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Developing Mathematical Representation And Belief in Mathematical Learning Using Cognitive Conflict Strategy

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Abstract

The skill of representing, and student's belief to mathematic are an important elements one student should have, to help students to solve mathematic problems, along with daily problems. One of the ways to develop this is through a learning process where a situation, fact, and condition that polarize student's cognitive structure are involved. In such situation, conflict between student's knowledge and designed situation happened. The main problem of this research is about how the developing representing, and student's mathematical belief, are reviewed based on learning method (cognitive conflict strategy and conventional), and school rank (high and middle). This research is an experiment with pretest-posttest control group design. Cognitive conflict strategy is given to the experiment group, while conventional learning is given to control group. This research is involving 140 seventh grade students in Bandung City that represent schools in high and middle rank. The instruments of this research is Mathematical Representing Skill test, and Mathematical Belief scale. Data analysis used in the hipotesist test is t-test, two way Anova, and Scheffe test.

Keywords

cognitive conflict strategy, mathematical representation, mathematical belief.

Introduction

Realize it or not, cognitive conflict often shows up in mathematic studying and lucturing activities, it is caused by varied cognitive skills from each individu and the characteristic of the material that is given. It means that cognitive conflict can happened in studying process when student's information and knowledge is unbalanced with the information they faced when in studying scene.

In mathematical problem situation, student usually facing challenges and they oftenly facing an impasse. By providing a designed congnitive conflict, it is one of the efforts to make students accustomed to such situation and giving them an experience on how to handle an unwanted situation, giving them challenge and opportunity to stabilize their mathematical knowledge and skill.

Knowledge inventing according to constructivity sees active students creating cognitive structures in their interaction with environment. With the help from their cognitive structure, subject arranges the definition of the reality. Cognitive interaction will happened as far as the reality are arranged through cognitive structure that the students made their own. Cognitive structure had to be changed constantly and be adjusted based on environmental pressure that changing. An adaptation process is happened continually through reconstruction process (Piaget, 1988).

In constructivism theory, the most important thing at the learning process is that the students themselves had to be active developing their knowledge, and had to be responsible to their learning result. The emphasizing in this student's active learning process is got to be developed. Student's creativity and liveliness will help them to stand alone among student's cognitive life, so that studying could be directed more into concrete experience, discussing with classmates, then become contemplated idea and new concept development.

In studying mathematic, the important goal in using representation is to be able to communicate with the others using representing manifestation. Representing means to make another form from the idea or the problem, e.g. one table is represented into diagram shape or vice versa. Representing could help student explain concept or idea and make them easier to get the strategy to solve mathematical problem. E.g, graphic can be used as a tool to communicate information and understanding and make definition in mathematical way. By using graphic, student can dig invisible aspect in one context; representing process could lead a question about the context itself; student can construct something new and concepting the first context by graphic's important character; so that students can elaborate their understanding about graphic and the context through mathematical representing that they do, Monk (in Wu, 2004).

Goldin (2002) explain that one's belief is shaped by his attitude to

mathematic, then the belief will form mathematic value in that person. Regarding another role of beliefs, Greer, Verschaffel, and Corte (2002) emphasized that to be able to do mathematic is not enough by knowing on how to do it, but had to be along with the belief of concept truth and its procedure. E.g. when doing a manual counting or counting with a tool, the belief element is there (Nunokawa, 1998; Watanabe, Patitad, & Janmontree, 2022).

In order to create an optimal learning process, rank factor or school qualification is also necessary to be concern and consider. It has several reasons: (1) the fact that shows that school rank is very related to student's mathematical skill in general; and (2) diverse student's background is oftenly show varied responses as well. It could be seen from several research result in middle rank school just like the report result in the research by Suryadi, D (2005); Herman, T (2006) that stated that school rank is significantly influential to the improvement of student's mathematical skill.

