The abstraction of junior high school student in learning geometry

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Abstract. This paper is prepared to describe the abstraction of junior high school students in studying geometry, in this case studying cubes and constructing cube nets. Abstracts were obtained through interviews that aim to get a picture of the abstraction that occurs in students in learning cube activities and constructing cube nets which are part of learning geometry. The data is presented in the form of an interview transcript which explains how students learn the cube pattern and constructing cube nets by remembering previous learning activities and imagining the shape of the cube pattern and cube nets in their mind which is then visualized. Based on these data, it can be concluded that the abstraction of junior high school students in geometry learning activities is an abstraction which is an epistemic action which includes recognition, build-whit and constructions that are interrelated with one another.

1. Introduction

Research on abstraction in the last 20 years has been very rapid and has provided a lot of development in science. Experts who have introduced abstractions and developed it are Skemp in 1986 and Hershkowitz in 2001. Those abstractions introduced by those experts were then developed by several researchers under certain mathematical topics \[4,5\].

Abstracting is an activity by which we become aware of similarities among experiences. Classifying is defined as the process of collecting together our experiences on the basis of these similarities. An abstraction is some kind of lasting change, the result of abstracting, which enable us to recognize new experiences as having the similarities of an already formed class... to distinguish between abstracting is an activity and abstraction as its end product, we shall ... call the latter a concept \[1\]. Abstraction refers to any thinking that tries to “deal with” phenomena to which we do not have access solely through our five senses but rather exist only in our mind and/or our interaction with other \[2\]. Abstraction is an activity of vertically reorganizing previously constructed mathematics into a new mathematical structure \[4,5,7\].

This definition is sharper than the definition of abstraction introduced by other experts where the definition has an important role in the development of broader abstraction research. The vertical term used in this definition indicates that the new concept is at a higher level than the previous concept \[6,7\]. The new concept referred to in this research is a new mathematical structure that is constructed or generated through the product of abstraction in the form of epistemic action which includes recognition,
build-with and construction, which are then known as the nested epistemic action model where these actions are interrelated with each other [5].

The nested epistemic action model is inspired by davydovian epistemological theory which shows that there is a dialectical relationship between concrete and abstract. In addition, the vertical reorganization that has been previously described is also based on Freudenthal which states that vertical mathematization points to a process that typically consists of the reorganization of previous mathematical constructs within mathematics and by mathematical"[8]. What he has stated provides an answer to something that is the focus of researchers in developing abstractions. He argues that previous knowledge is an artifact that can build new knowledge in cascading "vertical mathematics". Research on abstraction in the context of epistemic action has recently been carried out by some of the experts [5-8, 11] but it is still unclear how epistemic action takes place in mathematics learning or specific math topic such us geometry.

Inside epistemic actions include recognition, build-with and construction [5]. The first action is recognition where action is the activity of forming a previous mathematical structure where the student's activity is stored and has relevance to the current situation of constructing new mathematical structures[4]. The second epistemic action is building-with where this action refers to the use of available mathematical elements to achieve the goal, such as simplifying problem solving or providing explanation [7] and third action, namely construction which refers to assembling mathematical structures in producing new mathematical structures [5].

Through this research the author aims to explain how the epistemic action of junior high school students in learning geometry, especially in studying cubes and constructing the cube net pattern as in Figure 1 below:

![Cube nets pattern](source: Jeon 2009 [13])

**Figure 1. Cube nets pattern**

2. Methods
This research activity is carried out with a descriptive qualitative approach which aims to describe the abstraction of students in studying cubes and constructing the cube nets pattern. As for obtaining the abstraction data, it was carried out by conducting clinical interviews on subjects who had been selected with certain criteria, the students were interviewed after the activity in studying the cube and constructing the cube-nets patterns was completed. From the interview data were then analyzed data starting with data transcripts from clinical interviews in the form of audio and audio visuals. Transcripts in the form of interviews based on CNCT as revealing student abstraction data which are then carried out classification and categorization. The subjects in this research were 12 junior high school students in the city of Serang who had previously studied basic geometry.

3. Results and Discussion
This research was conducted on several junior high school students in Serang City. It was found that 2 students understood the cube concept well and were able to construct all cube net patterns properly and correctly and as many as 7 students understood the cube concept well and were able to construct some of the cube nets. cube nets and as many as 3 students did not understand the concept of a cube well and had difficulty constructing cube nets patterns. The data is presented in Table 1. Following.
Table 1. Students’ achievements

| Achievements                                                                 | Student |
|------------------------------------------------------------------------------|---------|
| Students understand the concept of a cube and are able to construct all grid patterns of cubes | 2       |
| Students understand the concept of a cube and are able to partially construct a grid pattern cube | 7       |
| Students understand the concept of a cube but have difficulty constructing a cube net pattern | 3       |

The researcher conducted clinical interview to one of the students who understood the concept of cube and did a good job to reconstruct the whole pattern of cube nets, with I as the code for the researcher, and S as the code for the student.

