Analysis of Students' Critical Thinking Abilty and Mathematical Understanding

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Abstrak

Pendidikan merupakan hal yang sangat penting sebagai upaya untuk meningkatkan kualitas sumber daya manusia. Kemampuan berpikir kritis mendasari kemampuan berpikir tingkat tinggi termasuk di dalamnya berpikir kreatif pemecahan masalah dan pengambilan Keputusan sehingga wajib dikuasai terlebih dahulu. Kemampuan pemahaman matematis adalah kemampuan peserta didik yang dapat memahami suatu konsep dengan baik. Tujuan Penelitian ini adalah untuk menganalisis kemampuan berpikir kritis dan pemahaman matematis siswa dalam menyelesaikan soal system persamaan linear dua variable (SPLDV). Penelitian ini dilaksanakan di MTS EX PGA UNIVA dengan menggunakan metode adalah metode deskriptif kualitatif. Teknik pengumpulan data yang digunakan dalam penelitian ini yaitu Teknik tes dan non tes. Instrumen penelitian meliputi instrument tes : kemampuan awal matematis, kemampuan berpikir kritis, intrumen tes pemahaman matematis, dan pedoman wawancara. Hasil Penelitian menunjukkan adanya interaksi berkelanjutan antar guru dan siswa, secara data hasil nilai yang diperoleh siswa pada test awal mengalami peningatan setelah siswa di mendapatkan pembelajaran dengan model pemahaman matematis siswa, dimana nilai awal siswa sebelum melakukan pendekatan ini, nilai rata-rata siswa hanya 69,42 setelah melakukan pendekatan model pembelajaran pemahaman matematis siswa meningkat menjadi 80,76,berarti bahwa Model pembelajaran Pemahaman matematis siswa berpengaruh terhadap terhadap kemampuan berpikir kritis siswa.

Kata Kunci: Analisis Berpikir, Pemahaman matematis siswa

Abstract

Education is very important as an effort to improve the quality of human resources. Critical thinking skills lie beneath high-level thinking skills, including creative thinking, problem solving and decision making, so they must be mastered first. Mathematical understanding ability is the ability of students to understand a concept well. The aim of this research is to analyze students' critical thinking skills and mathematical understanding in solving two-variable linear equation systems (SPLDV) problems. This research was carried out at MTS EX PGA UNIVA using a qualitative descriptive method. The data collection techniques used

in this research are test and non-test techniques. Research instruments include test instruments: initial mathematical abilities, critical thinking abilities, mathematical understanding test instruments, and interview guidelines. The research results show that there is continuous interaction between teachers and students, in terms of data, the scores obtained by students in the initial test experience an increase after students receive learning using a model of student mathematical understanding, where the initial score of students before taking this approach, the average score of students was only 69 .42 after taking the learning model approach to students' mathematical understanding increased to 80.76, meaning that the learning model for students' mathematical understanding had an effect on students' critical thinking abilities.
Keywords: Thinking Analysis, Students' mathematical understanding

Introduction (10%)

Education is very important as an effort to improve the quality of human resources. Through education, humans can be educated, trained and develop their potential. The rapidly developing science and technology today requires humans to have expertise and skills that are in accordance with needs and demands of the times.

The process of learning mathematics in schools is expected to equip students with logical and critical thinking skills in solving problems related to everyday life (Early and Winarti). Critical thinking skills are a person's ability to solve a problem, both simple and complex, both in lessons and in everyday life. Critical thinking skills according to Stobaugh (in Azizah 2020, p. 62) that critical thinking is a deep reflection in making a decision and solving problems to analyze situations, evaluate arguments, and draw conclusions. Critical thinking skills underlie high-level thinking skills including creative thinking, problem solving and decision making so that they must be mastered first (Hasnunidah, 2012; Afriansyah, 2021). Critical thinking skills are very much needed by students because this ability helps students solve a problem. Students who are able to develop critical thinking skills will find it easier to solve the problems given (Syafruddin & Pujiastuti, 2020)

In teaching students with their thinking skills, it is very necessary to hone them as well as possible. Starting from the habit of low-level thinking such as memorizing, applying formulas, and others, students must be taught and accustomed further to be able to use their high-level thinking skills (Ahmadi). A critical thinker is able to analyze and evaluate every piece of information they receive (Nurhayati et al). To understand mathematical topics, students are expected to be able to have mathematical skills that will help them overcome global challenges. What is meant by mathematical ability is the ability that students need to have, so that they can develop the mathematical knowledge that students have (Yani et; 2019).

