

# Mathematics Critical Thinking Skills Viewed by Learning Style

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**Abstract.** This study aimed to describe the critical thinking skills of students in terms of learning styles with converger category, diverger, assimilator, and Accommodator with guided discovery methods. This type of research is qualitative. Subjects study consisted of four students for each style of learning in class VIII-A SMP Muhammadiyah 1 Surakarta. Data collection techniques in this research was a questionnaire to determine the student's learning style, technique test to determine students' critical thinking skills, and interview was used to make sure mathematics critical thinking skills. Prior to conducting the test the students participating in learning activities during three meetings on the circles material for the sub materials are elements of circles, area and circumference of a circle, as well as the comparison and difference in circumference and area of a circle with a guided discovery method. Results of tests and interviews were analyzed based on indicators of critical thinking as follows: (1) Focusing question, (2) Assess whether a source is reliable or not, (3) Observe and consider the observation reports, (4) Make conclusions and consider the results of induction, and (5) Integrate. Results showed that: (1) For indicator 1 students accommodator able to master, while students diverger, converger, and assimilator are less able to master, (2) For the indicators 2 and 4 students assimilator, converger, and accommodator less able to master, while students diverger able to master, (3) For indicator 3 students assimilator and diverger able to master, while students converger and accommodator less able to master, (4) To indicator 5 students assimilator and converger are able to master, while students diverger and accommodator less able to master. Those, the learning model could sharpen the critical thinking skill to achieve deeply learning outcomes.

## PRELIMINARY

Education is an important process to create quality human resources. The higher the quality of education will improve human resources so as to create a superior generation. Therefore, education is the key to the progress of a nation. One of the subjects that have an important role in education, namely mathematics.

Mathematics is a universal science that underlies the development of modern technology. This means that mathematics has an important role in a variety of disciplines and promotes the power of human thought argued by Hardini. Through mathematics, students used to generate the habit of thinking so that students are able to master the skills of thinking in the higher levels of thinking that is critical thinking.

Critical thinking skills in mathematics are used to gain insight. This is supported by the statement of Johnson which says that the critical thinking process requires open-mindedness; humility and patience in which these qualities help a person achieve a deep understanding. But in fact, critical thinking ability of students is still low which resulted in students' understanding of mathematics courses to be low as well. This has an impact on students' mathematics learning outcomes.

Results of report of the Research and Development of the Ministry of Education and Culture (BalitbangKemendikbud) state that the results of the evaluation Trends in Student Achievement in Mathematics and Science (TIMSS) in 2011, for study results of mathematics of Indonesia is in the position 40 of the 44 countries participating with acquisition value of 386. The same thing was evidenced by the results of the PISA (Program for International student assessment) mathematics in 2012 showed the average of Indonesian student competency achievement is at level 1. Level 1 is the lowest level of 6 levels in mathematics PISA

assessment. This condition makes Indonesia under Singapore, Malaysia, Thailand, or even Vietnam. These results are a barometer of Indonesian mathematics learning achievement in international competition.

The low results of mathematics learning are determined by many things, one of the things that affect the ability of critical thinking which is owned by the student. Desmita describes the ability of critical thinking is the ability to think deeply that will result new insights and knowledge or provide a foundation for the quality of intelligence. Mathematics does not only solve the problem by applying the equations in the book only. So many problems that require students to find solutions independently by utilizing the information contained on the matter.

Teachers often faced with the differences in the characteristics possessed by each student at the time of developing critical thinking skills. Each student has difference between the one with the other individual. Characteristics to note that is learning style. According to Kolb learning styles are divided into four categories, namely: converger, diverger, assimilator, and Accommodator. By knowing the students' learning styles, teachers can customize the style of teaching so that students gain an effective way to absorb the subject matter.

Critical thinking ability of students is also influenced by learning methods applied by teachers during the learning process. Appropriate learning method is to provide a space for students to be actively involved in learning, one of them with a method of guided discovery. Jacobsen says that in learning by applying the method of guided discovery, students create their own abstraction by using examples and under the guidance of teachers. Guided discovery learning methods will engage students to be actively in developing critical thinking skills and acquire in-depth understanding.

Based on the above efforts to be made in order to improve the learning process in accordance with the student individually is analyzing the critical thinking skills of students based on learning styles. To make it easier to analyze the critical thinking skills in students that is by applying the method of guided discovery. Guided discovery method can basically help students resolve problems independently, analytically, critically, and scientifically, so that involves the whole ability of students with the guidance of teachers in guiding and facilitating students to study.

This study refers to the equation of the problem, how the descriptions of critical thinking skills of students reviewed from learning styles by category of converger, diverger, assimilator, and accommodator with guided discovery methods? And this study aims to describe the critical thinking skills of students in terms of learning styles by category coverger, diverger, assimilator, and accommodator with guided discovery method.

