

# Comparative Study of Reasoning Capability and Mathematical Understanding of Student between Application of Open-Ended Approaches and Expository Approaches and Relation to student Early Capabilities

Nur 'Afifah

*Departmen of Guidance and Counseling  
University of Muhammadiyah Sumatera  
Utara*

Medan, Indonesia  
nurafifah@umsu.ac.id

**Abstract** —The problem in research is the low reoning ability and mathematical unnderstanding of students is the lecturer-centered learning outcomes. Change in the learning process into student-centered learning must be done, one of wich is learning that applies the Open-Ended approach. This research is aimed to comparing : (1) Reasoning skills and mathematical understanding of groups between Open Ended approaches and expository learning. (2) Reasoning skills of mathematical learning between learning and early math ability of student mathematical learning result. (3) Mathematical understanding between learning and early math ability of student mathematical learning result. This research is quasi-experiment. The subjects of this study were students of Mathematics Education Study Program who were randomly selected by two classes. Class B was treated with 32 students by Open ended approaches and Class C was treated with 32 students by Expository Learning. The instrument used was a description test from reasoning and mathematical understanding test, observations of student activities, diversity and answer patterns given by students. Data analysis was performed by t-test and Kruskal-Wallis Non-Parametric Test to see the mean difference and Anova of two Factorial 2 x 3 lines. The main result of this study is that students who study with the Open Ended Approach significantly have higher reasoning and mathematical comprehension skills than students who learn with the Expository Approach. Students with high abilities significantly have higher reasoning and mathematical comprehension skills than students with moderate abilities compared to low ability students, except mathematical reasoning abilities in groups of students with expository learning. There is no interaction between learning factors and students ability factors that influence students' reasoning and mathematical understanding abilities

**Keywords** — *Reasoning Capability, Understanding Capability, Open Ended, Expository, Early Capabilities*

## I. INTRODUCTION

The student of mathematics education have weaknesses in reasoning and mathematical understanding of students during teaching and learning. The example is students difficult to find out the pattern or rule that underlies the pattern, so that only memorizing formulas and will be confused when writing a formula that has been memorized in other forms so the students need to be given the opportunity to learn to improve and develop their reasoning abilities and mathematical understanding in order to solve mathematical problems or related to mathematical problems in ways and results they know according to the students' mathematical experience. This means that reasoning skills are needed in order to achieve better results in solving a mathematical problem. And the hope of a class situation where students actively engage in various activities related to mathematics to build mathematical understanding so that mathematics is understood by students is not only memorized (rote learning). For this reason, it is necessary to develop an appropriate learning model to improve students' mathematical reasoning and understanding abilities, especially for students of mathematics education study program FKIP UMSU, where the writer is a lecturer in mathematics study program at FKIP UMSU. One of the learning models is Open-Ended Approach. According to Neny Lestari , dkk (2016) the study of mathematics by open-ended approach has influence in mathematical reasoning students. The purpose of open-ended learning according to Shimada (MKPBM Team, 2001) is to help develop creative activities and mathematical mindset of students through problem solving simultaneously. In other words creative activities and mathematical mindsets must be developed according to the abilities of each student. Things that can be outlined are the need to give students the

opportunity to think freely according to their interests and abilities. This class activity filled with mathematical ideas will in turn spur students' high level thinking skills.

All the facts and weaknesses above are not accompanied by developing appropriate learning models in an effort to arouse students' mathematical reasoning and understanding, the learning outcomes obtained are limited to theory and memorization of formulas. This will be an obstacle to the development of subsequent mathematics, because mathematical knowledge obtained through learning models commonly used so far (expository strategies), only from memorization, lecturer information and the practice of answering questions repeatedly without increasing students' mathematical reasoning and understanding, will be pseudo and quickly disappear (forget).

In addition, the Ministry of National Education (2003: 12) states that there is no single learning model, learning model or the most effective strategy to achieve all kinds of learning objectives. But at least the learning model, learning model or strategy applied by the lecturer is able to make interactions between student groups, including between groups of students' initial abilities. Then students with high, medium, and low initial abilities can benefit from the application of learning models, learning models or strategies that teachers do, especially in terms of improving their reasoning and mathematical understanding skills. As has happened so far, students with high initial abilities feel tired in their learning because they feel the presentation of the material is too "normal" or students with moderate and low initial abilities feel the presentation of the material is too difficult to understand. So that a core class was formed which consisted of students with high initial mathematical abilities or a special class that consisted of students with low or moderate initial abilities.

