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COGNITIVE PROCESSES OF ELEMENTARY SCHOOL STUDENTS IN MATHEMATICAL INVESTIGATION BASED ON GENDER DIFFERENCE

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Abstrak

The aim of this research is describing cognitive processes profile of elementary school student in doing mathematical investigation. Cognitive processes checked here cover three processes, that are (1) specialising, (2) conjecturing, (3) justifying, and (4) generalising. Mathematical investigation studied in this research load three phases, that are (1) entry, (2) attack, and (3) review. This research represent explorative research with qualitative approach, that is exploring cognitive processes of student do the mathematical investigation. Exploration through deep interview base on the task. Research subject consist of two people, that is a men student and a woman student with equivalent capable in mathematics. Result of research indicate that woman student better than the men student. At entry phase, both subject conduct it by reading problem just once, not repeating. While in attack phase, all cognitive processes have been shown by both subject. At specislising process, both students are done the same procedure. At conjecturing process, both subjects doing similar step, nevertheless the woman subject has pattern conjecture more effective. At justifying process, the woman student more regular in making pattern. While at generalizing process, woman student is quicker and better in making generalizing.

Keywords: *cognitive processes, elementary school student, mathematical investigation, gender*

A. INTRODUCTION

Association formation activity (establishing process of bond between two or more information) in mind can not be observed directly. This process is internal , but that seems to control individual responses. The process of formation of the association of the mind called cognitive processes. Cognitive process is the mental process of an individual which can be understood as information processing (Jones, 2006: 17). Cognitive processes can be expressed as information processing (Someren, 1994: 19).

Activities someone always involves memory, so memory has a very important role in the cognitive process (Matlin, 1989). Cognitive process is a process in the mind of a person (which can not be observed directly, but can be studied in ways or methods specified), from the time of receiving the data, then process it, and store in the form of information in memory and call him back from memory when needed in order to further data processing (Marpaung, 1987: 51). How a person receives information, then process it and store it, will affect the recall of the information. So as to understand the information, one needs to integrate new knowledge with existing knowledge in memory (Woolfolk, 1995).
According Suharnan (2005) human cognitive activities ranging from recording information (sensory registers), the transformation of information (encoding) , storing the information in its

memory, and then multiplying the information that has been stored in the memory (retrieval) to be recalled in order to respond to a task (recall). Interrelated cognitive processes between the units to one another, and do not walk alone. It matters, not merely lie in the processing of the stimulus from the outside only (botom - up processing), but also involves the knowledge of a person and has been stored in the memory (top-down processing). Likewise, when a person is solving a problem , necessarily involve perception (perception), the representation of the problem, the knowledge stored in memory, reasoning and decision-making on some alternative solutions.

The term investigations in mathematics learning was first put forward by the Committee of Inquiry into the Teaching of Mathematics in the School in 1982 Cockroft Report (Grimison and Dawe , 2000). In the report recommended that the study of mathematics in all levels of education should include : (1) exposition of teachers, (2) discussion, (3) work practices, (4) training and strengthening basic skills, (5) solving the problem, and (6) investigative activities .

According Bastow (1984), mathematical investigation is an activity that can encourage an activity experiment, collect data, make observations, identify a pattern, make and test the conclusion/conjecture and make a generalization. With invetigation, students can develop a mathematical curiosity, daring to ask and express opinions, and willing to take risks and confidently, making it more active in thinking and can spark ideas in finding a way out of problems, focused related to mathematics.