Mathematical understanding is a very important mathematical ability that students must have when learning mathematics. Lestari & Yudhanegara (Ridha & Afriansyah, 2019, p. 516) mathematical understanding ability is an individual's ability to absorb and understand mathematical ideas. Septriani (Njatlama et al,. 2020, p. 14) mathematical understanding ability is the ability of students who can understand a lesson material, in mathematics lessons, with the results of forming their own thoughts and can restate it in another form that is easy to understand and can apply. Mathematical understanding ability is the ability of students to: a) explain concepts, which can be interpreted as students being able to restate what has been communicated; b) use concepts in various different situations; c) develop several consequences of the existence of a concept which can be interpreted as students understanding that there is a concept as a result students are able to have the ability to

solve problems correctly Duffin & Simpson (Njatlama et al,. 2020).

The purpose of this study is to analyze students' critical thinking skills and mathematical understanding in solving problems on systems of linear equations in two variables (SPLDV).

Method (15%)

This research was conducted at MTs EX PGA UNIVA Medan located at Jl. Sisingamangaraja km 5.5 UNIVA Harjosari I Complex, Medan Amplas District, Medan City. This research will be conducted in class VIII of the academic year 20 23 -202 4

The data collection techniques used in this study are test and non-test techniques. Test techniques are used to see students' critical thinking skills and mathematical understanding in solving problems, while non-test techniques are used to use interview methods to obtain data credibility.

Research Instruments

The instruments used in this study are divided into main instruments and supporting instruments. The main instrument is the researcher himself, where the researcher is the planner, data collector, data interpreter, and reporter of research results. However, in collecting data, the researcher is assisted by supporting instruments, namely: test instruments (1) initial mathematical abilities (2) critical thinking skills (3) mathematical understanding test instruments, and (4) interview guidelines.

Critical Thinking Ability Test Instrument

Critical thinking ability test instrument in the form of a descriptive test that aims to determine the extent of students' critical thinking abilities. The test is conducted after mathematics learning using a conventional model to determine students' critical thinking abilities. The volume of this test is the material presented in the learning process, namely the two-variable linear equation system. The critical thinking ability test question grid is shown in the following table:

Critical thinking ability instrument grid

Critical Thinking Ability Indicators	No Question
Providing simple explanations (focusing questions, analyzing opinions, asking unclear questions and answering problems)	1
Forming skills base (consider source Which relevant And results observation from source which is relevant)	2
Make conclusion (designing) And consider deduction and induction, designing conclusion And evaluate)	3
Provide further explanation (evaluate definitions and identify key terms and opinions	4
Developing strategies and tactics (deciding what actions to take and interacting with others)	5

Mathematical Understanding Test Instrument

The preparation of the test grid is adjusted to the basic competencies and indicators of critical thinking and students' mathematical understanding. After the preparation of the instrument device is arranged, it is then tested first on the experimental group, so that it is a group outside the research group. The grid of the student's mathematical understanding test is adjusted to the indicators and students' mathematical understanding

Table .2 Grid of mathematical understanding instruments

Mathematical Understanding Ability Indicators	No Question
Re-explaining a concept	1
Classifying various objects based on whether or not the requirements that form the concept are met	2
Implementing concepts algorithmically	3
Presenting examples of what is being studied	4

Interview Guide Instrument

This instrument contains an outline of the researcher's questions that will be asked to the subject. This instrument contains questions that will be asked to the research subject. This interview guide instrument is not fixed, meaning that questions can change according to conditions. Of course, it is still based on indicators of students' critical thinking skills and mathematical understanding.   .

Data Validity Test

According to Sugiyono (2019:364), data validity tests in qualitative research include data credibility tests, *transferability tests* , *dependability tests* , and *confirmability tests* .

Results and Discussion (70%)

The calculation results of the KAM data obtained an average $(\tilde{x}) =$ 61,9 with a standard deviation $(SD) =$ 5,8. Based on the average value of the standard deviation, students are grouped into three criteria that can be seen in table 1

Table 3. Categorization of Initial Mathematical Ability

Initial mathematical ability score (EAP)	Category
$X \geq 67.6$	Tall
$56.1 < X < 67.6$	Currently
$X \leq 56.1$	Low

From table 1, we get a picture of the KAM of students who are categorized as low KAM, medium KAM, and high KAM at each level of student KAM. The purpose of classifying KAM is to consider this in compiling KAM during learning, because mathematics materials are generally arranged hierarchically and the material is a prerequisite (initial ability).

Therefore, students have difficulty in mastering materials that require prerequisite materials, which are then used as a starting point to improve measurable mathematical abilities. Thus, the following are the results of students' initial mathematical abilities.