It can be understood because the problems the teacher served in mathematic learning with cognitive conflict strategy needed the teacher's role as facilitator that will help student have a more active role in the studying process. Meanwhile, the skill of mathematical representing, and mathematical belief inside the students can be improved to be more optimal because student's role in class can be proceed even more. Therefore, mathematical learning with cognitive conflict strategy is potential to be able to interact with the skill of mathematical representing, and student's mathematical belief. This is possible to happen when a studying process that been applied to students gave significant influence compare to conventional learning approach.

Based on briefing above, the needs to do a study that is focused on applying mathematical learning with cognitive conflict strategy is allegedly could develop the skill of mathematical representing, and student's mathematical belief, is seen by the authors to be very urgent and prime. In this correlation, the researchers conduct a research that linked to mathematical learning process with cognitive conflict strategy. By considering that: (1) the research that relate to such problem in Junior High School rank is still rare; (2) the skill of mathematical representing, and student's mathematical belief are important to student for a stock to come to higher education; That is why, a research for Junior High School rank is so important and urgent to be done soon. Therefore, the title that is proposed for this research is "Developing Representing, and Belief in Mathematic on Mathematical Learning Using Cognitive Conflict Strategy (Eksperimental study to Junior High School student)".

A. Methods

Design and Research Procedure

This research is a quasi experimental research, with research design by pretest-posttest control group design, that can be describe as follows:

O X O

O O

Notes:

X = Mathematical learning with cognitive conflict strategy

O = Measurement of mathematical representing skill before and after learning process

----- = Subject is not picked randomly

In this design, every group is given pretest (O), then one group is given a mathematical learning process with cognitive conflict strategy (X), and one group which the class control is given a conventional learning approach or any special treatment. After each attitude is applied to each group, then posttest is held. Pretest and posttest that are given is a mathematical representing skill.

Procedure of this research is consist of three steps: preparation step, doing step, and data analysis step. These three steps is elaborated as follows:

1. Preparation Step

Activities that is done in this step are

a. Designing learning tool and research instrument, also asking expert's valuation.

b. Analysing the validation result of learning tool and research instrument with a purpose to improve learning tool and research instrument before field test is held.

c. Socializing mathematical learning design with cognitive conflict strategy to the teacher and observer that will be involved in the research.

d. Held the field test and observe didactive situation and pedagogical during testing process is occured.

e. Analysing test result of learning tool and research tool with a purpose to improve learning tool and research instrument before experiment is held.

2. Doing Step

3. Activities in this step are

a. Giving pretest to experiment class and control class. This test is held to measure mathematical representing skill in student before mathematical learning is occured.

b. Doing the mathematical learning with cognitive conflict strategy to experiment class (during this activity, an observation about the didactive and pedagogical situation that happened is held).

c. Doing the conventional learning to control class (during this activity, an observation about the didactive and pedagogical situation that happened is held).

d. Giving posttest to experiment class and control class. This test is to measure mathematical representing skill in student after the mathematical learning is held.

4. Data Analysis Step

Activities in this step are as follows

a. Doing data analysis and hypothesis testing.

b. Doing a session that relates with data analysis, hypothesis test, observation test, and literature research.

c. Data analysing so that findings can be found and to arrange research report result.

5. Result and Discussion

6. Result Analysis on Mathematical Representing Skill

Data result analysis shows that whether to be reviewed on learning method or on school rank, the average of student's mathematical representing skill with cognitive conflict strategy given is better than student's with conventional learning. For high rank school with the class that is given cognitive conflict strategy, has the average of 15,55, and in conventional class, the average is 14,93.

Before testing the average difference between sample groups, normality test and homogeneity test is conducted firstly. Normality test to mathematical representing in high rank and middle rank school is using Kolmogorov-Smirnov test, served on Table 1.

Table 1. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
KRM SKK PA	,140	35	,080	,939	35	,052
KRM KV PA	,122	35	,200*	,952	35	,128
KRM SKK PM	,148	35	,052	,921	35	,015
KRM KV PM	,139	35	,084	,928	35	,024
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

Based on the counting result in Table 1 above, shows that for SKK Class and conventional class have significance level or probability value of each group are all bigger than 0,005, so it can be conluded that the data result of mathematical representing in for those class is distributed normally.

