

ANALYSIS INDICATOR OF CRITICAL THINKING SKILLS IN PHYSICS TEXTBOOKS FOR SENIOR HIGH SCHOOL GRADE X SEMESTER 1 IN PADANG

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ABSTRACT

This research aims to determine the availability of critical thinking skills indicators in physics textbooks for grade X semester one high-school physics used in Padang. This research is descriptive research with a qualitative approach. The data population in this study was all physics textbooks for Grade X semester 1 used in senior high schools in Padang. The research sample is the three physics textbooks that are most widely used in senior high schools in Padang. The data in this study were taken using critical thinking indicator analysis instruments in physics textbooks for grade X Senior High School with data collection techniques through documentation studies. Based on the results of the analysis of critical thinking skills indicators in the physics textbook for grade X semester 1, it was found that the physics textbook written by Marthen Kanginan published by Erlangga has the highest level of availability of critical thinking skills indicators with a percentage of 51.6% in the available category. In contrast, physics textbooks written by Aris Prasetyo Nugroho et al. and published by Mediatama have the lowest availability of critical thinking skills indicators with 29.6% with the less available category.

Keywords : Critical Thinking Skills; Physics Textbooks; Textbooks Analysis



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I. INTRODUCTION

Science and technology are developing very rapidly in the 21st-century. In the 21st-century, students have faced the era of globalization, which requires skills. Students are required to be able to master information technology in order to be able to adapt to the development of an increasingly advanced era. Students' skills in skills mark success in global competition as communicators, creators, critical thinkers, and collaborators. The rapid development of science and technology can significantly influence.

Education is a crucial benchmark in life or a reference for the quality of human resources. Through education, students are trained to have the skills to use technology and information media in order to adapt to the development of an increasingly advanced era. In order to compete with the advancement of education and the times, students are required to master various skills, one of which is the 6C skills (Collaboration, communication, critical thinking and problem solving, creativity and innovation, computational, and compassion).

6C skills can be achieved if learning in schools is student-centred, has innovation, teamwork, empowers metacognitive and contextual learning. The government has made efforts to achieve these 6C skills, one of which is by developing a curriculum. Currently, the curriculum used is the 2013 revised 2017 curriculum. The 2017 revised 2013 curriculum contains several important points, such as strengthening character education and HOTS (High Order Thinking Skills). HOTS and 6C skills are related to each other [1]. HOTS achievement indicators include problem-solving, critical thinking skills, creative thinking skills, and decision-making skills. HOTS can also be defined as the ability to use the information to solve problems, analyze arguments, and make predictions [2]. This HOTS achievement indicator shows that it is related to 6C skills, which both require students to have critical thinking skills.

Critical thinking is analyzing and evaluating thinking with a view to improve it, in another words, self-directed, self-disciplined, self-monitored, and self-corrective thinking [3]. Critical thinking enables the students to process information logically and prepare for independent study. Critical thinking is also known as thinking to regularly investigate the thought process itself [4]. The students who have critical thinking skills can determine which information is important, irrelevant, or useless [5]. Critical thinking is essential given to students to be equipped in facing the challenges of the 21st century in the era of globalization and competing in the world of work. Critical thinking skills in learning can be developed with several critical thinking indicators, including interpretation, analysis, evaluation, inference, explanation, and self-regulation. Interpretation is a skill in understanding and expressing the meaning of the problem. The analysis is a skill in identifying and inferring relationships between statements, questions, concepts, descriptions, or other forms. Evaluation is a skill in accessing the credibility of a statement/representation and logically accessing the relationship between statements, descriptions, questions, and concepts. The inference is a skill in identifying and obtaining the elements needed to conclude. Explanation is a skill in establishing and providing logical reasons based on the results obtained. At the same time, self-regulation is a skill to monitor one's cognitive activity [6]. The inference is a skill in identifying and obtaining the elements needed to conclude. Explanation is a skill in establishing and providing logical reasons based on the results obtained. At the same time, self-regulation is a skill to monitor one's cognitive activity[6]. The inference is a skill in identifying and obtaining the elements needed to conclude. Explanation is a skill in establishing and providing logical reasons based on the results obtained. At the same time, self-regulation is a skill to monitor one's cognitive activity[6].

