

The Effect of Concept Attainment Model on Mathematically Critical Thinking Ability of The University Students

L MAngraini^{1,2}, B Kartasmita^{1,3}, and D Dasari¹

¹Departement of Mathematics Education, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi No. 229, Bandung 40154, Indonesia.

²Departement of Mathematics Education, Universitas Islam Riau, Jl. Kaharuddin Nasution No. 113, Pekanbaru 28284, Indonesia.

³Departement of Mathematics Education, Universitas Pasundan, Jl. Dr. Setiabudhi No. 193, Bandung 40154, Indonesia.

Email: lilismarina@student.upi.edu

Abstract. This study examined the university students' mathematically critical thinking ability through Concept Attainment Model learning. The Kolmogorov-Smirnov test, Levene test, t test, ANOVA one and two ways were used to analyse the data. The results of this study showed that (1) there is no difference grade on the student's mathematical critical thinking ability between experimental group and conventional group as a whole, (2) there is no difference on the students' mathematical critical thinking ability of experimental classes based on their mathematical early ability (3) there is no interaction between the learning that is used with the students' mathematical early ability on the students' mathematical critical thinking ability.

1. Introduction

Committee on the Undergraduate Program in mathematics (CUPM) [1] provided six basic recommendations for the department, programs, and courses in mathematics. One of recommendation stated that each course in mathematics should be an activity that will assist students in the development of analytical, critical reasoning, problem solving, and communication skills. The CUPM Recommendation above explained, the task of the institution in charge of educating prospective teachers who will teach mathematics, including prepare students to have mathematically critical thinking ability. Institutions of Higher Education Personnel (LPTK), Elementary School Teacher (PGSD) which is in charge of childbirth prospective teachers who will teach math partially take responsibility to prepare their students to have mathematically critical thinking ability. Mathematically critical thinking ability is the ability that could be cultivated, so that the lecturer had a role in the development efforts of students' mathematical critical thinking ability.

Inch, *et al* [2] say "Critical thinking is a process in which a person tries to answer rationally those questions that cannot be easily answered and for which all the relevant information is not available". Critical thinking is more focused on doing something, the students are able to think critically not immediately believe the explanation from the lecturer, but students were trying to consider the reasoning and find other information to obtain the truth.

According [3] critical thinking is characterized by rational activities such as: interpreting information based on the framework of a particular theory, linking theory to practice, file a claim and justify it, utilizing the data in support of the argument, making the relationship between ideas, ask



questions, evaluate knowledge, predict, describe something, analyzing, synthesizing, categorizing, comparing or contrasting, identify problems and solve them.

According to Bruner, learning process will go well and creatively, if lecturer give students an opportunity to find a rule (including concepts, theories, definitions, and so on) through examples that describe / represent rules that became the source [4], in other words, students are guided inductively to understand a common truth. Study process that presented by Bruner is in line with the theory of concept attainment model according to Bruce [5] concept attainment model is more focused on ways to strengthen the internal human impulses in understanding science, by digging and organizing, as well as developing the language to express it. Bruner, Goodnow, and Austin reveal concept attainment model deliberately designed to help students learn the concepts that can be used to organize information, so it makes easy for students to learn concepts in more effective way [6]

Concept attainment model has several stages of learning, the stages in concept attainment models help train students in critical thinking mathematically. The first learning stage, namely the presentation of the data and the identification of the concept, in this stage, students are asked to compare the characteristic features in the example and non-example, students were asked to create and test the hypothesis, then the student making the definition of the concept on the essential characteristic features, here the students are trained to think critically because students asked to compare the characteristic features in the examples and non-examples, so that they can find the definition of the concept on the characteristic of concept essential features. The second stage is the stage of testing the achievement of the concept, at this stage the students were asked to identify examples of concepts and create additional instances, here the students are trained to think critically for students to think about what characteristics are represented on a concept and what kind of example that meets the criteria of the concept. The third stage is the stage of analytical thinking strategy, at this stage the students are trained to communicate math, because students are asked to express the concept with their own words, reveals the reasons relating to create additional instances, and write down the steps to resolve the task of the concept being studied, and formulated the mathematical concept, so that this learning model proposed by Bruce, *et al* , theoretically believed that students' mathematical critical thinking ability become more better.

