The influence of guided inquiry learning model on mathematical critical thinking ability viewed from student's mathematical prior abilities

by Kartin Usman

Submission date: 28-Jun-2023 03:00PM (UTC+0800)
Submission ID: 2123841854
File name: 040047_1_5.0126172.pdf (483.74K)
Word count: 3364
Character count: 18347

RESEARCH ARTICLE | JUNE 16 2023

The influence of guided inquiry learning model on mathematical critical thinking ability viewed from student's mathematical prior abilities FREE

Fiqi Garibaldi Umar; Nurhayati Abbas; Tedy Machmud ✉; Kartin Usman; Abdul Wahab Abdullah

AIP Conference Proceedings 2614, 040047 (2023)
https://doi.org/10.1063/5.0126172

The Influence of Guided Inquiry Learning Model on Mathematical Critical Thinking Ability Viewed from Student's Mathematical Prior Abilities

Fiqi Garibaldi Umar[1], Nurhayati Abbas[2], Tedy Machmud[2, a)], Kartin Usman[2] and Abdul Wahab Abdullah[2]

[1]*Postgraduate Students, Universitas Negeri Gorontalo, Gorontalo, Indonesia*
[2]*Faculty of Mathematics and Science, Universitas Negeri Gorontalo, Gorontalo, Indonesia*

[a)] Corresponding author: tedy_m@ung.ac.id

Abstract: The purpose of this research is to determine the effect of the guided inquiry learning model on mathematical critical thinking skills of student's mathematical prior abilities. This research is an experimental study that using a treatment by level research design. The research data was obtained through a test instrument for students' mathematical critical thinking skills on the material of Arithmetic and Geometry sequences and series in the form of an essay test, and a student's mathematical prior abilities test in the form of a multiple choice test. The results showed that: (1) The mathematical critical thinking ability of students who were taught using the guided inquiry learning model was higher than the direct learning model; (2) There is an interaction effect between learning models and mathematical prior abilities on students' mathematical critical thinking abilities; (3) The mathematical critical thinking ability of students who have high mathematical prior abilities taught by the Guided Inquiry learning model is higher than the direct learning model; (4) The mathematical critical thinking ability of students who have low mathematical prior abilities taught by the Guided Inquiry learning model is lower than the direct learning model.

Keywords: *Mathematical Critical Thinking Ability, Guided Inquiry, Mathematical Prior Abilities*

INTRODUCTION

One of the focuses of the objectives of learning mathematics in the 2013 Curriculum is to develop students' abilities in understanding mathematical concepts, explaining the interrelationships between concepts, and using concepts or algorithms in a flexible, accurate, efficient and precise way in solving problems. Based on the demands of the curriculum [1], students are expected to be actively involved in the learning process through 4C activities (Communication, Collaboration, Critical Thinking and Problem Solving, Creativity and Innovation).

Based on the results of observations in class, there are still many students who have not mastered the 4C skills, especially critical thinking skills. In accordance with the results of interviews with several teachers that students have not been able to solve a variety of questions, which require critical thinking skills. Most of them only rely on sample questions, if they are given daily assignments or tests and the questions are different from exercises, then these students have difficulty, especially for HOTS (Higher Order Thinking Skills) questions, which really require critical thinking skills. Critical thinking is reasoning and reflective thinking with an emphasis on making decisions about what to believe and do. To become reasonable reflective thinkers, students must be able to evaluate sources and arguments and ask informed questions [2],[3].

In addition, the results of interviews with several teachers, students' critical thinking skills in learning have not been developed. Learning in schools mostly emphasizes lower-order thinking skills. Students are only required to absorb information passively and then remember it when taking the test. This has an impact on the relatively low score

