Mathematics creative thinking levels based on interpersonal intelligence

R H Kuncorowati, Mardiyana and D R S Saputro
Universitas Sebelas Maret, Jl. Ir. Sutami No.36 A, Surakarta 57126, Indonesia

E-mail: ririnherpina@gmail.com

Abstract. Creative thinking ability was one of student’s ability to determine various alternative solutions toward mathematics problem. One of indicators related to creative thinking ability was interpersonal intelligence. Student’s interpersonal intelligence would influence to student’s creativity. This research aimed to analyze creative thinking ability level of junior high school students in Karanganyar using descriptive method. Data was collected by test, questionnaire, interview, and documentation. The result showed that students with high interpersonal intelligence achieved third and fourth level in creative thinking ability. Students with moderate interpersonal intelligence achieved second level in creative thinking ability and students with low interpersonal intelligence achieved first and zero level in creative thinking ability. Hence, students with high, moderate, and low interpersonal intelligence could solve mathematics problem based on their mathematics creative thinking ability.

1. Introduction
Mathematics is one of important learning objectives since it has been used importantly in sciences and technologies development. Mathematics subjects are given to all learners to equip them in logical, analytical, systematic, critical and creative thinking, and the ability to cooperate [1]. Based on those aspects, it is known that the potential learners that need to be developed and improved is High Order Thinking Skills (HOTS). HOTS is indispensable to learners, because the real life problems are complex, unstructured, complicated, new, and require more thinking skills than just applying what has been learned. Learners should be creative in solving problems to be faced in society. Everyone is assumed to be creative, but the level of creative thinking is different [2]. Those facts could be seen from contextual phenomenon by looking at people who create technology and people who use technology. Learning to know our creativity ability is one of the most significant aspects of our life, for everything we do, is affected by our thinking abilities [3]. Currently, not a few students who view mathematics as a subject that is boring and terrifying. Many students find difficulty to understand mathematics. It affects students’ low achievement. The absorption capacity of junior high school students in Karanganyar District in mathematics subjects for geometry and measurement materials has the lowest absorption of 42.01% at the district level, 40.26% at the provincial level, and 47.19% at the national level [4].

In the learning of geometry, needs student’s creativity to solve the problem. Creativity is classified by multiple levels as if it is related to intelligence levels as well. Since creativity is one of creative
thinking process, so that creative thinking also has levels [5]. The fourth level in creative thinking is (very creative). In this level, students are able to solve problem with multiple answers and solutions due to various states fluently in a flexible way [6]. The third level in creative thinking is (creative). Students are able to create new answer with different solution (flexible) though they are not fluent in creating different various answers (not flexible). Besides, students are able to create new problem fluently (fluent) though single problem could lead to new divergent problem. Students who are capable in pursuing this level are called creative. The second level in creative thinking is (enough creative). Students are able to create one different answer or problem from common habit though students do this without flexibility or fluent way, or students are able to show various different solutions though the answer is not new [6]. The first level in creative thinking is (less creative). Students are not able to create different answer of problem (new), though one condition is fulfilled, regarding to create different solutions (flexible) or various answers or problems (fluent) [6]. The zero level in creative thinking is (not creative). Students are not able to create alternative answer or solution or different problem fluently (fluent) and flexible [6].

Student’s creative thinking ability can be enhanced by giving various models of questions and problems which have a lot of solutions. Open-ended approach could be used effectively when teachers give exercises after course. Open-ended approach is started by giving open problem with multiple correct answers to students [7]. In open-ended problem solving, students are allowed to cooperate with their friends so that various alternative solutions will arise. The ability to think creatively can be obtained through interaction with the other people [8]. Creative students have many opportunities and readiness to accept and absorb ideas from various sources [9]. In this context, social environment will definitely influence student’s role to deal with a bunch of scientific and mathematics problems and create creative ideas. Regarding to instructional learning process, social environment consists of teachers or school mates with higher intelligence or competencies [10]. In the other hand, Piaget’s theory as one of stress cognitive theories is focused on student’s apperception to create ideas and reduce social environment’s influence as well [11]. One of related intelligence in social environment is interpersonal intelligence. Interpersonal intelligence is referring to individual’s ability to communicate cooperatively in group, whether it is verbal or non-verbal. Besides, people who have effective interpersonal intelligence tend to be sensitive with feelings and emotions from other people around them [12].

