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Analysis of Students' Mathematical Critical Thinking Ability on Polyhedron in Term of Learning Styles

Hasenda Alfa Dinara[1], Fadhilah Rahmawati[2]*, dan Aprilia Nurul Chasanah[3]
[1,2] Pendidikan Matematika, Universitas Tidar
Jl. Kapten Suparman No.39, Kota Magelang, Jawa Tengah, Indonesia
Corresponding Author: fadhilahrahmawati@untidar.ac.id

ABSTRAK

Penelitian ini bertujuan untuk mendeskripsikan kemampuan berpikir kritis matematika siswa kelas VIII SMP N 2 Magelang. Subjek dalam penelitian ini adalah siswa kelas VIII-A dan VIII-D. Penelitian dilaksanakan pada semester genap tahun pelajaran 2021/2022. Data yang dikumpulkan berupa hasil angket gaya belajar, tes kemampuan berpikir kritis matematika, dan wawancara secara tidak terstuktur. Angket gaya belajar digunakan untuk mengetahui gaya belajar siswa, tes untuk mengukur kemampuan berpikir kritis matematika terdiri dari empat soal uraian materi bangun ruang sisi datar. Hasil angket dan tes kemudian dianalisis sesuai dengan indikator kemampuan berpikir kritis matematika yang digunakan pada penelitian ini yaitu memberikan penjelasan sederhana, membangun keterampilan dasar, membuat kesimpulan, membuat penjelasan lebih lanjut, dan memadukan. Hasil analisis data menunjukkan bahwa kemampuan berpikir kritis siswa pada gaya belajar visual, auditorial, dan kinestetik tergolong sedang. Hasil penelitian ini dapat memberikan informasi kepada guru mengenai kemampuan berpikir kritis siswa sehingga guru diharapkan mampu merancang kegiatan pembelajaran yang dapat meningkatkan kemampuan berpikir kritis siswa menjadi lebik baik.
Kata Kunci: Kemampuan Berpikir Kritis Matematika; Bangun ruang sisi datar; Gaya Belajar.

ABSTRACT

This research aims to describe the critical thinking ability of mathematics students of class VIII of Junior High School N 2 Magelang. The subjects in the study were students of grades VIII-A and VIII-D. The research was carried out in the even semester of the 2021/2022 school year. The data collected is in the form of learning style questionnaire results, mathematical critical thinking ability tests, and interviews in an unscathodox manner. Learning style questionnaires are used to determine students' learning styles, tests to measure mathematical critical thinking ability consist of four questions about the description of polyhedron materials. The results of the questionnaire and test were then analyzed according to the indicators of mathematical critical thinking ability used in this study, namely providing basic clarification, bases for a decision, inference, advanced clarification, supposition and integration. The results of data analysis show that students' critical thinking ability in visual, auditorial, and kinesthetic learning styles is classified as moderate. The results of this study can provide information to teachers about students' critical thinking ability so that teachers are expected to be able to design learning activities that can improve students' critical thinking skills to be good.
Keywords: Mathematical Critical Thinking Ability; Polyhedron; Learning Style.

INTRODUCTION

Mathematics is the science that underlies the development of modern technology and plays an important role in various sciences. Mathematics is also the universal science that underlies the development of modern technology today (Suandito, 2017). To meet the challenges of the 21st century everyone must have 6 abilities that include: a) critical thinking, b) collaboration, c) communication, d) creativity, e) citizenship/culture, f) character education/connectivity (Anugerahwati, 2019). Based on several previous studies, there are several definitions of critical thinking, among others according to Chukwuyenum (2011) Critical thinking is one of the tools used in everyday life to survive because it involves logical reasoning, interpreting, analyzing, and evaluating information to allow one to make reliable and valid decisions. Next Ennis (2011) Stating indicators of critical thinking ability include providing simple explanations (basic clarification), building basic skills (bases for a decision), making inferences, making further explanations (advanced clarification), and blending (supposition and integration).

Mathematics learning in schools so far has not provided many opportunities for students to develop critical thinking skills. Facts on the ground show that the critical thinking ability of students in Indonesia, especially junior high schools, is still unsatisfactory. The low critical thinking ability of these students can be seen in the 2018 Survey of The Programme for International Student Assessment (PISA) which shows that mathematics skills in general in Indonesia have an average score of 379 from the international average score of 500. In other words, Indonesia is below Thailand which is ranked 58th and Malaysia is ranked 48th, while Singapore is ranked 2nd (Schleicher, 2019). Meanwhile, the Trend in International Mathematics and Science Study (TIMSS) survey in 2015 showed that Indonesia was ranked 44th out of 49 countries with an average score of 397 out of an average international score of 500 (Hadi & Novaliyosi, 2019). According to (Fachrurazi, 2011), critical thinking allows students to find the truth in the midst of many events and information every day.

