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COUNTEREXAMPLE IN COGNITIVE CONFLICT AS FACTOR INFLUENCING CONCEPTUAL CHANGE

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Abstract

When a teacher trying to use anomaly phenomenon to encourage conceptual change, he/she will use model process cognitive conflict to anticipate how students may experience cognitive conflict. It can help teacher not to let students have conflict. Conflict Cognitive defined as conflict between structure Cognitive (i.e, structure Organized knowledge in brain) with the environment (For example, an experiment, demonstration, opinions of peers, books, or other), or conflict between concept in the cognitive structure. Based on the results of the field study counterexample is important to create cognitive conflict that can support the development of specific knowledge on the students.

Keywords: *Counterexample, Cognitive Conflict, Solving Math Problems*

A. Introduction

In terms of problem solving situations, students are usually faced with the challenges and often they are dealing with difficulties. By presenting a cognitive conflict by deliberately an attempt to familiarize the students and give the experience how to deal with a situation that is undesirable, giving the challenges and opportunities for students to strengthen their knowledge and skills of their mathematics. According to Stenberg (2012: 460), one of the factors that can hinder the problem solving is *a mental set* - a frame of mind that involves existing model to represent the problem, the context of the problem, or procedure for solving a problem. Another term for *a mental* set is a *set of entrenchment.* When the problem solver have *the mental set-rooted,* they are glued to the strategy usually works well in solving many problems but it does not work well in solving a particular problem.

In a learning situation, cognitive conflict can take many forms, for example, appear naturally when someone guesses or hypotheses proven wrong after the results of a demonstration or may be provoked by teachers and other students who express opinions contrary. According to Kwon and Lee (2003), Cognitive conflict defined as conflict between Cognitive stucture (i.e, structure Organized knowledge in brain) with the environment (For example, an experiment, demonstration, opinions of peers, books, or other), or conflict between concept in the Cognitive structure. If a child eventually became aware of the the fact that he hold two views conflicting situation and cannot be true, this step referred to as conflict cognitive or disequilibrium. Another opinion expressed by Moody (2008), that cognitive conflict is a term used to describe the tension created when new evidence is recognized by students and contrary to prior knowledge. The emotional reactions that appear on the student cognitive conflict situations such doubt, confused, experiencing uncertainty, anxiety, tension and always look back (Lee & Kwon, 2003; Limon, 2003).

According to Lee and Kwon (2003), cognitive conflict developed for explains when a student confronted with anomaly situation which is not in accordance with or its preconception in learning. Anomaly data play an important role in the learning of science and has been widely used in teaching to promote conceptual change (Lin, 2007). The main purpose of the conflict in the teaching of mathematics is to help students reflect on their current understanding of mathematics, to face the contradictions that arise in situations where some of this understanding is no longer appropriate, and recognized the importance (necessity) modify this understanding to solve different problems (Stylianides 2008). This model has three stages: the initial stage, the stage of conflict, and stage resolution.

First stage is the phase before cognitive conflict and including process beliefs/conceptions preexisting and receive anomaly situation as genuine (Ie, the experimental results obtained by a teacher). In this model, processes or stages cognitive conflict defined as student (1) recognizes anomaly situation, (2) express an interest or anxiety in dealing with cognitive conflict, and (3) engaging in reappraisal cognition. For example, when a student recognize that the situation is odd with conception, he must be interested and or anxious about this situation. After this stage or along with this, students will estimate conflict situations cognitive to complete or only for stop it (Lee & Kwon, 2003).

In situations of cognitive conflict, students will utilize cognitive abilities in an effort to seek justification, confirmation or verification of the opinion. This means that cognitive abilities have the opportunity to be empowered, refreshed, or strengthened, especially if the student is still working. For example, students will take advantage of his memory, his understanding of math concepts or experiences to make an appropriate decision. In the situation of cognitive conflict such as this, students can get clear of the environment, among others, from the teachers and students who are smarter (scaffolding). In other words, cognitive conflicts that exist in a person who

positively responded appropriately or can refresh and empower the cognitive abilities of the students (Liu, 2010).

