Creativity of Field-dependent and Field-independent Students in Posing Mathematical Problems

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Abstract. This study aims at describing the creativity of elementary school students with different cognitive styles in mathematical problem-posing. The posed problems were assessed based on three components of creativity, namely fluency, flexibility, and novelty. The free-type problem posing was used in this study. This study is a descriptive research with qualitative approach. Data collections were conducted through written task and task-based interviews. The subjects were two elementary students. One of them is Field Dependent (FD) and the other is Field Independent (FI) which were measured by GEFT (Group Embedded Figures Test). Further, the data were analyzed based on creativity components. The results show that FD student’s posed problems have fulfilled the two components of creativity namely fluency, in which the subject posed at least 3 mathematical problems, and flexibility, in which the subject posed problems with at least 3 different categories/ideas. Meanwhile, FI student’s posed problems have fulfilled all three components of creativity, namely fluency, in which the subject posed at least 3 mathematical problems, flexibility, in which the subject posed problems with at least 3 different categories/ideas, and novelty, in which the subject posed problems that are purely the result of her own ideas and different from problems they have known.

1. Introduction
Mann and Singer stated that specifically, mathematics creativity refers to the growth of mathematics as a whole. Therefore, the failure in including creativity in mathematics class will eliminate students’ opportunities to enhance their understanding of mathematics [1, 2]. Students’ creativity must be facilitated in order to have maximum growth, but previous research conducted by Jellen and Urban revealed that Indonesian students’ creativity were in the low level compared to the other countries. Indonesian students’ lack of creativity cannot be separated from the educational influences [3]. In addition, the research that was conducted by Mann, Hirsh, and Savic revealed that the learning process and assessment of traditional mathematical class which emphasized on speed and accuracy in counting with limited problem-solving did not give adequate opportunities for the students to develop their creativity in mathematic class [4, 5, 6]. One way to support students’ creativity in mathematic class is through problem-posing activity. Lavy and Shriki, Georgiev and Nedyalkova, Singer, Unal and Arikat state that problem-posing activity can be viewed as a way to explore students’ mathematical thinking in order to build up their mathematical understanding and to foster their creativity [7, 8, 9].

According to Woodman and Schoenfeldt, every student has different creativity from one another [10]. One of the reasons about the differences in their creativity is because they have different cognitive styles. Someone’s cognitive style can be differed from many characteristics. Witkin introduced Field-
Dependent (FD) and Field-Independent (FI) as types of cognitive style. Idris explained that, generally, the characteristic differences between Field-Dependent individual and Field-Independent individual is on how the surroundings affect their perspective about something [11]. A research about creativity conducted by Rahman revealed that Field-Independent students were better in terms of posing mathematical problems than Field-Dependent student [12]. Another research about creative thinking process conducted by Mudrika revealed that Field-Independent students were better in explaining, verifying and checking their problem-posing procedures than Field-Dependent student [13]. Those researches mentioned earlier showed the superiority of Field-Independent students compared to Field-Dependent ones.

This study aims at describing the creativity of Field-Dependent and Field-Independent students in mathematical problem-posing. The creativity of the posed problems was reviewed from three components of creativity, namely fluency, flexibility and novelty [14]. Fluency in problem posing refers to the number of problems posed. Flexibility refers to the number of different categories of generated problems. Novelty refers to how rare the response was in a set of all responses known by the subject.

2. Research Methods
This study uses descriptive design with qualitative approach. Before conducting the research, several research instruments such as mathematical problem-posing task sheet and interview guidelines were established and validated. The determination of the subjects’ cognitive style was done through GEFT (Group Embedded Figures Test). The GEFT results decided two subjects with different cognitive style, one subject is Field-Dependent and the other subject is Field-Independent. Aside from GEFT results, the subjects were also determined through the consideration that both of them have similar mathematic achievements and have good communication skills in order to carry out the interviews in order to get a complete data of their creativity in mathematical problem-posing.

The data were conducted through written task about mathematical problem-posing and task-based interviews. This study used semi-structured type and pre-solution type problem-posing since the students were asked to pose mathematical problems freely based on the given information. The given information in the mathematical problem-posing task sheet were three different plane figures. The given information in the first mathematical problem-posing task consists of the figures of kite, rhombus and rectangle. The given information in the second mathematical problem posing task consists of the figures of right triangle, parallelogram and square.

Time triangulation and member-check were used to check the credibility of the data. The data of students’ creativity in mathematical problem posing were analyzed based on three creativity components (fluency, flexibility and novelty). Fluency component is fulfilled if the student posed at least three mathematical problems [14]. Flexibility component is fulfilled if the student posed mathematics problems with at least three different ideas[14]. Novelty component is fulfilled if the student posed at least one mathematical problem that is purely the result of her own ideas and its different from the problems she has known[14].

3. Results
The results of this study are the description of the creativity of Field-Dependent and Field-Independent students in mathematical problem-posing which is described in detail as follows.

3.1. Field-Dependent Student
Field-Dependent student posed five mathematical problems in the first mathematical problem-posing task and also five mathematical problems in the second task. Fluency component is fulfilled if the student posed at least three mathematical problems. Hence, it can be stated that Field-Dependent student’s posed problems have fulfilled the fluency component. In the first mathematical problem-posing task, Field-Dependent student posed five problems with four different ideas, such as the area of kite, the volume of cuboid, the area of rectangular, and the similarities. In the second mathematics problem-posing task, Field-Dependent student posed five problems with five different ideas, such as the angle of right triangle, the length of rectangular, the volume of cubic, the circumference of square, and the characteristics of square. Flexibility component is fulfilled if the student posed mathematical
problems with at least three different ideas. Hence, it can be stated that the Field-Dependent student’s posed problems have fulfilled the flexibility component.