Kauchak and Eggen suggested that concept attainment model is an inductive learning model, designed by lecturer to help students learn the concepts and train the students in practicing high-level thinking skills [7]. Concept attainment model is very relevant in the teaching of mathematics [8], because the concept attainment models can foster understanding and appreciation of students to the concepts, principles so grows the power of reason, think logically, critically, systematically and others.

Concept attainment model is a learning model that aims to help students understand a particular concept, this model is more appropriate when the emphasize of learning is more focused on the introduction of a new concept, so as to train high-level thinking skills [4]. Formulation of the problems are: Is there any significant difference between students' mathematically critical thinking who taught by concept attainment model with the students who taught by conventional teaching as a whole? Is there any significant difference on the students' mathematically critical thinking ability who taught by concept attainment model based on their mathematical early ability (KAM)? Is there an interaction between the learning that is used and the mathematical early ability (KAM) on the students' mathematical critical thinking ability?

2. Experimental Method

The research plan design for this experiment is depicted in Figure 1 below.

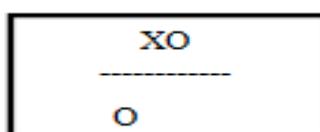


Figure 1. Design a plan[9]

Information :

O: Give the test (mathematically critical thinking ability)

X: Learning concept attainment model

This research was conducted in one of the Islamic State University. The population of this research was all students of Elementary school Teacher Education (PGMI) 5th Semester. All the population selected as sample of the study, the control class and experiment class.

The materials tested are two-dimensional figure that contained in the subject of Mathematics Education II. The test instrument of mathematically critical thinking consists of three questions that formed as description. Time Allocation for execution of the test is 3 x 50 minutes.

3. Result and Discussion

The data of Mathematically Early Ability (KAM) is collected and analyzed to determine the students' Mathematically Early Ability before this research was conducted. Mathematically Early Ability was obtained from the grades of mathematics education subject, which they acquired in the fourth semester. Then the grade is grouped by early capability categories of high, medium and low. The following Table 1 is the test results KAM Data equality both groups learning:

Table 1. Data Equality Test of KAM

<i>Test-t</i>	Data	Criteria
N	82	H ₀ Accepted
<i>Sig. (2-tailed)</i>	0,23	

The table above shows there is no difference of KAM average between students who taught by concept attainment model learning and students who taught by conventional model learning. The test results of data equivalence of Students' mathematically critical thinking ability based learning model that used is presented in the following Table 2:

Table 2. Data Equality Test of Mathematically Critical Thinking Ability

<i>Test-t</i>	Data	Criteria
N	82	H ₀ Accepted
<i>Sig</i>	0,122	

The table above shows there is no significant difference between students' mathematically critical thinking ability who taught by concept attainment model learning and students who taught by conventional model learning. The results of test calculations differences of students' mathematically critical thinking ability who taught by concept attainment model presented in the following Table 3.

Table 3. ANOVA Test One Way

	The sum of squares	Df	Average	F	Sig.
Inter-group	112,93	2	61,46	1,29	0,28
In the group	1949,61	41	47,55		
Total	2072,54	43			

The table above shows there is no difference of students' mathematically critical thinking ability who taught by concept attainment model based on KAM. Furthermore, The results of calculation of the effect of interaction between the learning that used and KAM on the students' mathematically critical thinking ability will be tested using ANOVA two ways are presented in the following Table 4:

Table 4. ANOVA Test Two Ways

	The sum of squares Squares	Dk	Average	F	Sig.	H ₀
Learning	134,59	1	134,59	2,88	0,09	Accepted
KAM	302,16	2	151,08	3,23	0,04	Denied
Interaction	74,45	2	37,22	0,79	0,45	Accepted
Error	3546,24	76	46,66			
Total	12127,00	82				

The table above shows that the learning factor used in each study group did not have a significant impact on the students' mathematically critical thinking ability. Afterward, KAM factor that owned by each study group had a significant influence on the students' mathematically critical thinking ability. Furthermore, there is no significant effect caused by the interaction between the learning factor that used and each KAM group learning on the students' mathematically critical thinking ability.

