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# THE PROFILE OF JUNIOR HIGH SCHOOL STUDENTS' CREATIVITY IN SOLVING NUMBER PATTERN PROBLEMS BASED ON MATHEMATICAL ABILITIES

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## Abstract

One of the aims of 2013 curriculum is preparing students so that can creative thinking. Creativity is needed by students to find the solution of a real problem. The important components that be used to assess creativity are fluency, flexibility, and novelty. Number pattern problem solving is one of supporting activities can exercise and develop students' creativity. Strategies in problem solving are influenced by mathematical abilities of students. This research is a descriptive qualitative research with the aim to describe the profile of junior high school students' creativity in solving number pattern problems based on mathematical abilities. The subjects of this research consist of three students are determined by high, medium, and low level mathematical abilities. Instruments consist of mathematical ability test, number pattern problem solving task, and interview. The research results showed that the creativity profile of student with high-level mathematical ability could show flexibility and novelty components. While, student with medium-level mathematical ability could show flexibility and novelty components. Compared with them student with low-level mathematical ability could show novelty component.

***Keywords:*** Creativity, problem solving, number pattern problems, mathematical abilities.

## INTRODUCTION

Education is an effort to provide certain knowledge and expertise in order to produce quality human beings. Education is very important for human life because education is a path that can be taken to develop the thinking and skills are possessed by every human being. Education can be used to improve and develop science and technology. The development of science and expertise is needed so that each individual is able to face changes from the progress of science and technology. At every level of education, students are always given mathematics lessons, one of them at the junior high school level. Because mathematics is one of the important subjects and determines the activities of students' daily lives.

The education system in Indonesia has implemented the 2013 curriculum since 2013 nationally replacing the existing curriculum. In accordance with the 2013 Curriculum that learning is intended to develop the potential of students to have the ability to live as individuals and citizens who are faithful, productive, creative, innovative, and affective, and able to contribute to the lives of people, nation, state and world civilization (Depdikbud, 2013) In addition, in the future development of the mathematics curriculum is directed to improve life skills, especially in building creativity, creative thinking ability, collaboration or collaboration and communication skills (Kemendikbud: 2016). This shows that the importance of the implementation of learning, especially mathematics learning in order to emphasize the creativity of students.

Reality in education, creativity is rarely emphasized in mathematics learning because most teachers in school teach mathematics lessons by memorizing routine problems. Rubin (2015: 37) said that, "Recent trends have re-targeted mathematics as a subject that is need of an overhaul in terms of the emphasis in the curriculum, the degree to which it should be assessed, and the focus on developing higher order thinking skills". In order to achieve the goals in mathematics learning in schools, be up to dated and still exist for every change and development in the world of education, it is necessary to improve mathematics learning by focusing on developing high-level students 'thinking by increasing students' creativity in school. Davis (1984) explains 6 reasons why mathematics learning needs to emphasize creativity, that are (1) mathematics is so complex and broad to be taught by rote, (2) students can find original solutions when solving problems, (3) teacher needs to respond to the original and surprised student contributions, (4) mathematics learning with memorization and routine problems makes students unmotivated and reduces their abilities, (5) originality is something that needs to be taught, such as making genuine proofs of theorems, (6)

daily real-life needs mathematics, daily problems not a routine thing that requires creativity in solving it.

In daily life, every individual will be faced with a problem and required to find a solution. Sabandar (2009) states that many mathematics educators argue that to train students' creativity, students must be faced with challenging problems. Challenging problems will provide opportunities for students to use their creativity. Creativity is needed especially in mathematics learning. Creativity is the ability possessed by someone in solving a problem to produce a product. Novitasari (2018) states that creativity is be able to encourage student to be skilled in solving problems and finding alternative solutions of problems. Haylock (1997) also explained that problem solving can be an approach to knowing students' creativity. There is relation of mathematics problem solving to core components of creativity (Silver 1997). Three important components to indicate students' creativity, namely fluency, flexibility, and novelty Fluency is students' ability to solve a problem by giving at least two different and correct answers. Flexibility is students' ability to provide solutions of a problem using at least two different ways. Novelty is students' ability to solve a problem by using a solution method that has never been used by the students before.

