

The Critical Thinking Skills Analysis of High School on Rotational Dynamics

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Abstract. 21st-century learning emphasizes the importance of collaboration, creativity, critical thinking, and communication. Critical thinking skills is one thing that students need to have in order to solve problems. Based on the results of a survey by Trends in International Mathematics and Science Study (TIMSS), students in Indonesia rank 46 out of 51 countries in the field of science. This study aims to analyse the critical thinking skills of students of grade XI in SMA Negeri 5 Surakarta on rotational dynamics materials. The method used in this research is descriptive quantitative. Data were collected by giving a multiple-choice test that based on five critical thinking skills indicators by ennis. Tests were given to 70 students. The test result shows critical thinking skills of 51.4% students are low, 34.3% are moderate, and 14.3% are high categorized. Critical thinking skills per indicator, for elementary clarification 61% is high, the basis for the decision 51.9% is moderate, inference 46.7% is moderate, advanced clarification 21.4% is low and strategies and tactics 25.2% is low. The average critical thinking skills of all the students of grade XI in SMA Negeri 5 Surakarta on rotational dynamics is 45%, it can be classified in moderate categorized.

Keywords: Critical Thinking Skills; Rotational Dynamics

1 Introduction

Education in the 21st century emphasizes student success, not only on academic skills but also on success in life [1]. Therefore, learning in the 21st century must support the achievement of these educational goals. This learning emphasizes the importance of 4C achievements, namely collaboration, creativity, critical thinking, and communication [2]. Learning in science is also directed towards 21st century learning. Based on the results of a survey conducted by Trends in International Mathematics and Science Study, students in Indonesia are ranked 46th out of 51 countries in the field of science [3].

Physics as a branch of science is one of the subjects in schools which in learning is expected to lead to 21st century learning. Physics learning related to natural phenomena has the goal of making students think critically, logically and creatively and solve related problems with the phenomenon. Therefore, interaction between teachers, peers, and the environment is needed to solve existing problems. One of the abilities needed to solve problems is critical thinking.

Critical thinking is a reflective thinking that focuses on determining what should be believed or done [4]. In addition, critical thinking which is part of high order thinking skills (HOTS) must be based on efforts to collect the necessary information, look for reasons, and also need to consider other people's opinions before doing something [5]. The skills to think critically is one of the important factors in learning physics, because it can help students draw a conclusion about something by considering the facts and data. The indicators of critical thinking skills according to Ennis are formulated in the table below.

Table 1. Critical Thinking Skills [6]

Indicator Critical thinking skills	Sub Indicator	Aspect
Elementary clarification	1. Focus on a question	<ul style="list-style-type: none"> a. Identify or formulate a question b. Identify or formulate criteria for judging possible answers c. Keep the question and situation in mind
	2. Analyze arguments	<ul style="list-style-type: none"> a. Identify conclusions b. Identify reasons or premises c. Identify simple assumptions d. Identify and handle irrelevance e. Determine the structure of an argument, possibly with a diagram f. Summarize
	3. Ask and answer clarification questions	<ul style="list-style-type: none"> a. Why? b. What is your main point? c. What would be an example? e. d. What would not be an example (though close to being one)? e. How does that apply to this case (describe a case, which appears to be a counterexample)? f. What difference does it make? g. What are the facts? h. Would you say more about that?
The basis for the decision	1. Judge the credibility of a source	<ul style="list-style-type: none"> a. Expertise b. Lack of conflict of interest c. Agreement with other sources d. Reputation e. Use of established procedures f. Known risk to reputation g. Ability to give reasons h. Careful habits
	2. Observe, and judge observation reports	<ul style="list-style-type: none"> a. Minimal inferring involved b. Short time interval between the observation and the report c. Report by the observer, rather than someone else d. Provision of records e. Corroboration f. Possibility of corroboration g. Good access h. Competent employment of technology i. Satisfaction by observer
Inference	1. Deduce, and judge deduction	<ul style="list-style-type: none"> a. Class logic b. Conditional logic c. Interpretation of logical terminology
	2. Make and judge inductive inferences	<ul style="list-style-type: none"> a. To generalizations