Learning mathematics should be emphasized that both the students as a learning center activity. Students are encouraged to be active both mentally and physically. According Turmudi (2008), in mathematics, students should be stimulated to seek its own, conduct an investigation, do a proof of a conjecture that they make themselves, and find out the answer to a question a friend or teacher questions. Japa of research results (2008) showed that the application of mathematical investigations can enhance the activity, creativity, and productivity of students 'thinking, as well as improving students' skills in mathematical problem solving open. According Deizmann (2001) mathematical investigations can enhance children's learning elementary school, teachers need to provide the necessary guidance to overcome the limitations of skills and knowledge, because of the difficulty in linking students' problem solving, representation, manipulation, and reasoning. While Ponte (1998) says that one of the investigation was to determine the activity patterns of many events that occurred during the investigation.
According to Yeo & Yeab (2010), an investigation can be divided into three categories, namely a task, a process and an activity. They then propose an alternative characteristic of the process of investigation using terms of cognitive processes: Specialising, conjecturing, justifying, and generalising. Research results show that mathematics does not have to open an investigation.

Yeo & Yeab (2009a , 2010) split open investigative activity in five stages , namely (1) Entry, (2) Goal Setting, (3)Attack, (4) Review, and (5) Extension. Attack stage is a mathematical investigation process with four core cognitive processes that include (1) Specialising, (2) conjecturing, (3) justifying, and (4) generalising.

Gender is a characteristic that distinguishes between individuals. Gender is an innate gender are influenced by social and cultural factors. Results of previous studies show that gender is a factor that affects the way of gaining knowledge of mathematics. Keitel (1998) states that "gender, social, and cultural dimensions are very powerfully in conceptualizations of mathematics education, ...". Based on these opinions can be stated that gender is one dimension that is

influential in the process of conceptualization in mathematics education. Benbow and Stanley (1980) found no effect of gender differences in junior high school students. While research Hilton and Herglund (in Astin, 1974) revealed gender differences in mathematics achievement, there are significant differences in mathematics achievement of men and women in class seven and this difference increased in subsequent classes. The results of this study indicate that differences in math ability between boys and girls begin to look at the child's age at the junior level. Therefore, in this study the profile of cognitive processes of students in mathematics will be reviewed investigations of gender at each level math skills, and research will be imposed on junior high school students.

B. RESEARCH METHODS

This study was an exploratory study with a qualitative approach, the research that seeks to find the meaning or essence behind the symptoms that occur. This study is intended to multiply and qualitatively describe the cognitive process profile junior high school students in mathematical investigation and the difference is reviewed based on differences in mathematical ability and gender differences.

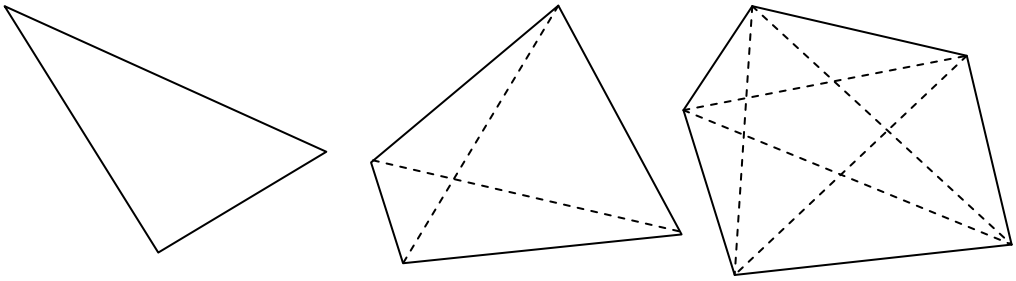
The approach used is a qualitative approach based on the reason that this study meets the characteristics of qualitative research, namely: (1) it is natural, that is the actual state of the research carried out in accordance and researcher as the main instrument, (2) descriptive data, in the form of a series of word-words or images, (3) further emphasize the process rather than outcomes, (4) data processing tends to be done inductively, and (5) the main focus of the research is aimed at all activities conducted individual (Fraenkel and Wallen, 2009).

C. RESULTS AND DISCUSSION

Disclosure profile of cognitive processes of students in mathematical investigations have been tested on two fifth grade students of SDN 13 Ampenan Mataram NTB on the date October 18, 2013 one male student and one female student. Both students who are the subject pre-trial been capable of high and relatively equal according to the class teacher.
Pre-trial using two mathematical investigation tasks.