In connection with mathematics lessons at school, number pattern is one of the materials taught to junior high school students. Based on the 2013 curriculum, one of the subjects learned in the number pattern is to solve problems related to number pattern. Based on the experience of researchers at the time of teaching at the Institute of Tutoring shows that most junior high school students are accustomed to solving problems, especially the problem of number pattern with a single solution. Most students have difficulties in understanding the problems that are given and tend to only be able to solve problems using usual way that's given by teacher. This is in line with Munandar's opinion (2009: 7) that in field of education, especially mathematics, the emphasis is more on memorization and looking for a correct answer to the questions given so that students' creativity is rarely trained. This causes students have less opportunity to develop their creativity and is not appropriate with the objectives of 2013 curriculum which is to form creative people.

Ormrod (2009) argues that problem solving is a skill or knowledge that is used to answer the problem of all learning that requires a good amount of mastery of the concept well as a basis for students to solve a given problem. Each individual has different abilities in mastering mathematical concepts so that it influences the ability to solve mathematical problems. There are students who can quickly solve the problem, but there are also students who are slow. Students' quick or slow in solving problem depends on the problem solving strategy determined by each student. This strategy is strongly influenced by mathematical abilities. This is in line with the opinion of Nurman (2008) that there is an influence between mathematical abilities and problem solving.

According to Soemarmo (2010), mathematical abilities are skills in carrying out and completing mathematical tasks. There are three categories that be used in classifying students based on their level of mathematical ability, namely high, medium, and low-level mathematical abilities. The difference in mathematical abilities was used as the basis of this research. Students selected in this research are students with heterogeneous abilities in terms of their mathematical abilities, so that this research is expected to later lead to the right learning strategies in accordance with the mathematical abilities of each student.

Based on the background above, the researcher intends to conduct a research entitled "The Profile of Junior High School Students' Creativity in Solving Number Pattern Problems Based on Mathematical Abilities".

The problems of this research are how the profile of creativity of junior high school students with high, medium, and low-level mathematical abilities in solving number pattern problems.

## METHODS

The research is a descriptive research with qualitative approach, which is to describe the profile of creativity of junior high school students with high, medium, and low-level mathematical abilities in solving number pattern problems. This research was conducted to 32 students of class VIII-A at State Junior High School of 1 Wringinanom in odd semester of the academic year 2018/2019. There are three students selected who become the research subjects. The complete research plan is described in the figure below.

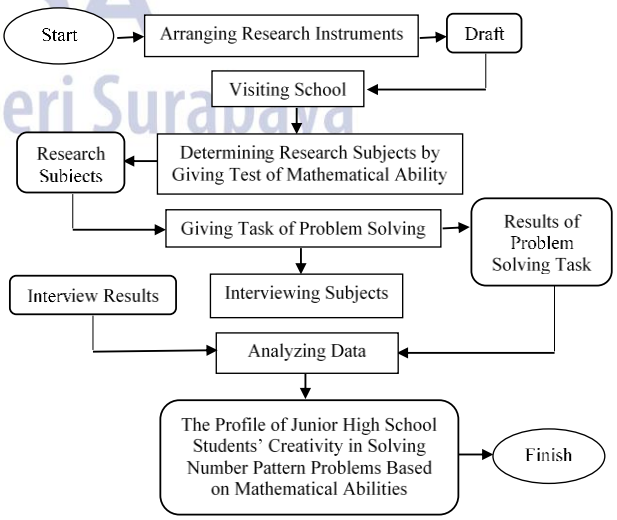



Figure 1. Research Plan

The supporter instruments that were used in this research are mathematical ability test, problem solving task and interview guidance. The research was conducted in two meetings. First, researcher gives mathematical ability test to 32 students of class VIII-A at State Junior High Shool of 1 Wringinanom to determine three research subjects. Second, the researcher gives task of number patter problems solving to three research subjects to obtain data about student's creativity in solving number pattern problems. In the same day, then the researcher conducts interview to the three research subjects to obtain data about student's creativity and to confirm the result of problem solving task.