Based on the description above, the formulation of the problem that the authors examine in this study is formulated as follows: Is the mathematical reasoning of the student group that has open-ended approach higher than the group of students who obtain expository learning. Is the mathematical reasoning abilities of students with high initial abilities are higher than those with moderate initial abilities higher than those with low initial abilities. Is the mathematical understanding of the student group that has open-ended approach higher than the group of students who obtain expository learning. Is the mathematical understanding abilities of students with high initial abilities are higher than those with moderate initial abilities higher than those with low initial abilities.

## II. METHODOLOGY

This research is an experimental study with the type of research is quasi experiment because there are conditions around the subject that are expected to affect the subject that cannot be excluded, such as climate, health factors and classroom atmosphere.

The location of this research was at University of Muhammadiyah Sumatera Utara, Mathematics Education Study Program, where such research had never been conducted. The population of this study were the second semester students of Mathematics Education Study Program with 120 students. The sample of this research are 64 students divided into two groups (experiment and control)

where class B as the experimental group class and class C as the control group with sampling was done by random sampling. This study was an experimental study with a final test designed without initial tests, using experimental groups and control groups. The experimental group is a group of students who are treated with learning with Open Ended Approach. While the control group is a group of students with expository Approach. And both groups were given a prerequisite knowledge test which served as a test of the student's initial ability.

**Table 1.** The result of prerequisite knowledge

N0.	The problem Research	Hipotesis	type of statistical test
1.	Is the mathematical reasoning of the student group that has open-ended approach higher than the group of students who obtain expository approach	1	Anava 2 jalur
2.	Is the mathematical reasoning abilities of students with high initial abilities are higher than those with moderate initial abilities higher than those with low initial abilities	2	Kruskal-Wallis (NonPar)
		3	Kruskal-Wallis (NonPar)
4.	Is the mathematical understanding of the student group that has open-ended approach higher than the group of students who obtain expository learning.	4	Anova 2 jalur
5.	Is the mathematical understanding abilities of students with high initial abilities are higher than those with moderate initial abilities higher than those with low initial abilities.	5	Kruskal-Wallis (NonPar)
		6	Kruskal-Wallis (NonPar)

## III. RESULT AND DISCUSSION

### 1. Students 'Mathematical Reasoning Ability Based on Learning Factors and Students' Early Capability Factors

**Table 1.** Summary of Factorial 2 x 3 ANOVA Test Student Mathematical Reasoning Ability Based on Learning Factors and Students' Early Capability Factors

Dependent Variable: MATHEMATICAL ABILITY

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	861.709 <sup>a</sup>	5	172.342	7.424	0.000

Dependent Variable: MATHEMATICAL ABILITY

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	13840.457	1	13840.457	596.217	0.000
FACTOR Of Learning	145.137	1	145.137	<b>6.352</b>	<b>0.015</b>
Factors Of Early Ability Of Mathematics Students	603.975	2	301.987	13.009	0.000
Error	1346.400	58	23.214		
Total	19997.000	64			
Corrected Total	2208.109	63			

R Squared = ,390 (Adjusted R Squared = ,338)

**Table 2.** Normality Test for Distribution of Open Ended and Expository Reasoning Data by Kolmogorov-Smirnov Test

		Open Ended	Expository
N		32	32
Normal Parameters <sup>a</sup>	Mean	<b>18.35</b>	<b>15.19</b>
	Std. Deviation	5.471	6.013
Most Extreme Differences	Absolute	0.097	0.157
	Positive	0.070	0.157
	Negative	-0.097	-0.115
Kolmogorov-Smirnov Z		0.550	0.887
Asymp. Sig. (2-tailed)		0.923	0.410

Based on table 1. and table 2., the value of F for learning factors is **6.352** with a significance value of **0.015**. This significance value is smaller than the significance level of 0.05, so the null hypothesis which states there is no difference in students' mathematical reasoning abilities between learning factors is rejected. This means that the difference in the average score of mathematical reasoning abilities of groups of students who have open ended approaches (**18.35**) differs significantly from students who have expository approach (**15.19**). So it can be concluded that students' mathematical reasoning abilities in the two groups are relatively different. These results indicate that students with mathematical learning with open ended approach are higher than students who have mathematical learning applying the expository approach.