In problem-solving situations, students are usually faced with challenges and often they are dealing with deadlock. By presenting a cognitive conflict by deliberately an attempt to familiarize the students and give the experience how to deal with a situation that is undesirable, giving the challenges and opportunities for students to strengthen their knowledge and skills of its mathematics (Stylianides, 2008).

The results of the research of Lee & Byen (2011) showed that cognitive conflict begin the first step in the process of conceptual change. Anxiety is an important component of cognitive conflict, as well as the relationship between cognitive conflict and student's response. It is another of the study's findings that cognitive conflict has affective and cognitive features, as well as features of cognitive conflict affect students' response to anomalous situations, a response that occurs as a result of a decision or an attempt to resolve the conflict. In addition, anxiety is an important component of cognitive conflict to increase its influence on conceptual change. Another study conducted Kabaca (2011) examine the misconceptions, cognitive conflict and conceptual change in geometry. The results obtained in this study indicate that the cognitive conflict generated through teaching with the help of mathematical *software* require previous knowledge of the subject of research. Thus, in the research to be conducted, prior knowledge or previous knowledge of the students was important to get the profile observed in the students' cognitive conflict.

B. Cognitive Conflict

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Kwon and Lee (2003) present three types of cognitive conflict. Their references of imbalance Cognitive Piaget is cognitive conflict between Cognitive structure and someone's environment. Additionally using Hashweh's analysis, Kwon also considers conflict metacognitive as other conflict Cognitive which is conflict between schemata cognitive. This Cognitive conflict will inflame when someone can check/cognition its own without contacting environment. Even in concept disequilibria which emphasized by Piaget, there is a meaning which is similar to conflict cognitive; Hashweh creates concept clear. In addition to the second type of conflict cognitive, Kwon suggests third conflict cognitive. This kind of conflict Cognitive may inflame when a new concept, which may concept scientific the new study, is not compatible with past experience individual and / or familiar with his / her old conception. Kwon indicate three kinds of cognitive conflict.

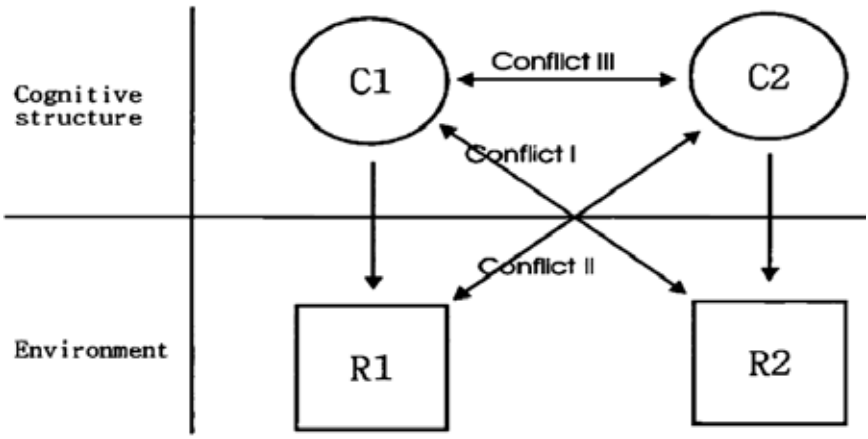


Figure 1. Kwon's model of cognitive conflicts

The top constitute structure Cognitive and bottom constitute environment. For instruction science, structure Cognitive may replace with concept scientific. C One constitute preconceptions student or misunderstanding. In classroom situation largely experienced misunderstanding. C2 constitute concept scientific to be learned. R1 constitute environment can also described by Cl, whereas R2 are any environment only described by C2. R1 and R2 do not only represent one phenomenon single external. It represents whole a group observation and stimulus of the environment person. In diagram This, cognitive conflict by Piaget are conflict between Cl and R2 (TypeI), cognitive conflict by Hashweh conflict between Cl and C2 (Type III).