Following it, homogeneity test to variants' mathematical representing score for two sample groups in each school rank is conducted by using Levene test. The counting resulis served on Table 2 and Table 3.

Table 2. Test of Homogeneity of Variances

KRM PA			
Levene Statistic	df1	df2	Sig.
,923	9	57	,512

Table 3. Test of Homogeneity of Variances

KRM PM			
Levene Statistic	df1	df2	Sig.
,545	9	58	,836

Based on the counting result in Table 2, shows that Levene test's result for mathematical representing score in high rank school is 0,923, and Table 3 for middle rank school is 0,545, meanwhile the significance value are all bigger than 0,05. Therefore it can be concluded that the two sample groups (cognitive conflict strategy class and conventional class) on each high rank school and middle rank school is homogenous

After knowing that those two groups are distributed normally and homogenous, then the difference test is conducted by using t test to each school rank. The t test counting result is served on Table 4 and Table 5.

Table 4. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PRE KRM PA - POS KRM PA	-5,11429	3,05762	,36546	-5,84335	-4,38522	-13,994	69	,000

Table 5. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PRE KRM PM - POS KRM PM	-5,77143	2,42075	,28934	-6,34864	-5,19422	-19,947	69	,000

Based on the counting result at Table 4 above, shows that t test result for mathematical representing score in high rank school is t_{hitung} = -13,994, and t_{tabel} = $t_{(0,025;69)}$ = 1,995 with significance value of 0,000. Because $t_{hitung} < t_{tabel}$ then H_0 is denied. Therefore it can be concluded that on high rank school, the result of student's mathematical representing with cognitive conflict strategy learning compare to the result of student's mathematical representing with conventional learning is significantly different. Table 5 on middle rank school with the t test to show the score of the mathematical representing is t_{hitung} =-19,947, and t_{tabel} = $t_{(0,025;69)}$ = 1,995 with significance value of 0,000. Because of $t_{hitung} < t_{tabel}$ then H_0 is denied. Therefore it can be concluded that in middle rank school, the score of

student's mathematical representing with cognitive conflict strategy learning compare to the score of student's mathematical representing with conventional learning is significantly different.

After knowing that the combination of those school ranks are distributed normally and homogenous, then two way Anova test is conducted to discover the role of learning factor, school rank factor, and the interaction between those two factors. The counting result of two way Anova test is served on Table 6.

Table 6. Counting Result of ANOVA to The Score of Student's Mathematical Representing According to Learning Method and School Rank

Tests of Between-Subjects Effects					
Dependent Variable: Mathematical Representing					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	687,486[a]	3	229,162	36,533	,000
Intercept	39111,429	1	39111,429	6235,193	,000
SCHOOL	460,829	1	460,829	73,466	,000
LEARNING	173,829	1	173,829	27,712	,000
SCHOOL * LEARNING	52,829	1	52,829	8,422	,004
Error	853,086	136	6,273		
Total	40652,000	140			
Corrected Total	1540,571	139			
a. R Squared = ,446 (Adjusted R Squared = ,434)					

From the ANOVA counting result on Table 6 above, shows that the significance value from Learning factor, School factor, and interaction factor (School * Learning), all of them are smaller than 0,005 which are 0,000. Therefore, it can be concluded that: (a) student's mathematical representing skill with Cognitive Conflict Strategy learning is significantly different to students with conventional learning; (b) there is a significance different in student's mathematical representing skill on two groups of school rank; (c) there is an interaction between school rank factor and learning factor to student's mathematical representing skill in general.