I : What is meant by a cube?
S1: A cube is a shape that has six equal sides
I : What elements are in a cube?
S1: The cube has vertices, has sides, has edges, hmmm forgot what else (student experiencing difficulties in answering)
I : Does it have a diagonal of space?
S1: I think they have (students hesitate to answer)
I : Earlier you made a cube mesh pattern, how many grids can you make?
S1: Eleven (answered with confidence)
I : How do you get it?
S1: Cut the sides of the cube first then just arrange them
I : Are you sure the shape of the cube mesh pattern that you made is correct?
S1: Sure, you can imagine, sir, if the sides are moved, we already know which base and which roof (while student shows how to make the cube nets pattern)

From the answers explained by the student with the S1 code, the student recognizes the cube concept well. The student also tries to combine his previous knowledge with his new knowledge to get a cube net pattern. In the last part, students believe in the new concept they make. From the results of the first interview in studying the cube and constructing the cube net, the students showed abstraction in the form of epistemic action which includes recognition, namely recognizing the concept of the cube, building-by combining previous knowledge with new knowledge to get cube netting patterns and constructing new knowledge and concepts. new grids cube pattern. The three epistemic actions on these students are tiered, where the first action is recognition, then building-with and finally construction.

The researcher conducted a second interview with students who understood the concept of a cube and were able to partially construct a cube grid pattern. Of the 7 students, researchers only conducted interviews with one of them who felt biased in providing information in their learning activities and constructing their cube nets.

I : What is meant by a cube?
S4: A cube is a shape that has edges, sides and angles.
I : What elements are in a cube?
S4: The corner points, the sides are ebam, hmmm (students are silent and think to continue the answer)
S4: Oh yes there is a diagonal
I : What is a diagonal?
S4: it is when you pull it from one point to another it can turn diagonal (students remember learning basic geometry)
I : Earlier you made a cube mesh pattern, how many grids can you make?
S4: I can only make eight patterns sir, dizzy (students claim to have difficulty making all patterns)
I : How do you get it?
S4: Cut the cubes out first, then arrange the grid pattern of the cubes (students answer confidently)
I : Are you sure the shape of the cube mesh pattern that you made is correct?
S4: Sure, but actually I have made 13 shapes of cube nets, sir, but I think the three are wrong sir, let's see, sir. (students show their work and indeed the three cubes shown are not the correct cube grid pattern)

The results of the second interview with the student's answer with code S4, the student recognizes the cube concept well, which means that in this case the student takes action recognition, the student also takes action building-with, which is trying to combine previous knowledge with new knowledge to get a cube net pattern although not drawing all the desired patterns and there are still wrong cube nets patterns. In the last part of the interview the students believed in the new concept they made but with a little doubt.

Furthermore, the researcher conducted a clinical interview with one of the students who understood the concept of a cube but had difficulty in constructing a cube net pattern with the code Researcher (I) Student (S) and Numbers were the students being interviewed.

I : What is meant by a cube?
S10: Hhmm a cube is a shape.
I : What elements are in a cube?
S10: he has a point, has a line, has a side, has a lot of ruuk, sir (students convince researchers of the answer)
I : How many sides are there in a cube?
S10: There are six hhhmmm for a moment, I think six, sir
I : What is the point of the corner?
S10: hhhmmm how many, one, two, hhhmmm there are eight, I think sir (students imagine their knowledge of cubes)
I : Oh yeah, you made a cube netting pattern, how many cube mesh patterns can you make?
S10: Ouch sir dizzy, I kept making mistakes so I just made this (shows the work)
I : How do you get it?
S10: Earlier I had cut the sides but I was confused about how to make the desired cube mesh pattern it's like this
I : Are you sure the shape of the cube mesh pattern that you made is correct?
S10: No, but I think it's wrong sir because the shape is different from the others. (students do not believe in the results of their work and compare the results of their work with the students next to them)

The results of the interviews with the three students' answers with the S10 code show that the student recognizes the concept of a cube concept, which means that in this case the student takes action recognition, but the student has difficulty combining previous knowledge with new knowledge to get a cube netting pattern so that it constructs a grid pattern, the wrong cube. In the last part of the interview the students did not believe in the new concept they made. It is necessary to do more in-depth research because the researcher cannot conclude that the student is abstraction of epistemic action partially or not at all and this needs to be carried out further research.

Overall, based on clinical interviews that have been conducted, it was found that nine students had stated that they had studied basic geometry before so that they were familiar with the elements and the concept of the cube and were able to construct cube nets patterns correctly. The ability to recognize this concept is recognition which is one of the actions in epistemic action, then students also do various ways to solve the given problem, namely by recalling previous knowledge and thinking very hard to use the cube concept that was previously found to be used. In making the cube netting pattern, in this epistemic action, this activity is a building-with action, but of the 9 students only 2 students succeeded in constructing a complete cube netting pattern. In addition, in the interview, students also stated that they
had combined a new concept based on the previous concept, which in epistemic action was a construction action so that the three epistemic actions including recognition, building-with and construction were interrelated with one another. In this study, three students also experienced difficulties in studying the cube and constructing the grid pattern of its cubes. Based on the interviews conducted, the student had done an abstraction but had difficulty remembering correctly the geometry lesson he had previously encountered, the student stated that he had thought and tried to get the cube grid pattern correctly. Based on this, it is necessary to do more in-depth research to find out what kind of abstraction students do in studying the cube and constructing its cube nets.

4. Conclusion
Based on the results of the research, it can be concluded that the abstraction of junior high school students in studying the cube and constructing the cube grid pattern shows the abstraction in the form of epistemic action which includes recognition, namely recognizing the concept of a cube, building-by combining prior knowledge with new knowledge to obtain cube netting patterns and building construction. new knowledge and new concepts of cube mesh patterns. The three epistemic actions of junior high school students in studying cubes and constructing cube-nets patterns are tiered and related to one another where the first action is recognition, then building-with and finally construction, but this needs further research considering this research is only limited to junior high school students in Serang City.

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