The Uniquness of Students' Cognitif Conflict in Solving Integral Problems

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Abstract—This writing described the uniqueness of students' cognitive conflict based on cognitive style in solving integral problems. The type of this research was a qualitative study with research subjects were students majoring in mathematics education at IAIN Tulungagung, East Java, Indonesia. The results of this study indicated that: 1). The forms of cognitive conflict experienced by *dependent field and independent field* cognitive students were very different, and 2). Students with independent field cognitive style experienced *auto cognitive conflict* and vice versa for students with field dependent cognitive style did not.

Index Terms — Cognitive conflict, integral problems, field independent, field dependent

1. INTRODUCTION

The main goal of teaching mathematics by using cognitive conflict was to help students reflected their mathematical understanding, dealed with the contradictions that arose in solving problems that were not in accordance with their understanding, and helped students modified their understanding to solve different problems [1]. In the learning conditions it was felt necessary to present a cognitive conflict as an effort to familiarize and provide experience to students about how to deal with an undesirable situation, provided challenges and opportunities to strengthen their mathematical knowledge and skills [1]. Berlyne said that cognitive conflict (he called it conceptual conflict) had the potential to motivate students to solve problems by finding new information or by trying to rearrange the insights they had gained so far [2]. According to Kwon & Lee, cognitive conflict was defined as a conflict between cognitive structures and the environment (for example, an experiment, demonstration, peer opinion, books, or others), or conceptual conflict in cognitive structures [3]. Another expert opinion that cognitive conflict was a term used to describe the tension created when new evidence was recognized by students and contrary to previous knowledge [4]. The results of research on misconceptions, cognitive conflict and conceptual changes in the geometry of the results indicated that cognitive conflicts that arose through teaching with the help of mathematical software required prior knowledge of the research subject to solve the problem [5]. Other research showed that cognitive conflict started the first step in the process of conceptual change. Another thing showed that anxiety was an important component of cognitive conflict, and affected the relationship between cognitive conflict and student response [6]. This model had three stages: the preliminary stage, the conflict stage, and the resolution stage. Preliminary stage, was a stage that includes; the process of believing pre-existing conceptions and accepting anomalous situations. At the stage of cognitive conflict includes; (1) students acknowledged anomalous situations, (2) students expressed interest or anxiety in solving problems, and, (3) students engaged in cognitive reappraisal of existing situations.

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2. LITERATURE REVIEW

Cognitive Conflict

In situations of learning cognitive conflict could arise naturally when someone guessed or the hypothesis was proven wrong after the results of an experiment or may was provoked by a teacher or other student who expressed the opposite opinion [7]. For learning to occur, conflict must create dissatisfaction with existing beliefs and the emergence of alternative views must be understood and reasonable. Even from educational research many suggestions for providing teaching scenarios to promote cognitive change. Although to a large extent based on the presentation of counter-empirical examples, reviews of alternative conceptions, educators also emphasized the need for students to make their own explicit conceptions so they could make changes [8]. Mathematics educators had considered similar issues in an effort to help students built appropriate mathematical understanding.

Lee & Byen's research results showed that cognitive conflict initiated the first step in the process of conceptual change [3]. Anxiety was an important component of cognitive conflict, and affected the relationship between cognitive conflict and student response. Another thing from this research finding was that cognitive conflict had affective and cognitive features, and cognitive conflict features affected students' responses to anomalous situations, responses that occured as a result of decision making or attempts to resolve conflicts. There was a level of cognitive conflict that had constructive potential including if students experienced too low or too high a level of cognitive conflict then conflict would had a negative impact on student learning. In addition, anxiety was an important component of cognitive conflict to increase its influence on conceptual change. The results of the study entitled re-examining the role of cognitive conflict in learning science concepts obtained results that there were statistically significant differences in the level of cognitive conflict at the level of logical thinking ability in *field dependent students / independence* [9]. Cognitive conflict was a term used to describe the tension created when new evidence was recognized by students but contradicted previous knowledge [4]. This statement was describing students while the teacher could only provide situations of cognitive conflict to overcome the problem of resistance to change. Other opinions about cognitive conflict awere defined as conflicts

between cognitive structures (that was, the structure of knowledge in the brain) and the environment (for example, an experiment, demonstration, peer opinion, books, or others), or conflicts between conceptions in cognitive structures. If a child eventually became aware of the fact that he held two opposing views about the situation and couldnot be true, this step was called cognitive conflict or disequilibrium [10].