However, among all of her mathematical posed problems, none of them is purely the result of her own ideas not it is different from the problems she knows. Trough task-based interviews, she stated that she posed problems that are similar to the ones she had solved in the past. She just changed the number but the big ideas were all the same without any modifications that differentiate them from the problems that she knows in the past. Novelty component is fulfilled if student posed at least one mathematical problem that is purely the result of her own ideas and different from the problems she knows. Hence it can be stated that Field-Dependent student’s posed problems have not fulfilled the novelty component. The posed problems by Field-Dependent student can be seen in Figure 1.

### Figure 1. Field-Dependent Student’s Posed Problems.

The summary of Field-Dependent student’s creativity in posing mathematical problem can be seen in the following table.

| Creativity Components | Description |
|-----------------------|-------------|
| Fluency               | Posed at least three mathematics problems. |
| Flexibility           | Posed mathematics problems with at least three different ideas. |
|                       | Did not posed at least one mathematical problem that is purely the result of her own ideas and different from the problems known to her. |

* √ means fulfilled

### 3.2. Field-Independent Student

Field-Independent student posed four mathematical problems in the first mathematical problem-posing task and five mathematical problems at the second task. Fluency component is fulfilled if the student posed at least three mathematical problems, hence it can be stated that Field-Independent student’s posed problems have fulfilled the fluency component. In the first mathematical problem-posing task, Field-Independent student posed four problems with four different ideas, such as the area of kite, the similarity, the area of rectangular, and the volume of cube. In the second mathematical problem-posing task, the Field-Independent student posed five problems with five different ideas, such as the number of roses (the circumference of parallelogram), the volume of cube, the area of triangle, the size of the plane thatis
made from a square sheet that was cut the same size, and the area and circumference of a square. Flexibility component is fulfilled if student posed mathematical problems with at least three different ideas. Hence, in can be stated that Field-Independent student’s posed problems have fulfilled the flexibility component.

Among all of her mathematical posed problems, there is one problem in every task that she posed which is purely from the result of her own ideas and different from the problems she has known. In the first mathematical problem-posing task, there is one problem that she posed by modifying the ideas of the problems she knows in the past. She added the ideas of kite’s area and the similarity. The problem posed is an open-ended problem that has many solutions. She also posed a problem that is purely from the result of her own ideas and different from the problems she knows in the second problem-posing task. She posed a problem, the idea of which came from many papers that she saw in front of her. The problem is about the size of the plane that is made from cutting or folding a sheet of square paper several times with the same size in every cuts or folds. That problem is also an open-ended problem that has many solutions. Novelty component is fulfilled if student posed at least one mathematical problem that is purely the result of her own ideas and different from the problems she knows. Hence, it can be stated that Field-Independent student’s posed problems have fulfilled the novelty component. The posed problems by Field-Independent student can be seen in Figure 2.

![Field-Independent Student’s Posed Problems](image)

**Figure 2.** Field-Independent Student’s Posed Problems.

The summary of Field-Independent student’s creativity in mathematical problem-posing can be seen in the following table.

**Table 2.** The Creativity of Field-Independent Student in Math Problem Posing.

| Creativity Components | Description |
|-----------------------|-------------|
| Fluency               | Posed at least three mathematics problems. |
| Flexibility           | Posed mathematical problems with at least three different ideas. |
| Novelty               | Posed at least one mathematical problem that is purely the result of her own ideas and different from the problems she knows. |

* √ means satisfied
4. Discussion
From the previous descriptions, it is revealed that there is a correlation between students’ cognitive style and their creativity in posing mathematical problem. Therefore, this study tried to draw an outline of the creativity of Field-Dependent and Field-Independent Students in mathematical problem-posing. The summary of Field-Dependent and Field-Independent students’ creativity in mathematical problem posing were reviewed through three creativity’s components which can be seen in the following table.

| Creativity’s Components | Indicator | FD Student | FI Student |
|-------------------------|-----------|------------|------------|
| Fluency                 | Posed at least three mathematics problems. | √          | √          |
| Flexibility             | Posed mathematics problems with at least three different ideas. | √          | √          |
| Novelty                 | Posed at least one mathematical problem that is purely the result of her own ideas and different from the problems she knows. | -          | √          |

* √ means satisfied

Brosnan states that, generally, Field-Dependent individual saw the stimuli globally and in less analytical way [15]. It can be seen from the Field-Dependent student’s posed problems in which all of them focused on the global aspects such as area, circumference and volume. The posed problems also consist of only one idea in each problem. Field-Dependent student didn’t pose mathematical problems that consist of more than one idea in one problem. It showed that Field-Dependent student was less analytical in posing mathematical problems.

Different from Field-Dependent Individual, Brosnan states that Field-Independent individual saw the stimuli in a structured and analytical way [15]. It can be seen from Field-Independent student’s posed problems in which there is one problem that not only asked for the circumference of parallelogram but also asked the detail about the number of roses around the garden if there were five roses in every three meters. There is also one problem that consists of more than one idea, such as the area of kites and their similarity. Those two ideas were put into one context. It showed that Field-Independent student was analytical in posing mathematical problems.

5. Conclusions
From the descriptions explained previously, it can be concluded that Field-Dependent student’s posed problems fulfilled only two components of creativity, namely fluency since she posed at least three mathematical problems and flexibility since she posed mathematical problems with at least three different ideas. In the other hand, Field-Independent student’s posed problems have fulfilled all the three components of creativity, namely fluency, since she posed at least three mathematics problems, flexibility, since she posed mathematical problems with at least three different ideas, and novelty, since she posed at least one mathematical problem that is purely the result of her own ideas and different from the problems she knows.

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