GEOMETRY LEARNING BASED ON COGNITIVE CONFLICT IN THE DEPARTMENT OF MATHEMATICS

UNIVERSITAS NEGERI MEDAN

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ABSTRACT. *Geometry is one of the compulsory courses for students majoring in mathematics at the State University of Medan. Geometry has a deductive axiomatic character, which is a science whose truth leads to previous truths. Conflict is an action from the existence of a gap that arises and is felt from an information or incident. Cognitive conflict occurs when students become aware of a mismatch between what is on their mind and information from outside. The concept of learning geometry occurs as a result of the information or system received by a person that causes action, interaction and reflection. Thus for action to occur, it is necessary to have contextual problems that challenge as a source of conflict. With cognitive conflict, which results in an awareness of incongruity with prior knowledge, this can spur emotions or motivate students to seek the real truth. This motivation can encourage the integration of efforts to find the real truth as a result of one's rational thinking ability and will be arranged in a cognitive structure and occupy long-term memory. The purpose research is to improvement of students' mathematical reasoning abilities and creative thinking in learning geometry through cognitive conflict approaches in the Mathematics. This type of research is a semi-experimental study with a two-class control and pretest-posttest experimental design. The location of this research is the Department of Mathematics, Universitas Negeri Medan. While the subjects in this research were 35 students in the 2019 F PSPM and 32 PSPM 2019 A classes. The object in this study is a learning geometry based on a cognitive conflict approach. The research result that the role of cognitive conflict in learning geometry will be able to improve students' rational thinking and emotional intelligence.*

Keywords: *cognitive conflict, learning, geometry, rational thinking, emotional.*

PRELIMINARY

A new paradigm of learning geometry is connecting learning and thinking and developing personality attitudes. Hasratuddin (2018) said that teaching geometry now is the time to focus on thinking skills and learning reflection, interaction and development of specific thinking concepts, and developing interactive social attitudes and behavior. This becomes the basis for and consideration of changes in the geometric learning process, no longer only emphasizing the development of the cognitive realm alone, but need to involve attitudes or emotional intelligence.

Naturally, students have a tendency to understand the world around them. Students construct their concepts as a result of their observations and investigations of the world

around them (Bayer, 2016). Therefore, studying geometry is a concept construction process based on observing a conflict or real world context.

The existence of a conflict with someone will lead to dissatisfaction. Learning through conflict is learning that raises dissatisfaction in students, because students realize that what they have is not in accordance with the real truth. Naturally, students tend to nullify dissatisfaction. The desire to minimize conflict is a very strong human motivation (Kang et al., 2015). This characteristic states that learning is a construction activity, where students discover their own concepts, principles or procedures for themselves. According to this principle, studying geometry is a construction activity. Learners construct internally, mental representations that can concrete images, schemata, procedures, work methods at the level of abstract symbols, intuitions, contexts, schemata settlement, or through experiments. The characteristic of this construction, among others, is that students find themselves solving procedures of a contextual problem.

In the framework of learning geometry, conflicts can occur if students realize that their understanding or perception of mathematical objects is incompatible with the nature of the true geeometric object.Students will consciously try to eliminate this conflict by accepting the truth they should. This realization made him not repeat the mistakes he had made again. The process of eliminating conflict will strengthen the true understanding of a concept. Therefore, learning through the process of eliminating conflict can lead to strong and holistic understanding for students.

One alternative learning that can spur the mastery of student conceptions is to use cognitive conflict strategies, which is the application of constructivism. Osborne (1993) suggests that cognitive conflict strategies have a general pattern, namely: exposing alternative frameworks, creating conceptual cognitive, encouraging cognitive accommodation. Lee and Kwon (2003) state that there are three phases in the cognitive conflict learning process, namely the preliminary stage, the conflict stage and the resolution stage. In the preliminary stage, the lecturer can explore the initial conceptions of students and create anomalous situations. that is, a situation that is contrary to the student's prior knowledge. In the conflict stage, the lecturer observed the student's response to the anomalous situation given. Recognition of anomalous situations can be in the form of attraction or anxiety. The resolution phase, with lecturer conditioning, students will attempted resolve conflicts in cognitive structures to gain knowledge in accordance with scientific concepts. The stages of cognitive conflict-based geometry learning carried out in this study are as follows:

1. Cognitive conflict orientation. In this case, the lecturer provides a conflict context that contains conceptual barriers to students. Students understand and discuss in groups.
2. Lecturers facilitate classical discussions. Students present alternative solutions as a comparison.
3. Lecturers provide opportunities for students to reflect on conflict resolution.
4. Students find complete and applicable knowledge.