Kwon & Lee presented three types of cognitive conflict. His thinking reference for Piaget's cognitive imbalance was a cognitive conflict between a person's cognitive structure and environment. Besides using Hashweh's analysis, Kwon also considered metacognitive conflict as another cognitive conflict which was a conflict between cognitive schemata. This cognitive conflict would be aroused when someone could check / his own cognitive. Even in the concept of disequilibation that Piaget emphasized, there was a meaning that was similar to the type of cognitive conflict; Hashweh made a clear concept. In addition to the two types of cognitive conflict, Kwon suggested a third type of cognitive conflict. This kind of cognitive conflict could be aroused when a new concept, which might be a scientific conception that had just been studied, was not compatible with an individual's past experience and / or is familiar with his / her previous conception. Kwon showed three types of cognitive conflict [3].

3. RESEARCH METHOD

This research WAS categorized in qualitative research type with case study research strategy. The subjects of this study were 4 students of mathematics education at IAIN Tulungagung in semester 4. The research instrument consisted of Group Embeded Figure Test (GEFT) questions, test questions, and interview guidelines. Subjects were asked to work on the problem individually and based on their work, then conducted interviews related to their work to find out the cognitive conflict they experienced.

4. RESULTS AND DISCUSSION

Based on the results of the GEFT settlement analysis, four student subjects were specified with the breakdown of two students who had a *field dependent* cognitive style and two students who had an *independent field* cognitive style and each subject was given the same opportunity to solve a wide area problem by using integrals.

4.1. Subjects with *independent field* cognitive style

The problem used in exploring cognitive conflict in Tulungagung IAIN students for independent field cognitive styles is as follows "Determine the area of the area bounded by the curve y = 2x, the X axis, the line x = -2 and x = 2!". The results of the subject's work are as follows:

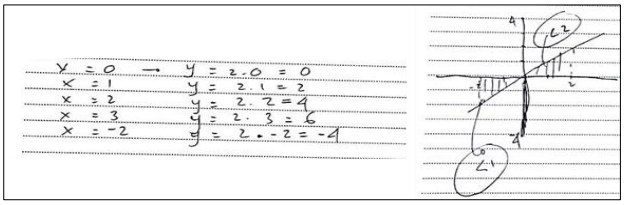
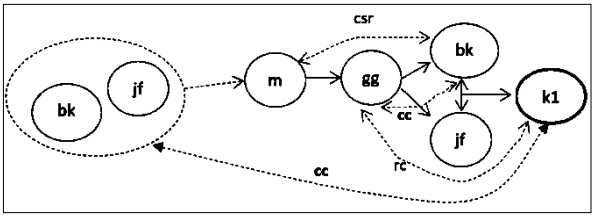


Figure 1. Results of the subject's work

The written result shows that the subject field was independent in finding the area that was bounded by the curve y = 2x, the X axis, lines x = -2 and x = 2 by observing the curve that had been made and given a conclusion that the area of the curve above the X axis neutralizes the area which was under the X-axis so that the area was zero. Cognitive conflict in independent field subjects was marked by the emergence of anxiety to see the final results obtained so that the subject paused for a long time, and the subject scratched his head. The subject became aware of the mismatch between the cognitive structure owned by the new information it received in this case the broad results obtained, and this awareness arose from itself or better known as auto cognitive conflict. The broad problems that researchers gave responded to the subjects by using their conceptions to solve them through the introduction of graphical images based on the identification of the types of functions in the symmetry theorem. Cognitive conflict began when the subject saw the value of the area sought as zero. The response that was raised was not believing and the subject immediately rechecked the results of his work. The first checked was done by looking at the graphic image he had made and then the conclusion obtained was the impossibility of the area value obtained equal to zero. What happened in this case was the emergence of modifications to existing cognitive structures in order to integrate with new information. Cognitive conflict that arose when the subject completed the area was a picture of a mismatch between the cognitive structure that a person had with the new information he received. The cognitive conflict that arose when the subject resolved the area of the region in the first way includes the calculation of the area of zero equal to the student's conception, that was, the area could be searched using the theoretic symmetry by observing graphic images and then neutralizing each other. Based on this the type of cognitive conflict experienced by the subject was a conflict between conception in the cognitive structure with external information sources (the results of its settlement).On this first settlement, the subject had not been able to get out of the conflict experienced so that what the subject was doing was by trying another way. The type of cognitive conflict experienced by the subject was the conflict between conception (c1) and the results of the settlement explained by c1.conception of the subject