## RESEARCH METHODS

This type of research based on approach is a qualitative research. Qualitative research is a study aimed at describing and analyzing the phenomenon of events, social activities, attitudes, beliefs, perceptions, thoughts of people individually or in groups. As for the research design used is a case study. The research was conducted in SMP Muhammadiyah 1 Surakarta in the second semester of the academic year 2016/2017. This research subject is class VIII-A SMP Muhammadiyah 1 Surakarta totaling 28 students. The subject chosen

Data collection techniques in this study were a questionnaire to determine the student's learning style categories, tests to analyze the description of the students 'critical thinking skills, and interviews to deepen students' critical thinking skills in terms of learning styles. While the validity of the data used include the credibility test, transferability test, dependability test, and conformability test.

Data analysis techniques in this study included: (1) reducing the data, in this case the reduction step was to analyze the learning style questionnaire and group the students have the same learning style. Furthermore, the results of analysis of student's learning style questionnaire and the results of post-test students on tests of critical thinking skills used as materials in conducting interviews to the subject of research, and processed the results of the interview into the structure of good language and easy to be understood, (2) the presentation of the data, the data presented in the study this form of data analysis results questionnaire learning styles of students, the analytical test results of critical thinking skills of students, and interviews that have been conducted research on the subject of research, (3) conclusion, in this case pay attention to the results of analysis of questionnaire to determine the category of student learning styles, test results of students 'critical thinking skills, and interviews were used to draw conclusions concerning the description of critical thinking skills based on students' learning styles.

## RESULTS AND DISCUSSION

The results of student learning styles questionnaire analysis showed that 9 students included in diverger category, 6 students included in converger category, 10 students included in a ccommodator category, and 3

students included assimilator category. The accumulated data grouping of class VIII-A SMP Muhammadiyah 1 Surakarta based on the analysis of learning styles questionnaire can be seen in Table 1 as follows.

**TABLE 1. Learning Style of Student Class VIII-A SMP Muhammadiyah 1 Surakarta**

Learning styles	Many Students	Percentage
Diverger	9	32.14%
Converger	6	21.43%
Accomodator	10	35.71%
Assimilator	3	10.72%
Amount	28	100%

The research data about students' critical thinking skills obtained from the post-test conducted at each end of the meeting and the results of interviews with purposive sampling technique conducted by researchers with the research subjects that is a student from each category of learning styles. Indicators of students' critical thinking are analyzed by researchers, among others: (1) focus on the question, (2) assess whether the source is reliable or not, (3) observe and consider the report of observation, (4) making inferences and considering the results of the discussion, and (5) mix. Analysis of critical thinking skills in terms of learning styles diverger, converger, assimilator, and accommodator is as follows. There is taken four student: CAF, RDAN, DF, and FD whose the critical thinking skill assimilator, diverger, converger, and accomodator respectively.

First, the paper describes Critical Thinking Skills of Students on Indicator of Focus on Questions. CAF subjects critical thinking skills that students who have learning styles assimilator on indicators of focus on question that is the subject of CAF were less able to write the facts and problems in question completely and correctly. This was because the subject of the CAF did not write down the problems contained in the matter. However, in general were able to write down the facts is complete and correct.

Critical thinking skills of RDAN subject with diverger learning style based on the results of research on indicator of focus on questions, the subjects of RDAN were less able to write down the facts and problems in the matter completely and correctly. This was because the questions of post-test I did not write down the facts and problems due to forget, but when the researchers conducted interviews with RDAN subjects related to the problems, the subjects of RDAN were able to state with complete and accurate facts and problems in the matter. But in general the subjects of RDAN learning styles of diverger were able to write the facts and problems completely and correctly.

In the focus on questions indicator, the subject of DF that students who have learning styles of converger were also less able to write down the facts and problems in the matter. DF subjects were only able to write down the facts and information as well as the unit of measurement known precisely, but in general the subject DF did not write down the problems in question. It can be seen from the work of subject of DF and results of interviews conducted by investigators with the subjects of DF.

The results showed that critical thinking skills of the subjects of FD with accommodator with learning styles based on indicator of focus on question that were able to write down the facts and problems in the matter completely and correctly. Overall the subjects of FD with learning styles of accommodator were able to write down the facts along with units that were known as well as problems in the matter properly. It was also based on the results of interviews conducted by investigators with the FD subjects that the subjects of FD were able to explain any of the information contained in the matter.

Next, the paper discuss about Critical Thinking Skills of Students on indicators assess whether a source is reliable or not. Subjects of CAF with assimilator learning style write equations or concepts in critical thinking skills test questions with many shortcomings. So that the students with learning style of assimilator were less capable in indicators to assess whether the source was reliable or not. It can be seen in the work of CAF subjects did not write down some facts and concepts used to solve the problems. This is in accordance with the opinion Kuncoro and Amat (2007) which says that students with learning styles of assilimator were less able to develop ideas and realistic understanding of the concept.

