ISSN 2715-7458
E-ISSN 2715-7466

Journal of Mathematical Pedagogy
Volume 2, No. 2, July 2021, pp. 59-67

The Effect of Guided Discovery Learning Model towards the Mathematics' Critical Thinking Ability on Secondary School Students

Samron[1], Afudin La Arua[2]
[1]Universitas Muslim Buton, Jalan Betoambari 146, Baubau, Indonesia, 93721
[2]Universitas Muslim Buton, Jalan Betoambari 146, Baubau, Indonesia, 93721
Email: samron2772@gmail.com; laaruaafudin@gmail.com

Abstract

This study is aimed to determine the effect of guided discovery learning model on mathematical thinking ability of secondary school students. This study was a quasi-experimental study involving students in the VIII grade at SMP Negeri 9 Baubau, Southeast Sulawesi Province. T-test analysis is used to analyze the collected data. The findings revealed that (1) the guided discovery learning model had a significantly better on improving students. Mathematical critical thinking skills than the direct learning model; (2) both classes experienced an increase in every aspect of mathematical critical thinking skills, but the the guided inquiry learning model had asignificantly higher increase in every aspect of mathematical critical thinking skills than the direct learnign model

Keywords: Guided Discovery Learning Model, Mathematical Critical Thinking.

Abstrak

Penelitian ini dilakukan untuk mengetahui pengaruh model pembelajaran penemuan terbimbing terhadap kemampuan berpikir kritis matematis siswa SMP. Q*uasi experimental* adalah jenis penelitian yang diaplikasikan pada penelitian ini dengan bentuk desain *pretest-posttest control group design*, pada siswa kelas VIII SMP Negeri 9 Baubau Provinsi Sulawesi Tenggara. Data dianalisis dengan menggunakan analisis uji-t. Hasil penelitian menunjukkan (1) model pembelajaran penemuan terbimbing berpengaruh lebih baik secara signifikan terhadap peningkatan kemampuan berpikir kritis matematik siswa jika dibandingkan dengan model pembelajaran langsung; (2) kedua kelas mengalami peningkatan setiap aspek kemampuan berpikir kritis matematik, tetapi kelas yang diajar dengan model pembelajaran penemuan terbimbing mengalami peningkatan di seluruh aspek kemampuan berpikir kritis matematis yang lebih tinggi dibandingkan kelas yang diajar dengan model pembelajaran langsung.

Kata kunci: Model Pembelajaran Penemuan Terbimbing, Berpikir Kritis Matematis

How to Cite: Samron & Arua, A.L. (2021). The Effect of Guided Discovery Learning Model towards the Mathematics' Critical Thinking Ability on Secondary School Students. *Journal of Mathematical Pedagogy, 2* (2), 59-67.

Introduction

Along with the advancement of science and technology, mathematics plays an increasingly important function that can be applied in a variety of sectors (Hartono, 2020; Siswono et al, 2016). Mathematics is one of the discipline that must be thaught at all stages of school since it thought to improve students' understanding, particularly in logical, rational, effective, efficient, and critical thinking. The importance of mathematics has not been followed up by the enthusiasm of students in learning mathematics (Kurniawan & Hartono, 2020). Students still consider mathematics as a difficult subject and a lesson that is avoided which result in the ability of students to solve math problems.

Furthermore, the Industrial Revolution 4.0 emphasizes high-level abilities, so the learning which occurred should be able to hone high-level thinking skills (Hartono, 2018; Hartono, 2019). Students should develop critical thinking abilities since they will be able to be sensible and choose the best alternative options for themselves (Zakiah & Lestari, 2019). The results of Trends in International Mathematics and Science Studies (TIMSS) 2015, Indonesia is ranked 44 out of 49 participants with an

average score of 397 out of an average international score of 500. This shows the average ability of Indonesian students in the low category, especially high-level abilities, so high-level abilities need to be improved. One of the high-level abilities that need to be improved is the ability to think critically in mathematics.