Information:

m: problem gg: graphic image
Jf: function type (odd function) ts: symmetry theorem
L: an area that has an area ≠ 0 k1: final result
rc: recognition of contradiction cc: cognitive conflict
csr: cognitive reappraisal of situation bk: curve form

Based on the results of interviews the subject considers that the problem that has been resolved with the final result of area value equal to zero is not relevant to the conception it has. What the subject did, among others, was to reinterpret

the area determined under the X-axis with the results of the area calculation of zero value. The independent field subject tried to get out of the cognitive conflict that was experienced but was still unable so that what was done was to continue his work by looking for the area above the X axis Subjects experiencing cognitive conflict that is continuous / protracted this is seen when the subject resolves the problem given in the first way has not been able to get out of the conflict experienced so that what the subject is doing is to try another way. The type of cognitive conflict that arises in the subject is the conflict between conception (c2) and the outcome of the settlement explained by c1. The following is an overview of cognitive conflicts experienced by independent field subjects.

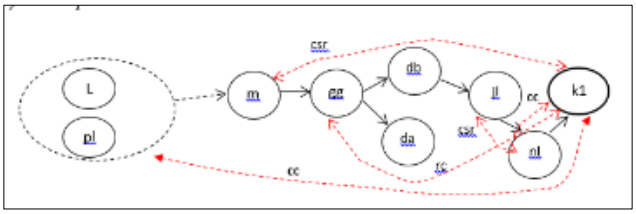


Figure 3. Subject field independent cognitive conflict when resolving area under the X axis

Information:
m : (problem), cc : *cognitive conflict*
gg : graphic image , rc : *recognition of contradiction,* da : the area above the X axis, csr : *cognitive reappraisal of situation* (the area above the X axis), db : (area under X axis) L :area width $\neq 0$, k1: (final result equal to zero), pl: (limit calculation)
nl : (limit value), jl: (total area of approximation)

Based on the exposure to cognitive conflict experienced by the subject in solving wide area problems using integrals, the subject experienced cognitive conflict that was continuous / protracted. This was seen when the subject resolved the problem given in the first way and had not been able to get out of the conflict experienced so what the subject did was tried the other way. Based on these exposures in this study the subject was called experiencing ongoing cognitive conflict / prolonged (sustained cognitive conflict).
As for the final settlement, the type of cognitive conflict experienced by the *independent field* subject in this study is the conflict between conception (c1) with the results of alternative settlement.

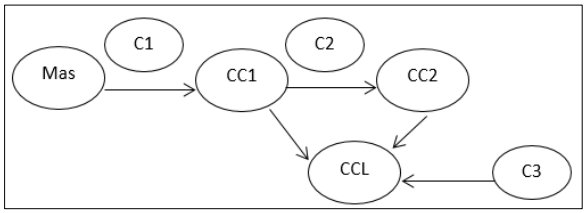


Figure 4. Cognitive conflicts that occured in independent field subjects in solving "wide area" problems

Information:
Mas : (problem), CC1 : (first cognitive conflict)
CC2 : (second cognitive conflict), CCL : (cognitive conflict further), C1: (first step), C2: (second step), C3 : (third step)

4.2. Subjects with *field dependent* cognitive styles

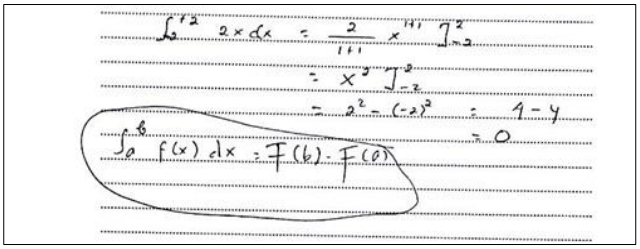


Figure 5. The results of the subject's work with cognitive style *field dependent*