On the indicators to assess whether the source is reliable or not, the subjects of RDAN they were students who have learning styles of diverger were able to write equations and concepts needed to solve the problems in question completely and accurately. Only the matter of *the* post-test III the subjects of RDAN were less able to write concepts needed in the search for the value of the problem. But the subjects of RDAN were able to write equations in every process properly.

On the indicators to assess whether the source is reliable or not, the subjects of DF with converger learning styles there are many deficiencies in writing equations or concepts needed to solve the problems. Subject DF did not write down the concept to find many rounds as in question I post-test II or many spotlights are required as in the matter of post-test III. But the subjects of DF were able to write with the right equations. Although there

were some mistakes due to careless in writing it. So that the DF subjects who have learning style of converger were less able to indicators determine the credibility of the source.

On the indicators to assess whether the source is reliable or not, subjects of FD with accommodator learning styles were also less able to write equations and concepts used in solving problems. This is evident in the work the subjects of FD that there were many deficiencies in writing the facts and concepts. At question 1 post-test II the subjects of FD able to write facts and concepts completely and correctly. But in general, in other questions the subjects of FD which have accommodator learning style made a mistake in writing down the equation for careless or forget to write the concepts used to solve the problems.

The last is about Critical Thinking Skills of Students on Indicators to Observe and Consider the Observation Report. On indicators of observing and considering the report of the observation, the subjects of the CAF were the student with learning style of assimilator were able to write in solving process completely and accurately. This is evident in the work of the subjects of CAF to write down every process in solving every problem. And it was supported from the results of interviews conducted by the researcher and the subjects CAF were capable of explaining each process in resolving the problems clearly and in detail.

Critical thinking skills of the RDAN subjects with learning style of diverger related to indicators to observe and consider the report of observation that is able to write with complete and accurate in every process for resolving problems in the matter. Only in the questions of post-test III shows that the subjects of RDAN did not write information to find the necessary high lights. But in general, the subjects of RDAN's work and researchers' interviews with the subjects of RDAN showed that subjects of RDAN were able to write the process for resolving the problem in question completely and correctly.

DF subjects were students with learning styles of converger were less able to write completely and accurately related to indicators to observe and consider the report of the observation. Although generally the subjects DF were able to write a complete process, but in some of works appear that there was no systematic work of DF subjects. On the questions of post-test I, it can be seen that the subjects of DF wrote process with many drawbacks. Students with this learning style of converger did not write information to find the circumference and area of the shaded region, but directly subtracting the result area and perimeter of a rectangle with an area and circumference of a circle.

Critical thinking skills of FD subjects related of indicators to observe and consider the report of the observation that students who have learning styles of accommodator were less able to write in solving process completely and accurately. This is evident in the work of the subjects of FD in question 2 post-test II made many mistakes in solving problems. In addition to the subject matter of the post-test III FD did not provide information if the calculation was to find the number of lamps required.

Followed by explanation about Critical Thinking Skills of Students on the indicator to Make Conclusion and Consider Discussion Results. CAF subjects were students with learning styles of assimilator were less able to write a conclusion or consider the outcome of the discussion. On this indicator, for the questions of post-test I and questions 2 post-test II of the subjects of CAF did not write the conclusion of the matter. When being interviewed, the subjects CAF feel confused in writing a conclusion, especially in question 2 post-test II. Whereas in the question have obvious problems that must be solved.

At the indicator to write conclusion or consider the results of the discussion, the subjects RDAN were students who have learning styles of diverger were able to draw appropriate conclusions in terms of the questions. This can be seen on every work of the RDAN subjects who wrote the conclusion of the problem completely and correctly. Conclusion was written an answer to a question asked on the matter.

At the indicator to write conclusion or considering the results of the discussion, the subject of DF were less able to write with complete and accurate conclusion. It was seen in the work of questions post-test I, the subjects of DF were less about writing around the shaded area. Even at questions 2 post-test II the subjects of DF were unable to draw conclusions from the problems due to forget. But for another questions the subjects with the converger learning style were able to write complete and accurate conclusion.

FD subjects critical thinking skills of students who have accommodator learning styles associated to indicator to write or consider the results of the discussion were less able to draw conclusions from the problems. It was seen in the work of FD subjects who did not write the conclusion to questions 2 post-test II and post-test III questions because the students were not able to understand how to draw conclusions from the problems in question. For other questions the subjects of FD considered the final answer to problems that have been given unit of measure was the conclusion.