The 8th International Conference on Mathematics, Science and Education 2021
AIP Conf. Proc. 2614, 040047-1–040047-5; https://doi.org/10.1063/5.0126172
Published by AIP Publishing. 978-0-7354-4549-9/$30.00

of student learning outcomes. This is because the learning process carried out in schools emphasizes more on aspects of knowledge and understanding, while aspects of application, analysis, synthesis, and evaluation are only a small part of the learning carried out. This kind of learning does not give students the experience of practicing critical thinking skills. Learning that does not emphasize efforts to develop critical thinking skills conditions students into rote learning, so that learning becomes less meaningful and students easily forget the material that has been taught previously. Therefore, a learning model is needed that can stimulate students' critical thinking power through the problems that exist around them. Models that provide broad opportunities for students to think, propose conjectures through contextual problems, see patterns through modeling and draw conclusions from mathematical statements. The model is not only used to be able to realize a good teaching and learning process, but can provide an experience for students to be able to find mathematical concepts for themselves so that these concepts are not easily forgotten by the students themselves. The model in question is a guided inquiry learning model. Guided inquiry learning model is a learning model that gives students the opportunity to discover their own knowledge and play an active role in learning so that they are able to understand concepts well and develop critical thinking skills. [4]

Based on the problems mentioned above, the researcher will examine the influence of guided inquiry learning model on mathematical critical thinking ability viewed from student's mathematical prior abilities. The problems to be addressed are:

1. to find out the difference between students' mathematical critical thinking skills taught by guided inquiry models and direct learning models;
2. to determine the effect of the interaction between the guided inquiry learning model and prior mathematical abilities on students' mathematical critical thinking skills;
3. to determine the difference between students' mathematical critical thinking skills who are taught by guided inquiry models and direct learning to students who have high prior mathematical abilities;
4. to determine the difference between students' mathematical critical thinking skills who are taught by guided inquiry model and direct learning to students who have low prior mathematical abilities.

METHODS

This research was conducted at a Vocational High School in the odd semester of the 2020-2021 academic year. This research is a quasi-experimental research, which is treatment-by-level experiments. The population is all Vocational High School students.

In the experimental group, Guided Inquiry was applied, while in the control group, a direct learning model was applied. The main variable is the ability to think critically mathematically obtained through a description test, while the sorting is seen from the moderator variable, which is the mathematical prior abilities obtained through a multiple choice test. Categorization of mathematical prior abilities at the beginning of learning, using the following criteria:

High mathematical prior abilities:	$MPA \geq \bar{x} + SD$
Moderate mathematical prior abilities:	$\bar{x} - SD \leq MPA < \bar{x} + SD$
Low mathematical prior abilities:	$MPA < \bar{x} - SD$

where $\bar{x}$ is the average value of the mathematical prior abilities score and SD is the standard deviation [5].

The analysis technique used in this research is descriptive analysis technique and inferential analysis. For the purposes of testing the hypothesis, a two-way analysis of variance (ANOVA 2 x 2) was used. The analysis of variance used in this test is the F-Test.

RESULTS AND DISCUSSION

The results of the study are summarized in the form of a recap of the statistical size of the data as shown in table 1, while the summary of Anova 2 lines and the Tukey test can be seen in table 2 and table 3.

TABLE 1. Description of Mathematical Critical Thinking Ability Data

Data	*N*	Min	Max	Mean	Modus	Median	Std Dev	Variance
A_1	64	82	174	146,90	162,33	149,85	17,38	302,06
A_2	64	104	157	135,625	140,3	136,89	10,47	109,62
A_1B_1	18	136	174	156,389	165,21	157,5	10,94	119,68
A_1B_2	22	82	150	131,14	126,3	133,3	14,64	214,33
A_2B_1	27	104	157	134,67	135	135	11,02	121,44
A_2B_2	16	104	148	129,375	135,64	130,5	10,84	117,51

TABLE 2. Results of ANOVA Calculation of Mathematical Critical Thinking Ability Data

Variance source	Number of Squares	Degrees of freedom	Average Sum of Squares	F_{count}	F_{table} $\alpha = 0,05$
Between Learning Models	909.7003	1	909.7003	5.66	3.96
Between Prior Ability	3155.29	1	3155.29	19.63	3.96
Between Learning Models and Prior Ability	3181.7	1	3181.7	19.79	3.96
In	13363.22	79	160.77	-	-
Total	16340.17	82	3146.11		

TABLE 3. Tukey's Test Calculation Results

No	Group	T_{count}	$t_{table\ (0.01)}$	$t_{table\ (0.01)}$	Conclution
1	A1B1 with A2B1	4.997	2.704	2.021	Significant
2	A1B2 with A2B1	0.659	2.704	2.021	Not Significant

The Differences in the Ability to Think Critically Mathematically from Students Who Are Taught Using the Guided Inquiry Learning Model and Students Who Are Taught Using the Direct Learning Model

The results of testing the first hypothesis indicate that there is an influence of guided inquiry learning models and direct learning models on mathematical critical thinking skills. By using the two-way ANOVA test, it shows that the average score of mathematical critical thinking skills in students taught by the guided inquiry learning model is higher than the direct learning model.