1. Analysis Result of Mathematical Belief

Data analysis result shows that in general, whether reviewed from learning method and school rank, the average of student's mathematical belief with cognitive conflict strategy is better than students with conventional learning. For high rank school with cognitive conflict strategy learning, the average is 200,27, and in conventional class, the average is 199,88. For middle rank school, the class with cognitive conflict strategy has the average of 199,36, and the average in conventional class is 198,44.

Normality test for mathematical belief scale in high rank school and middle rank school is using Kolmogorov-Smirnov test. The counting result for each school rank is served on Table 7.

Table 7. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
KYM SKK PA	,095	35	,200*	,966	35	,351
KYM KV PA	,095	35	,200*	,966	35	,351
KYM SKK PM	,086	35	,200*	,966	35	,354
KYM KV PM	,097	35	,200*	,966	35	,347
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

Based on the counting result served in Table 7 above, shows that for Cognitive Conflict Strategy class and conventional class have significance level or probability value on each group are all bigger than 0,05, therefore it can be concluded that the result data for mathematical belief score on each class is distributed normally.

Next, homogeneity test is conducted to discover the mathematical belief variant's score to two sample groups on each school rank using the Levene test. The counting result is served on Table 8 and Table 9.

Table 8. Test of Homogeneity of Variances

Table 8. Test of Homogeneity of Variances	df1	df2	Sig.
Table 8. Test of Homogeneity of Variances	16	30	,097

Table 9. Test of Homogeneity of Variances

KYM PM			
Levene Statistic	df1	df2	Sig.
1,560	18	27	,144

Based on the counting result served on Table 8, shows that Levene test result to score mathematical belief on high rank school is 1,721, and Table 9 for middle rank school is 1,560, meanwhile the significance value are all bigger than 0,05. Therefore, it can be concluded that the two sample groups (cognitive conflict strategy class and conventional class) in each high rank and middle rank school is homogenous.

After knowing that the combination of these school rank are distributed normally and homogenous, then two way ANOVA test is conducted to discover the role of learning factor, school rank factor, and the interaction between those two factors. The counting result with two way ANOVA test is served on Table 10.

Table 10. The Counting Result of ANOVA to The Score of Student's Mathematical Belief based on Learning Method and School Rank

Tests of Between-Subjects Effects					
Dependent Variable: Mathematical Belief					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	107,907[a]	3	35,969	,122	,947
Intercept	5575626,579	1	5575626,579	18904,899	,000
SEKOLAH	75,779	1	75,779	,257	,613
PEMBELAJARAN	32,064	1	32,064	,109	,742
SEKOLAH * PEMBELAJARAN	,064	1	,064	,000	,988
Error	40110,514	136	294,930		
Total	5615845,000	140			
Corrected Total	40218,421	139			
a. R Squared = ,003 (Adjusted R Squared = -,019)					

From the ANOVA result served on Table 10 above shows that significance value of Learning factor, School factor, and interaction factor (School * Learning), are all bigger than 0,05 which is 0,988. Therefore, it can be concluded that: (a) student's mathematical belief with Cognitive Conflict Strategy learning method is not significantly different with students that learning with conventional way; (b) there is no significant different on student's mathematical belief on the two groups of school rank; (c) there is no interaction between school rank factor and learning factor to student's mathematical belief in general.

Interaction between school factor and learning factor to student's mathematical belief can be seen on Table 19. On the table, shows that interaction between school and learning factor has the F value of 0,000 and its significance is bigger than 0,05, which is 0,988. So it can be concluded that there is no significant interaction between school and learning factor to student's mathematical belief.

B. Conclusion

The summary of this research is as following.

1. In general, student's mathematical representing skill that is given the cognitive conflict strategy is significantly different than student that is given the conventional learning.
2. There is an interaction between learning method (cognitive conflict strategy and conventional) and school rank (high and middle) to student's mathematical representing skill.
3. In general, student's mathematical belief that is given the cognitive conflict strategy learning is not significantly different than student that is given the conventional learning.
4. There is no interaction between learning method (cognitive conflict strategy and conventional) and school rank (high and middle) to student's mathematical belief.

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