The low critical thinking ability that occurs due to the learning model applied by the teacher does not involve students actively in finding and concluding themselves to solve the given mathematical problem, so that it has not allowed students to work in various ways and systematically. The teacher still puts students as objects in the learning process where the teacher explains the material using the lecturing method while the students only listen and pay attention. This makes students in learning mathematics only memorize formulas. In addition, the examples of math problems given by the teacher have not trained students in solving critical thinking skills. As results, students have been unable to solve the problems related to critical thinking skills. Critical thinking skills are already a student need, so educators must be able to develop critical thinking skills in students (Zakiah & Lestari, 2019). Improving students' mathematical critical thinking skills necessitates a learning model that promotes student participation in the learning process in order to develop critical thinking skills in students. Learning models provides opportunities for students to be actively involved in finding their own concepts, rules, theorems, patterns, formulas and so on so forth. For this reason, students are managed to save their memories of learning that kind of subject. In addition, the learning model can improve students' mathematical critical thinking skills. Learning environment that actively angage in the investigation of information and the application of knowledge will promote students' critical thinking skills (Peter, 2012).

The guided iscovery learnign model is a learning model that can help students enhance their mathematical critical thinking skills by allowing them to participate actively in the learning process in self-discovery. Learning using the guided discovery method will make students active in learning whose role is to find a concept with regular teacher guidance (Wahyu & Sutiarso, 2017). The guided discovery learning model is a model that gives students the freedom to develop their intellectual abilities through problem-posing, which is in the process of investigation until the conclusion of the student's problem is carried out under the guidance of the teacher. (Purwatiningsi, 2013) on her research stated that the application of the guided discovery method can improve student learning outcomes on the material of surface area and volume of blocks in the class of VIII SMP 12, Palu. Furthermore, (Karim & Maulida, 2014) supported that the guided discovery model is higher than the understanding of students' concepts using conventional learning.

Thereby, this present study is aimed to determine the effect of the Guided Discovery Learning Model on the Mathematical Critical Thinking Ability of secondary school's students.

Method

This study was a *Quasi Experimental research*. The research design was in the form of a Pretest-Posttest Control Group Design which is presented as follows (Sugiyono, 2015):

	KE	O_1	X_1	O_2
	KK	O_1	X_2	O_2

Information:

KE = Experimental class

KK = Control class

X1 = Treatment, namely the guided discovery learning model.

X2 = Control, namely direct learning model.

O1 = Pretest before the treatment of the guided discovery learning model.

O2 = Posttest after treatment of guided discovery learning model

O1 = Pretest before the direct learning model treatment

O2 = Posttest after direct learning model treatment

This research was conducted on the 8th grade students of SMP Negeri 9 Baubau, Southeast Sulawesi Province. The population of this study were all 8th grade students of SMP Negeri 9 Baubau which consisted of 5 classes. Sampling using purposive sampling technique by taking two parallel and homogeneous classes. This study was conducted by following these procedures below:

1) Arranging the research instruments such as student worksheets, scoring rubrics, Pretest and posttest Grids. These were used to measure mathematical critical thinking skills;
2) Validating the research instruments;
3) Estimating the reliability of the research instrument;
4) Revising of research instruments;
5) Giving a pretest;
6) Conducting teaching and learning process in classroom (as the treatment);
7) Giving posttest.

In this study, a mathematical critical thinking ability test was performed. T-test analysisi was used to examine the data. The researcher, however, administered the other test stages in terms of normality and homogenity as preliminary test before administering the *t-test*. A *t-test* was done when both classes were normally distributed and homogeneous.

Results and Discussion

The inferential statistical analysis began with a number of prerequisite tests including the normality test and the homogeneity of variance test. The normality test was conducted to asses whether the data were normally distributed or not, while the homogeneity of variance test was conducted to determine whether or not the variance of the population was homogeneous.

The Kolmogorov-Smirnov test was used to determine normality, and the Levene test was used to determine data homogeneity both with a significance level of = 0.05. The test criteria are as follow: H0 is accepted if *the p-value (Sig.) = 0.05*, else H0 is refused.

Table 1. Normality Test of Classroom Data Guided Discovery Learning Model (MPPT)

One-Sample Kolmogorov-Smirnov Test

		Pre_MPPT	Post_ MPPT	NGain_ MPPT
N		16	16	16
Normal Parameters[a,b]	Mean	35.75	59.94	0.4176
	Std. Deviation	17.786	24.534	0.27835
Most Extreme	Absolute	0.193	0.144	0.175
Differences	Positive	0.135	0.095	0.175
	Negative	-0.193	-0.144	-0.109
Test Statistic		0.193	0.144	0.175
Asymp. Sig. (2-tailed)		0.113	0.200	0.200

a. The test distribution is Normal.
b. Calculated from data.

