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Mathematical Critical Thinking Ability in terms of Student Learning Independence Character in SQ4R Learning Model with Project Assessment

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Abstract

The purpose of this research was to describe critical mathematical thinking in terms of the character of students learning independence. The method used in this research is mixed metholds using a concurrent embedded model. The population in this study were students of class XI MA Mu'allimat NU Kudus Academic Year 2018/2019. The data in this study were obtained by using a character questionnaire for independent learning, observation, mathematics critical thinking tests and interviews. The subjects in this study were based on the character category of student learning independence, namely the category of students with high, medium, and low student learning independence characteristics. The result of the research is that SQ4R learning with a project assessment is effective in improving students critical mathematical thinking and enhancing the character of students learning independence. Students who have high learning independence character and moderate learning independence will create excellent critical thinking skills. Students who have low learning independence are classified as good.

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INTRODUCTION

The Critical thinking is an activity that must be carried out by everyone to gain deeper and meaningful knowledge. Everyone will think before doing something so that they will gain knowledge about something. According to Liliasari (2001), one of the basic capital or intellectual capital for everyone and a fundamental part of human maturity is critical thinking.

Ennis (2011) states that critical thinking is reasonable and reflective, which focuses on what to believe or do. In line with Rochmad (2013), he explains that critical thinking emphasizes thinking that is reasonable and reflective. This is supported by Lipman's statement (in Rochmad, et al, 2016) which states that critical thinking is developed by developing mental activity. Rifqiani, et al, (2016) explained that critical thinking emphasizes thinking that is reasonable and reflective is used to make decisions to do and provide correct arguments based on existing facts or information. From these opinions, what is meant by critical thinking skills is the thought process for analyzing information.

The Critical thinking is a process that leads to drawing conclusions about what we should believe and what actions we will take, not only to seek answers, but above all, to question the answers, facts, or existing information. Critical thinking needs to be developed in mathematics learning, in accordance with the objectives of school mathematics education which emphasizes structuring children's reasoning and the formation of children's personalities (Lambertus, 2009). According to Marzano (Slavin, 2009) states that one of the main goals of school is to form mathematical critical thinking skills and one of the subjects that are able to teach critical thinking skills is mathematics.

Mathematical material and mathematical critical thinking skills are two things that cannot be separated, because mathematics material is understood through critical thinking, and critical thinking is trained through learning mathematics. According to Fathani (2009: 17) mathematics has a very broad study, so that it develops along with human knowledge and needs as well as the pace of changing times. Therefore, the ability to think critically in mathematics also supports them to be able to apply concepts to different conditions, and to adapt to any challenges or guidance they face in life more effectively and efficiently (Maftukhin, et al, 2014: 31).

The implementation of mathematics learning in schools tends to pay less attention to mathematical critical thinking skills. Based on the data obtained, the mathematical critical thinking skills of Indonesian students, especially MA Mu'allimat NU Kudus students, are still not satisfactory. This is shown from the results of the questions given by measuring the indicators of mathematical critical thinking skills as shown in Figure 1.1.

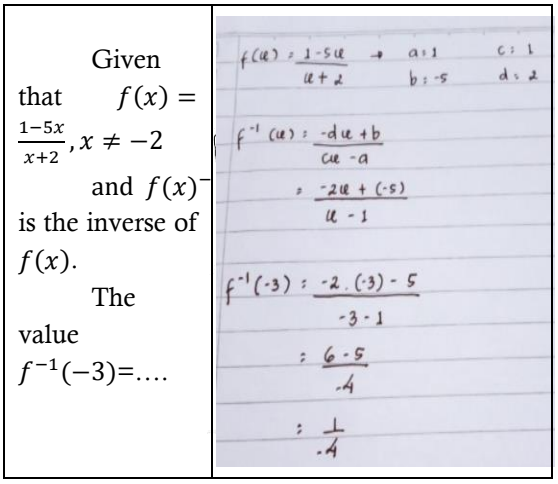

Figure 1.1 Student Work Results on the Mathematical Critical Thinking Ability Criteria Problem

Based on Figure 1.1 above, it appears that students have not been able to generalize from the problems in the questions and have not given conclusions to the questions. Thus, the indicators of critical thinking skills have not been achieved properly. Indirectly, these results indicate that mathematical critical thinking skills in mathematics are still relatively low and are still experiencing difficulties. Students tend to prefer to be explained by the teacher rather than group discussions. At the time of learning with group discussions, some students still lacked focus in participating in the discussion. In addition, based on interviews with several students, it shows that students feel happier when the teacher explains rather than discussing in groups, students only learn when there is homework (PR) or tests, if they get homework, they don't do it right away, most students are less active in class, students only actively answer questions when appointed by the teacher.