However, in diagram which may easily recognize the other types of cognitive conflict among C2 and Rl. Kwon propose this as Other types of cognitive conflict (Type II). One might argue that this is just Type I Cognitive conflict. This may be true, but for the purpose of instructional, to categorize this as conflict different would be meaningless. Since Type I and Type II is all conflict Cognitive among structure Cognitive and the environment, both conflict Cognitive can be categorized as the same type.

In situations such as real as a teacher design instruction new, however, two types conflict Cognitive will function very different in the preparation teaching materials and time allocation activities. Therefore, to categorize Type II as independent type conflict Cognitive very meaningful.

When we think on the type of cognitive conflict, this diagrams would be useful because of its simplicity. But from our interpretation of cognitive conflict, Cl and C2 should not only new pre/conception which studied in the passage of time, but also a belief, a sub - structure, total structure, or something that is in cognitive structure, as has been mentioned in definition cognitive conflict.

C. Sign of Cognitive Conflict

Many researchers have tried to observe cognitive conflict and find markings diverse it. For example, Miller (In Kwon, 2003) observes doubt, tension, indecision, and blocking complete in situation of cognitive conflict. Berlyne explained conceptual conflict have something like this: doubt, confusion, contradiction, incongruity conceptual, confusion, and irrelevant.

Based on the article by Kwon (2003), the level of uncertainty Berlyne think kids (about anomalous information) as the main sign (indicator) of their level of cognitive conflict (conceptual conflict). He measured by the uncertainty of subjective cognitive conflict (which is provided by their children themselves). Smedslund find doubtful (reaction time), looked back and forth, anxiety, and tension as the children in the cognitive conflict situation. Zimmerman and Blom measured students 'cognitive conflict' by observing the level of uncertainty, and the response latency by using a method similar to that Berlyne. Movshovitz-Hadarand Hadass students find expression in a state of cognitive conflict from a discussion recorded.

They said students showed expression curiosity passion and expression of inner drive to complete, as well as the expression frustration, expressions satisfaction with overcome

inability to continue, and the expression satisfaction with feeling confident about state shaking.

In short, many researchers find many signs of Cognitive conflict which can be observed and they use these signs as indicator of level cognitive conflict. According to this literature, we can conclude construction psychological conflict cognition. For example, uncertainty, doubt, confusion, contradiction, incongruity Conceptually, irrelevant, which remarkable are signs cognitive conflict when someone recognizes anomalous situation which conflict with expectations person. So recognition anomaly will be one construct cognitive conflict. As markings other of cognitive conflict, feeling free to response and or of look back and forth are behavior when someone tried not only for resolve conflicts, but also to decide to continue to or not. In the circumstances internal person, one reappraises situation of conflict. So reassess conflict situations Cognitive are build other conflict cognitive.

Based Anderson and Bourke (2000) classification affective domain, we classify many signs affective conflict Cognitive become interest and anxiety. For example, reveal curiosity are signs conflict Cognitive as construct of interest. Tension, anxiety, and frustration are signs conflict Cognitive as construct of anxiety. After all, there are four psychological constructions in conflict cognitive. They are anomalies recognition, revaluation situation conflict Cognitive, interest, and anxiety. According to Kwon and Lee (2003) there are four construction conflicts cognitive, classify markings as follows:

1. **Anomaly Recognition**
   When students acknowledges that their predictions do not consistent with outcome of the demonstration, they asking questions, wonder and muttering the results for themselves, or say the results strange:
2. **Interest**
   After seeing the anomaly outcome, students expressed interest with a laugh or apparently curious feeling:

3. **Anxiety**
   In this case, we can find report oral of student when they witness anomalous outcome. They confess difficult to problem solving and conflict.
4. **Reappraisal of Situation Conflict Cognitive (Hesitant to Response)**
   When students witness outcome anomalies, many of them assess the problem it must be completed or not. A student does not move, and think of results very long.