From the cognitive conflict-based learning stage above, the problem of cognitive conflict context is the starting point of the learning process, and will end by eliminating the conflict that is presented. Learning through conflict elimination will not occur if there is no conflict to condition it. So that learning through cognitive conflict can facilitate students to gain a strong understanding.Therefore, to build conflict, the lecturer should create events

that are not in accordance with the student's final conception. The event in question is a symptom or situation that cannot be explained by the conception captured by the student, but can be explained by the actual concept. For example, students would know about Original numbers, A = {1,2,3,4, ...} and whole numbers, C = {0,1,2,3, ...}. Then, if students are asked "which has more natural numbers with whole numbers? What is their answer? Also they certainly know about rectangles. Then, do they know about the rectangle?

Learning mathematics through cognitive conflict is cognitive conflict conditioning during the mathematical process. Conflict conditioning can occur when introducing concepts (as a preventive measure) or it can also occur to straighten misconceptions that occur to students. The delivery of procedural information or the provision of "drill" alone cannot achieve optimal cognitive conflict learning. A learning approach that demands a sense of dissatisfaction is more appropriate for learning through cognitive conflict. This feeling of dissatisfaction will lead to long duration retention.

The emotional intelligence referred to in this research is a series of non-cognitive abilities and skills that affect a person's ability to successfully cope with environmental demands and pressures such as the ability to recognize feelings of oneself and others and interpret them, reach and generate feelings to help critical thinking and emotional development. . Emotional intelligence includes interpersonal and intrapersonal intelligence. The application of cognitive conflict as a preventive action can be started by predicting student conceptions of the given topic. Predictions about student conceptions can be made based on previous student experiences or the lecturers' personal experiences with the subject matter.

Research methods

1. This type of research is a semi-experimental study with a two-class control and pretest-posttest experimental design.
2. The location of this research is the Department of Mathematics, FMIPA UNIMED Medan, Jl. Willem Iskandar Psr. V Medan Estate.
3. While the subjects in this research were 35 students in the 2019 F Mathematics Education Study Program (PSPM) and 32 PSPM 2019 A classes.
4. The object in this study is a learning geometry based on a cognitive conflict approach.
5. Implementation of learning

   The learning action stage with the cognitive conflict approach to be carried out in this study are;

   a. Conflict situation. At this stage, the lecturer presents problems in the form of challenges or conflicts to be resolved by students either individually or in groups.
   b. Organizing learning. At this stage the lecturer organizes assignments related to problem conflicts.
   c. Investigation guidance. At this stage the lecturer encourages students to collect information in carrying out experiments to get explanations and problem solving.

   Presentation and sharing. At this stage the lecturer gives the opportunity to convey student ideas or solutions to the conflicts given. Students report their own or group problem solving or activity results or discuss their answers to conflict solutions. Process analysis and evaluation as a reflection stage. At this stage the lecturer fosters student analysis and evaluation as a reflection of thinking, so that students find concepts or knowledge.