The following mathematical problem that has pre-trial investigation on October 18, 2013 at two sixth grade students of SDN 13 Ampenan Mataram:

1. Consider the following figure



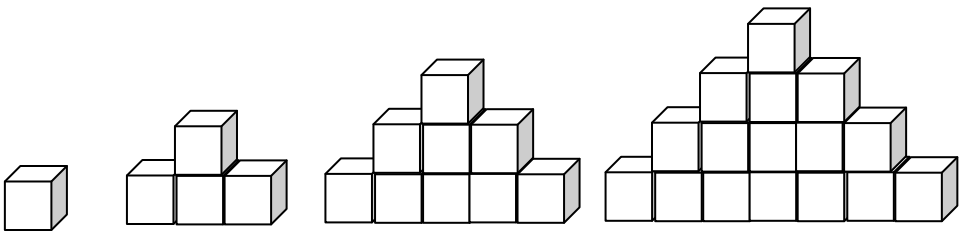
(a) (b) (c)

Complete the following table based on the above image

Figure	Name of plane	Number of diagonal
(a)		
(b)		
(c)		

a. Describe the building hexagon and its diagonals!
   The number of diagonal in hexagons is ....
b. Describe the building 7-gon and its diagonals!
   The number of diagnal in 7-gon is ....
c. Without drawing, what is the number of diagonal terms in the 10-gon?
   Explain your answer!

2. Joko made a building use bricks with the following pattern:



(i) (ii) (iii) (iv)

a. Make building 5^{th}! How many bricks are needed?
b. Make building 6^{th}! How many bricks are needed?
c. How many bricks are needed to make the building pattern of the 10^{th}?
d. How many bricks are needed to make the building pattern of the 100^{th}?
e. What can you conclude about the number of bricks required building related pattern above?

Results of women subject Answers (Problem about number of diagonal 10-gon)

Female subjects did specialization by drawing a diagonal in the image triangles, rectangles and pentagons are provided. After the drawing, the subject of women then fill number of diagonal in the table. Subjects make a hexagon then make a diagonal image on the image, then create a presumption that there was an additional amount of regular diagonal, ie 2, 3, and 4. Subject then continue to make patterns, from hexagons to the addition of 5 7-gon diagonal , from 7-gon to 8-gon adding 6 diagonal, from 8-gon to 9-gon adding 7 diagonal, and from 8-gon to 10-gon adding 8 diagonal. So number of diagonal on 10-gon is 35. Subjects wrote down the number of diagonal 10-gon = 35 = difference + difference + ... = 2 + 3 + 4 + 5 + 6 + 7 + 8. Subjects make generalization about number of diagonal and diagonal patterns that increase the number of regularly to look for in terms of the number of diagonal in 20-gon , which is 35 + 9 + 10 + 11 + 12 + 13 + 14 + 15 + 16 + 17 + 18 . Subjects also found that there is a pattern of odd and even patterns of regularit . But this pattern is not so used because according to this pattern is more complicated subject.
In making the generalization , the subject is still confused to determine the number - n diagonal terms , although it can determine the number of diagonal of 100-gon , which is 98 , with details of 90 + 19 + 20 + 21 + ... + 98 .

