teachers can train and improve students' creative thinking skills in solving mathematical problems. (2) For other researchers, there should be further research regarding developing tools to improve students' creative thinking skills or research using more varied problems with a higher difficulty level. (3) This research was still limited to students' mathematical creative thinking skills, especially to number pattern material in eighth grade. Other researchers can examine students' mathematical creative thinking skills more profoundly and employ research subjects with different views or materials.

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