Research Results and Discussion

A. Online Learning Process.

1. Meeting 1.

Learning begins with providing "Online Lecture Rules", namely; 1)Prepare equipment and special rooms for your meeting, 2) Straighten your intention to learn, 3) Dress politely and neatly, 4) Login on time, 5) Leave 10 minutes before the class meeting starts, 6) Turn off the Mic (mute) when not talking , 7) Raise your hand when you want to talk, 8) Focus and not leave the meeting, 8) Do not share the meeting link with others. This thickest system recognition aims to form students who are orderly, civilized and have good emotional intelligence. In discipline 2) straighten the intention, this is harmonious in studying. This means that it is not enough for them to just study online or join online courses. If you learn, it's true, it can be done anywhere and anytime. Thus, it is not wrong that Ngadim Makarim, Minister of Education and Culture in 2020 said the term "independent learning". Obviously, learning does not form morals or good behavior, because learning while squatting, smoking in the bathroom can also be done. However, if you are studying, it is clear that there must be a teacher, it cannot be done anywhere, you can ask questions if you don't know, and there are ethics as manners that must be maintained. This is something that must be done by teachers so that a culture of good character for students is formed. After that, the teacher / lecturer can provide useful knowledge for students. Al'adaabul fauqol 'ilmu =: adab is more than science.

Student Response.

S1: About the intention. Initially when asked about their answer to "learning" Of course, the intention to learn this must be changed to learning, because we will provide knowledge when they have morals. This is called the partial formation of emotional intelligence.

2. Second online learning.

The lecturer gives a problem in the form of a conflict in mathematics study program students "what is mathematics". The purpose of giving this conflict problem is so that students have a consistent attitude towards the application and practice of mathematical values in the form of consistent, rational, honest, obedient, critical and creative thinking. (Hasratuddin, 2018). As for the student response to the conflict "what is mathematics?", The researchers grouped them into 4 parts, namely;

a. S1: Mathematics is a branch of knowledge that deals with numbers.
b. S2: Mathematics is an exact science.
c. S3: Mathematics is solving life's problems.
d. S4: Mathematics is the mother of all knowledge.

From the 4 student responses, at S1 a mathematical principle and value were found that mathematics is not a knowledge, but is a science that is not the result of experiments but is found (Wittgenstein, 1974b). This is what makes mathematics equalized with philosophy. In this session the lecturer gave a challenge in the form of a conflict to students, namely to investigate whether the following statements were the same or different? 1) *Arrogant people are not smart, and 2) smart people are not arrogant*. Apparently, to give answers with reasonable reasons is mathematical logic.

Obviously the problem does not involve numbers or numbers but it can only be solved by mathematical means. The conclusion that can be found is that mathematics does not only solve problems related to numbers.

From the S2 response, it was found that in terms of mathematical measurements it is not always certain, thus mathematics is not an exact science. But mathematics must be in rules or systematics. Soejadi (1997) in the book Mathematical Tips "*The supreme judge of mathematics is systematic, while the highest judge of science is reality, the iron is burned expands*".

From S3's response, it was found that mathematics is a tool and means of solving all problems in general, which is the closest to being true and based on rational human reason. As such, all disciplines use mathematical principles. From S4's response, it was found that mathematics is the mother of all sciences. This is based on all fields of science that require mathematics. Freuthental (1991) states that mathematics is a human activity. The point is that mathematics is used by all humans who have activities. The logical consequence is that any human being who is active must use mathematics. Furthermore, people who don't use math are those who have no activity. In conclusion, people who shy away from math are better off to stay inactive.

From this learning activity, the lecturer directs students to understand and live out the objectives of learning mathematics, among others; 1) Math teaches you to admit when you're wrong. Mathematics makes humans aware of their limitations or admits that they are often wrong. 2) To choose exact and correct words. Math teaches you to choose the right and correct words. 3) To think several steps ahead. Mathematics teaches you to think ahead (move on). 4) Not like everyone else but in your own way. Mathematics teaches you to think your way, (reasonable skepticism). 5) And never give up. Mathematics teaches you to never give up.