Results of male subject Answers (Problem about number of diagonal 10-gon)

Male subjects did specialization by drawing a diagonal in the image triangles, rectangles and pentagons are provided. After the drawing, the male subject then fill number of diagonal in the table. Subjects were then create an image 10-gon, but the difficulty in drawing. Subjects then drawing a hexagon and make diagonal in the picture there 9. Subjects continued to draw and make diagonal 8-gon, recalculated, there were 20 diagonal. Subjects then made a number of allegations that the addition of regular diagonal, ie 2 , 3, 4, 5, and 6. Namely the addition of many diagonal of the triangle to the addition of two diagonal rectangles, pentagons of the quadrilateral to the addition of 3 diagonal, from pentagons to hexagons adding 4 diagonal, from hexagons to 7-gon diagonal and the addition of 5 7-gon to 8-gon to the addition of 6 diagonal. Subject done justification by matching the number of images and diagonal 8-gon of the patterns made by adding the number of regular diagonal, it is suitable, ie the number of diagonal 8-gon is 20. Subjects make a generalization with the addition of many diagonal pattern regularly to look for in terms of the number of diagonal 9-gon, in 10-gon, and 11-gon. Subjects found the number of diagonal 9-gon: 20 +7 = 27, aspect 10-gon: 27 + 8 = 35, and facet 11-gon: 35 + 9 = 44. Subjects using many additional diagonal pattern to look for in terms of the number of diagonal 20-gon. But the subject is still wrong answer, ie 35 + 18. Having asked to see a pattern on it, subject realizes his mistake but still difficult to find the answer without any sort pattern. After several attempts finally found the number of diagonal 20-gon is 170. Finally able to find the subject in terms of the number of diagonal 25-gon and find the general form number of diagonal of n-gon.

Results of women subject answers (Cube problem)

Subject specialism women start by counting the number of beams on to the pattern 1, pattern 2, pattern 3rd, and 4th pattern in the picture provided. Subject makes predictions
to the number of beams on to the pattern - 10, which is 100. then to show that it was true, the subject stated that the number of blocks as the number of squares, ie the number of beams on to

the pattern - 1 is 1^2 , the number of beams on to the pattern - 2 is 2^2 , the number of beams on to the pattern - 3 is 3^2 , the number of beams on to the pattern - 4 is 4^2, and the number of beams on to the pattern - 10 is 10^2. Then subject make geralization pattern, ie the number of beams on to the pattern - 100 is 100^2 and the number of beams in a pattern to - n is n^2.

Results of male subject Answers (Cube problem)

Male subjects make specialization by counting the number of beams on to the pattern 1, pattern 2, pattern 3^{rd}, and 4^{th} pattern in the picture provided. Subjects then assumed the number of blocks in the pattern of the 10th, which happens gradually increase the number of blocks 3, 5, 7, 9, and so on. Thus subject to find the number of beam pattern to - 10 is 100. Subjects showed that it was true to state that the number of beams on to the pattern - 10 is 1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17 + 19, ie as the sum of consecutive odd numbers. But then the subject found that the number of beams in the 10th pattern is 10x10. Then subject memperumum number of beams on the n-th pattern is nxn, but the subject did not show that nxn = n^2.

Investigating issues that have been tested can be used to reveal the students' cognitive process profile. It can be seen from the test subject answers that can express the four cognitive processes of students. Therefore, in-depth research with in-depth interviews again needed to reveal more comprehensive profile of cognitive processes of students in mathematical investigations.

D. CONCLUSION AND RECOMMENDATIONS

Disclosure profile of cognitive processes of elementary school students in mathematical investigations have been tested on two sixth grade students of SDN 13 Ampenan Mataram NTB. Both students were selected test subject is capable of high and relatively equal according to the class teacher. Test results concluded that girls are superior to boys. In the entry phase, two subjects did read about it once, not repeated. While the attact phase, the fourth general cognitive processes, ie specialising, conjecturing, justifying and generalising has been demonstrated by both subjects. In the first cognitive process, the specialising of boys and girls do the same. In the second cognitive process, conjecturing of both boys and girls perform almost the same steps, except that the female students guessed pattern is more effective. In the third cognitive process, justifying of female students in making a more regular pattern. While the four cognitive processes, namely generalising of female students are better and faster. Therefore, it is possible that a more in-depth research to get a profile of students' cognitive processes in a more comprehensive mathematical investigation, which is not only in terms of gender differences.

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