Based on Table 1, it is found that the entire sample class value p-value = 0.05, then H0 is accepted. With the acceptance of H0, it can be concluded that the class data taught with the guided discovery learning model showsa normal distribution of data.

Table 2. Normality Test of Direct Learning Model Class Data (MPL)

One-Sample Kolmogorov-Smirnov Test

		Pre_MPL	Post_ MPL	NGain_ MPL
N		17	17	17
Normal Parameters[a,b]	Mean	22.00	33.00	0.1579
	Std. Deviation	15.957	22.672	.22096
Most Extreme	Absolute	0.147	0.167	0.196
Differences	Positive	0.147	0.167	0.196
	Negative	-0.130	-0.100	-0.145
Test Statistic		0.147	0.167	0.196
Asymp. Sig. (2-tailed)		0.200	0.200	0.081

a. Test distribution is Normal.
b. Calculated from data.

Based on Table 2, it is determined that the entire sample of class with the *p-value* ≥ α = 0.05, indicated that H0 is accepted. With the acceptance of H0, it can be concluded that direct learning model's class data follows a normal distribution.

Table 3.Test of Homogeneity of Variance for Each Class

Independent Samples Test

	Levene's Test for Equality of Variances	
	F	Sig.
Ngain	3.706	0.063

Table 3 demonstrated that each class has a p-value of 0.063 = 0.05, indicating that H0 is acceptable. With H0 accepted, it may be stated that the two classes shows a homogeneous variance.

Table 4 Results of t-test The Effect of Guided Discovery Learning Model on Mathematical Critical Thinking Ability

One-Sample Test

	Test Value = 35.75					
			Sig. (2-	Mean	95% Confidence Interval of the Difference	
	t	df	tailed)	Difference	Lower	Upper
Post_Eks	3.943	15	0.001	24.188	11.11	37.26

The value *of t_count=3.943>t_table=1.740* with *(sig.)/2=0.0005< =0.05* is found in Table 4, hence H0 is rejected. With the rejection of H0, it can be stated that the guided discovery learning model improves students' mathematical critical thinking skills significantly.

Table 5 Results of the t-test The Effect of Direct Learning Model on Mathematical Critical Thinking Ability

One-Sample Test

	Test Value = 22					
					95% Confidence Interval of the Difference	
			Sig. (2-	Mean		
	T	df	tailed)	Difference	Lower	Upper
Post_Ktrl	2.000	16	0.063	11.000	-0.66	22.66

Table 5 shows that *t count=2.000> t table=1.746 with (sig.)/2=0.0315< =0.05*,indocated that H0 is rejected. With the rejection of H0, it can be concluded that the direct learning model has a significant effect in improving the students' mathematical critical thinking skills.

Table 6 The effect of increasing the Guided Discovery Learning Model rather than the Direct Learning Model on Students' Mathematical Critical Thinking Ability

Independent Samples Test

		t-test for Equality of Means			
		T	df	Sig. (2-tailed)	Mean Difference
Ngain	Equal variances assumed	2.977	31	0.006	0.25962
	Equal variances not assumed	2.956	28.628	0.006	0.25962

H0 is rejected based on Tables 6's value of *t count=2,977>t table =1,692 with (sig.)/2=0.003< =0.05*. With the rejection oh H0, it can be concluded that the guided discovery learning model has a

much greater impact in improving students' mathematical critical thinking skills than direct learning model.

Table 7. The Results of Students' Mathematical Critical Thinking Ability in Each Aspect

Aspek	Model Penemuan Terbimbing			Model Pembelajaran Langsung		
	Pretest **(%)**	***Posttest*** **(%)**	**Peningkatan (%)**	***Pretest*** **(%)**	***Posttest*** **(%)**	**Peningkatan (%)**
Trigger Event	74.38	89.38	15	56.76	66.47	9.71
Eksplorasi	68.44	83.13	14.69	52.06	61.18	9.12
Analisis	62.19	76.88	14.69	46.76	56.18	9.42
Klarifikasi	55.94	70.63	14.69	40.88	50.29	9.41
Resolusi	49.69	64.38	14.69	35.29	45.59	10.3

Table 7 demonstrated that students' mathematical critical thinking skills have improved in all aspects. In general, both classes experienced an increase in every aspect of mathematical critical thinking skills, but the class taught with the guided discovery learning model experienced an increase in every aspect of mathematical critical thinking ability which higher than the class taught with the direct learning model.