Students with high interpersonal intelligence would be easy to socialize with friends, so that they can solve any problem by collecting multiple ideas. When students are faced with open-ended questions are questions with several solution, students can build their creative ideas by discussing with other friends so that the role of interpersonal intelligence is needed. Creative thinking abilities of students led to the student's skills in solving problems with various solution. These skills must be trained with exercises that have some alternative solution. Perrya Anna state that granting practice aim to develop creativity through learning and practicing creative thinking strategies and through transforming information and experiences from training into new knowledge and skills [13]. The results of the research conducted by Leikin merely to measure creativity possessed by the students but did not provide conclusions about the level of creative thinking that is owned by the students [14]. Therefore, at this researchers will analyze of mathematics creative thinking levels of students based on student interpersonal intelligence.

2. Method
Qualitative descriptive method is used in this research to explain the influence of student’s interpersonal intelligence toward their mathematics creative thinking ability. This research is held during second term of 2016/2017 in SMP Negeri 3 Karanganyar. Purposive random sampling technique is used to choose subjects based on student’s interpersonal intelligence category in VII C class with 32 students. Based on the result, three subjects are obtained to represent each category of interpersonal intelligence which is classified as high, moderate, and low. Subjects are given by test to determine creative thinking ability level of each student. Then, interview is held to determine student’s
creative thinking ability. Subject 1 is symbolized (S1), subject 2 is (S2), and subject 3 is (S3). Table 1 is method in determining the levels of student’s interpersonal intelligence.

| No. | Interval                      | Category         |
|-----|-------------------------------|------------------|
| 1   | $x_i > \bar{x} + 0.5 s$      | High             |
| 2   | $\bar{x} - 0.5 s \leq x_i \leq \bar{x} + 0.5 s$ | Moderate         |
| 3   | $x_i < \bar{x} - 0.5 s$      | Low              |

Labels:
- $x_i$: student’s interpersonal intelligence score in each respondent
- $\bar{x}$: mean score of student’s interpersonal intelligence in samples
- $s$: standard deviation in samples [15]

3. Result and discussion
Interpersonal intelligence category is derived from total score of measurement scale of interpersonal intelligence. Based on the result, it has been obtained that the score $x_i > 98.47$ means high interpersonal intelligence, $91.21 \leq x_i \leq 98.47$ means moderate interpersonal intelligence, and $x_i < 91.21$ means low interpersonal intelligence. Essay test with open-ended type is used in this research to measure student’s mathematics creative thinking ability levels. Question given has multiple alternative solutions. Interview is held to confirm student’s written answer, so that researcher could get in depth information. As Sowder and Wheeler based interviews around solutions to estimation problems from hypothetical students in order to elicit explanations [15].

3.1 Analysis of subject with high interpersonal intelligence (S1)

Figure 1 shows that S1 has finished question number 1 in three different ways (flexible). S1 made the auxiliary line, so the shape looks like a combination of plane. S1 was able to show 3 different ways of completion (flexible). Based on the description above, it means that S1 able to understand the meaning of the problem, then plan some alternative solutions and solve the problem by combining some concepts that have been obtained (fluent).
Figure 2. S1 answer for number 2

Figure 2 shows that S1 also completed in 3 different answer alternatives (flexible). As well as in question number 1, S1 created auxiliary lines to divide the combined plane into 2 planes so it can calculate the area of each of its planes. S1 wrote in a row the area of plane to be searched (fluent).

Based on the interview, S1 was able to explain what was written smoothly and mastered the area of plane material. S1 said that he likes to try to think of ways that are different from what has been taught by the teacher. From the description above, it can be said that S1 classified as having creative thinking. In line with Laycock's view, creative thinking is the ability to analyze a given problem in many ways, to observe patterns, to see similarities and differences, to generate ideas and to decide on appropriate methods for coping with foreign mathematical situations [16].

