The Abstraction Ability in Constructing Relation Within Triangles by The Seventh Grade Students of Junior High School

by Suwardi Annas

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Abstract. Abstraction is an activity to organize a mathematical concept that has been previously owned into a new mathematical structure. Activites in abstraction are recognizing, organizing and constructing. Recognizing is a process of identifying a mathematical structure that had existed before. Organizing is a process of using structural knowledge to be assembled into a solution of a problem and constructing is a process of organizing the characteristics of the object into a new structure that does not exist. In abstraction process, the students use attributes to address the object, including routine attribute, nonroutine attributes, and meaningless attributes.This research applied descriptive qualitative research which aimed to describe the abstraction ability of students from high, moderate, and low groups to construct a relation within triangle. In collecting the data, this research used students' pre-ability math test, abstraction test, and guided interview. The sampling technique in this research was based on the students' scores in pre-ability math test, which were divided into three groups. Two students from each group were opted as the subjects of this research. Questions of the test are based on the indicators of steps in abstraction activity. Thus, based on the data gained in this research, researcher determined the tendency of attributes used in each abstraction activity.The result of this research revealed that students from high, moderate and low groups were prone to use routine attributes in recognizing triangles. In organizing the characteristics within triangles, high group tended to organize the triangle correctly, while the moderate and low groups tended to organize the triangle incorrectly. In constructing relation within triangles, students in high, moderate and low groups construct it incompletely.

1. Introduction

Mathematics is a science studying the abstract structure and its relationship pattern. Nurhasanah states that mathematics is a science focusing on abstract object. Mathematics is considered abstract because the objects and symbols do not exist in the real life [1]. Learning mathematics actually are to learn the concept, the structure of the concept, and to seek the relationship among concepts and their structures. Learning mathematics can learn using cognitive style [2][3], problem solving [4][5], problem posing. Learning mathematics can doing using online media [6][7]. The emphasis of good mathematics learning process is how to assist students to comprehend mathematical concepts well. It is in line with Cooney's statement (in [8]) who indicates that students' ability in learning mathematics is directly linked to their understanding about mathematical concepts and principles. Thus, all definitions, basic concepts, and even the most complicated concepts in mathematics are built on the abstract foundation.

It is different from students' condition at school, they are accustomed to think with evident objects. They are not accostumed to mathematics, which focusing on abstract objects.

There is gap between mathematics and students' thought at school. Marti in [9] describes that abstract mathematical object is a trouble that students face in learning mathematics. It is not only the students, teachers also get difficulties in teaching mathematics with its abstract disposition. Concepts in mathematics can be easily understood if they are in the concrete form. Therefore, teaching mathematics must be undertaken step by step. Learning mathematics should begin with concrete step, then direct into semi-concrete step. Eventually students can think and understand mathematics in its abstract features [10]. The process is termed as abstraction process.

Abstraction is a fundamental process in mathematics and mathematics education, the existance of abstraction in the learning process is a must, as it has an important role in forming mathematical concepts. Abstraction process needs much attention. Through the process, we can measure how far students understand a concept and how students construct the previous concept with the new one to find relationship.

Geometry occupies distinctive position in the mathematics learning at school with many concepts it has. Nurhasanah desribes, geometry is one of the mathematics' branches which discusses about objects like point, line, surface, dimension and their connections where all the objects are abstract [1]. Nurhasanah proposes that abstract object in geometry is frequently visualized and linked with real object empirically. Juwita adds, the visualization makes students get difficulties in learning geometry [8].

The concept of triangle is one of the materials in geometry in school mathematics in which many students get trouble in, especially in forming definition of triangle, sorting and drawing triangle based on its type. Yezita et al. also reveal that material in identifying the characteristics of triangle based on its side and angle is a difficult material for students to understand [11]. Thus, abstraction process is considerably needed in mathematics learning specifically the concept of triangle in geometry [12].

Based on the above elaboration, the problem statement in this research is "How is the abstraction ability of the high, moderate and low group of VII grade junior high school students in constructing the relation within triangles?". The objective of this research is to know the abstraction ability of the high, moderate, and low group of VII grade junior high school in constructing relation within triangles. The significance of the research is expected to give constibution to in investigating how the abstraction ability of the VII grade students junior high school in triangles material in mathematics learning and as a consideration for the upcoming similar research.

