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Mathematical Conjecturing Ability in Junior High School Students on the Material of Angles, Lines, and Two Dimensional Figure

1st Yani Supriani
Departement of Mathematic Education
Universitas Serang Raya
Serang, Banten
yani.supriani2@gmail.com

2nd Ria Noviana Agus
Departement of Mathematic Education
Universitas Serang Raya
Serang, Banten

3rd Usep Sholahudin
Departement of Mathematic Education
Universitas Serang Raya
Serang, Banten

***Abstract*—Mathematical cognitive ability, is an ability that supports students' skills in learning mathematics. One of the cognitive abilities developed is the mathematical conjecturing ability in junior high school students. Conjecture is the reason why someone has a belief, an explanation of why a belief is true, or how someone knows what they know. Therefore, it is necessary to conduct an in-depth study and analysis of students' mathematical conjecturing ability. This study involved 26 students in one of the junior high schools in Serang City as research subjects, the approach used in this study was a qualitative approach. The results of this study was that students' mathematical conjecturing ability was still classified as not good in the category of students' ability in making evidence of solutions. Therefore, an improvement was given from the lack of ability of students' mathematical conjecture.**

Keywords: conjecture, formulate, eksperiental learning

I. INTRODUCTION

In the teaching and learning process, thinking skills can be developed by enriching meaningful experiences through the ability of mathematical conjectures. Humans are creatures that have the ability to think, so through such ability humans can gain knowledge and leave other creatures created by God. In general, thinking is defined as a mental activity to gain knowledge. In gaining its knowledge, humans today do it in a scientific way, which is by understanding problems, formulating hypotheses, collecting data, testing hypotheses and formulating conclusions.

Conjecture is the reason why someone has a guess, belief, an explanation of why a belief is true, or how one knows what they know. Justification also means making rational responsibility for claims of truth in beliefs or opinions held. In teaching Mathematics in schools, the ability of mathematical conjunctions is a need that must be applied in learning so students can have the skills and apply them in daily life to improve learning outcomes.

Starting from [1], they used the term evidence to explain the ability of the conjecture. But [2] expanded it with the term conjecture, because evidence is a specific form of conjecture. According to them, conjecture is used to validate a statement, produce insight into a phenomenon, and systematize knowledge. The more careful someone evaluates a statement and the more they maximally separate relevant and irrelevant issues, the more critical their thinking will be. So mathematical conjectures require skills including the ability to listen and read carefully, search and find hidden assumptions, and investigate the consequences of a statement.

Mathematical conjecture has become one of the tools used in our daily lives to solve several problems because it involves logical reasoning, interpreting, analyzing and evaluating information to allow one to take reliable and valid decisions. Mathematical conjecture is the ability to make mathematical statements that are of true value based on observation, investigation, exploration, experimentation, and inquiry. The truth of the statement has not been formally verified (general), but it will be informal when shown in example or picture. Indicators of conjecture competence are indicators of the ability of observation, investigation, exploration, and inquiry [3].

[4] explained that the role of the conjector in building Mathematics skills at least includes three aspects, namely mathematical reasoning, deep understanding of mathematical concepts and mathematical communication. In the aspect of mathematical reasoning Kilpatrick et al. [5] stated that the ability to construct is an important element in adaptive reasoning, because doing conjecture means providing sufficiently clear reasoning. They argue that students need to have the ability to construct and explain ideas so that their reasoning becomes clear, honed, and able to enhance conceptual understanding.

The understanding aspect of the concept of mathematical conjecture does not only function to convince others of the answers we make, but also to deepen the understanding of the concepts of Mathematics. The research results of [6] also showed that students experience an increased understanding of the concept of Mathematics when taught using the conjecture strategy. In their article, they stated that students 'understanding of a deep mathematical concept is thought to be able to improve the conjecturing ability, so that it has an impact on the inability of students to explain what is thought which is always associated with students' incomplete understanding of the problem at hand.

In the aspect of mathematical communication, conjecture has a role to explain that a belief is true. Justification also means making rational responsibility for claims of truth in beliefs or opinions held. Based on [7] students at each level should have the ability to communicate mathematical ideas, analyze the ideas of other students, use mathematical language appropriately, develop and evaluate

arguments and mathematical evidence. The conjecture also needs mathematical communication skills.