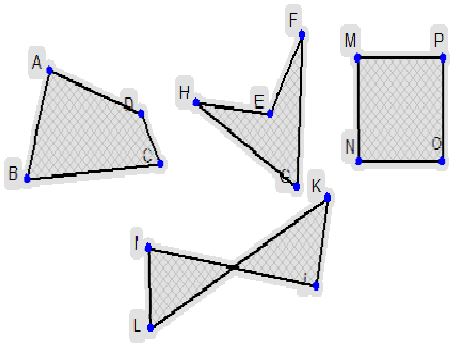
For this purpose, students are expected to understand that they are often wrong, have weaknesses and are limited in everything (above the sky there is still a sky). This will form students who do not have to be arrogant, arrogant and like to ridicule or slander others. And, it is hoped that students will have the principle of understanding means forgiving everything as a part of good emotional intelligence. Then from the attitude value in goal 1, it is hoped that students will have an attitude towards goal 3, namely as a wise, wise and lucky person, they must always have the principle "today must be better than yesterday, and tomorrow the day after tomorrow must be better than today in things can choose the right and the right, according to the second goal. Furthermore, in that it will always be better day by day, students will arrive at the 5th goal,

3. The third online learning is by providing conflict with the material.

At the third meeting, the conflict given was "if there is a rectangle having a circumference of 24 cm, then determine the size of the rectangle that has the largest area". Various responses were given by students on this problem. There are students who say that the size of a rectangle with a circumference of 24 m is 5 x 7 with an area of 35 m2. There were students who gave the answer 6 x 6, but because it was already a square, the answer was changed to 5.5 m, x 6.5. This happened because the concept of rectangles and squares was not fully understood for them.

So, this moment will be a strengthening of the square concept that lecturers must do, so that they will find a strengthening of their reasoning ability about the square concept. And immediately, students will accept this if it is given based on logic or reasoning. Of course, this acceptance is part of the realm of emotional intelligence. Therefore, it is not excessive if it is found that cognitive conflict-based learning will be able to improve students' reasoning abilities and emotional intelligence.

So that in order to strengthen the understanding of the concept of the rectangle, the lecturer asks students to define a rectangle. There are students who define a rectangle as a rectangle that has 2 pairs of equal sides. There are also students who define a rectangle as a rectangle that has length and width, and so on. From this answer, the lecturer began to describe 4 flat buildings, as follows.



Then, ask students to indicate which of the flat shapes is a rectangle.

Student response;

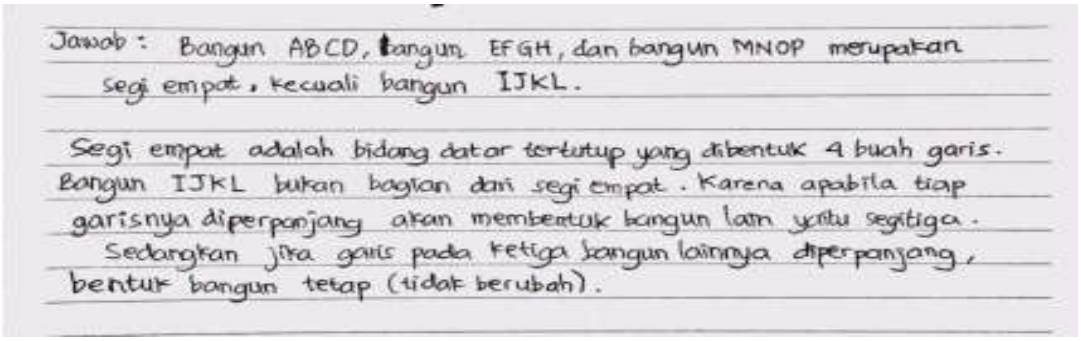
S1: A quadrilateral is a polygon with four sides and four corners.

S2:

ANSWER

In my opinion, the image which is a rectangle is only the ABCD rectangle, the EFGH rectangle, and the MNOP rectangle. A quadrilateral is a closed shape that has four sides and four lines. If we draw a straight long line from each side of the image, only the ABCD rectangle, the EFGH rectangle, and the MNOP rectangle have four sides and four lines. Meanwhile, the IJKL image cannot be called a rectangle because if a straight long line is drawn on each side, no rectangle is formed. And the IJKL image only has four sides.

S3:


Jawab : Bangun ABCD, bangun EFGH, dan bangun MNOP merupakan segi empat, kecuali bangun IJKL.

Segi empat adalah bidang datar tertutup yang dibentuk 4 buah garis. Bangun IJKL bukan bagian dari segi empat. Karena apabila tiap garisnya diperpanjang akan membentuk bangun lain yaitu segitiga. Sedangkan jika garis pada ketiga bangun lainnya diperpanjang, bentuk bangun tetap (tidak berubah).