2. Content and Method

Soedjadi in his book "Kiat Pendidikan Matematika di Indonesia" concludes that an abstraction happens when we notice several objects and we "abolish" the unnecessary features and characteristics of the objects, and only the important characteristics taken [10]. Suharnan (in [8]) adds that abstraction is a process of separating the essential features or the same features of some objects and discarding the nonessential features of the objects to conclude at the end.

Cooney (in [13]) states that abstraction happens when someone realizes the similarities among the differences. Soedjadi explains the process of abstraction through the following scheme [10]:
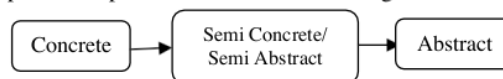

Figure 1.The Scheme of Abstraction process

In Geometry, the explanation of triangle concept can begun by using "cardboard triangle" then "wire triangle/leaf-rib triangle" can be used, then a more abstract image of triangle. Therefore, it is inferred that **abstraction** is the outcome and the process of organizing existed mathematical concept into new mathematical structure.

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Budiarto explains more about the activities in the abstraction process as collecting, compiling, organizing, and developing the elements into novel elements so the activities in the abstraction process are recognizing, organizing, and constructing [14].

Recognizing in abstraction means identifying an existed mathematical structure in the similar or different activities. Recognition of a mathematical structure which has been learnt by the student before, happens when the student realizes that the structure he/she constructed of used before is appropriate with the mathematics situation given.

Organizing is an application uses structural knowledge which then organized to be the solution of the problem gained. Organizing is combining structural elements to achieve the appointed objective. Knowledge uses in organizing step is recognizing features of a structure and its definition.

Constructing is a necessary stage in abstraction. Constructing is organizing features of an object into new structures that its never owned. The activity of organizing characteristics of square changes into a network of relation within squares.

Budiarto adds that activity in the abstraction process which elaborated previously, is not linked chain [14]. Constructing does not only happen after recognizing and organizing in linear but recognizing and organizing can be undertaken simultaneously to do the structure of constructing.

Furthermore, Budiarto explains that in the abstraction process, students use attributes and characteristics of the objects [14]. Attributes used are divided into three, namely routine attribute, nonrutin attribute, and meaningless attribute.
1. Routine attribute is an attribute which commonly learnt at school in the initial process of compiling the definiton of a concept.
2. Nonroutine attribute is an attribute which not commonly learnt at school in the initial process of compiling definiton of concept.
3. Meaningless attribute is an attribute which cannot be used in the initial process of compiling definition of concept.

This research described students' abstraction as a process and outcome concerning how students recognize triangles, characteristics and definition of triangles, organize the characteristics of some triangles to construct the relationship of triangles. To know the abstraction process, this research used abstraction activities which cover recognizing, organizing the characteristics of triangles, and constructing the relationship of triangles. In the activities students possibly use routine attributes, nonroutine attributs and meaningless attributess.

Abstraction process in mathematics benefits as a process which spurs mathematics development so all things in the universe can be utilized prudently. Besides, abstraction also elaborates in depth the relationship among branches and parts in mathematics [15].

This research was a descriptive research using qualitative approach which aimed at describing or elaborating students' abstraction ability in constructing relation within triangles. This research was undertaken in SMP Negeri 2 Takalar with the research subjects were students of VII.1 class of 2015/2016 who had learnt the material of triangles. The procedure of collecting data was done by administering pre-ability test to the 30 subjects of the research individually. 8 students were categorized as high group, 8 students were in low group and 14 other students were in moderate group. Then, two subjects were opted from the three groups as the representatives. Students who became the representatives were given abstraction test and they were interviewed. The data analysis process began by analyzing the whole data provided from different sources, including the outcome of the written test, interview and field observation. The next step was the elaboration and the last stage was concluding the data of abstraction from the subject of the research.

3. Result and Discussion

3.1. Abstraction Ability of High Group
In recognizing activity of trianges, the first and second subjects were able to classify 6 (six) groups of triangle. Consideration used by the first and second subject was the same in classifying the triangle as

both used routine attributes. Thus in the recognizing activity, subjects of high group were prone to use routine attributes.

In the organizing stage, students began by recognizing the charactertistics of each triangle and define it. In the recognizing activity, the first and second subjects used routine attributes for each group. In defining, the first and second subjects defined 6 (six) group of triangles completely and correctly. Thus, in defining triangle high group were prone to be precise. While in the organizing activity, the first and second subjects were able to organize 7 (seven) connections within triangles correctly. Therefore, in organizing the same characteristics within triangles, high group tended to organize well.