The last but not the least is Critical Thinking Skills of Students on Integrating Indicators. CAF subject were students who have learning styles of assimilator were able to integrate each process based on the indicators previously to obtain the final results in resolving problems completely and accurately. Only in questions 1 post-test II, the subject of CAF did a little mistake in the calculation so as to obtain results that were less precise. But

in general, the subjects of the CAF were able to integrate every process so as to obtain complete and accurate results.

On the integrating indicator the subjects of RDAN with learning styles of diverger were less capable of integrating every process of the indicators previously so as to obtain the correct final result. This was because the RDAN subjects were not appropriate in substituting numbers into equation which they wrote. This is supported by the opinion Kuncoro and Amat which says that students with learning styles of diverger concrete experience and reflective observation were the dominant learning abilities, and less focus on the problem being solved. Shown in the post-test I questions that the subjects of RDAN also did not understand perfectly the concept in fractional operation so that the final result was not correct.

The subjects of DF with learning styles of converger capable of integrating every process so as to obtain the final result completely and precisely. Students with learning styles converger has the advantage on the ability of cognitive strategies, implementation and practical application of concepts, ideas and theories, and excels in solving. Similar disclosed by Chermahini which stated that students with learning styles converger resourceful in making the application practical ideas and use productive reasoning in solving problems. This is why the subject of DF is not systematic in doing any process for resolving problems in the matter but understand the questions well. So as to integrate each process based on the indicators previously to obtain the final result with a complete and precise.

At questions 1 post-test II the subjects of FD with learning styles accommodator integrate every process correctly just made a mistake in the final calculation resulting in less precise answer. While on question of the post-test III the subjects of FD integrating each process with fewer errors in substituting numbers into a equation but was able to get the right results. Related to the above the subjects of FD were wrong in writing the process because of the rush. In addition to the question 2 post-test II the subjects FD could not combine the facts and problems that they wrote to equations and concepts used in solving problems, so they could not determine the right answer even due to constraints of time the subject of FD was unable to resolve problems in the questions. So the critical thinking skills of students who have learning style of accommodator is related to combine indicators were less able to integrate every process to obtain the final result.

After analyzing the data of students' critical thinking skills of critical thinking skills test results and the results of interviews conducted by investigators to each subject based learning style, the result of analysis of critical thinking skills based subjects students' learning styles are presented in Table 2 below.

**TABLE 2.** Students Critical Thinking Skills in terms of Learning Styles

Indicators Critical Thinking Skills	Learning styles			
	Assimilator	Diverger	Converger	Accommodator
1. Focus on questions	Less able to write down the facts and problems in the question	Less able to write down the facts and problems in the question	Less able to write down the facts and problems in the question	Being able to write down the facts and problems in the question
2. Assess whether the source is reliable or not	Less able to write equations and concepts needed to solve problems	Being able to write equations and concepts needed to solve problems	Less able to write equations and concepts needed to solve problems	Less able to write equations and concepts needed to solve problems
Indicators of Critical Thinking Skills				
Indicators of Critical Thinking Skills	Learning styles			
	Assimilator	Diverger	Converger	Accommodator
3. Observe and consider the results of observation report	Being able to write out the process in solving problem	Being able to write out the process in solving problem	Less able to write in the process of solving problems	Less able to write the process of solving problems
4. Observe and consider the results of observation report	Less able to draw conclusions from the problems in question	Able to draw conclusions from the problems in question	Less able to draw conclusions from the problems in question	Less able to draw conclusions from the problems in question
5. Integrate	Able to integrate every process based on the indicators	Less able to integrate all processes based on previous	Able to integrate every indicators to obtain the outcome in question	Less able to integrate all processes based on previous

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previously to obtain the final result on the question	indicators to obtain the outcome in question	indicators previously to obtain the final result on the questions
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## CONCLUSION

Based on the results of research and discussion, it can be concluded that the ability of critical thinking mathematically in terms of learning styles using guided discovery method in class VIII as follows. Critical thinking skills question mathematically the focus indicator that students with learning styles assimilator, diverger, and converger were less able to write down the facts and problems in the questions. As for the students with the learning style of accommodator were able to write down the facts and problems in the questions.

Mathematically critical thinking skills on indicators to assess whether the source is reliable or not and indicators about writing or consider the results of the discussion found similar results that students with learning styles assimilator, converger, and a ccommodator were less able to write equations and concepts. While the students with learning style diverger were able to write equations and concepts used to solve the problems.

Mathematically critical thinking skills in observing indicators and consider the report of observation of the students with learning style and diverger assimilator were able to write every process in resolving the problem. While the students with learning style accommodator and converger were less able to write every process in resolving the problem.

Mathematically critical thinking skills in integrating indicator namely students with learning styles converger and assimilator were able to integrate each process based on the indicators previously to obtain the final result. While the students with learning style accommodator and diverger were less able to integrate each process based on the indicators previously to obtain the final result. Those, the learning model could sharpen the critical thinking skill to achieve deeply learning outcomes.

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