Indicator Critical thinking skills	Sub Indicator	Aspect
	and arguments	b. To explanatory hypotheses and conclusions
	3. Make and judge value judgments	a. Background facts b. Consequences of accepting or rejecting the judgment c. Prima facie application of acceptable principles d. Alternatives e. The need to balance, weigh, decide
Advanced clarification	1. Define terms and judge definitions	Three basic dimensions: a. Form b. Stance c. Content
	2. Identification assumptions	a. Unstated assumptions b. Needed assumptions
Strategies and tactics	1. Decide a course of action	a. Define the problem b. Choose a possible criteria as a solution of the problem c. Formulate the alternatives for solution d. Decide things to do e. Review f. Implementation monitor
	2. Interact with others	a. Label b. Logical strategy c. Rhetorical strategy d. Presenting a position, whether oral or written

This indicator helps to see the extent to which students in the learning process use critical thinking. Critical thinking that is accustomed to educators to students provides opportunities for students to understand and take an active role in learning. The skills to think critically provides benefits for students, namely students are more effective in learning, ask more challenging questions, and are more intensely involved in learning [7]. Based on this background, the problem raised was how students critical thinking skills were based on five indicators according to Ennis. The purpose of this study was to analyze the critical thinking skills of class XI students in the rotation dynamics material.

2 Methodology

The method used in this research is descriptive quantitative. The sample in the study was 70 students of class XI SMA Negeri 5 Surakarta. The data were obtained by giving a test of 15 multiple choice questions on the rotation dynamics material. The questions are arranged based on 5 indicators of critical thinking skills, namely elementary clarification, the basis for the decision, inference, advanced clarification, and strategies and tactics. Data analysis was performed after the data was collected using descriptive analysis techniques in the form of a percentage which was calculated using the following formula [8].

$$NP = \frac{R}{SM} \times 100\% \quad (1)$$

Keterangan:

NP = percent value

R = obtained score

SM = maximum score

The research data were grouped into five categories, namely very low, low, moderate, high, and very high with the following grouping categories:

Table 2. Critical Thinking Skills Category [9]

Categories	Score (%)
Very high	81 - 100
High	61 - 80
Moderate	41 - 60
Low	21 - 40
Very low	0 - 20

3 Results and Discussion

The following are the results of research data analysis and discussion:

Table 3. Critical thinking skills students as a whole

Categories	Student percentage (%)
Very high	0
High	14.3
Moderate	34.3
Low	51.4
Very low	0

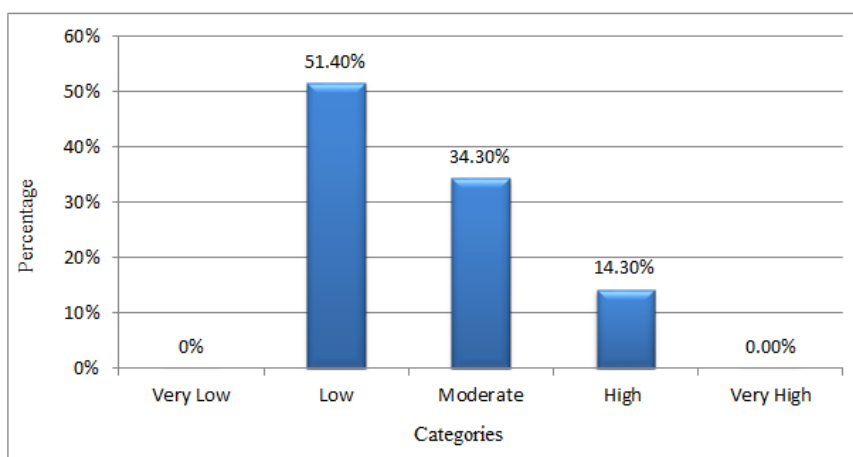


Fig. 1. Result of critical thinking skills students as a whole

Table 3 shows the students overall critical thinking skills. The highest percentage of students critical thinking skills was in the low category at 51.4% of the total students. Based on these results, it can be seen that half of the students are still in the low category and only 14.3% of students are in the high category. This shows that students critical thinking skills,

especially in the matter of rotational dynamics, really need to be improved. The learning process that makes students active can be one way to develop students critical thinking skills. In line with what Murawski said, that students critical thinking skills are more effective in the learning process where students can ask challenging questions, which means the student is able to analyze every problem [7].