The aspects of the conjecturing ability in this study were as follows:

- The ability to investigate cases intact
- Students are able to investigate an image to determine which lines are parallel.
- The ability to do mathematical manipulation
- Students are able to determine the extent of irregular areas with regular shapes.
- The ability to determine patterns to make generalizations
- Students are able to determine the broad pattern of two-dimensional figure by dividing it into parts of a two-dimensional figure
- The ability to do evidence
- Students are able to find a formula from the area and perimeter of a kite that is not directly known.

II. METHODS

This study applied a qualitative approach, in which participants or subjects were 26 junior high school students in one of the schools in Serang City. There were 4 questions given to students which aimed to develop the ability of students' mathematical conjectures on the material of Lines and Angles and Two-dimensional figure. Students were asked to answer the question in the form of a description. Then the students' answers were analyzed for its content, through procedural and conceptual aspects in answering questions. Data retrieval was done by giving a question consisting of four questions relating to the ability of the conjecture. From students 'answers, the data obtained shows that the answers were descriptive of the ability of students' mathematical conjectures.

The stages of this study were divided into three stages, namely: (1) Pre-field stage, (2) Field work stage, and (3) Data analysis stage. In the pre-field stage, the researcher observed and asked permission from the school and prepared instruments for the ability of mathematical conjectures. At the stage of field work the researcher gave a question in the form of a student's mathematical conjecturing ability test, while at the data analysis stage, the researcher analyzed the results of the student's mathematical conjecturing ability test.

The material of angles, lines and two-dimensional figure consists of four questions which show the ability of student conjecture as follows: (1) Through illustrations, students are able to form right angles, students are able to give a conclusion that the sum of all angles in the image is equal to a right angle, (2) Students are able to arrange the same type of angle first to determine the angular magnitude asked, (3) Students are able to prove some corresponding angles so that they can compare the area of the two-dimensional figure found in the image, (4) Students are able to determine which prerequisite knowledge should be used to understand and solve the area of a rectangle contained in an isosceles triangle. These questions aim to enable students to draw conclusions, compile evidence, make evidence of solutions and make decisions.

III. RESULTS AND DISCUSSION

The data that had been obtained were analyzed through three criteria answers, namely: (1) Correct answers, (2) Incorrect answers, and (3) No answer. The data obtained were then grouped based on the aspects of mathematical conjecture, which are presented in table form.

TABLE 1. STUDENTS' CONJECTURES ANSWERS

No	Mathematical Conjecture Aspect		Indicator	Correct answers	Incorrect answers	No Answer
1.	[1]	The ability to investigate cases intact	Students are able to investigate an image to determine which lines are parallel.	5	11	10
2.	[2]	The ability to do mathematical manipulation	Students are able to determine the extent of irregular areas with regular shapes.	6	18	2
3.	[3]	The ability to determine patterns to make generalizations	Students are able to determine the broad pattern of two-dimensional figure by dividing it into parts of a two-dimensional figure	8	6	12
4.	[4]	The ability to do evidence	Students are able to find a formula from the area and perimeter of a kite that is not directly known.	6	5	15

Based on Table 1 the percentage of answers to the ability of student conjectures is illustrated through Bar Diagram 1 as follows:

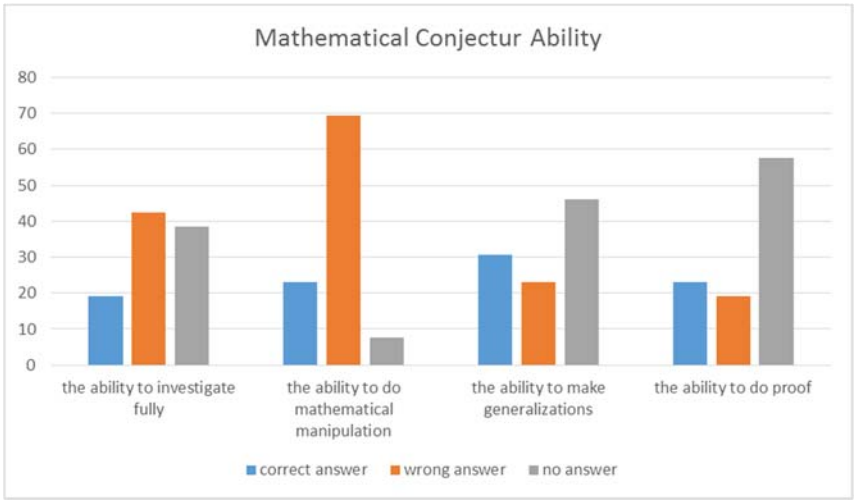

Fig.1. Students' Mathematical Conjecturing Ability

Based on Bar Diagram 1.1, on the aspect of the ability to investigate the case intact there were 19% of students who were able to answer correctly, 42% of students who answered incorrectly and 39% of students who did not answer the question. In the aspect of the ability to do mathematical manipulation, students who answered correctly were 23%, students who answered incorrectly were 69%, and students who did not answer were 8%. In the aspect of the ability to determine patterns to make evidence of solutions and generalizations, 31% of students answered correctly, 23% of students answered incorrectly and 46% of students did not answer the questions. In the aspect of the ability to do evidence, 23% of students answered correctly, 19% of students answered incorrectly, and 58% of students did not give answers. Based on this percentage it can be seen clearly that the ability of students' mathematical conjectures is still not good. However, in terms of the ability to draw conclusions, it was 42%, and 69% were in the form of compiling evidence where students gave answers, but they were wrong. This proves that Based on Bar Diagram 1.1, on the aspect of the ability to investigate the case intact there were 19% of students who were able to answer correctly, 42% of students who answered incorrectly and 39% of students who did not answer the question. In the aspect of the ability to do mathematical manipulation, students who answered correctly were 23%, students who answered incorrectly were 69%, and students who did not answer were 8%. In the aspect of the ability to determine patterns to make evidence of solutions and generalizations, 31% of students answered correctly, 23% of students answered incorrectly and 46% of students did not answer the questions. In the aspect of the ability to do evidence, 23% of students answered correctly, 19% of students answered incorrectly, and 58% of students did not give answers. Based on this percentage it can be seen clearly that the ability of students' mathematical conjectures is still not good. However, in terms of the ability to draw conclusions, it was 42%, and 69% were in the form of compiling evidence where students gave answers, but they were wrong. This proves that students still need to be trained and the ability to draw conclusions and compile evidence still needs to be improved. Things that do not look good are seen in the aspect of the ability to make evidence of the solution and make a decision, that 46% of students make evidence of the solution and 58% of students in the aspect of making a decision do not give an answer.

In the ability of students' mathematical conjectures, the zone of proximal development (ZPD) needs to be developed, which can be with the help of others, through teachers (tutors), peers and the environment who can develop these abilities. Vygotsky (1978) argued that “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers”. So that in developing conjecture abilities, the role of counselor and environment is very necessary.

[8] explained that building student knowledge cannot be separated from social and cultural contexts, so exploring the ability of students 'mathematical conjectures is done by understanding students' mental development, student’s learning environment, and gradual cognitive assistance from the teacher. Vygotsky [9] warned us that social interaction is the most important factor in shaping the psychological development of students in learning. In line with Vygotsky, [10] suggested that “the main goal of education from Vygotskian perspective is to keep learners in their own ZPDs as often as possible by giving them interesting and culturally meaningful learning and problem-solving tasks that are slightly more difficult than what they do alone, such that they will need to work together either with another, more competent peer or with a teacher or adult to finish the task.”

IV. Conclusion and Suggestion

Based on descriptive data and the theory and findings, the indication is that students' mathematical conjecture's ability is still not good. This indicates that there is a need for further research to provide a solution to the lack of ability of students' conjecture. The poor ability of students' mathematical conjecture in this study was caused by several factors, which are: (1) Students are not accustomed to solving the problems of conjecture abilities specifically, (2) Students experience difficulty in proving some corresponding angles so that they can compare the area of the two-dimensional figure found in the image and make decisions on the given problem (3) Students experience a lot of mistakes in the illustration question that forms a right angle, which is the ability of students to give the conclusion that the sum of all angles in the image is equal to the right angle and students mistakenly arrange the same type of angle first to determine the angular magnitude asked. However the students' mathematical conjectures ability is not empty; students already have the ability of mathematical conjecture, only that ability has not been well developed. Student's Zone of Proximal Development (ZPD) has been formed before.

The author suggested several things related to the learning process above such as:

- Improve the ability to formulate the conjecture so that learning can be done widely so as to create increased learning outcomes.
- To develop mathematical ability and critical thinking skills and mathematical reasoning and understanding, students can implement the ability to formulate the conjectures that they have acquired.
- The author also expects criticism and suggestions in writing articles in the future

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