Critical thinking skills will be achieved if the 2013 curriculum is implemented well. In fact, in schools, the 2013 curriculum has not been implemented optimally[1]. Teachers in the learning process still use the lecture method so that students' activeness has not been seen. The learning process is also not supported by learning resources that can train students to think critically. Students' critical thinking skills in learning will have an impact on student learning outcomes. This can be seen based on the analysis results of the first-semester physics exam for grade X in high school in Padang. The results of the analysis of the physics semester exam for grade X semester 1 in Padang that the percentage of students who answered the HOTS questions correctly was still categorized as low,

Improve students' critical thinking skills, and the Physics learning process can take place well, so teaching materials should support learning. Teaching materials that are often used in the learning process are textbooks. According to Muslich a good textbook must fulfill five main elements as follows: (1) The accuracy of concepts and definitions; (2) The accuracy of principle; (3) The accuracy of procedures; (4) the accuracy of examples, facts, and illustrations; (5) The Social Accuracy [7]. Sitepu argues that in writing a textbook, the materials provided in each chapter should contain four basic elements, including a foreword or introduction, subject matter, assessment, and summary[7].

There are four characteristics and functions of textbooks for students, namely: (1) motivating students to learn; (2) representing the subject of knowledge in the form of a systematic change of presentation, providing an accurate view of the nature of science and representing a picture of a phenomenon; (3) guide students' learning by identifying prior knowledge, providing explanations and activities to contain the knowledge and changing concepts, providing practice and application opportunities, including self-assessment; (4) guiding students to obtain learning strategies by stimulating students' metacognition and the use of learning strategies[8]. For teachers, there are two characteristics and functions of textbooks, namely: (1) assisting teacher planning by describing relevant content or subject knowledge, improve pedagogical knowledge relevant to the content being taught; (2) assisting the development of the teaching profession by developing content or subject knowledge and seeing the nature of teacher science, and can develop pedagogical knowledge, beliefs, and attitudes of teachers [8].

Because many publishers have widely circulated physics textbooks, it is necessary to study whether these books already contain indicators of critical thinking skills. Physics textbooks that already contain critical thinking skills are textbooks that contain critical thinking indicators. Therefore, it is necessary to conduct an analysis of the presentation of physics textbooks for grade X semester one related to critical thinking skills, to obtain relevant textbooks and already contain indicators of critical thinking skills.

II. METHOD

The type of this research is descriptive research and uses a qualitative approach. According to Sukmadinata descriptive research is a form of research aimed at describing existing phenomena, both natural phenomena and man-made phenomena[9]. Margono added that in this qualitative research, the analysis used is more descriptive-analytic, which means that the interpretation of the content is made and compiled systemically or thoroughly and

systematically[10]. This study attempts to report the object's state under study, namely analyzing critical thinking indicators in physics textbooks for grade X semester one.

The population in this study were all physics textbooks for grade X semester one used in Indonesia and circulated in Padang. The sampling technique used is non-probability sampling, which is purposive sampling, meaning that the sampling technique uses specific considerations. The samples in this study were three physics textbooks for grade X semester one curriculum 2013. The books that were used as samples were *Buku Fisika untuk SMA/MA Kelas X* by Marthen Kanginan with codebook A, *Buku Peserta didik Fisika untuk SMA/MA Kelas X* by Pujiyanto, et al. with book code B, *Buku Siswa Fisika Peminatan Matematika dan Ilmu-ilmu Alam untuk SMA/MA Kelas X* by Aris Prasetyo Nugroho, et al with book code C.

The instrument sheet is according to the indicators of critical thinking skills from Facione. The analysis sheet is made for each subject of physics in Senior High School grade X semester one by determining the indicators of critical thinking skills and then defining each of these skill indicators into instrument items. Each item of the instrument is given a choice of "yes" and "no." If there is an indicator of critical thinking skills in the textbook, it is given a checkmark. Suppose there is no indicator of critical thinking skills in the textbook for physics lessons. In that case, a tick is given to that condition.

The result of the validity as a whole is looking for using the moment kappa cohen formula in Boslaugh & Watters's book. The overall validity value is sought using the equation for the total average value of all criteria:

$$k = \frac{Po - Pe}{1 - Pe} \tag{1}$$

Information :

k = moment of kappa that shows product validity

Po = observed agreement

Pe = expected agreement

The validity category of the instrument made can be seen in Table 1.