During learning using guided inquiry, there are elements of metacognitive learning where the learning directs students to improve the learning and thinking process through the guidance of the teacher. This guidance is carried out by providing metacognitive questions or instructions in the learning instructions to direct students to the final conclusion. The teacher designs discovery activities that will be carried out by students so that students are trained to collect facts from various sources so that the concept of a material that has been obtained will last a long time in memory. The guided inquiry learning model is a learning pattern through the stages of discovery or investigation by students, by carrying out activities to understand the problem, design or carry out an activity with their own abilities and knowledge, and look for various supporting evidence to build concepts from the findings during learning cannot be separated from teacher guidance [6].

While the direct learning model is a model that emphasizes the process of delivering material in one direction, where teachers dominate learning activities, teachers control all lesson flows by conveying information and demonstrating the completion of a problem. While students are not involved much, as a result students will lose attention after a few minutes of learning and will remember little of the content of the material presented, students believe that the teacher will tell them everything they need to know. This will eliminate the sense of responsibility and curiosity about the learning.

The Influence of Interaction Between Learning Models and Students' Prior Ability on Mathematical Critical Thinking

The results of testing the second hypothesis indicate that there is an interaction effect between the learning model and prior abilities on students' mathematical critical thinking skills. This happens because the selection of the right learning model will greatly affect the achievement of learning objectives, while students' mathematical critical thinking skills on the material being studied also influence it. There are several things that make learning attractive,

which is the subject itself and the second is how to package and teach teachers [7]. By creating a comfortable learning atmosphere, it allows students to be able to focus more on what is being studied, especially in learning mathematics. The Guided Inquiry learning model is a teaching model that emphasizes the concept discovery process and the relationship between concepts where students follow experimental procedures so that the role of students is more dominant, while the teacher guides students in the right direction. Students who have high prior abilities will greatly assist students in the learning process. With good prior abilities, students can direct and more quickly catch what the teacher says in carrying out learning activities. In learning activities, prior ability can be said as the basis possessed by students in participating in learning activities. The prior ability of students is an ability that has been possessed before learning takes place which is a prerequisite for following the next learning process [8]. The prior ability possessed by students in mathematics subjects that the teacher knows before starting learning is very useful to find out whether students have the prerequisite knowledge to take part in learning and the extent to which students already know the material to be presented, so that teachers can design better learning.

The direct learning model of the teacher explains the material and conducts guided training and provides opportunities for students to conduct independent training so that students can find real experience about a material or theory. This model is a teaching approach that is specifically designed to support student learning processes related to well-structured declarative knowledge and procedural knowledge that can be taught with a gradual, step-by-step pattern of activities so as to achieve learning objectives.

The Students Who Have High Prior Ability, Mathematical Critical Thinking of Students taught by the Guided Inquiry Learning Model is higher than the direct learning model

Based on the findings in the study, it was shown that students who had high prior abilities were very suitable to be taught using the Guided Inquiry learning model in developing their mathematics learning experience.

Learning with the guided inquiry learning model, is a learning model that focuses on the discovery process. When faced with questions, students can perform critical thinking skills to connect concepts. Not only by memorizing without thinking, critical thinking skills expand the thinking process. The advantage of applying the guided inquiry model is that it is one of the teaching models designed to teach concepts and the relationship between concepts. When using this learning model, the teacher presents examples to students, guides them as they try to find patterns in the examples and provides a kind of closing when students have been able to describe the ideas taught by the teacher. So that it can encourage students to believe that they can solve problems, both independently and with support from others in the class.

One of the things that affect students' ability to think critically is their prior ability to learn. Students who have high prior abilities will be able to direct and maintain perseverance in carrying out learning activities. This is in line with [9] which states that students who have prior abilities strong enough to be involved in learning will choose tasks according to their abilities, and immediately start activities when given the opportunity, and exert intensive effort and concentration in the implementation of learning tasks.