4. Conclusion

The conclusions found in this study are as follows. First, the time of the study is only six meetings and one meeting to the test, causing limitations of students to develop mathematically critical thinking ability. Especially in mathematically critical thinking ability that takes practice continuously so that students become increasingly critical in learning. The implementation time which is lasted for two months there not too make students used to learning by using the concept attainment model, so that the results are as expected, more research time should be extended again.

Second, there are many experimental class students who do not understand the basic concepts of algebra operations, so during the learning process the researcher more preoccupied with fixing concepts that are still wrong, as a result of learning with concept attainment model less effective due to the ability of students that are not balanced. Learning by concept attainment model is more stresses on the discovery of concept by each individual. Because many students still wrong with the basic mathematical concepts, the learning much more constrained, lecturers should improve the concepts that are still wrong, and then pass the learning materials.

Third, a large number of students in one class (experiment class), were 44 students, so the researchers somewhat overwhelmed in providing stimuli so they can achieve the concept. Of the 44 students, only about 15 students who have basic mathematical concepts were good. During the teaching process the lecturer come to the students (which basic mathematical concepts was not yet good enough) one by one giving the stimuli of learning materials to keep students achieve its own concept.

Fourth, 5th semester PGMI Students, overall not have interest in learning mathematics. Furthermore, in the 7th semester they will be grouped according to their specialization. From 44 students of Experimental class only about 15 people who wish to join math majors, others wish to choose Indonesian majors and Natural Science. Those who will choose math majors, seemed enthusiastic during the course in following the subject matter. But those who chose Indonesian Language (Bahasa) and Natural Science major less enthusiastic for learning, in addition of their basic concepts of mathematics are still wrong, they also felt that learning mathematic is caused dizziness, and later they also do not want to be a teacher Madrasah Ibtida'iyah (MI) who teaches mathematics, It seems most of their interest in learning math is not good.

Fifth, students used to learn to accept the subject matter. Students usually pay attention, and lecturers explain and use power point. This kind of habit learning is unfamiliar and difficulties for students with learning concept attainment model, because learning by using this model requires students to discover concepts on their own without direct lecturer explained, the role of lecturer only

provide stimuli until they can find their own concept. Because learning by new concept attainment model is new experienced by students, therefore students need habituation so that students are not confused following study.

Sixth, the Mathematically critical thinking ability is a mathematical ability that have a high grade. So that the effect of concept attainment model learning model looks better, it takes a habituation process of learning that focuses on students' mathematically critical thinking ability.

5. References

- [1] Mathematics Association of America 2004 *Undergraduate Programs and Courses in the Mathematical Sciences: CUPM Curriculum Guide 2004* (Washington DC: The Mathematics Association of America Published) p 2
- [2] Inch,*et al* 2006 *Critical Thinking and Communication* (Boston: Pearson Education, Inc) p 5
- [3] Sihotang,*et al* 2012 *Critical Thinking* (Jakarta: Pustaka Sinar Harapan) p 2
- [4] Uno B H 2008 *Model Pembelajaran* (Jakarta: BumiAksara) p 10-12
- [5] BruceJ,*et al* 1992 *Models of Teaching* (Boston: Allyn and Bacon) p 125
- [6] Aunurrahman 2009 *Belajar dan Pembelajaran* (Bandung: Alfabeta) p 158
- [7] Silitonga M 2006 *Jurnal Penelitian Bidang Pendidikan*. **12** 172
- [8] Mustamin A 2005 *Pembelajaran Matematika Menggunakan Model Pembelajaran Pencapaian Konsep* (Kendari: WAKAPENDIK) p 72
- [9] Ruseffendi E T 2005 *Dasar-dasar Penelitian Pendidikan dan Bidang Non-eksakta Lainnya* (Bandung: Tarsito) p 49

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