Table 1. Instrument Validity Category [11]

Mark	Criteria
0,81 – 1,0	Very valid
0,61 – 0,80	Valid
0,41 – 0,60	Currently
0,21 – 0,40	Not valid
0 – 0,20	Invalid

This research is divided into three stages, namely the preparation stage, implementation stage, and completion stage. At the preparatory stage, several things must be done, namely: preparing a research design, determining the subject and object of research, compiling a draft instrument, testing the validity of the instrument to three validators, namely Drs. Amali Putra, M.Pd with a validation of 0.90 in the very valid category, Silvi Yulia Sari, M.Pd with a validation of 0.90 in the very valid category, and Putri Dwi Sundari, M.Pd with a validation of 0.78 with valid analyzing the results of the instrument validity test, and improving the instrument. The second stage is the implementation stage by analyzing the three physics textbooks using an analytical instrument for critical thinking skills indicators. The third stage is the completion stage, processing the research results, drawing conclusions from the research, and reporting the results.

The data collection technique of this research is through a documentation study. This documentation study is carried out by collecting documents or data needed in the research problem, then examined in depth. In this study, the document was used in a written document, namely a physics textbook for grade X semester 1. The data analysis technique used in this study was a content analysis technique from the written data. Content analysis is research conducted systematically on records or documents as data sources. The steps taken in the data analysis technique are as follows:

- 1) Summing up the critical thinking skills indicators in the analyzed textbooks.
- 2) Calculating the percentage of presentations of textbooks for SMA grade X semester one, which already contains indicators of critical thinking skills in each textbook which is analyzed by the formula:

$$\frac{\sum \text{Indicator of critical thinking skill found}}{\sum \text{Total of instrument items}} \times 100\% \tag{2}$$

- 3) Determine the average percentage of the proportion of each category of critical thinking skills from all analyzed books

- 4) Determine the criteria for presenting the physics textbook for grade X semester one related to critical thinking indicators according to riduwan, modified in Table 2.

Table 2. Textbook Presentation Criteria [12]

Percentage Interval	Criteria
81 – 100	Very Available
61-80	Available
41-60	Enough Available
21-40	Less Available
0-20	Not available

- 5) Draw conclusions based on the analysis indicators of critical thinking skills in physics textbooks for grade X semester 1.

III. RESULTS AND DISCUSSION

The textbooks used in this research were three samples of textbooks labelled book A, book B, and book C. The analysis was carried out to determine the availability of critical thinking skills indicators in each material. The results of the analysis of indicators of critical thinking skills in each physics textbook for grade X semester one are shown in Table 3 below.

Table 3. The Results of The Analysis of Indicators of Critical Thinking Skills in Physics Textbooks for Grade X High School Semester 1

Book Code	Material	Score (%)						Average (%)	Average per book (%)
		Interpretation	Analysis	Evaluation	Inference	Explanation	self-regulation		
Book A	The Nature of Physics	50	75	25	66.7	66.7	0	47.2	51.6
	Measurement of Physical Quantities	75		50	66.7	66.7	50	68.1	
	Vector	50	75	25	33.3	33.3	0	36.1	
	Straight Motion	25	75	66.7	100	33	50	58.3	
	Parabolic Motion	0	100	50	100	66.7	0	52.8	
	Circular Motion	0	75	25	66.7	66.7	50	47.2	
B book	The Nature of Physics	25	75	0	33.3	33.3	0	27.8	31.5
	Measurement of Physical Quantities	25	75	0	66.7	33.3	50	41.7	
	Vector	25	75	50	33.3	33.3	0	36.1	
	Straight Motion	25	75	0	33.3	66.7	0	33.3	
	Parabolic Motion	0	50	50	33.3	0	0	22.3	
	Circular Motion	0	100	0	66.7	0	0	27.8	
C book	The Nature of Physics	25	0	25	66.7	33.3	100	25	29.6
	Measurement of Physical Quantities	50	50	25	66.7	0	0	31.9	
	Vector	25	75	0	66.7	0	0	27.8	
	Straight Motion	0	100	50	66.7	0	0	36.2	

Parabolic Motion	0	75	0	66.7	0	0	23.6
Circular Motion	0	50	50	100	0	0	33.3
Amount	400	1300	491.7	1133.5	533	200	701.5
Average(%)	22.2	72.2	27.4	62.9	29.6	11.1	38.9

Table 3 shows the results of the analysis of critical thinking skills indicators in Physics textbooks for grade X semester one from book A, book B, and book C. Based on the results of the analysis in Table 3, it is found that the percentage of critical thinking skills indicators in each textbook different. Aspect, The indicator of critical thinking skills that often appears is in the analytical aspect. Almost all books display a higher and dominant aspect of analysis with a percentage of 72.2%. The three books also emphasize the inference aspect. However, the value is less than the analytical indicator, with a percentage of around 62.9%. The indicator aspect of critical thinking skills that appears the least is the aspect of self-regulation, with a percentage of 11.1%.