## 2. Early Ability of Students with the Kruskal-Wallis Test in each learning group

**Table 3.** Summary of Testing Results Three Average Initial Capability of Students with the Kruskal-Wallis Test in each learning group

	Mathematical Reasoning Ability of Open Ended Approach Group Students	Student Mathematical Reasoning Ability for Expository approach Groups
Chi-Square	20.934	.862
Df	2	2
Asymp. Sig.	0.000	0.650

a. Kruskal Wallis Test

b. Grouping Variable: Student Mathematical Reasoning Ability OE dan EK

From Table 3. above, it can be seen that in the Asymptotic Significance column there is a value of **0.000** for the open ended approaches group and **0.650** for the expository learning group. The significance value for the open ended approach group is smaller than the 0.05 significance level, so that there is no difference between the initial abilities of students is rejected. This means that in the open ended approach group, students' mathematical reasoning abilities between the initial abilities differ significantly. In other words, after being taught with open ended approach of learning, mathematical reasoning ability of students with high initial abilities is higher than students with moderate initial abilities higher than those with low initial ability. Whereas in the expository learning group, the significance value is greater than the 0.05 significance level, so the null hypothesis which states that there is no difference between the initial abilities of students is rejected. This means that in the expository learning group, students' mathematical reasoning abilities between initial abilities do not differ significantly. In other words, after being taught with the expository learning model, mathematical reasoning ability of high-ability students is the same as students with early ability being the same as low-ability early students.

## 3. Students' Mathematical Understanding Ability Based on Learning Factors

**Table 4.** Summary of Factor 2 x 3 ANOVA Test Student Mathematical Understanding Ability Based on Learning Factors and Students' Early Capability Factors

Dependent Variable: MATHEMATICAL UNDERSTANDING ABILITY

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	5660.870 <sup>a</sup>	5	1132.174	10.719	.000
Intercept	150434.771	1	150434.771	1.424E3	.000
Factor of Learning	436.313	1	436.313	<b>4.131</b>	<b>.047</b>

Dependent Variable: MATHEMATICAL UNDERSTANDING ABILITY

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Factor of Early Mathematic Student Ability	4218.789	2	2109.394	19.971	.000
Error	6126.114	58	105.623		
Total	205497.000	64			
Corrected Total	11786.984	63			

a. R Squared = ,480 (Adjusted R Squared = ,435)

**Table 5.** Normality Test for Distribution of Open Ended and Expository Understanding Data by Kolmogorov-Smirnov Test

		Open Ended	Expository
N		32	32
Normal Parameters <sup>a</sup>	Mean	<b>59.38</b>	<b>50.66</b>
	Std. Deviation	14.377	11.589
Most Extreme Differences	Absolute	0.090	0.135
	Positive	0.055	0.135
	Negative	-0.090	-0.072
Kolmogorov-Smirnov Z		0.507	0.764
Asymp. Sig. (2-tailed)		0.959	0.603

Based on Table. 4 and Table 5. above, the F value for learning factors is **4.131** with a significance value of **0.047**. This significance value is smaller than the significance level of 0.05, so the null hypothesis which states there is no difference in students' mathematical understanding ability between learning factors is rejected. This means that the difference in the average score of mathematical comprehension abilities of groups of students who obtain open ended approach (**59.38**) differs significantly from students who obtain expository approach (**50.66**). So it can be concluded that the ability of students' mathematical understanding in both groups is relatively different. These results indicate that students with mathematical learning with open ended approach are higher than students who have mathematical learning applying expository approach

#### 4. Students 'Mathematical Understanding Ability Based on Students' Early Mathematical Capability Factors

**Table 6.** Summary of Testing Results Three Average Initial Capability of Students with the Kruskal-Wallis Test in each learning group

	Ability to Understand Mathematics Open Ended Approach Group Students	Expository Mathematics Group Understanding Ability
Chi-Square	11.681	8.588
Df	2	2
Asymp. Sig.	<b>0.003</b>	<b>0.014</b>

a. Kruskal Wallis Test

b. Grouping Variable: Kemampuan Awal Siswa OE dan EK

From Table 6. above, it can be seen that in the Asymptotic Significance column there is a value of **0.003** for the open ended approach group and **0.014** for the expository learning group. Significance values for the Open Ended approach group and for the expository group were each smaller than the 0.05 significance level, so that there was no difference between the initial abilities of students was rejected. This means that in the open ended approach group, the ability of students to understand mathematics between initial abilities is significantly different. In other words, after being taught with a open ended approach of learning, mathematical reasoning ability of students with high initial abilities is higher than students with moderate initial abilities higher than those with low initial ability.

