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Analysis Availability-Indicators of Critical Thinking Skills in Printed Physics Book

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ABSTRACT

Thinking skills have become the basis for implementing learning in the 21st century. Efforts that can be made to apply critical thinking skills are using teaching materials. However, no known teaching material includes indicators of critical thinking skills. This study the availability of critical thinking skills indicators in teaching materials. Therefore, analytical research was conducted on the availability of critical thinking skills indicators in one type of teaching material, namely printed books. This type of research is descriptive research with quantitative and qualitative approaches. The population determined in this study is the textbook for physics in high school class XI which was found in Senior High School throughout the city of Padang. The research sample was physics books for class XI, which were mostly found in Senior High School in Padang City. The research data was obtained by using an analysis sheet in high school physics books for class XI. Data analysis results obtained are book X with a percentage of 56.38%, book Y with 48.78%, and book Z with 56.14%. The criteria for critical thinking skills indicators in the three books are quite available.*

Keywords :*printed book; critical thinking skills*

I. INTRODUCTION

Critical thinking skills need to be applied as the basis of learning in the 21st century [1]. Therefore, the curriculum as a guide to the implementation of learning [2] must direct the application of critical thinking skills [3]. Applying critical thinking skills in the curriculum can help citizens prepare for careers and meet national education standards [4]. Critical thinking skills are strategies for solving problems and making reflective decisions [5]. These skills are essential for innovation and discovery [6]. The essence of this skill is to give birth to ideas or products that have never existed before, both personally and in a wider cultural context [7]. The indicators of thinking skills according to Ennis are: 1) elementary clarification directs to analyze statements from an explanation, 2) basic support which directs to consider the truth of information sources, 3) inference directs to conclude the results of the discussion, 4) advance clarification directs to identify terms and assumptions, 5) strategies and tactics directing action against others are controlled [8]. According to CTTST (2011) critical thinking skills consist of 1) analysis, namely interpreting and understanding the presentation of images, graphs, diagrams, and others, 2) evaluation, namely the ability to assess and conclude information, 3) inference, namely the ability to draw conclusions from various sources of information, 4) deductive thinking, namely the ability to draw conclusions from general to specific, 5) inductive thinking, namely making conclusions that are specific to general [9]. According to Facione there are six indicators of critical thinking skills, namely: 1) The indicators of critical thinking skills developed in this study are based on six indicators according to Facione (2011), namely: Interpretation that leads to understanding the meaning of a problem from events, situations, data, procedures, criteria, conventions, examples of sub-indicators, namely describing, identifying, clarifying, interpret. In addition, according to [10] interpretation is the ability to analyze situations based on facts and evidence, 2) The analysis directs to identify the inferential and actual relationship of a question, statement, concept, description, or another form of description, examples of sub-indicators identifying similarities and differences, selecting claims, identifying, sketching [11]. An example of an analysis is identifying the conceptual relationship between

questions and statements [10], of analysis is to identify a statement, concept, description, and information according to [12] 3) Evaluation leads to assessing the credibility of a statement or representation and assessing inferential and actual relationships, examples of sub-indicators assessing, and comparing [11]. Evaluation activities can compare data and facts [13], 4) Inference directs to identify and secure elements in drawing conclusions, making hypotheses, considering information, and examples of sub-indicators developing, doing, confirming, or denying [11]. The ability to draw conclusions from an observed event [14]. An example of an inference indicator is drawing conclusions from concepts and information [12], 5) The explanation leads to convincingly presenting a result, examples of sub-indicators presenting and designing the display of experimental results [11].The explanation aspect provides arguments based on the data and facts obtained [10]. One form of dismissal of an explanation is to re-explain the information presented [12], 6) Self-regulation directs to apply of analysis and evaluation skills to oneself with sub-indicators of self-examination and correction [11]. Self-regulation is the ability to monitor oneself in evaluating understanding [10]. Aspects of self-regulation in the form of correcting activities [12]. The indicators developed in this study were adopted from Facione, which can be seen in Table 1.

Table 1. Item Instrument

Item		Item Indicator
Interpretation	1.	Printed books lead students to recognize a problem in an application
	2.	Printed books guide students to identify problem solutions
	3.	The printed book guides students to clarify the facts presented
	4.	The printed book guides students to determine the data from a question
	5.	Printed books guide students to interpret data based on pictures/graphs/tables
	6.	Printed books guide students to explain the meaning of pictures/graphs/tables
	7.	Printed books guide students to explain a procedure
	8.	Printed books guide students to identify a problem with different criteria presented
Analysis	1.	The printed book guides students to sketch the relationship of a concept
	2.	Printed books guide students to identify similarities or differences in a concept
	3.	Textbooks guide students to identify the influence of a concept
	4.	The textbook guides students in identifying the relationship between several concepts/principles
	5.	Printed books guide students to identify two or more methods of problem-solving
	6.	The printed book guides students in choosing a claim from several statements
Evaluation	1.	Printed books guide students to assess the truth of a concept
	2.	The printed book guides students to assess whether two or more statements are contradictory or not
	3.	Printed books guide students to compare the results of discussion/experiment activities
Inference	1.	Printed books guide students to find/gather information
	2.	Printed books guide students to conduct discussions/experiments
	3.	Printed books guide students to create a project (props, videos, etc.)
	4.	Printed books guide students in developing an idea
	5.	Printed books guide students to conclude the results of discussions/experiments/ideas/ideas
	6.	Printed books guide students to confirm or refute a principle
Explanation	1.	Printed books guide students to create/design a display of discussion results/experimental results/projects/ideas/ideas
	2.	Printed books guide students to present the results of discussions/experiments/projects/ideas/ideas
	3.	Printed books lead students to give an argument

