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Identification of Student's Concept on Area Conservation in Solving Proof Task Based on Witkin's Cognitive Styles

A Case of Indonesian Primary Student

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Abstract. Area Conservation is one of the basic geometry concept which is very important to be mastered as prerequiste knowledge for studying area concept in primary school. Knowing the concept of area conservation is giving opportunities for them exploring reasoning skill and limiting the use of formula at the early stage. This research is gaining information about student'conception of proof task by using area conservation problem. We identify and gather student task for finding out their conception in developing reasoning skill in verifying their conjecture on proof tasks. A sample students was chosen by their differences on cognitive styles, field dependent and field independent, by applying GEFT (Group Embedded Figure Test) adopted from Witkin. The data are analyzed by time triangulation, descriptive qualitative research design, for describing student's concept of area conservation in solving proof task. The result shows that field independent student have more concept of area conservation than field dependent student. The latter are only applying the compensation concept in proofing the area of plan figures.

INTRODUCTION

Area conservation is one of the basic level geometry concepts that are important to be mastered as a prerequisite for a comprehensive study in plan figures. Kordaki stated that area conservation is a modification in geometry figures such that the area of the figures is not changed [1], [2]. Mcleod explains that conservation is the ability to understand that redistributing the material does not affect its mass, volume or number [3]. Knowing the concept of area conservation is giving opportunities for them exploring reasoning skill and limiting the use of formula at the early stage

There are two concepts of area conservation widely used in proving the area conservation problems, namely compensation and part-whole relation. The former is the idea to change the composition of a certain geometry figures to another form simply without changing breadth . The latter, the idea that the area of plan figure can be arranged from the area of the compilers of the structures [4]. So, this concept facilitate students in developing the ability of proof and spatial abilities because students can separate, drawing, modeling, locate, measure and construct geometric relationships. In combining and consolidating conservation idea in proving area

conservation problem, this paper focused on area conservation issues to explore students understanding of this concept which have already obtained.

The students ability in constructing proofs can be analyzed from the representation of evidence, emerged from act, visual, evidence, symbolic and formal proof [4]. Proof in geometry problems have complete representation forms contain evidence and arguments based on the premises in geometry [5]. Proving area conservation problem giving opportunities to elicit students understanding of area concepts in primary school. This paper refill the difference of concept identification in proving area conservation task given two plan figures based on their cognitive styles.

Witkins cognitive style [6], field dependent and field independent, allows the identification of area conservation concept between two geometry plan figures. Field independent subject may find that it sees that plan figures composed from others plan figures, so that he may find that the same area of them by its constituent elements. However, field dependent subject have difficulties in finding a simple part of the original context.

RESEARCH METHOD

This paper is qualitative research that will produce descriptive data of an overview of the identification of students' area conservation concepts used in proof task in terms of their cognitive style. Research data collection method starts from the determination of the subject. Once a subject is determined, the subjects were asked to complete a booklet containing area conservation problems within a predetermined time limit. The next process is interviewing subjects in greater depth in order to verify the results of data written assignments.

The sample are 5th grade students and using purposive sampling. The selection of them based on considerations, such as supporting the objectives of learning elementary that is using reasoning on the pattern and nature, perform mathematical manipulation in making generalizations, compile evidence or explain mathematical ideas and statements;The 5th grade of elementary school is included in the concrete operational stage where the subject can prove the area problem by using area conservation; based on the stage of cognitive development of proof, elementary students have entered the verbal description stage, they can connect and represent visual objects or symbols and start thinking about certain properties and relationships [7]. Research subjects are determined by referring to the cognitive style classification test results field dependent and field independent.

In this study, students are grouped into 2 categories of cognitive styles, namely Field Dependent (FD) and Field Independent (FI). The determination of student cognitive style was done using Group Embedded Figures Test (GEFT) by Witkin Cognitive Styles. If the selected classes are not found in groups of students with cognitive style field dependent and field independent, then the cognitive style determinant test is done in another class. Based on the results of GEFT test, the selection of FI subjects are students with the highest score and subject FD is the students who have the lowest score. The subject's selection is also based on students' communication and mathematical skills. Communication skills are intended so that students do not experience difficulties when invited to communicate orally and able to express opinions. The mathematical ability referred to in this study is represented by a mathematical score where the difference in the mathematics score <5 in the scale of 1-100. The information is obtained from the math teacher who teaches in the classroom used.

Identification process that is revealed in this study refers to student's strategy in proving those problems, where such activity may refer to types of concepts used. The type of concepts that may be used by students in proving the area conservation problems are compensation and part-whole relation. Time triangulation was uses in this paper for checking the level of confidence and the accuracy of the data obtained by comparing the results of the students' assignments along with an interview with the results of similar tasks together with interviews at different times. Analysis of the data in this study refers to the stage of qualitative data analysis by Miles and Huberman as follows: data reduction, presentation of data, validation and drawing conclusion.

RESULTS AND DISCUSSION

There are four given questions consisting of about proving area conservation problems. The first question, there are two plan figures which is given their pattern. The second question, there are two plan figures which only one figure is unknown pattern. The third question, where only one figures is known its pattern but its structure doesnt known directly, and the last question in which both plan figures are unknown composition and pattern. The instrument were validated by the expert judgement for data analysis.