According to Ural (2015), One of the factors influencing academic success or student success in the classroom is their learning styles such as visual, auditorial, and kinesthetic. Research results Nurbaeti, Nuryanti, & Pursitasari (2015) It shows that there is a positive relationship between learning style and student critical thinking ability, which means that learning style can improve students' critical thinking ability. One of the learning characteristics related to absorbing, processing, and conveying such information is the

student's learning style (Sari, 2014). Each student has a different learning style (Gunawan, Chasanah, Hendrastuti, & Prihatiningrum, 2021). Therefore, it is very important for the teacher to analyze the learning style of his students. This makes teachers more sensitive to student differences in the classroom and gets information to assist them in developing meaningful learning.

This study is the result of preliminary observations. This study aims to find out the critical thinking ability of students of class VIII of junior high school N 2 Magelang on polyhedron materials based on indicators of critical thinking ability reviewed from learning styles. When students' critical thinking ability and learning styles have been known, then the teacher needs to design learning activities that facilitate and familiarize students to hone students' critical thinking ability so that students' critical thinking ability can be improved optimally.

RESEARCH METHODS

The method used in this study is a qualitative method, meaning that it describes the events that are the main topic (the ability to think critically in problem solving is in term of the student's learning style) qualitatively and based on qualitative data. Qualitative descriptive research is research that is descriptive and widely used to describe socially related phenomena (Suardi, 2017). Qualitative descriptive research is a research method that moves on a simple qualitative approach with an inductive flow that begins with an explanatory process or event so that finally a conclusion can be drawn from the process or event studied (Yuliani, 2018).

Based on some of the above definitions, it can be concluded that qualitative descriptive research is a research method that utilizes qualitative data and is described descriptively which displays the results of the data as is without any manipulation process or other treatment. In this study, all student data including observation results, learning style questionnaire results, critical thinking ability test results, and interview results that have been observed and other related documents are outlined as is then studied as often as possible to answer problems. In this study, the study subjects were 43 students of grades VIII-A and VIII-D as a complement to auditory learning style data at SMP N 2 Magelang. The research procedure used in this study is carried out in two stages, namely the first stage, examining various theories and implications regarding students' mathematical critical thinking ability judging from the learning style. Furthermore, in the second stage, data collection is carried out, namely the mathematical critical thinking ability test (TKBKM) and interviews. The

instruments used to obtain, process, and analyze data in this study are learning style questionnaires and mathematical critical thinking ability (TKBKM) tests. In this study, researchers compiled a test question consisting of 4 questions about the description of polyhedron material and then shared the problem with 43 students of grades VIII-A and VIII-D of Junior High School N 2 Magelang. On each of the questions used by researchers to measure students' mathematical critical thinking ability. Students are asked to provide simple explanations (basic clarification), build basic skills (bases for a decision), make inferences , make further explanations (advanced clarification), and blend (supposition and integration). The test results are analyzed using the assessment rubric that has been compiled and then conducted an interview with the student regarding the test results to obtain more valid data. In this study, data were collected using research instruments. The research instruments used were observation sheets, learning style questionnaires, mathematical critical thinking skills tests, and interview guidelines. Furthermore, all data is analyzed by collecting data, reducing, and presenting the results. Presentation of data includes data values, classification of students' mathematical critical thinking ability levels, and drawing conclusions. Classification of students' mathematical critical thinking skills based on the classification table according to Ridho, Ruwiyatun, Subali, & Marwoto (2020) as can be seen in Table 2.

Table 2. Classification of Mathematical Critical Thinking Ability Levels

TKBKM Value	Category
$8,00 \le skor \le 10,00$	Very high
$6,00 \le skor \le 8,00$	High
$4,00 \le skor \le 6,00$	Medium
$2,00 \le skor \le 4,00$	Low
$0 \le skor \le 2,00$	Very low

RESULTS AND DISCUSSIONS

In this section, the discussion of student answers is carried out for each number of questions. The results of the analysis of tests and interviews based on indicators of mathematical critical thinking skills can be seen in the following explanation.