The research subjects consisted of three students who were selected from one student with high, medium, and low-level mathematical abilities. Mathematical ability test was given to prospective subjects, namely 32 students of class VIII-A at State Junior High School of 1 Wringinanom. The results of mathematical ability test scores are used by researchers as a reference for determining the subject of research, which is based on the level of high, medium, and low mathematical abilities. The following table is about the category of mathematical abilities as a reference to determine the subject of research.

Table 1**.** Category of Students' Mathematical Abilities

| **Students' Mathematical Abilities** | | |
|---|---|---|
| **High-Level Ability** | **Medium-Level Ability** | **Low-Level Ability** |
| $81 \leq x < 100$ | $71 \leq x < 81$ | $0 \leq x < 71$ |
| Note: $x$ is the score of students' mathematical ability test | | |

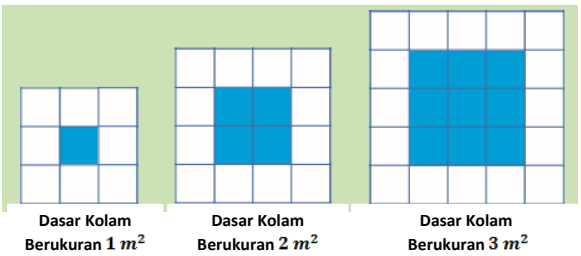
The three selected research subjects will be given task of number pattern problems solving and conduct the interview and code of research subjects are as follows.

Table 2**.** Detail and Code of Research Subjects

| **Students' Name** | **Score** | **Students' Mathematical Abilities** | **Code** |
|---|---|---|---|
| ANF | 90 | High-Level | SKMT |
| SF | 80 | Medium-Level | SKMS |
| STS | 70 | Low-Level | SKMR |

The three subjects were given task of number pattern problem solving as follows.

*Pak Dika membuat beberapa desain dasar kolam yang berbentuk persegi yang akan dipasang ubin dengan suatu pola. Tiap-tiap dasar kolam pada bagian tengah diberi ubin berwarna biru dan bagian luar dipasang ubin berwarna putih. Desain dasar kolam dengan ukuran* 1 $m^2$ *dipasang ubin biru sebanyak* 1 *ubin dan ubin putih sebanyak* 8 *ubin. Sedangkan desain dasar kolam dengan ukuran* 2 $m^2$ *dipasang ubin biru sebanyak* 4 *ubin dan ubin putih sebanyak* 12 *ubin. Desain dasar kolam dengan ukuran* 3 $m^2$ *dipasang ubin biru sebanyak* 9 *ubin dan*




*ubin putih sebanyak* 16 *ubin, dan seterusnya. Jika digambar, maka akan tampak seperti gambar di bawah ini.*

Figure 2. *Desain Dasar Kolam*

1. *Gunakan minimal dua cara untuk menentukan banyak ubin berwarna putih jika ubin berwarna biru sebanyak* 25 *ubin.*
2. *Tentukan banyak ubin berwarna putih yang dibutuhkan untuk membuat kolam dengan ukuran* $n\ m^2$*. Gunakan minimal dua cara yang berbeda.*
3. *Apakah ada cara lain yang berbeda yang belum pernah kamu gunakan saat di kelas untuk menyelesaikan soal b? Jika ada, gunakan cara lain yang berbeda dengan jawabanmu pada soal b untuk menyelesaikan soal yang sama.* ***(Misalnya menggunakan konsep luas persegi)***

The analysis of problem solving task and interview results based on creativity components by Silver (1997) that are fluency, flexibility, and novelty. The students' creativity indicators in solving number pattern problems used in this research were as follows.