From the answers to the three respondents above, it can be concluded that students still have doubts about the meaning of rectangles. Thus the conflict will be used for discussion until it finds answers rationally.Bayer, M (2016), said that learning with cognitive conflicts will be able to improve students' mathematical reasoning abilities. And, this is what is called a process of improving students' reasoning abilities.

B. Formative test results 1

After 3 online meetings, the researcher gave 1 formative test of 1 question, namely "*If there are any triangles, right angles, equilateral and isosceles having the same circumference, then determine which triangle has the largest area*! "
Following are the results of the reasoning skills test obtained by 47 students of the Mathematics Department of FMIPA UNIMED Medan, with a range of scores of 0-100.

Table 1. Descriptive Statistics Data of Final Learning Test

Statistics	Reasoning ability		
	Low	Moderate	High
Number of	12	23	12
Mean	39.44	65.33	78.67
Stdev	9.91	14.36	12.39
Min scor	21	57	71
Max scor	57	71	100

Based onIn the table 1. above, it can be seen that the low level student groups have not achieved optimal performance. Their achievement range is 21-57, which is still below the average class achievement. Whereas for the medium level group, it reached a score of 57-71, and the high-level group reached 71-100. Statistically, the descriptive statistical table of the achievement scores for the student's reasoning ability shows that the average level of achievement of the moderate level group has reached the minimum completeness, which is above a score of 60. above there are 32 out of 47 people (68%) who achieved completion. This shows that cognitive conflict learning is effective in improving students' mathematical reasoning abilities. Against student emotional intelligence in cognitive conflict learning can be seen in the following discussion.

ELEMENT	**STUDENT'S EMOTIONAL INTELLIGENCE SCORE**									
Level / Class	**Below** (0 - 19)		**Low** (20 - 39)		**Normal** (40 - 59)		**Super** (60 - 79)		**Perfect (**80 - 100)	
Condition	Early	End	Early	End	Early	End	Early	End	Early	End
Average	32.5	45.2	32.5	45.2	32.5	45.2	32.5	45.2	32.5	45.2
Std. Dev	19.2	16.4	19.2	16.4	19.2	16.4	19.2	16.4	19.2	16.4

Lots	6	2	13	12	19	20	9	10	0	3
Percentage	13	4	28	27	40	42	19	21	0	6

Table 2. Student Emotional Intelligence Achievement Scores.

From the table of emotional intelligence achievements above, it can be seen that for each level as follows;

a. Below; before learning 6 people (13%) changed after learning to 2 people or 4%.
b. Low: before learning 13 people (28%) changed after learning to 12 people or 27%.
c. Normal; before learning 19 people (40%) changed after learning to 20 people or 42%.
d. Super; before learning 9 people (19%) changed after learning to 10 people or 21%.
e. Perfect; before learning 6 people (13%) changed after learning to 2 people or 4%.

In general, it can be said that students who have below normal emotional intelligence before learning are 17 or 36%, after learning they turn into 14 people or 30%. So there are 3 people whose emotional intelligence has changed to normal. So, it can be said that the emotional intelligence of students majoring in mathematics at the State University of Medan can be improved through learning with a cognitive conflict approach. In addition, based on students' responses to learning with a cognitive conflict approach, it can make students happy and eager to always get this learning for the next course.

CONCLUSION

Based on the research results, it can be concluted that:

1. Learning geometry based on the cognitive conflict approach in the Mathematics department of the State University of Medan can improve reasoning skills.
2. Learning geometry based on the cognitive conflict approach in the Mathematics Department of State University of Medan can improve emotional intelligence which includes self-understanding, understanding of others, empathy, motivation and self-control.
3. Through learning geometry with a cognitive conflict approach, students gain a strong understanding of the fundamental concepts of geometry rationally. So that, students will have a long memory or long term retention for any geometric concepts.
4. Learning conflict-based cognitive geometry can help students correct misconceptions or misconceptions.

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