In learning activities, prior abilities can be said to be the basis or foundation in students so that it is very easy for these students to receive lessons from the teacher. In other words, for groups of students who have high prior abilities and good mathematical critical thinking skills and are taught using the guided inquiry learning model, their learning outcomes will be higher when compared to the direct learning model. Thus, students' mathematical critical thinking skills with the guided inquiry learning model will be better when compared to students who are taught with direct learning models for students who have high learning motivation.

For Students Who Have Low Prior Ability, the Mathematical Critical Thinking of Students Who are Taught Using the Guided Inquiry Learning Model is Lower Than the Direct Learning Model

Based on the results of data analysis, it was found that the average score of students' mathematical critical thinking skills who had low prior abilities and were taught by the guided learning model ($\bar{Y}$A1B2) was 131.14 higher than those taught by the direct learning model ($\bar{Y}$A2B2) of 129.375. These results indicate that the mathematical critical thinking ability of students who have low prior abilities taught by the guided inquiry learning model are still higher than those taught by direct learning. In this case, the researcher's hypothesis which states that the mathematical critical thinking ability of students who have low prior abilities who are taught using the guided inquiry learning model is lower than the direct learning model is not proven.

This is because the prior ability is only one of the factors in students that affect their achievement in learning. This factor does not necessarily contribute to learning outcomes and students' ability to solve mathematical problems, but there are other factors that can also contribute to student achievement including learning models, learning environments, student activities, learning activities and student motivation. The same thing was also expressed in his research related to the factors that influence student success in learning, he stated that in the learning process, many factors influenced it, including prior abilities, attitudes, interests, study habits, and self-concept. For this reason, further research is needed related to the mathematical critical thinking skills of students who are taught using the guided inquiry learning model when viewed from these other factors.

One of the other factors that cause the mathematical critical thinking skills taught by the guided inquiry model to be higher than the direct learning model for students who have low prior abilities is the use of Learning Instructions (LI) in the learning process. Making LI that has been made following the syntax of the guided inquiry learning model was able to stimulate students' critical thinking skills not only in groups of students who have high prior abilities, but also groups of students who have low prior abilities.

With the application of the Guided Inquiry learning model which is a learning model that is able to increase student activity which of course can affect the students' prior abilities, it can improve the learning outcomes of students who have high prior abilities and those who have low prior abilities. As opinion [11] which states that guided inquiry learning is learning that provides the widest opportunity for students to express opinions in generating ideas, by ending criticism and assessment until new concepts are created. This model emphasizes the interaction of students in groups to find the best solution from the various solutions found when analyzing the given problem. So, with this model students will be more accustomed to interacting and of course can be motivated to be better in their groups and in the learning process. Thus the mathematical critical thinking ability of students who have low prior abilities who are taught with the guided inquiry learning model is lower than the direct learning model.

CONCLUSION

Based on the research results and the results of hypothesis testing and discussion as described above, the researchers conclude that (1) The Guided Inquiry Learning Model is superior to the Direct Learning Model in improving students' mathematical critical thinking skills in arithmetic and geometric sequences and series for students who have high prior mathematical abilities; and (2) Although the researchers suspect that students' mathematical critical thinking skills taught by the Guided Inquiry learning model are lower than the direct learning model on arithmetic and geometric sequences and series for students who have low prior abilities, but the results in the field, what happens on the contrary, the guided inquiry learning model is superior to the direct learning model for students who have low prior abilities.

REFERENCES

1. Depdikbud, Konsep dan Implementasi Kurikulum 2013, Paparan Wakil Menteri Pendidikan dan Kebudayaan R.I Bidang Pendidikan, (2014)
2. R. H. Ennis, Informal Log, **18** (2 & 3), (1996).
3. J. Mclaughlin, *How to Think Critically: A Concise Guide* (Broadview Press, Ontario, 2014).
4. I. D. Masitoh, Marjono, and J. Ariyanto. J Bioedukasi, **10** (1), (2017).
5. T. Machmud, "Peningkatan Kemampuan Komunikasih, Pemecahan Masalah Matematis Dan Self-Efficacy Siswa SMP Melalui Pendekatan Problem-Centered Learning Dengan Strategi Scaffolding" Ph.D. thesis, Universitas Pendidikan Indonesia, 2013.
6. Isrok'atun., and A Rosmala, *Model-Model Pembelajaran Matematika*. (PT Bumi Aksara, Jakarta, 2018).
7. L. Lambertus and H. Hijayah, J Pendidik Mat, **3** (2), 175-186 (2012).
8. F. Razak, J Mosharafa, **6** (1), (2017).
9. Fakhrah, JESBIO J Eduk Sains Biol, **4** (2), (2015).
10. A. A. Rizqi, dkk., J Published. FKIP Universitas Lampung, (2018)
11. C. C. Kuhlthau, L. K. Maniotes., dan Ann. K. Caspari. *Guided Inquiry Learning In The 21th Century*, (Libraries Unlimited, London, 2007)