Table 3. Students' Creativity Indicators in Solving Number Pattern Problems

| **Creativity Components** | **Indicators** |
|---|---|
| Fluency | Giving at least two different and correct answers in solving number pattern problems. |
| Flexibility | Giving solution of number pattern problems using at least two different ways. |
| Novelty | Solving number pattern problems using solution methods that have never been used by the students before. |

## RESEARCH RESULTS AND DISCUSSIONS

This research was done in one class of VIII-A at State Junior High School of 1 Wringinanom on July, 31st 2018 and August, 4th 2018. On July, 31st 2018, students were given mathematical ability test to determine subject

research. On August, 4th 2018, three students as subject research were given task of number pattern problem solving, then they conduct the interview to obtain data for describing the profile of junior high school students' creativity in solving number pattern problems based on mathematical abilities.

To facilitate the presentation of the data in this research, we use the analysis code of students 'work results to analyze students' creativity in solving number pattern problems as follows.

Table 4. The Analysis Code of Students' work result

| Code | Explanation | Creativity Components |
|---|---|---|
| J0n | Giving n correct answers in solving number pattern problems. | Fluency (FL) |
| C0n | Giving solution of number pattern problems using n two different ways. | Flexibility (FX) |
| Bx | Solving number pattern problems using solution methods that have never been used by the students before. | Novelty (NV) |

1. Analysis and Discussion of The Results of Number Pattern Problem Solving Task by Student with High-Level Mathematical Ability

The results of SKMT's Problem Solving Task are presented in Figure 3, and the analysis of its data is presented below the figures.

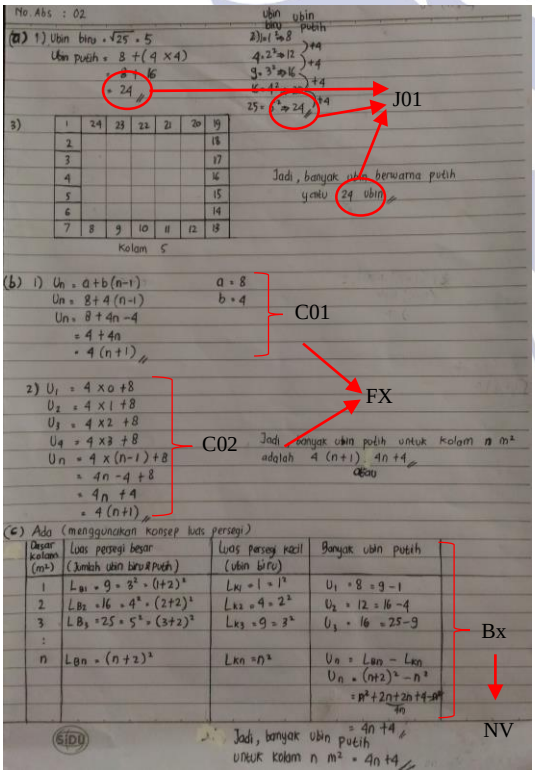



Figure 3. SKMT's Answer for Number Pattern Problem

Based on the Figure. 3 and the interview, the profile of creativity of High-Level Mathematical Ability Student (SKMT) in solving number pattern problem, can be seen as follows. In solving the first problem in Problem Solving Task (PST), student is able to give one correct answer, namely 24 white tiles (J01). Student is unable to show the component of fluency, because student cannot provide at least two different and correct answers, but are only able to provide one correct answer (J01).

In solving the second problem in the PST, student is able to provide solutions by using two different ways (C01 and C02), namely the nth term formula in the Arithmetic sequence and by looking at the pattern of many white tiles that are known in each pool. Two different ways (C01 and C02) given by student is able to show that subject fulfill the flexibility component (FX).

Student is also able to show different method that student have never used when in class to solve the third problems in PST (Bx). It is using the concept of square area. Student makes a table and say the size of a large square, the area of a small square, and lots of white tiles for easy workmanship. Then, student makes generalizations of the area of a large square, the area of a small square, and many white tiles so that the generalization of many white tiles at the base of the size pool is obtained. Solution method that are not commonly used by students (Bx) have been able to show novelty (NV).