Cognitive conflict in the subject field dependent was marked by the emergence of anxiety to see the final results obtained so that the subject was silent for a long time, and the subject was holding his head. When the subject processed information between the value of the area obtained and the conception that the subject had, what happened was the emergence of cognitive conflict. The subject tried to absorb new information related to the area obtained and integrated it into existing cognitive structures. Based on the results of the interview, the subject considered that the problem that had been resolved with the final result of area value equal to zero was not relevant to the conception it had. Cognitive conflict that arose when the subject resolved the area was an awareness of the subject that arose not from him because there was a mismatch between the cognitive structure owned by the new information it received (*not auto cognitive conflict*). New information was maximized in this study after the subject resolved the problem area and got the conclusion of the desired result. The subject's awareness arose after the interview and stated that the area obtained could not be zero.
The wide problems that researchers gave responded to the subjects by using their conceptions to solve them through the basic theorem of calculus $\int_a^b f(x)\,dx = F(b) - F(a)$.. Based on the search for the final results of the answers with task-based interviews, it raised cognitive conflict and this starts when the subject saw the area value sought was zero. The response that was raised was not believing and the subject immediately checked back the results of his work. The first check was done by looking at the problem given and the steps of its work and then the conclusion that was obtained was the impossibility of the area value obtained equal to zero. What happened in this case was the emergence of modifications to existing cognitive structures in order to integrate with new information. The subject performs information processing based on the value of the area obtained and the conception that he had then what happens was *incomplete fit* meaning that new information (the value of the area was equal to zero) was recognized not being explaining ideas any further. This *incomplete fit* information produced cognitive conflict. When subjects experienced *incomplete fit* they tried to reduce conflict by finding information that might provide a solution. The type of cognitive conflict that arose in the subject was

the conflict between conception (c1) and the results of the settlement explained by c1.
Subject conception - field dependent

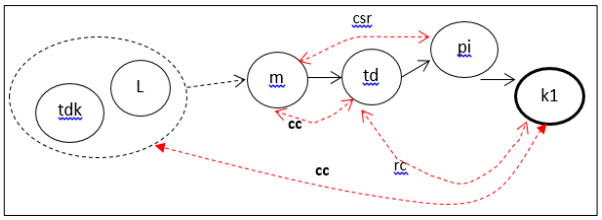


Figure 6. subject cognitive conflict - field dependent

Keterangan:
m : (problem)
pi : (integral settlement)
cc : cognitive conflict
rc : recognition of contradiction
csr : cognitive reappraisal of situation
tdk : (basic theorem of calculus)
L : (an area that had width, if the width was sought for)
k1 : (the final result was equal to zero)

The cognitive conflict that arose when the subject resolved the area, among others; the calculation of the area of an area equal to zero by using the basic theorem of calculus was contrary to the conception of students, that was the area of the estimated area had an area not equal to zero. Based on this the type of cognitive conflict experienced by the subject was a conflict between conception (c1) with the results of the settlement explained by c1.

5. CONCLUSION

The results of this study indicated that: 1). The forms of cognitive conflict experienced by students dependent cognitive style and independent fields are very different, 2). students with cognitive style field independent experienced auto cognitive conflict and vice versa for student with cognitive style field dependent did not, 3). Conflicts that occured in mathematics students of IAIN Tulungagung with independent field cognitive styles in solving integral problems, among others; A. Conflict between conception (caused by c1) with conception (caused by c2), b. Conflict between conception (c1) and the results requested by c2, c. Conflict between conception (c2) and the results requested by c1, and d. Conflict between conception (c1) with alternative results using the triangle area formula, and 4). Conflicts that occured in mathematics students of IAIN Tulungagung with cognitive style fields depended on solving integral problems, among others; A. Conflict between conception (c1) and the results requested by c1, and b. Conflict between conception (c1) and the results requested by c2.

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