Table 4. Grouping of Students Based on KAM Results

No	Student code	Category
1	S1	Currently
2	S2	Low
3	S3	Currently
4	S4	Currently
5	S5	Low
6	S6	Low
7	S7	Currently
8	S8	Tall
9	S9	Tall
10	S10	Tall
11	S11	Currently
12	S12	Currently
13	S13	Currently
14	S14	Tall
15	S15	Currently
16	S16	Currently
17	S17	Currently
18	S18	Tall
19	S19	Low
20	S20	Currently
21	S21	Low
22	S22	Low
23	S23	Low
24	S24	Low
25	S25	Currently
26	S26	Currently
27	S27	Currently
28	S28	Low
29	S29	Low
30	S30	Low

It can be seen from table 2 above that many students are classified as low KAM, 11 students, medium KAM 14 students and high KAM 5 students, so the overall total is 30 students who took

the initial mathematical ability test, the complete details can be seen in the attachment.

Table 5. KAM of Class VIII Students of MTs. EX PGA (UNIVA) Medan

No	THURSDAY	Category
1	Tall	5
2	Currently	14
3	Low	11
	Total	30

The subjects selected to carry out the initial mathematical ability test for students with three categories and two students were selected in each category as follows:

Table 6. Subject Selection Reviewed From KAM

No	Subject code	Subject Selection Reviewed From the Camera
1	S5	Low Ability
2	S19	Low Ability
3	S7	Medium Ability
4	S16	Medium Ability
5	S10	High Ability
6	S14	High Ability

The following will present the findings and analysis of students' initial mathematical abilities in three criteria, namely low, medium and high criteria as follows.
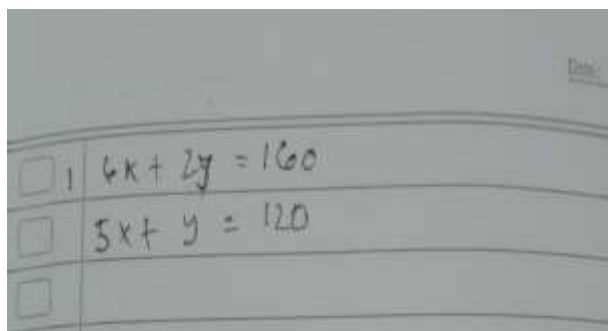
a. Low Subject

Figure 1. Results of the written test of subject S5 in working on questions

From the picture above, the results of the work show that subject S5 students cannot solve the questions given. Subject S5 students only write down the questions. From the answers, it can also be seen that student S5 is unable to convey the information in the questions, this indicates that student S5 does not understand the questions given. The following are the results of interviews with student S5.

Q: Do you understand the meaning of the questions given?
S5: No ma'am. I'm confused and don't understand the meaning of the question.
Q: Then why did you write the question again there?
S5: I saw my friends writing questions.
Q: Did you cheat on those questions?
S5: hehe, yes ma'am
Q: What is your reason for cheating?
S5: Because I don't understand the questions given, sir.

Based on the interview results, it was found that student S5 did not understand the questions given. The answers given by student S5 were also admitted to being the result of seeing his friends even though the answers were only written questions.

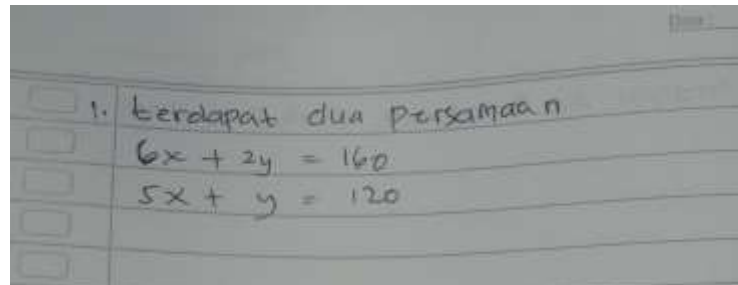The answers of students in subject 14 can be seen in Figure 4.2 below.

Figure 2. Low level student answers for subject S19

From the picture above, it can be seen that student S19 cannot solve the given problem. Subject student S19 only wrote the problem.

From the answer, it can also be seen that student S19 is unable to convey the information in the problem, this means that student S19 does not understand the problem given. The following are the results of interviews with student S19.

Q : Do you understand the meaning of the questions given?

S19 : No ma'am. I'm confused and don't understand the meaning of the question.

Q : Then why did you write the question again there?

S19 : I don't understand how to answer the question, so my answer is empty, so I'll rewrite the question, hehe

Q : When the learning process takes place, do you have a social orientation? (for example, do you prefer working in groups rather than individually)

S19 : I prefer working in groups, ma'am, because it will help me more if I work in groups. Besides, I'm not good at math. Therefore, when I am given an assignment, I often ask my friends to complete it.