Based on the analysis of the creativity profile that have been described above in line with the opinion of Silver (1997) that the product of problem solving activities can determine a person's level of creativity clearly. Silver also explained that there are three important components that can be used to assess a person's creativity, namely fluency, flexibility, and novelty.

2. Analysis and Discussion of The Results of Number Pattern Problem Solving Task by Student with Medium-Level Mathematical Ability

The results of SKMS's Problem Solving Task are presented in Figure. 4, and the analysis of its data is presented as follows.

Based on the Figure. 4 and the interview, the profile of creativity of Medium-Level Mathematical Ability Student (SKMS) in solving number pattern problem, can be seen as follows. In solving the first problem in PST, student is able to give one correct answer, namely 24 white tiles (J01). Student is unable

to show the component of fluency, because they cannot provide at least two different and correct answers, but are only able to provide one correct answer.

In solving the second problem in the PST, student is able to provide solutions by using two different ways (C01 and C02), namely the $n^{th}$ term formula in the Arithmetic sequence and by seeing the pattern of many white tiles that are known in each pool. Two different ways given by student (C01 and C02) are able to show that student fulfill the flexibility component (FX).

Student is also able to show different way that students have never used when in class to solve the third problem in PST (Bx). It is using the concept of square area. Student explains the many white tiles in each pool which are the area of a large square minus the area of a small square, so that the student obtains a generalization of many white tiles on the base of pool. Although the solution method written by students is not too detailed in terms of what is known, but this solution method is not commonly used by the student beforehand so that it is able to show novelty (NV).

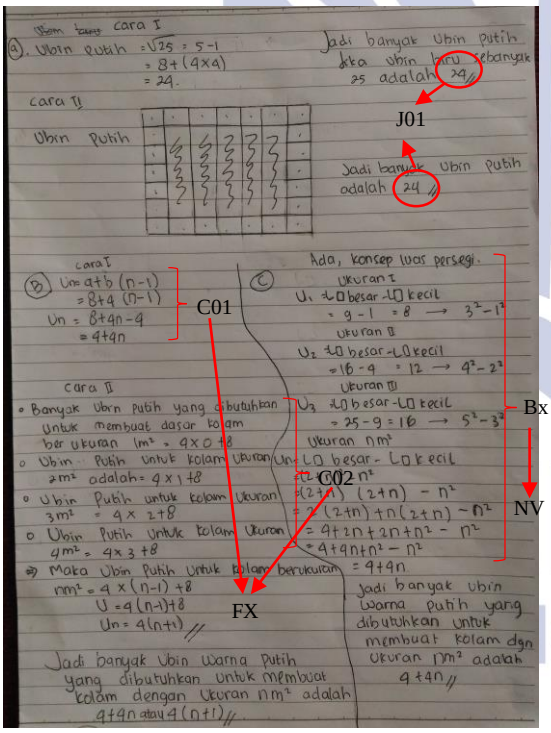



Figure 4. SKMS's Answer for Number Pattern Problem

Based on the analysis of the creativity profile that have been described above student shows his creativity by providing a method of completion that the student has never used before while in class. This is in accordance with what was revealed by Hurlock (1999) that creativity is a person's ability to produce any composition, product or idea that is essentially new and previously unknown to the maker.

3. Analysis and Discussion of The Results of Number Pattern Problem Solving Task by Student with Low-Level Mathematical Ability

The results of SKMR's Problem Solving Task are presented in Figure. 5, and the analysis of its data is presented below the figures.