This is in line with Porter, D. (2013) who stated that when in class, visual students prefer to take notes in detail to get information. The teacher explains and gives notes on the blackboard, visual students will enthusiastically pay attention to and take notes on the material. Of these several things indicate that the independence of students in learning mathematics is still low and needs to be improved.

In addition to the importance of mathematical critical thinking skills, students also need attitudes that must be possessed, including learning initiatives, monitoring, managing, and controlling learning, and evaluating learning processes and outcomes, which are indicators of student learning independence (Sumarmo, 2010). Independence in learning refers to learning that occurs mainly from the influence of thoughts, feelings, strategies, and behaviors produced by students, which are oriented towards achieving goals (Ahmad, et al, 2018). With this attitude, students are expected to continue to develop mathematical skills, using mathematics to solve problems faced in their lives. According to Lubis, et al, (2015) learning independence is currently very much needed by students in the learning process, this is so that students in the learning process in the classroom do not only depend on teacher factors and friends to be able to solve problems, but more on their own abilities. in diagnosing the need for learning. The reality that is currently happening in the field, most of the students have not been able to independently find, recognize, detail opposing things and arrange questions that arise from the problem. Because students initially only obey what is presented by the teacher or are still dependent on the teacher. If students are expected to be independent students, then they need to be active and be exposed to opportunities that allow them to think, observe and follow the thoughts of others. In line with Melissa's research, (2016) the problem-based learning (PBL) approach can increase students' independence and mathematics learning achievement.

The low ability of critical mathematical thinking and the low independence of student learning, it is necessary to apply a learning model that can improve students' mathematical critical thinking skills and independent learning. According to Happy, et. al., (2014) learning mathematics must involve students actively and facilitate students to be able to use critical thinking skills. So that someone is able to understand their world and think about their way about some things (Barn and Lloyd, 2010). For this reason, learning is needed that can involve students actively in learning, understand mathematical concepts, and convey ideas that come from their minds. One of the strategies that students expect to be able to develop mathematical critical thinking skills and independent learning is the learning strategy of the SQ4R model with a project assessment.

SQ4R learning model with project assessment as a suitable learning alternative to improve mathematical critical thinking skills. The SQ4R learning model with an assessment project can arouse student activeness, provide opportunities for students to carry out physical and mental activities, such as practicing theory, discussing, making a work or project as a learning medium then students and their groups explain or communicate the results both orally and in writing improve student learning independence. Project assessment is an in-depth investigation of a real topic where in the project assessment, students get the opportunity to apply their skills and abilities in learning. According to Masrukan (2017), project assessment is an assessment activity for a task that must be completed within a certain period or time. Project assessments are a good way to involve students in solving problems because they are very scientific, especially supported by activities related to the real world.

Based on the background described above, the authors are interested in conducting a more specific study of the objectives so that students can be active and able to think critically mathematically during the learning process. Learning strategies that further encourage mathematical critical thinking skills in terms of student learning independence in SQ4R learning with project assessment.

METHOD

This research uses a combination research type (mixed method). According to Creswell (2012: 535) the type of mixed method research is a research design with procedures for collecting, analyzing, and mixing quantitative and qualitative methods in one study or series of research to understand the research problem. The mixed method research model used in this study is concurrent embedded. Concurrent embedded is a research method that combines

qualitative and quantitative research methods by mixing these methods unequally (Sugiyono, 2013). Quantitative methods are used as primary methods, while qualitative methods are used as secondary methods. Both data collection were carried out simultaneously when carrying out the learning process.

The variable in this study is mathematical critical thinking after being treated in the form of learning with the SQ4R model with a project assessment in the experimental group and learning with the SQ4R model in the control group.

This research was conducted at MA Mu'allimat NU Kudus Academic Year 2018/2019 in Odd Semester. The research design used experimental and control classes. The study population was all students of class XI. Class XI IPA 1 is the experimental class and class XI IPA 2 is the control class. So only the experimental class is given treatment.