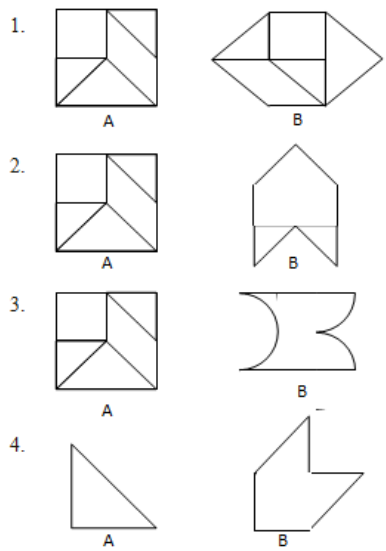

Figure 1. The problem sheet of the first triangulation

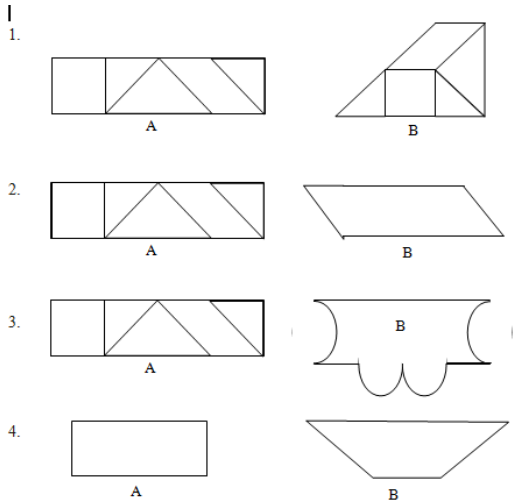

Figure 2. The problem sheet of the second triangulation

Field independent and field dependent subjects have a different approach to the concept of area conservation in proving those problems. On the first question, both field independent and field dependent subjects were able to show that the area of figure A and figure B is equals by using a different approach in which the FIS (Field Independent Subject) uses the concept of compensation and FDS (Field Dependent Subject) using part-whole relation concept based on their straregy in solving proof tasks.

There are some interesting findings to be discussed in this paper such as research subjects have a fundamental difference in any of the concepts used in the type of questions the second, third and fourth. FIS can reveal more than one concept to prove the area conservation problems, either with the concept of compensation, part-whole relation and using the formula for the area plan figures. While the FDS are more likely to see images and size regardless of the concept of area conservation either compensation or part-whole relation. Although the subject looking at its size, but the size is sought comparison is not appropriate and does not apply the formula for the area of plan figures. Furthermore, the FDS only focuses on the given arrangement pattern A, while FIS concentrated on figure B and turn it into a figure A. This is in accordance with the opinion of Witkin and Goodenough which states that the field independent cognitive style tend to approach problems analytically and solve problems as they can sort out in detail the parts contained in the problems [6]. So that the individual has the perception that is not easily affected by the manipulation of the situation around them. them.

Table 1. The Identification of Area Conservation Concepts of Subjects

Question	Field Independent Subject	Field Dependent Subject
1	Cut-paste strategy (compensation)	Comparing the arrangement between figure A and B (Part-Whole Relation)
2	Cut-paste strategy (compensation) Grid-paper strategy (quantitave approach)	Looking at figure and its size
3	Cut-paste strategy (compensation) Using formula of plan figure area	Looking at the form of the figures
4	Cut-paste strategy (compensation) Grid-paper strategy (quantitave approach) Comparing the number of unit by using grid paper (part-whole relation)	Cut-paste strategy (compensation)

The present study reveal that the students perform different strategy in solving proof task based on the cognitive styles. FIS are able to perform non-numerical (compensation, part-whole relation) and numerical strategies (quantitative approach) while FDS tend to be able to perform non-numerical strategies only. This finding supports the Tumova's framework that, in the progress of understanding area measurement, the students may produce non-numerical and numerical reasoning in measuring area [8]. Furthermore, Gagatsis and Sriraman state that the students perform different strategy in solving geometry-related problem based on the level of geometrical thinking [9] which is inline with the finding that different cognitive style in thinking elicite different approach in solving the proof tasks. Along with the idea of cognitive styles, this study suggests that in guiding the students in understanding area measurement non-numerical strategy should be used as fundamental approach as it occur in both cognitive styles. Then, developing array structure in area measurement should be more careful regarding the cognitive styles if the students..

CONCLUSION

The results of this study indicate a fundamental difference in the conservation concept widely used in the problem of area conservation between field independent and field dependent subject. It can be seen that FIS can reveal more than one strategy to prove the area conservation problems, either with the strategy of compensation, part-whole relation and using the formula for the area plan figures. While the FDS are more likely to see images and size regardless of the concept of area conservation either compensation or part-whole relation. In addition, this study elicite the relationship on how proofing ability result from the students level of geometry thinking. Further study in analyzing the proofing ability and its relation with the van Hiele level of geometry thinking may result interesting findings.

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