1. **Analysis of Mathematical Critical Thinking Ability Of Students Types of Visual Learning Styles**

    Based on the results of TKBKM there are 18 visual subjects with subjects that are classified as very low as 1 subject, low 2 subjects, medium 9 subjects, high 6 subjects, maximum value 7.25, minimum score 1.50, and average 5.19. So that subjects with visual learning styles are classified as medium ability to think critically of mathematics.

Analysis of Mathematical Critical Thinking Ability of Visual Subject S.38

In this analysis, the selected subject is S.38. While the question item in the analysis is the number two question point. A detailed description of the indicator is in Figure 1.
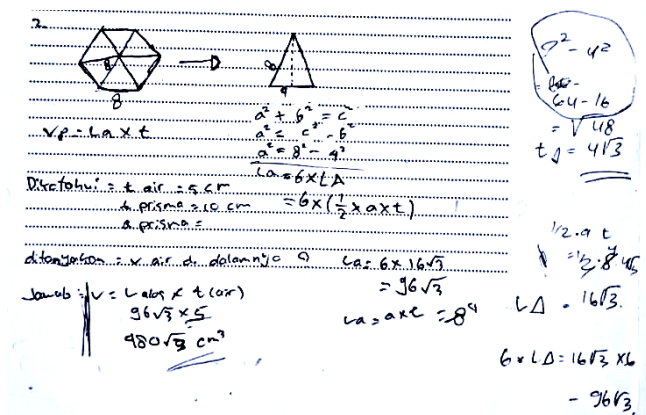

Figure 1. Subject TKBM Results S.38

1) Basic Clarification

Based on the results of the answers above and the transcript of the visual subject interview in appendix 11, it can be seen that subject S.38 gave a basic clarification regarding writing down what is known and asked. When writing, the subject is incomplete in providing information, while during the interview the subject provides complete information. S.38 writes that what is known is in the form of a water height of 5 cm and a prism height of 10 cm. In addition, S.38 also wrote down what was asked exactly, namely the volume of water in it. S.38 writes down what is known using its own language and sentences.

2) Bases for a Decision

Based on the results of the answers and interviews, it can be seen that S.38 is able to explain the plan of each step sought. It can be seen that S.38 wrote down his plan in detail and in order. S.38 has written down the result of the answer with the correct unit, namely cm^3. In the plan, S.38 can also mention the formula used correctly only that S.38 does not write down the implication symbol at each step.

3) Advanced Clarification

Based on the results of the answers and interviews of the subject S.38, it can be seen that the next step is to multiply the area of the hexagon prism base by the height of the previously known water.

4)   Supposition and Integration

Based on the results of the answers and interviews, it can be seen that S.38 is able to combine the results of the answers from each step that has been done so that it becomes the correct answer.

Based on the results of the TKBKM and the interview transcript, the subject of S.38 met four indicators of critical thinking ability, namely basic clarification, bases for a decision, advanced clarification, and supposition and integration. But there is one indicator that is not met, namely making inference. The subject did not write a inference because it directly multiplied the area of the prism base by the height of the water that had been known.

2.   **Analysis of Mathematical Critical Thinking Ability Students Auditory Learning Style Type**

Based on the results of TKBKM there are 11 auditory subjects with subjects that are relatively low as many as 2 subjects, low 2 subjects, medium 5 subjects, height 1 subject, very high 1, maximum value 8.25, minimum value 1.38, and average 4.72. So that subjects with auditory learning styles are categorized as medium mathematical critical thinking ability.

Analysis of Mathematical Critical Thinking Ability of Auditory Subject S.44

In this analysis, the selected subject is S.44. While the question item in the analysis is the number one question item. A detailed description of the indicator is in Figure 2.
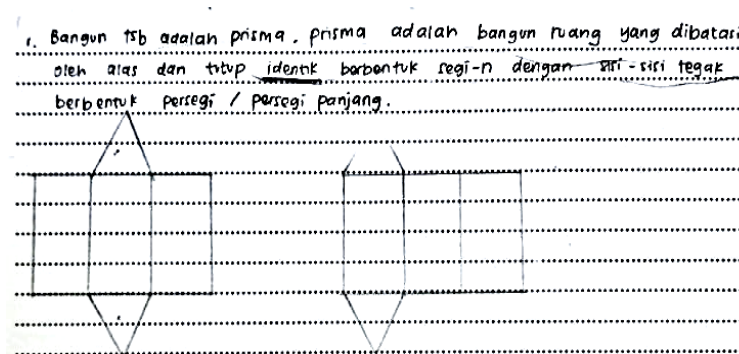