D. Cognitive Conflict Process

Based on a literature review and case studies, Lee et al (2003) have proposed a process model of cognitive conflict and according to this model, cognitive conflict requires that students have the preconception and believed that he was confronted with a situation that is anomalous (not as usual). If preconception or less anomalous situation, then there is no cognitive conflict. In this model, cognitive conflict is considered as a psychological state that is generated when a learner is faced with a situation that is anomalous. In these circumstances, the student (1) recognizes the anomalous situation, (2) express an interest and / or anxiety in resolving cognitive conflicts, and (3) engage in cognitive reappraisal to resolve this conflict situation. After this stage or coincide he would estimate / conflict situations cognitive to complete or only for stop it. Thus, this model assumes four psychological construction of cognitive conflict: recognition of anomalous situations, interest, anxiety, and cognitive reappraisal.

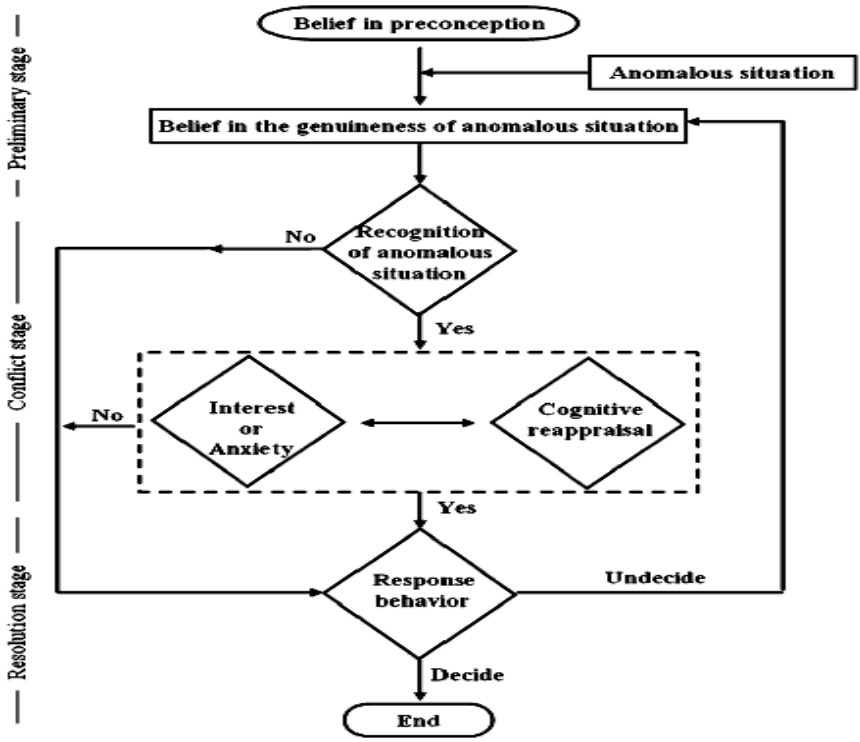


Figure 1. Cognitive process model of conflict

E. The importance of cognitive conflict counterexample

A common challenge faced by cognitive conflict approach to teaching mathematics is that students often have 'conflicting understanding' (from the mathematical point of view) without feeling the need to address the intellectual inconsistencies in their understanding (Zazkis & Chernoff, 2008). In other words, when teaching engage students in mathematical situations in which some existing understanding of ideas or topics are not durable, students often do not see the importance (or need) to be involved in the process of modifying their understanding to resolve the contradiction and they tend to treat contradiction as an exception. A situation such as mathematics provides an opportunity for potential conflicts, which may or may not develop into a cognitive conflict for students. In what ways

teaching turn potential conflict into a conflict engineered by cognitive teaching for students who are involved with tasks that consist of a sequence onal learning.