According to the analysis of critical thinking skills indicators in the three Physics textbooks for grade X semester 1, it was found that the percentage of critical thinking skills indicators in each textbook was different. Book A has the highest critical thinking skills indicator with a percentage of 51.6% with a reasonably available category. Then book B with an indicator level of critical thinking skills of 31.5% with a less available category. Book C with a critical thinking skill level of 29.6% with a less available category.

The results of the analysis indicators of critical thinking skills on each material contained in the Physics textbooks for Grade X for Senior High School semester one are analyzed as follows:

1. Book A

The analysis in book A can be seen in Figure 1.

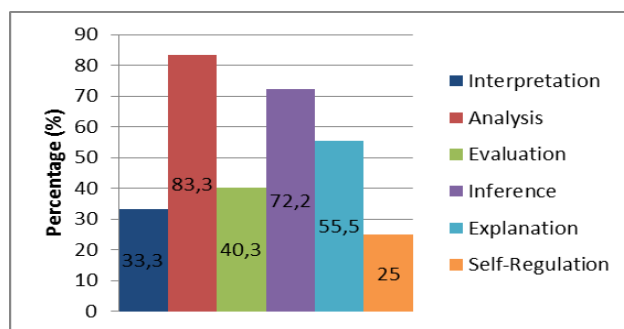


Fig. 1. Results of analysis of critical thinking skills indicators in book A

Figure above shows the percentage of results obtained from critical thinking skills indicators analysis in book A. The availability of critical thinking skills indicators in book A is 51.6% and is categorized as reasonably available. Book A has a higher critical thinking skills indicator availability than book B and book C. The most common aspect of critical thinking skills found in book A is the analytical aspect, with an average percentage of 83.3%. This aspect of the analysis as a whole is in the highest available category. This indicates that there is an activity in identifying a concept, statement, description, or information in book A. The analysis aspect is a skill in identifying or analyzing a concept, statement, description, information, or another form of representation[6]. Aspects of the analysis found in textbooks are in the form of in-depth identification activities of a statement, concept, description, and information[13]. This analysis's most commonly found aspect is the parabolic motion material pad with an occurrence percentage of 100%.

The second aspect with the emergence of a high percentage is the inference aspect, with an average percentage of 72.2%. This aspect is in the available category. The aspect of inference found in textbooks is the activity of concluding concepts and information [13]. The material for the straight and parabolic motion in book A has a very high percentage on the inference aspect, with a percentage of 100%. On the material nature of Physics. Meanwhile, the inference aspect of vector material has the lowest percentage, which is 33.3%.

Critical thinking skills that appear the least in book A is the interpretation aspect with an average percentage of 33.3%, which is in the moderately available category. Even this aspect of interpretation is not found in the material for the parabolic motion and circular motion. The most commonly found interpretation aspect is the material for measuring physical quantities, which obtains a percentage of 75%. As for the material

nature of physics, and the appearance vector of this interpretation aspect is 50%. Followed by the material of straight motion, the appearance of this interpretation aspect is only 25%. The interpretation aspect is related to the ability of students to interpret and describe the observed object[14].

2. Book B

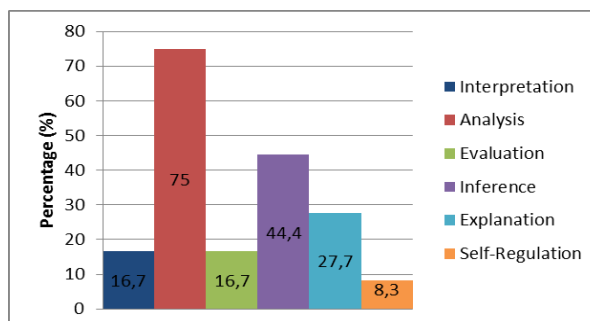


Fig. 2. Results of analysis of critical thinking skills indicators in book B

The analysis of critical thinking skills indicators in book B can be seen in Figure 2. The availability of critical thinking skills indicators in book B is 31.5% and is in the less available category. Critical thinking skills mostly found in book B are the analytical aspect with an average percentage of 75%. This aspect of the analysis as a whole is in the available category. Similar to book A, the analytical aspect still dominates its availability in book B. Because in book B, there is a skill that can make students able to investigate, identify, or analyze various facts, statements, concepts, etc. The analytical aspect in book B has the highest percentage of circular motion material. The material of the nature of physics, measurement and physical quantities, vectors, and straight motion aspects of the analysis obtained a percentage of 75%. Moreover, the parabolic motion material has a percentage of 50%.