The influence of guided inquiry learning model on mathematical critical thinking ability viewed from student's mathematical prior abilities

ORIGINALITY REPORT

13%	7%	5%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.iosrjournals.org Internet Source	1%
2	A P Yuniarti, I Pramudya, I Slamet. "Analysis of mathematic creative thinking skill with the material of matrix", Journal of Physics: Conference Series, 2021 Publication	1%
3	journal.upgris.ac.id Internet Source	1%
4	Submitted to UIN Sunan Gunung DJati Bandung Student Paper	1%
5	Submitted to Universitas Ibn Khaldun Student Paper	1%
6	Yuliarti Yuliarti, Sarwiji Suwandi, Andayani Andayani, Sumarwati Sumarwati. "Learning Model Inquiry-Based Local Wisdom Dilemmas Stories and Their Effects on Critical Thinking	1%

	and Scientific Writing Abilities", International Journal of Learning, Teaching and Educational Research, 2023 Publication	
7	Submitted to American College of Education Student Paper	1 %
8	buenvivir.us Internet Source	1 %
9	jurnal.fkip.untad.ac.id Internet Source	1 %
10	Submitted to The University of Manchester Student Paper	<1 %
11	Tutik S. Wahyuni, Rizki N. Analita. "Guided–inquiry laboratory experiments to improve students' analytical thinking skills", AIP Publishing, 2017 Publication	<1 %
12	ejurnal.ung.ac.id Internet Source	<1 %
13	jurnal.ustjogja.ac.id Internet Source	<1 %
14	Submitted to Universitas Khairun Student Paper	<1 %
15	text-id.123dok.com Internet Source	<1 %

16	Janet Hill, John Orr, Nicholas Dunne. "In vitro study investigating the mechanical properties of acrylic bone cement containing calcium carbonate nanoparticles", Journal of Materials Science: Materials in Medicine, 2008 Publication	<1 %
17	R Y Purwoko, E P Astuti, M S Arti, Y Widiyono. "Batik Nusantara Pattern In Design Of Mathematical Learning Model For Elementary School", Journal of Physics: Conference Series, 2019 Publication	<1 %
18	nova.newcastle.edu.au Internet Source	<1 %
19	Submitted to UIN Raden Intan Lampung Student Paper	<1 %
20	Submitted to Universitas Negeri Surabaya The State University of Surabaya Student Paper	<1 %
21	eprints.unm.ac.id Internet Source	<1 %
22	www.valenzuela.gov.ph Internet Source	<1 %
23	Karel Kroeze, Stephanie Van den Berg, Bernard Veldkamp, Ton de Jong. "Automated Assessment of and Feedback on Concept	<1 %

Maps during Inquiry Learning", IEEE Transactions on Learning Technologies, 2021
Publication

24	eprints.umk.ac.id Internet Source	<1%
25	repository.upi.edu Internet Source	<1%
26	Adi Nurjaman, Indah Puspita Sari. "THE EFFECT OF PROBLEM POSING APPROACH TOWARDS STUDENTS' MATHEMATICAL DISPOSITION, CRITICAL & CREATIVE THINKING ABILITY BASED ON SCHOOL LEVEL", Infinity Journal, 2017 Publication	<1%
27	D Hidayat, E Nurlaelah, J A Dahlan. "Rigorous Mathematical Thinking Approach to Enhance Students' Mathematical Creative and Critical Thinking Abilities", Journal of Physics: Conference Series, 2017 Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		

The influence of guided inquiry learning model on mathematical critical thinking ability viewed from student's mathematical prior abilities

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6