Likewise in the expository learning group, the ability of student's mathematical understanding between initial abilities is not significantly different. In other words, after being taught with the expository learning model, the mathematical comprehension ability of students with high initial abilities is higher than those with a moderate initial ability higher than those with low initial ability.

Some of the studies that are relevant to the research that researchers do include research conducted by Jarnawi (2004) of second grade junior high school students in Bandung concluded that the reasoning ability and mathematical understanding of students who learn through learning models with open-ended mathematics learning approaches combined with learning strategies cooperative has a pretty good quality. Yuniawati's (2000) study of second year high school students in Bandung showed that with the open-ended mathematics learning approach, student's mathematical connection abilities had increased.

Ruslan,dkk (2013) the research tha there is a significant difference in the improvement of students' mathematical reasoning ability between students who were given open-ended questions and students are given a routine matter , and there is a significant difference in the improvement of mathematical reasoning ability among the students at the level of initial knowledge of mathematics high, medium, and low. This result is also related to Batubara, IH (2009) told that model of learning methods assisted by some media higher than the students who were not given media in learning



#### IV. SUMMARY

The mathematical reasoning ability of groups of students who obtain an open-ended learning approach is significantly higher than the group of students who receive expository learning in FKIP UMSU. After being taught with the Open-ended Approach, the mathematical reasoning ability of students with high initial abilities is higher than students with early abilities are higher than students with low initial abilities. After being taught with the Expository Approach, the mathematical reasoning ability of students with high initial abilities is higher than students with early ability are higher than students with low initial ability.

The ability to understand mathematical groups of students who obtain an open-ended learning approach is higher than the group of students who receive expository learning at FKIP UMSU. After being taught with the Open-ended Approach, the mathematical understanding ability of students with high initial abilities is higher than students with initial abilities are higher than students with low initial abilities. After being taught with the Expository Approach, the mathematical understanding ability of students with high initial abilities is higher than students with early abilities are higher than students with low initial abilities.

#### V. ACKNOWLEDGMENT

The author give million expresses his deepest gratitude to the Committee as well as the editors of the The 4<sup>th</sup> Profunedu Conference University of Muhammadiyah,

Makassar, who have provided the opportunity to publish the results of this research at this forum or proceeding, and all parties who have supported and help implement this research program. Hopefully the results of this research can benefit to all of us

#### VI. REFERENCES

- [1] Neny Lestari,dkk." THE EFFECT OF OPEN-ENDED APPROACHES TO MATHEMATICAL REASONING OF FIRST MIDDLE SCHOOL STUDENTS". <https://ejournal.unsri.ac.id/index.php/jpm/article/view/3284>. Accessed September 4 2019
- [2] Shimada, S. And Becker, JP. "*The Open-Ended Approach: A New Proposal for Teaching Mathematics.*", Virginia : NCTM, 2001.
- [3] The Ministry of National Education, "Elementary Mathematics Learning Model", Dirjendikdasmen Section of the IPA Warrior Quality Improvement Project, 2003.
- [4] Jarnawi. "Improving the Reasoning and Understanding Ability of Junior High School Students through the Open-Ended Learning Approach". Bandung : Disertation PPs UPI. Not Published.2004
- [5] Yuniwati."Improving mathematical connection skills of high school students by using an open-ended mathematics learning approach". Bandung : Disertation PPs UPI. Not Published.2000
- [6] Ruslan,dkk." The Effect of Giving Open-Ended Questions to Students' Mathematical Reasoning Abilities". JURNAL KREANO, ISSN : 2086-2334 Diterbitkan oleh Jurusan Matematika FMIPA UNNES Volume 4 Nomor 2 Bulan Desember Tahun 2013.
- [7] Batubara, I.H. "Improving Student's Critical Thinking Ability Through Guided Discovery Learning Methods Assisted by Geogebra", Int. J. for Educational and Vocational Studies, Vol 1, no. 2, 2019. <https://ojs.unimal.ac.id/index.php/ijevs/article/view/1371>