The activities carried out at the research stage began with the selection of a sample consisting of 1 experimental class (class XI IPA 1) and 1 control class (class XI IPA 2). In the experimental class, giving a mathematics critical thinking test to determine the initial ability to think critically in mathematics. Furthermore, giving a questionnaire for the character of learning independence to students to determine the character of student learning independence before learning. From the results of the questionnaire, then they were grouped into high, medium, and low categories. Furthermore, each in the high, medium, and low categories was selected 2 students who would be seen to think critically in mathematics.

Data analysis was carried out quantitatively. Qualitative analysis was conducted to analyze the subject's mathematical critical thinking skills based on the type of combination of test results and interview results. Qualitative data using the Miles and Huberman model cited by Sugiyono (2013) were analyzed by reducing data, presenting data, concluding the data that had been collected and verifying these conclusions.

RESULTS AND DISCUSSIONS

The results of data analysis show that the two samples come from populations with normal distribution, have homogeneous variants, and there is no significant difference in the mean. Thus, both samples have the same conditions. In general, the condition of students' mathematical problem-solving abilities is still low.

The mathematics critical thinking test is carried out twice, namely before learning is given a pretest and after learning is carried out it is given a posttest. From the results of the pretest and posttest students' critical thinking mathematics, the students' critical thinking mathematics before learning the SQ4R model with an assessment project with the students' critical mathematical thinking after learning the SQ4R model with a project assessment. The pretest data for students' critical thinking mathematics is presented in Table 1.

Table 1. Data Pretest Critical thinking mathematics of Students in the Experiment and Control Class

No.	Description	Class Eksperiment	Class Control
1	many students	40	40
2	average value	65.55	61.62
3	maximum value	88	86
4	minimum value	38	29
5	variance	279.228	239.471
6	standard deviation	16.710	15.475

At the initial stage, the researcher tested the initial data. The result of the analysis is that the data taken is normally distributed, has the same variance and there is no difference in the average critical thinking of students from the two samples. The researcher conducted the research in four meetings. At the end of the meeting, the researcher collected the final data with a mathematics critical thinking test. The data on the results of the final mathematics critical thinking test are presented in Table 2.

Table 2. Posttest Data of Students' Critical Thinking Mathematics Experiment and Control Class

No.	Aspect	Class Eksperiment	Class Control
1	many students	40	40
2	average value	78.90	69.38
3	maximum value	90	88
4	minimum value	64	50
5	variance	45.015	76.343
6	standard deviation	6.709	8.737

The average completeness test aims to determine the critical thinking ability of students to reach the minimum learning completeness (KBM) or not. This test uses a one sample t test with the help of SPSS 21.0 with a significance level of 5%. From the results of the SPSS 21.0 output, the significance value was 0.1% <5%, it was stated that H0 was rejected. This means that the average value of students' critical mathematical thinking in the experimental class reaches the KKM limit (KKM = 70). The classical completeness test aims to determine the number of students who complete up to 70% in one class. Based on the results of the calculation of the classical completeness test, the value of z count = 1.826, and the value of z table = z_ (0.5-α) = 1.64. From z_hitung = 1,826> z_ (0,5-α) = 1,64 then H0 is rejected. This means that the proportion of completeness of students who get SQ4R model learning with a project assessment has reached 75%.

Based on the two tests above, it can be concluded that SQ4R learning with a project assessment is able to improve students' critical mathematical thinking to achieve KKM and complete classically. This is because, by using SQ4R learning with an assessment project students will be more active, interactive, feel excited to learn, and students will experience a more meaningful learning phase because students construct their own understanding of the concept of the material, and immediately apply it to daily problems. It is in line with Rustina's research (2014) which is quoted from Sudrajat (2001: 16) which states that SQ4R can encourage to be more active, critical, systematic, and purposeful in dealing with reading, so that readers can remember the main ideas of a reading longer.

The average difference test is used to determine whether there is a difference in the critical thinking of mathematics of students in the class with the SQ4R model with the project assessment and students' critical thinking in mathematics in the class with the SQ4R model. Based on Table 2, the average value of the experimental class is 78.90 and the control class is 69.38. This shows that there is a difference in the average critical thinking of mathematics between the experimental class and the control class. This is reinforced by testing the mean difference using the independent sample t test assisted by SPSS 21.0 with a significance level of 5%. From the results of the SPSS 21.0 output, the significance value was 0.009 <0.05, then H0 was rejected, meaning that the average critical thinking mathematics of students in the class who received the SQ4R learning model with a project assessment was more than the average critical thinking mathematics of students in the SQ4R class. This is in line with the research of Nurhasanah, N. (2013) showing that the average value of students' understanding of mathematical concepts for the experimental class is higher than the average value of understanding the concept for the control class.