In the activity of constructing relation within triangles, the first and second subjects were prone to do it incompletely.

3.2. Abstraction Ability of Moderate Group
In recognizing triangles, the first and second subjects were able to categorize 6 (six) groups of triangle. Consideration used by the first and second subjects in categorizing triangles was the use of routine attributes. Thus, in recognizing activity, subjects of moderate group tended to use routine attributes.

In organizing the same characteristics of triangle, students began by recognizing the characteristics of each triangle and define it. In recognizing the characteristics of triangle, the first subjects used routine attributes for each triangle and the second subjects used routine attributes of each triangle group. In defining phase, the first and second subjects defined 6 (six) triangles completely and correctly. Thus, in defining triangle, moderate group tended to be accurate. While in organizing characteristics within triangle, the first subjects could only organize the same characteristics of 6 (six) triangles, while the second subjects could only organize the same characteristics of 5 (five) triangles. Thus, in organizing the same characteristics of triangle, moderate group tended to do organizing activity incorrectly.

In constructing relation within triangle, the first and second subjects tended to do it completely.

3.3. Abstraction Ability of The Low Group
In the recognizing activity, the first and second subjects were able to classify 6 (six) groups of triangle, but the activity was still imprecise. Consideration used by the first and second subjects in classifying triangles was routine attributes. Thus, in recognizing triangles, subjects of the low group tended to use routine attributes.

In organizing the same characteristics of triangle, students started by recognizing characteristics of each triangle and defined it. In the recognizing activity, the first and second subjects used routine and nonroutine attributes of each group of triangles. In defining, the first subjects defined 5 (five) groups of triangle correctly and the second subjects were only able to define 5 (five) triangles correctly. Thus, in defining triangles, low group tended to define it incompletely. While in organizing the characteristics of triangles, the first subjects only organized the same characteristics of 3 (three) triangles, the second subjects only organized the same characteristics of 1 (one) triangle. Thus, in organizing the same characteristics within triangles, low group tended to organize it incorrectly.

In constructing relation within triangles, the first and second subjects tended to do it incorrectly

The summary of abstraction activity among students' groups in constructing relation within triangles is shown in the table 1.

Based on the table 1, in recognizing activity, students from high group, moderate group and low group tended to use routine attributes. In organizing the same characteristics of triangles, students began by recognizing the characteristics of each triangle and defined it. High and moderate group were prone to recognize the characteristics of each triangle through routine attributes, while low group used routine and nonroutine attributes. In defining triangles, high and moderate group tended to define triangles precisely, while the low group tended to be inaccurate. Then, in organizing the characteristics of triangle, high group tended to organize it correctly while moderate and low groups tended to

organize it incorrectly. In constructing relation within triangles, high, moderate and low groups tended to construct incompletely.

Table 1. Abstraction ability among groups

Subject Code	Recognizing Triangle	Sequencing the same characteristics of triangle			Constructing relation within triangle
		Recognizing the characteristics of triangle	Defining triangle	Sequencing the same characteristics	
High	Routine attributes	Routine attributes	Accurate	Correct	Incomplete
Moderate	Routine attributes	Routine attributes		Accurate	Incorrect
	Routine	Routine and			Incomplete
					e
Low	attributes	nonroutine attributes	incomplete	Incorrect	Incomplete

4. Conclusion

Based on the result of this research, it is concluded that in recognizing triangles process, students in high group tended to use routine attributes, in the process of organizing the characteristics of triangle, students of high group tended to organize correctly. In the process constructing relation within triangles, students in high group tended to construct incompletely. In the process of recognizing triangles, students in moderate group tended to use routine attributes, in the process of organizing the characteristics of triangle, students in moderate group tended to relate it incorrectly. In the process of constructing relation within triangle, students of i moderate group tended to construct incompletely. In the process of recognizing triangle, students in low group tended to use routine and nonroutine attributes, in organizing the characteristics of triangle, the low group tended to relate the triangle incorrectly. In constructing relation within triangle, students in low group tended to construct the triangle incompletely. For the future researchers who are interestedin studying the relevant studies, it is recommended to research on the idea of abstraction in reconstructing the definition of relation within triangles.

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