Figure 2. Subject TKBM Results S.44

a.   Basic Clarification

Based on the results of the answers above and the transcript of the visual subject interview, it can be seen that S.44 gives a basic clarification. Subject S.44 does not write down the known and asked, but directly answers the question. This has to do with the results of the questionnaire of learning styles that have been filled

in, S.44 sometimes does something in a hurry. Nonetheless, during the interview S.44 mentioned what was known and asked in full and correctly.

b. Bases for a Decision

The subject of S.44 is quite capable of building basic skills. This can be seen from the results of the answers and interviews. Although S.44 is able to explain the meaning of the existing nets, S.44 does not answer them correctly. S.44 only answers that the constructed wake is a prism build only. However, during the interview S.44 explained that the construct formed is a triangular prism. S.44 gives a complete explanation of the meaning of prism. S.44 also uses its own structured and easy-to-understand language.

c. Inference

The subject of S.44 is quite capable of making inference. This can be seen from the results of the answers and interviews, where S.44 writes the name of the wake that is formed is a prism and is clarified during the interview by explaining that the constructed wake is a prisma segitga. Both of the nets drawn by subject S.44 are also correct.

d. Advanced Clarification

Subject S.44 is capable of making advanced clarification. This can be seen from the results of answers and interviews, where S.44 is able to give the reason that the naming of a prism is based on the identical shape of the base and lid. S.44 explains that what is meant by identical bases and lids is the same size.

e. Supposition and Integration

Based on the results of the answers and interviews, Subject S.44 is quite capable of combining the steps that have been done. Although S.44's answer is not quite right, S.44 can explain that the base and lid of the prism must be identical (the same size). S.44 explains this using its own language.

Based on the results of the above analysis, it can be concluded that the subject of S.44 meets all indicators of critical thinking. Although not writing the known and asked, but during the interview the subject explained both things clearly and correctly.

3. **Analysis of Mathematical Critical Thinking Ability of Students Of Kinesthetic Learning Style Type**

Based on the results of TKBKM there are 12 kinesthetic subjects with subjects classified as very low as 2 subjects, low 3 subjects, medium 3 subjects, height 4 subjects, maximum value 7.63, minimum value 0.88, and average 4.65. So that subjects with

kinesthetic learning styles are categorized as medium mathematical critical thinking ability.

Analysis of Mathematical Critical Thinking Ability of Kinesthetic Subject S.13

In this analysis, the selected subject is S.13. While the question item in the analysis is the number one question item. A detailed description of the indicator is in Figure 3.
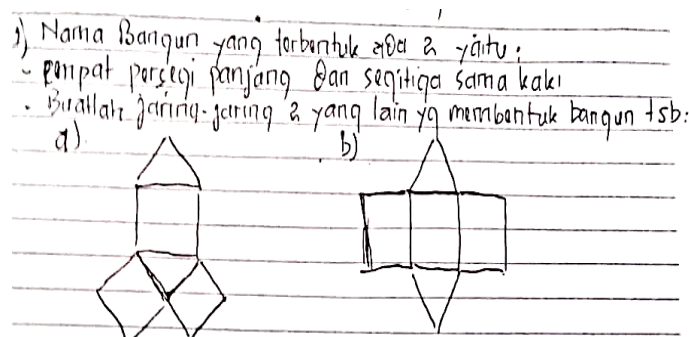

Figure 3. Subject TKBM Results S.13

a. Basic Clarification

Based on the results of the answer, it can be seen that the subject of S.13 gave a simple explanation regarding writing down the question. S.13 only wrote down one of the things asked, which was to draw the other nets that formed the building. During the interview the subject mentions the known thing. Subject S.06 mentions that what is known is a rectangle and an isosceles triangle. This shows that S.13 has not mastered the material of building a flat side room.

b. Inference

The subject of S.13 is quite capable of making inference. This can be seen from the results of the answers and transcripts of the interview. Based on the answer, subject S.13 mentioned that the constructed wake was a rectangle and an isosceles triangle. This shows that the subject of S.13 does not understand what is actually formed from the existing nets. Nonetheless, the subject of S.13 could have created two other nets correctly.

Based on the results of TKBKM and interview transcripts, S.13 subjects were unable to provide bases for a decision, advanced clarification, and supposition and integration. The subject does not elaborate on the answer completely because it has not mastered the material of polyhedron. The subject answers the question only by what is remembered on the material before polyhedron.