The second aspect of critical thinking skills found in book B is the inference aspect, with an average percentage of 44.4%. In textbooks, there are many commands in carrying out experiments or proof of concepts that require students to conclude. This aspect of inference is most commonly found in the material measuring physical quantities and circular motion with the percentage of availability of the inference aspect being 66.7%. For the rest of the material nature of physics, vectors, straight motion, and parabolic motion, the availability percentage is 33.3%.

The aspect of critical thinking skills least found in book B is self-regulation, with an average percentage of 8.3%. This is caused by the lack of activity in the textbook in monitoring the cognitive activity of students. As words of activity to question and make corrections to the information presented. Words used to question information in the textbook are to make a question on the sentence[13]. This self-regulation aspect is only found in the material for measuring physical quantities with an availability percentage of 50%. Meanwhile, the material nature of physics, vectors, straight motion, parabolic motion, and circular motion is not found in the availability of this self-regulation aspect.

3. Book C

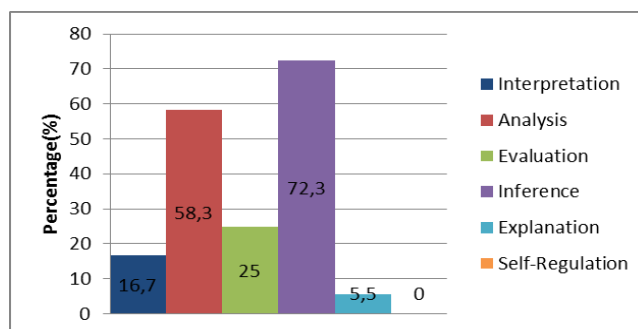


Fig. 3. Results of analysis of critical thinking skills indicators in book C

Figure 3 shows the results of the analysis of critical thinking skills in book C. The availability of critical thinking skills indicators in book C is 29.6% and is in the less available category. The aspect of critical thinking skills primarily found in book C is the inference aspect, with an average percentage of 72.3%. This aspect of

inference as a whole is in the available category. It is different from book A and book B. In book C more aspects of inference are found because of the many orders in conducting experiments or an activity that requires students to conclude these activities. The inference can identify and obtain the elements needed to make a reasonable conclusion[15]. The inference aspect in book C has the highest percentage of circular motion material. Other material aspects of inference obtained the same percentage of 66.7%.

Aspects of critical thinking skills found later are in the analysis aspect, with an average percentage of 58.3%. Similar to book A and B, there are several activities to identify in depth from a statement, concept, description, and information in book C. This aspect of analysis appears most in straight motion material with a very high percentage of 100%. Vector material and parabolic motion obtain an availability percentage of 75%. As well as the material for measuring physical quantities and circular motion obtained an availability percentage of 50%. Meanwhile, like physics, this aspect of the analysis was not found.

An aspect of critical thinking skills that are not found in book C at all is self-regulation. This is due to the absence of activity in the textbook or the absence of order in the Physics textbook for grade X semester 1, which directs students in questioning or critically correcting the views or information presented. Students' problems in this aspect are related to their ability to regulate their existence[14].

Thinking skills, one of which is critical thinking skills, have long been the primary goal in education[16]. Critical thinking skills are critical competencies to be applied. Because critical thinking skills are needed in life and can create quality resources if the knowledge is gained from applying a culture of critical thinking, it is better if teaching materials support learning in textbooks to improve students' critical thinking skills at school.

Several factors can affect the results of this study, including differences in the content and activities of each textbook so that the availability of critical thinking skills indicators is not evenly distributed. When viewed from the emergence of critical thinking skills in the books analyzed, generally more emphasis on the analytical aspect and less emphasis or less available on the self-regulation aspect.

IV. CONCLUSION

The textbook for high school physics grade X semester 1, which has the highest percentage of critical thinking skills indicators, is *Buku Fisika Untuk SMA/MA Kelas X* by Marthen kanginan with code (book A) with an average percentage of 51.6%, which is categorized as available critical thinking skills indicators. Physics textbooks for grade X semester one which has the lowest percentage of critical thinking skills indicators are *Buku Siswa Fisika Peminatan Matematika dan Ilmu-ilmu Alam Untuk SMA/MA Kelas X* by Aris Prasetyo Nugroho et al. with the code (book C) with a percentage of 29.6% which is categorized as lacking critical thinking skills indicators.

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