A way to overcome this problem is to enter into a strategic collection of instructional sequences that are important counter (Zazkis & Chernoff, 2008). According Zazkis and Chernoff, a counterexample is important for students if it creates a turning point in the perception of students' cognitive, that is, if it creates a dissonance in incorrect or incomplete understanding of the students of a particular topic or idea, or, in other words, if it helps developing the potential conflict into cognitive conflict for students. Although the counterexample is a mathematical concept, an important counterexample is a pedagogical concept (Zaslavsky 2005). Therefore, unlike a counterexample which can be determined universally important -balik can only be anticipated and recognized as such only after the implementation of an instructional sequence in which it originated. The difference between mathematical ideas counterexample and counterexample important pedagogical idea offers a useful theoretical tool to explain why some counterexample is presented to the student with the intent of creating cognitive conflict and dismissed by the student are treated as exceptions. However, the difference itself does not shed light on the conditions in which the counterexample has a good potential to be important for the students. Understanding these conditions have implications for the design of instructional sequences that aims to use the counterexample is important to create cognitive conflict that can support the development of specific knowledge on the students.

F. Learning Activities In Mathematics SMP

Based on the results of observations at a junior high school in Tulungagung, the mathematics learning materials rectangles and triangles, delivery of material carried by asking-anwer methods and the use of realistic mathematics approach. Problems are given refers to mathematical problem solving with

the goal of active students.

The series of learning activities carried out as follows;

1. At the preliminary stage, the teacher guiding students to pray and deliver learning objectives related subject rectangles and triangles.
2. At the core stage, the teacher explains how to find the properties of rectangles to determine the circumstance and area.

In explaining the circumference and area of quadrilateral, the teacher gives examples on the board and students were told to pay attention. In presenting this material the teacher tried to give an explanation by linking in their daily lives. For example;

Mr. Amal has a vacant plot of land shaped area rectangle next to his house. Length of 50 m and a soil width of 30 m.

a. Determine the land area in units of cm2 Pak Charity!

b. Determine the land area in units are Pak Charity!

The next learning activities, the teacher explains the area and perimeter of triangles by providing training to their students, as follows;

Granted some matchstick that will be used to form equilateral triangles. The composition of matchstick form equilateral triangles does not exceed two (2) levels. Many matchstick provided and lots of triangles with a maximum length of one side of the unit matches are presented in the following table.

N	3	5	7	9	11	13	15	17	18	...
S	1	2	3	4	5	6	7	8	9	...

a. Present the data in the table in the picture equilateral triangle!

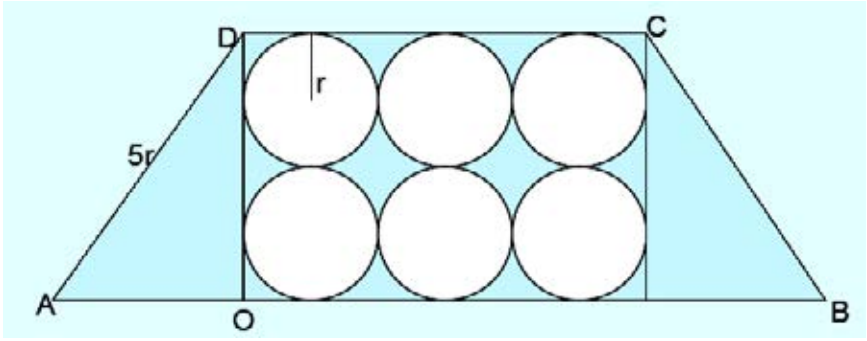
b. Discover the pattern of relationships matchstick many available and many equilateral triangles that can be formed!

c. How many equilateral triangles with sides of one unit of matches that can be formed if a lot of matchstick provided is 45?

d. How many matchsticks are provided if a lot of the triangle formed by 50?
e. What is the circumference of a triangle that can be formed from 21 matchstick?