The guided discovery learning model outperforms the direct learning paradigm in terms of improving students' mathematical critical thinking skills. Through idea discorey activities and active student participation,the guided discovery model stresses the development of students' critical thinking skills. While the learning process in school is still teacher-centered, pupils are still passive participant in learning process. As a result, students in learning mathematics only memorize the concepts given by the teacher and have an impact on the lack of ability in mathematics subjects in this case developing mathematical critical thinking skills. It can be seen from the results of the study that the mathematical critical thinking ability of students who are taught by direct learning model is lower than students who are taught by guided discovery learning model.

In order to enhance students' mathematical critical thinking skills, a student-centered learning approach is required, in which students actively seek out and solve mathematical problems in order to build their critical thinking skills. Students' mathematical sritical thinking skill can be developed using a guided discovery learning model. The guided discovery learning model is intended to help students improve their skills, specifically their capacity to think critically about mathematics.

In guided discovery learning, the teacher directs students by providing problems related to cubes and blocks in the context of everyday life so that the concepts learned are easy to understand. After students accept the topic presented by the teacher, then students form study groups, students make observations, collect, test, and analyze data, investigate relationships and ask questions and test hypotheses from the problems presented in the LKS in each group. The topics presented in the worksheets are adapted to authentic and meaningful problem situations so that students can make discoveries. After that, one group presented the results obtained as a result of the concepts found and formed, while the other group listened and gave responses (Hayati & Dwina, 2019). Pupils who learn through the guided discovery model have a greater knowledge of mathematical concepts than students who learn through conventional method.

Students' willingness and drive to learn mathematics can be improved by group discoveries, so that students do not have to recall formulas when learning mathematics.The teacher provides help to groups of students who are having problems understanding the content presented by the teacher through student discussion activities. With this guidance, students are expected to be able to gain a better understanding of the mathematical concepts they are learning and are also expected to be a good solution. In the learning process with the teacher-guided discovery method allow students to find their own information in the form of a concept, principle or theorem (Mardati, 2018). After the concept is found and formed, the teacher can provide feedback related to the problem solving process and results obtained in the form of critical thinking skills practice questions to further instill the mathematical concepts learned. During the guided discovery learning process, students are highly motivated to learn mathematics because they feel trained to solve a problem on their own even though there is still guidance from the teacher. The results obtained from guided discovery learning with a contextual approach showed an increase in student activity at each meeting (Arynda, Susanto, 2012).

The process of implementing mathematics learning with the guided discovery model is as expected. Students who study with the guided discovery model make observations, investigate and make conclusions in finding concepts. Students' understanding of concepts is more significant when they go through a cognitive process to find them. . Mathematical critical thinking is a mental activity in the field of mathematics in which It is carried out using the steps in the scientific method (Abdullah, 2013). Students were still perplexed and having difficulty at the start of guided discovery learning because the teacher had previously presented the content to be studied and given examples of questions and their solutions, resulting in students memirizing mathematics.

According to the study's findings, pipils' mathematical critical thinking skills improved in every area. Students whoare thought using guided discovery modelhave a higher gain in mathematical critical thinking skills than studentd who are thaught using the direct learning model. This deminstrated taht the guided discovery learning model is preferable to the direct learning model for strengthening students' mathematical critical thinking skill. This is in accordance with the results of research conducted (Jumhariyani, 2016) that there is an interaction impact between learning methods and students' critical thinking skills towards mathematics. In line with this, (Saragih & Afriati, 2012), students who receive learning using a guided discovery approach assisted by Autograph software have a significantly better increased understanding of concepts when compared to students who receive learning using the usual approach.

Conclusion

Based on the findings of the study and the discussion that follows, it can be concluded that: (1) the guided discovery learning model has a significant effect better than the direct learning model in improving the students' mathematical critical thinking skills; (2) there is an increase in every aspect of mathematical critical thinking skills in the both of experiment classrooms, however, the class taught with the guided discovery learning model experienced an increase in every aspect of mathematical critical thinking ability which is higher than the class taught with the direct learning model.