4. **Analysis of Mathematical Critical Thinking Ability Students Visual-kinesthetic Learning Style Type**

Based on the results of TKBKM there are 2 visual-kinesthetic subjects with subjects that are classified as medium and high each one subject. maximum value is 7.88, minimum value is 5.50, and average is 6.69. So that subjects with visual-kinesthetic learning styles are classified as high mathematical critical thinking ability.

Analysis of Mathematical Critical Thinking Ability of Visual-kinesthetic Subject S.18

In this analysis, the subject chosen is S.18. While the question item in the analysis is the number two question point. A detailed description of the indicator is in Figure 4.

Figure 4. Subject TKBM Results S.18

a. Basic Clarification

Based on the results of the answers above and the transcript of the visual subject interview in appendix 11, it can be seen that subject S.18 is able to provide a basic clarification related to writing down what is known and asked. S.18 mentions what is known and asked in full. During the interview, S.18 mentioned the length of the hexagon, which is 8 cm. This is not quite right because S.18 should mention the length of the hexagon side.

b. Bases for a Decision

Based on the results of the answers and interviews, it can be seen that S.18 is able to explain the plan of each step sought. It can be seen that S.18 writes down step by step clearly. In the plan, S.18 is also able to name the formula used correctly such as the formula of finding the base area and volume.

When using the Pythagorean formula to find the height of a triangle, the subject of S.18 is less precise and complete in writing the formula. S.18 writes the Pythagorean formula "$c = a^2 - b^2$", while the supposed writing should be "$a^2 = c^2 - b^2$". Based on the results of the learning style questionnaire, the subject of S.18 is a student who sometimes does not pay attention to the neatness of writing, so that what S.18 writes looks simple and as it is. Subject S.18 also did not write down the implication symbols at each step.

Based on the results of the TKBKM and the interview transcript, the subjects of S.18 only met indicators of critical thinking ability to provide basic clarification, bases for a decision, and supposition and integration. Based on the transcript of the interview, the reason the subject did not give further conclusions and explanations was because it directly multiplied the area of the prism base by the known water height of 5 cm.

Based on what has been outlined, subjects with visual, auditory, and kinesthetic learning styles are classified as subjects with moderate mathematical critical thinking ability. Subjects with visual learning styles are subjects with the highest average scores among auditory and kinesthetic learning styles, because visual subjects are better able to describe mathematical objects well before solving problems and writing answers in a structured manner. Subjects with a visual learning style are only able to process everything that is directly related to their sense of sight (Rokayana, 2017).

This is in accordance with the results of research according to Safitri & Miatun (2021) which states that subjects with visual learning styles get the highest average score among auditory and kinesthetic learning styles. However, it is different from the results of research according to Rokhimah & Rejeki (2018) which states that auditorial and kinesthetic learning style subjects have better critical thinking ability than visual learning style students. Subjects with auditory learning styles do not write down the known, but during the interview the subject is able to mention it and explain other things at length. Auditory subjects find it difficult to write, but are great at explaining (Khoeron, Sumarna, & Permana, 2016).

Subjects with kinesthetic learning styles are less structured in writing answers and have not mastered polyhedron materials, because teachers often provide materials through PDFs and briefly explain materials due to reduced teaching time during the pandemic. This is in accordance with the results of research according to Pardede, Ahmad, & Harahap (2021) which states that learning with the material provided in the form of documents will be difficult to understand by students in the style of kinesthetic learning.

Subjects with a visual-kinesthetic learning style are subjects of findings with a relatively high average score. At some stage there are students who have 2 combinations of learning styles such as visual-kinesthetic or visual-auditorial (Zahroh & Asyhar, 2014). Visual-kinesthetic subjects write answers neatly and structuredly but cannot sit still for long periods. The subject explains the answer concisely and quickly. Sometimes you also miss things that are considered unimportant.

CONCLUSION

Based on the results of the analysis and discussion, it was concluded 1) Subjects with a visual learning style in solving problem number two cannot make inference. 2) Subjects with auditory learning styles in accordance with all indicators of mathematical critical thinking ability, namely providing basic clarification, bases for a decision, inference, advanced clarification, and supposition and integration. 3) Subjects with kinesthetic learning style in solving problem number one do not meet the indicators of mathematical critical thinking ability to provide bases for a decision, advanced clarification, and supposition and integration. 4) Subjects with visual-kinesthetic learning style in working on problem number two, do not give inference and advanced clarification.

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