Test for improvement using the independent sample t test assisted by SPSS 21.0 with a significance level of 5%. From the results of the SPSS 21.0 output, it was obtained a significance value of 5.468> 2.02439, then H0 was rejected, meaning that the increase in critical mathematical thinking of students who received the SQ4R learning model with a project assessment was higher than the increase in mathematical critical thinking of students who received the SQ4R learning model. This is in accordance with what was stated by Rasjid (2015) which states that the improvement of the metacognition skills of students who are taught using the SQ4R learning model with the Talking Stick method cannot be separated from the syntax of the SQ4R learning model with the Talking Stick method with a revision component contained in the ability of students to do the steps. steps according to the instructions for the LKS SQ4R learning model with the provided Talking Stick method.

To analyze critical thinking skills in mathematics, critical thinking skills tests and interviews were conducted. The critical thinking ability test is carried out after students are provided with assistance in SQ4R learning with an assessment project. While interviews were conducted on six research subjects, namely 2 students with high learning independence, 2 students with moderate learning independence, and 2 students with low learning independence. The analyzed students' critical thinking skills include five indicators of critical thinking skills according to Watson and Glaser, namely drawing conclusions, assumptions, deduction, interpreting information, and analyzing arguments.

Data on Characteristics of High Learning Independence

In the high learning independence group students, it shows that students are very good in indicators of interpreting information, assumptions, and deductions. The indicators analyze the argument well, and the conclusion draw indicators are very good too. Before being given this lesson students often answered with short answers without including indicators of critical thinking skills, then after being given this lesson, students understood the indicators of critical thinking skills in solving problems of critical thinking skills in mathematics. This is in accordance with the research conducted by Early, et al, (2018: 398) which states that students in the high learning independence group master all indicators at the critical thinking stage, students in the moderate learning independence group only master indicators at the clarification stage and indicators at the stage in conclusion, students in the low learning independence group are only able to master the indicators at the clarification stage.

Moderate Learning Independence Characteristics Data

The group students with moderate learning independence are able to solve the given problems even though there are still imperfect critical thinking indicators. This was shown by the students being very good at interpreting information indicators. In the indicators of assumptions, deduction, drawing conclusions and analyzing good arguments. Before being given this lesson students often answered with short answers without including indicators of critical thinking skills, then after being given this lesson, students understood the indicators of critical thinking skills in solving problems of critical thinking skills in mathematics. Students with moderate independence in the argument indicators are classified as good because students can provide unwritten assumptions or prejudices from the statements or premises given.

Characteristics of Low Learning Independence Data

In group students with low learning independence in indicators of assumptions, deduction, drawing conclusions, analyzing arguments, and interpreting good information. Based on the results of the research above, it is found that students who can achieve their learning objectives are students who have a good attitude of independence in learning. Before being given this lesson students often answered with short answers without including indicators of critical thinking skills, then after being given this lesson, students understood the indicators of critical thinking skills in solving problems of critical thinking skills in mathematics. Students with low independence in indicators of assumptions, deduction, drawing conclusions, analyzing arguments, and interpreting information are good because students can provide unwritten assumptions or prejudices from given statements or premises, but there are students who have not been able to understand the relationship between existing premises.

Based on data on critical thinking skills based on student learning independence, it was found that students with high learning independence did not necessarily have better mathematical critical thinking skills than students with moderate learning independence and students with low learning independence. Likewise, students with moderate learning independence do not necessarily have better mathematical critical thinking skills than students with high learning independence and students with low learning independence. Likewise, students with low learning independence do not necessarily have better mathematical critical thinking skills than students with high learning independence and students with moderate learning independence. Supported by Johnson's theory (2010: 125), the ability to think critically is a directed and clear process used in mental activities such as problem solving, making decisions, analyzing assumptions, and conducting scientific research.

CONCLUSION

Based on this research, the following conclusions are obtained that students with high learning independence have good critical thinking skills in general by fulfilling the five aspects of critical thinking skills in mathematics. Students with high learning independence can solve problems with indicators of critical thinking, but on indicators conclude well. Students with moderate learning independence have critical thinking skills both on indicators of interpreting information, assumptions, deductions, and drawing conclusions to analyze arguments very well. Students with low learning

independence can think critically in general both in the indicators of assumptions, deduction, drawing conclusions, analyzing arguments, and interpreting good information. So, the SQ4R learning model with a project assessment can develop mathematical critical thinking skills and student learning independence.

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