Acknowledgement

I would like to express my gratitude to Mr. Afudin La Arua, M.Pd, for his contributions to the writing of this paper until it could be published and valuable tp a large number of individuals. I would also like to express my gratitude to SMP Negeri 9Baubau for granting me permission to conduct this study.

References

Abdullah, I. H. (2013). Berpikir Kritis Matematik. *Delta-Pi: Jurnal Matematika Dan Pendidikan Matematika*, *2*(1), 66–75.

Arynda, Susanto, D. (2012). Penerapan Metode Penemuan Terbimbing dengan Pendekatan Kontekstual dalam Meningkatkan Hasil Belajar Siswa pada Materi Aritmetika Sosial. *Kadikma*, *3*(3), 123–132.

Hartono, S. (2018). Original Paper Using Project Based Learning (PBL) Design to Expand Mathematics Students' Understanding: A Case Study in Statistics Problem. *Global Research in Higher Education*, 1, 98-104.

Hartono, S. (2019). Using Photomath Learning to Teach 21st Century Mathematics Skills: A case Study in Two-variable Linear Equation Problem. *4thICERD*, 296.

Hartono, S. (2020). Effectiveness of Geometer's Sketchpad Learning in Two-Dimensional Shapes. *Editorial from Bronisław Czarnocha*, 84.

Hayati, N., & Dwina, F. (2019). Pengaruh Model Pembelajaran Penemuan Terbimbing Terhadap Pemahaman Konsep Matematis Pseserta Didik Kelas VIII SMPN 23 Padang. *Jurnal Edukasi Dan Penelitian Matematika*, *8*(4), 53–58.

Jumhariyani, J. (2016). Pengaruh Metode Penemuan Terbimbing Dan Kemampuan Berpikir Kritis Terhadap Kemampuan Matematika Siswa Kelas Iv Sd Sekecamatan Setiabudi Jakarta Selatan. *Jurnal Pendidikan Dasar*, *7*(1), 62. https://doi.org/10.21009/jpd.071.06

Karim, K., & Maulida, T. (2014). Pengaruh Model Penemuan Terbimbing terhadap Pemahaman Konsep Matematika Siswa Kelas VIII SMP. *EDU-MAT: Jurnal Pendidikan Matematika*, *2*(1), 62–69. https://doi.org/10.20527/edumat.v2i1.605

Kurniawan, A. P., & Hartono, S. (2020). The Effect of Learning Style on Academic Achievement of Prospective Teachers in Mathematics Education. *Journal of Mathematical Pedagogy (JoMP)*, 2(1).

Mardati, A. (2018). Pendekatan Penemuan Terbimbing dalam Pembelajaran Matematika untuk Menghadapi Tantangan Abad 21. *Universitas Muhammadiyah Surakarta*, 183–192.

Peter, E. E. (2012). Critical thinking : Essence for teaching mathematics and mathematics problem solving skills. *African Journal of Mathematics and Computer Science Research*, *5*(3), 39–43. https://doi.org/10.5897/AJMCSR11.161

Purwatiningsi, S. (2013). Penerapan metode penemuan terbimbing untuk meningkatkan hasil belajar siswa pada materi luas permukaan dan volume balok. *Elektronik Pendidikan Matematika Tadulako*, *01*(1), 55–65.

Saragih, S., & Afriati, V. (2012). Peningkatan Pemahaman Konsep Grafik Fungsi Trigonometri Siswa SMK Melalui Penemuan Terbimbing Berbantuan Software Autograph. *Jurnal Pendidikan Dan Kebudayaan*, *18*(4), 368–381.

Siswono, T. Y. E., Kohar, A. W., Kurniasari, I., & Hartono, S. (2016, November). Inconsistency Between Beliefs, Knowledge and Teaching Practice Regarding Mathematical Problem Solving: A Case Study of a Primary Teacher. In *proceeding of the 4th international symposium on mathematics education innovation* (p. 54).

Sugiyono. (2015). *Metode Penelitian Pendidikan*. Bandung: Alfabeta.

Wahyu, M. N., & Sutiarso, S. (2017). Peran Model Pembelajaran Penemuan Terbimbing dalam Meningkatkan Kemampuan Berpikir Analitis Siswa SMK. *Seminar Nasional Matematika Dan Pendidikan Matematika 2017 UIN Raden Intan Lampung*, 95–100.