Based on the interview results, it was found that S19 students did not understand the questions given by the teacher. The answers given by S19 students were only writing down the questions and S19 students also admitted that they preferred working in groups compared to individuals, because they could help S19 students in working on the questions. the results of seeing their friends even though the answers did not help much.

Based on the results of the research conducted on mathematics learning using the application of the mathematical understanding model of students towards the critical thinking skills of class VIII students at Mts Expga UNIVA Medan obtained results of increased learning after researchers conducted an analysis of students' thinking skills towards students' mathematical understanding , after conducting research students were more critical in expressing their opinions and in the process of teaching and learning activities, this is evidenced by the existence of continuous interaction between teachers and students, in terms of data the results of the values obtained by students in the initial test increased after students received learning with a model of students' mathematical understanding, where the initial value of students before taking this approach, the average value of students was only 69.42 after taking the approach of the learning model of students' mathematical understanding increased to 80.76, so it can be concluded that H0 $_{is}$ accepted while H0 $_{is}$ rejected. This means that the learning model of *students' mathematical understanding* has an effect on students' critical thinking skills.

Initial Mathematical Ability (EAC)

The subject of the study for initial mathematical ability (KAM) is Before the researcher conducted the test, the researcher conducted a test without taking an approach. This aims to understand the initial mathematical ability of Class VIII Expga Univa students, the test given in the form of descriptive questions totaling 4 items, and after being worked on after conducting the test, the researcher can group the Initial Mathematical Ability (KAM) into categories that are in accordance with the results obtained after conducting the initial test and worked on individually within 80 minutes. From One Class, there are 30 students answer test which has given. In this study, researchers used three grouping methods based on ranking. Grouping based on ranking consists of high KAM, medium KAM, and low KAM. From each group, two subjects were selected with high, medium, and low abilities.

The calculation results of the KAM data obtained an average $(\tilde{x}) = 61,9$ with a standard deviation $(SD) = 5,8$. Based on the average value of the standard deviation, students are grouped into three criteria that can be seen in graph 1

KAM Score
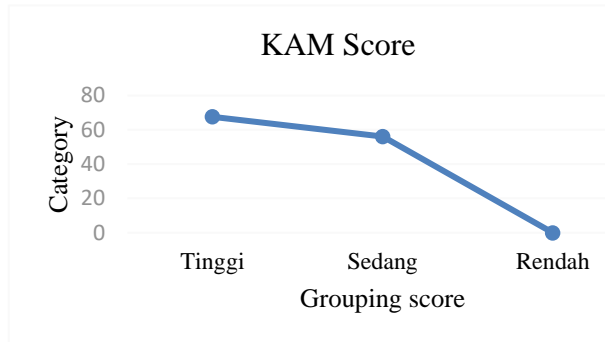
Graph 3. Initial mathematical ability

Critical Thinking Skills

The research used written tests to measure and analyze critical thinking ability of class VIII students of MTs Expga (UNIVA) Medan academic year 20 23 -202 4. After conducting a test with indicators of students' mathematical critical thinking ability, the researcher analyzed the results of the mathematical critical thinking ability test. Several subjects were taken, namely high, medium, and low subjects. In this study, the researcher used three grouping methods based on ranking. Grouping based on ranking consists of high KAM, medium KAM, and low KAM. Students S10 and S14 are categorized as high KAM, students S7 and S16 are medium KAM and S5 and 19 are low KAM. From each group, two subjects were selected with high, medium, and low abilities.

After conducting a test with indicators of students' mathematical understanding, the researcher analyzed the results of the mathematical understanding test. There were several subjects taken, namely high, medium, and low subjects. In this study, the researcher used three

grouping methods based on ranking. Grouping based on ranking consists of high KAM, medium KAM, and low KAM. Students S10 and S14 were categorized as high KAM, students S7 and S16 medium KAM and S5 and 19 low KAM. From each group, two subjects were selected with high, medium, and low abilities.

For the third indicator, high-ability S10 students and medium-ability S7 students can achieve it, while low-ability students are unable to implement the concept algorithmically, but for the fourth indicator, only high-ability and medium-ability students can achieve it, while low-ability students are unable to present the examples they have learned.

Conclusion

There is an increase in learning after researchers, conducted an analysis of students' thinking skills towards students' mathematical understanding , after conducting research students are more critical in expressing their opinions and in the process of teaching and learning activities, this is evidenced by the existence of continuous interaction between teachers and students, in terms of data the results of the scores obtained by students in the initial test increased after students received learning with a model of students' mathematical understanding, where the initial score of students before taking this approach, the average score of students was only 69.42 after taking the approach of the learning model of students' mathematical understanding increased to 80.76, so it can be concluded that H0 is accepted while H0 is rejected. This means that the Student Mathematical Understanding Learning Model has an effect on students' critical thinking skills.

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