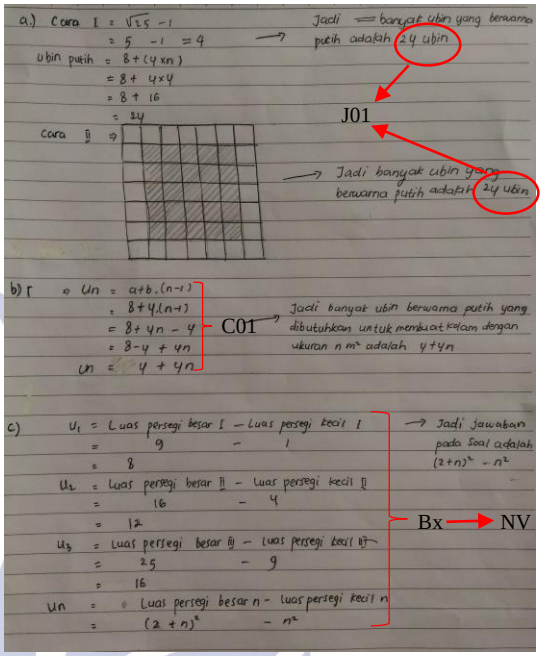



Figure 5. SKMR's Answer for Number Pattern Problem

Based on the Figure. 5 and the interview, the profile of creativity of Low-Level Mathematical Ability Student (SKMR) in solving number pattern problem, can be seen as follows. In solving the first problem in PST, student is able to give one correct answer, namely 24 white tiles (J01). Student is unable to show the component of fluency, because they cannot provide at least two different and correct answers, but are only able to provide one correct answer (J01).

In solving the second problem in PST, student is able to provide a solution that is simply using one method (C01), namely the $n^{th}$ term formula in the Arithmetic sequence. In solving number pattern problem, student only provides one way (C01) so that student is unable to show the component of flexibility.

However, student is able to show different way that are not commonly used by students when in class (Bx) in solving the third problems in PST, namely by using the concept of square area. Student say a lot of white tiles on each pool with U which is the area of a large square minus the area of a small square, so that students get a lot of white tiles on the bottom of the pool size that is. The solution method used by student is a method of completion that has never been used by

the student before when in class (Bx) so that student is able to show the novelty component (NV).

Based on the analysis of the creativity profile that have been described above student is able to write answers on the answer sheet which is a product. As explained by Siswono (2008) that product is something new and a combination of the synthesis of thoughts, concepts, information or experiences that are already in his mind.

## CLOSURE

### Conclusion

Based on the data analysis and discussion, the researcher draw conclusions about the profile of creativity of junior high school students with high, medium, and low-level mathematical abilities in solving number pattern problems as follows. The creativity profile of student with high-level mathematical ability is student could show flexibility and novelty components in solving number pattern problems. While, the creativity profile of student with medium-level mathematical ability is student could show flexibility and novelty components in solving number pattern problems. Compared with them, the creativity profile of student with low-level mathematical ability is student could show novelty component in solving number pattern problems.

### Suggestions

1. For teachers should be able to design mathematics learning that encourages students to optimize students' creativity who have high, medium and low-level mathematical ability.
2. For researchers who want to conduct relevant research.
   a. At the time of interview, researcher should use video recorder to record interview so that, there are no data or events are missed and researcher is more facilitated when analyzing data.
   b. The selection of research subjects should be based on recommendations from mathematics teacher in order to obtain communicative research subjects and make it easier for researchers during interviews. In addition, the selection of subjects for each category is selected students with the lowest score for subject with low-level mathematical ability and students with middle scores for subject with medium-level mathematical ability in order to clearly see the difference in creativity of the three research subjects.
   c. Researcher should be able to differentiate different answers and different ways when analyzing the work results of the research subject's PST (Problem Solving Task), so that there are clear differences between the components of fluency and flexibility to see students' creativity.
   d. In making question of Problem Solving Task for the fluency component, the question should be open-ended in the answer, so that the research subject is able to provide at least two correct and different answers in solving number pattern problem and able to show the fluency component.
   e. In question of PST for the novelty component, shouldn't need to give instructions (for example using the concept of square area), so that the answers given by students naturally and students really show the novelty component based on their own creativity.

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