From the results of student work and the interview results can be concluded that S1 is at the level of creative thinking 3. Creative thinking always seems to show flexibility [5]. It is also in accordance with the opinion of Tatag, the student was able to show a new answer in a different solution (flexible), although he is not fluent or make new answers in different ways (inflexible) [6].

3.2 Analysis of subject with moderate interpersonal intelligence (S2)

Figure 3. S2 answers for number 1 and 2
Figure 3 shows that S2 was able to solve the problem in 2 different ways (flexible) but S2 did not write the formula used to calculate each of these builds. In this work requires creativity that is how students can divide the combined plane into a few planes, so it can be calculated the area of each plane easily, and how the students can think of other ways that can be used to solve the problem. On the processing of number 2, S2 is shown to illustrate the third way to calculate the area of combined plane but not proceed to count it (not fluent).

From the results of interviews, S2 had already been understand and memorized the formula of plane, so he did not write the formula. S2 was able to understand the purpose of the problem, and found 2 different ways of settling. S2 tried to make an auxiliary line to calculate in the third way but still found difficulty in counting of each plane. So it can be said that in this case S2 is not fluent. In line with Tatag's opinion, the students are able to make one answer or different problem from common practice, though not flexibly or fluently, or able to show different ways of fluently different resolution even if the answer is not new [6] S2 is at the level of creative thinking 2.

### 3.3 Analysis of subject with low interpersonal intelligence (S3)

Figure 4. S3 answers for number 1 and 2

Figure 4 shows that on the work of number 1, S3 has done the work by 1 way of settlement. S3 step is to divide the combined plane into 5 parts. But when it came into calculation, S3 only wrote 3 areas of planes. S3 did the correct calculation in the first area of ABGF. When S3 calculated the second area of BCD triangle, S3 wrote incorrect number of triangle base and height. When S3 calculated the third area of BDEG trapezoid, S3 had a mistake in the calculation and S3 didn’t write the formula of trapezoid as well. S3 only wrote the multiplication of sides. After the interview was held, S3 stated that S3 has experienced difficulty in determining the height of BCD triangle so that S3 considered that the height was 30 cm. In the third calculation of planes area, S3 has experienced difficulty to determine the formula used to get the correct answer. Based on that result, S3 was able to divide the combined planes into parts but S3 was not able to determine each area. S3 didn’t create different alternative solutions. So, S3 had experienced various difficulties with only one solution.

In calculate number 2, S3 divided the combined planes into 3 parts. In the first calculation of PQUV rectangular, S3 wrote the formula and calculated the problem correctly. In QWTV calculation, S3 was only able to write the length of QV and not able to write the length of QW. So, S3 was not able to continue the solution to get the right answer. S3 didn’t calculate the third plane which was RSWQ trapezoid. From the result of interview, S3 stated that S3 has experienced difficulty in determining the length of QW. S3 only got it from side length in the question without any effort to try finding out more since S3 was confused to solve the problem. S3 didn’t calculate RSWQ area since S3 didn’t know the length of plane side. S3 couldn’t write the formula of planes area to find the answer. S3 didn’t write different alternative solutions.
From written answer and interview result of S3, it can be concluded that S3 is classified to fit into not creative level (zero level of creative thinking ability). This result is suitable with Tatag’s statement, student who is fitted into zero level of creative thinking ability (not creative), is not able to create new alternative answer through different solution or state different problem in a fluent or flexible way [6].

4. Conclusion
Based on the results of this research, on the level of students' mathematical creative thinking based on the interpersonal intelligence of grade VII students, it can be concluded that students with high interpersonal intelligence are at the level of creative 3 (creative) thinking. Students with interpersonal intelligence are at the level of creative thinking 2 (creative enough), and students with low interpersonal intelligence are at the creative thinking level 0 (not creative). The ability to think creatively is not only acquired through individuals, but creatively can be obtained through social relationships [8] which focus on interpersonal intelligence. Creativity will come with the knowledge received through the socialization process with the surrounding environment [17, 18] so that students with low interpersonal intelligence tend not to be creative. The results of this study are expected to provide information to the school, especially teachers about the level of creative thinking that students have different, so that teachers should be able to design learning that can train students’ creative thinking skills to achieve learning objectives.

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