Table 4. Critical thinking skills per indicator

Indicator	Percentage (%)	Categories	Average (%)
Elementary clarification	61	Tinggi	45 (Sedang)
The basis for the decision	51.9	Sedang	
Inference	46.7	Sedang	
Advanced clarification	21.4	Rendah	
Strategies and tactics	25.2	Rendah	

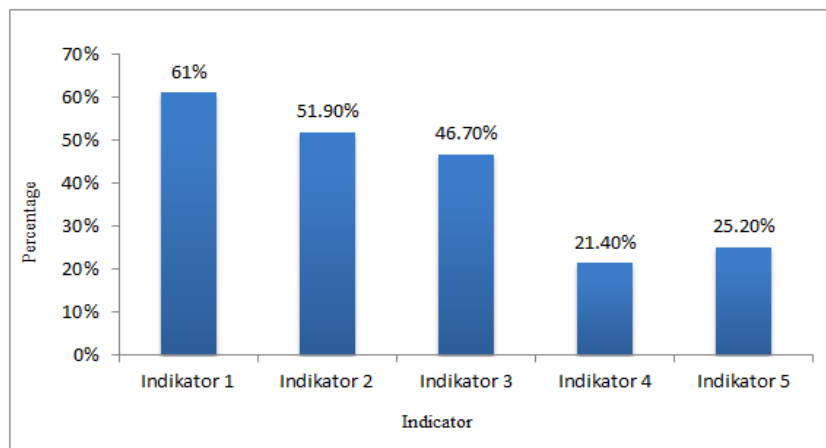


Fig. 2. Result of critical thinking skills students per indicator

Table 4 shows the students' critical thinking skills on each indicator according to Ennis. Based on the results above, it can be seen that the indicator of critical thinking skills with the highest percentage of achievement is elementary clarification, which is 61% and is categorized as high. While the lowest is the advanced clarification indicator at 21.4% which is included in the low category. Therefore, it appears that students have no difficulty solving problems that are included in the elementary clarification indicators. However, in advanced clarification, students experienced difficulties. This can be seen in the indicators of advanced clarification, the indicators of strategy and tactics are included in the low category, namely 25.2%. This exhibits that students still lack critical thinking skills when solving problems in this category. Two other indicators, namely the basis for the decision and inference are in the moderate category. This difference in achievement indicates that the questions or advanced problems still cannot be resolved properly by students. At an advanced level, solving problems requires higher critical thinking skills. This can be seen in the table of critical thinking skills, where the aspects of the indicators of advanced clarification and strategy and tactics are more difficult than other indicators [6].

Based on the results of this analysis, it can be seen that the students critical thinking skills in the rotation dynamics material are still categorized as low when viewed on each indicator.

Overall, the average critical thinking skills of students is 45% and can be classified in the moderate category. Therefore, in the learning process, methods that can improve students critical thinking skills should be used. This method can be in the form of problem based learning, discovery learning, or other methods that support active students in learning. As supposed by Majid and Rohman, learning such as a problem based learning model can develop thinking skills, problem solving, and help students become independent. This model challenges students to "learn how to learn" and work to find solutions to problem solving [10].

4 Conclusion

Based on data analyse, average critical thinking skills student of grade XI in SMA Negeri 5 Surakarta on rotational dynamics materials is 45%, it can be classified in moderate categorized. Results also shows critical thinking skills of student per indicator can be classified in high, moderate, and low categorized. Based on this research, critical thinking skills of student still needs to be improved. Critical thinking skills can be improved by applying learning models that can make students more active during the learning process in class. Students active role in the learning process can stimulate challenging questions that require students to think critically to solve problems.

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