Having completed all the exercises and discuss the teacher went on to explain kegiatanpun trapezoid. In explanation of the trapezoid teacher gives the following exercise;

Given six (6) circle with radius *r* in a region long trapezoid *ABCD* (samakaki) and *AD* = 5 *r.* Prove that the area of the shaded region is 6 r^2 (6 - p)!



A seller has a kind of pie-shaped cake area of rectangle with an area of 96 cm ^{2} surface area. Before the cake sale, first cut into small pieces with a parallelogram-shaped area side length 3 cm and 5 cm. After cutting, many areas parallelogram-shaped cakes as much as 6 cakes. Apparently the results of the rest of the pieces of cake there are not parallelogram-shaped area. What is the area of the surface of the cake is not parallelogram-shaped area?

3. In the closing stages, the teacher asks the students if they asked yng associated with rectangles and triangles and then followed by making inferences with students.

G. Observations And Interviews

The following are the findings of cognitive conflict based on the test results, observations, and student interviews.

Here the problem is given to students

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H. Findings

Based on observations while working on the problem set by the teacher; attitude seemed to include most of the students are confused, turn round, crowded, bullying is more to solve problems, and seemed anxious to solve the problems set by the teacher. To obtain the data, observers do in-depth study through interviews based on student answer sheets. Subject retrieval based on the signs of students who experience cognitive conflict as described above and based on the level of completion in accomplishing a given mathematical problem solving.

In general, based on interviews with some of the subjects that the students in solving mathematical problems often have doubts in ascertaining whether the proposed settlement of a settlement or award is right or wrong. In terms of problem solving situations, students are usually faced with the challenges they face and often with kebuntuaan. The cause of the impasse experienced by students SMP Bandung based on interviews among other problems too difficult, the initial knowledge of the students lack support in resolving problems, and students are not familiar with the form of problem-solving questions.

Here are presented the steps the student in solving mathematical problems indicated experiencing cognitive conflict. There seems to be a subject attempts to resolve the problem. Here tracing cognitive conflict; Subjects were confused when asked observer of the first sentence of the question â € œ A seller has a kind cake-shaped cake area of rectangle with an area of 96 cm ^{2}

surface area, but the subjects had the motivation to finish the back. This is evident from the attitude and confession when interviewed.

> ***Observer asks:***
> *"if each parallelogram-shaped pieces of cake dg sides 5 cm and 3 cm dg whole area is approximately 96 cm ^{2} may not sketch you?"*
> ***Subject replied:*** *"maybe, if its length and width are summed further summed then times them.*
> ***Observer:*** *you can try to multiply 20 by how to get a wide 96 cm $^{2?}$*

The last question made the subject of silent instantly, and thinks long. This is according to Kwon (2003), the uncertainty of the level of children's thinking (about the anomaly information) as the main sign (indicator) of their level of cognitive conflict (conceptual conflict).

> *"so that the subject is not able to find the area of a rectangle if one side is known 20 cm. so through scafolding observer, the subject begins to open his mind to solve such problems."*

As for the cause of students complete the work as sketched above as the subject of widespread disregard of the cake, so that the subject is free to cut the parallelogram-shaped cake that is important. Based on the results of the student interviews are also not careful in understanding the meaning of the question.

I. Conclusions

Based hasl above observation and interviews along with their implications can be deduced as follows:

Cognitive Conflict is a state perception where one notification not suitable among structure Cognitive person and the environment (External information), or between structural components Cognitive person (eg, conception someone, beliefs, sub - structure and forth which in the structure cognitive). A da four construction psychological conflict Cognitive: recognition anomaly, interest, anxiety, and reappraisal conflict situation cognitive. Cognitive Conflict have constructive, destructive, or

mean potential. This highly associated with how students conflict Cognitive. By examining markings conflict Cognitive, we can see potential conflict cognitive.

When a teacher trying to use phenomenon anomaly to encourage conceptual change, he will use model process cognitive conflict to anticipate how students may experience cognitive conflict. It can help teacher not to let students have conflict.

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