Self-regulation	1. Printed books guide students to review previous related material 2. Printed books guide students to self-evaluate their understanding of the material

Applying critical thinking skills in the learning process can train students' mindsets to solve complex problems [15]. Teachers play an important role in developing students' thinking potential, one of which is by improving critical thinking skills [16]. Critical thinking skills can be applied in all subjects in school, one of which is physics. Physics is a complex science that is related to its application in everyday life. Physics learning that incorporates indigenous science and scientific science can help students understand scientific concepts better and make learning more meaningful [17]**.** Physics is a science that requires reasoning in its study. Meanwhile, according to Chukwuyenum to solve complex problems requires critical thinking skills [18]. Thus, critical thinking skills are suitable to be applied in physics. One of the efforts to maximize the application of critical thinking skills in physics learning is to use teaching materials that lead to critical thinking skills. Teaching materials are a form of learning resource that can support the productivity of the learning process [19]. Learning that leads to critical thinking skills will motivate and improve learning outcomes [1]. However, based on learning outcomes, one of which is the percentage of the 2019 physics National Exam, it is known that students' critical thinking skills are still low at 53.84% [20]. The main factor that causes low critical thinking skills among students in that school is teacher-centered learning, which limits students' opportunities to develop their critical thinking skills independently [21]**.** The category of National Exam Physics results for Senior High School in Padang City is classified as less critical based on the category dismiss [22]. The percentage of National Exam results was obtained after analyzing the indicators of critical thinking skills dismiss Facione so that the results of the National Exam could describe the critical thinking skills of students in Senior High School throughout the city of Padang. Critical thinking skills are one of the cognitive skills that are important to optimize in physics learning [23]**.**

Critical thinking skills that are still low can be caused by various factors, namely the use of inappropriate materials [24]**.** Therefore, it is necessary to analyze the teaching materials found in Senior High School in Padang City, one of which is printed books. Printed books were chosen because printed books are the type of teaching materials that are made intentionally for learning [25]. Printed books can be used directly without the help of technology [26]. According to Swanepoel, printed books function to motivate students, present systematic material, guide students in acquiring knowledge, and stimulate students' metacognition [27]. So that the contents of the printed book are developed based on the required domain according to the applicable curriculum. According to that Sitepu, printed books contain at least 4 elements, namely introduction, subject matter content, evaluation, and content summary [28]. The selected printed book is a Class XI Senior High School Physics book because the scope of the material is the result of the National Examination.

II. METHOD

The type of research used descriptive research with quantitative and qualitative approaches. A quantitative used to obtain data from the analysis in the form of numbers, while to explain the meaning of numerical data, a qualitative approach is used [29]. This study describes the availability of indicators critical thinking skills in printed textbooks for class XI.

Population of the study was textbooks for high school physics class XI which were found in Senior Higr School throughout the city of Padang. The sampling technique of this research is non-probability with a purposive sampling type. The printed books used in the study were considered using textbooks for physics class XI which were mostly found in Senior High School in Padang City and were based on the revised 2013 curriculum. The research samples obtained were 3 pieces, namely the essays of Ketut Kamajaya and Wawan Purnama published by grafindo coded as book X, essays by Marthen Kanginan published by Erlangga coded as book Y, and the essays by Pujianto, et al. Intan pariwara publications are coded as Z book.

The research instrument used was an analysis sheet on the availability of critical thinking skills indicators in a physics textbook for class XI SMA. Aspects developed in the analytical instrument based on Facione are interpretation, analysis, evaluation, inference, explanation, and self-regulation. The feasibility of the instrument used was validated by 3 validators using a Likert scale of 1-5. Then the validation results are processed using the Aiken V formula [30], namely:

$$V = \frac{\Sigma s}{[n\,(c-1)]} \qquad (1)$$

$$(s = r - I_0)$$

Information:
V = index of agreement of raters (experts)
s = score given by rater is reduced by the lowest score
r = rater choice category score
I_0 = lowest score
n = number of raters
c = number of categories (highest value of the scale used)

Table 2. Aiken V. Rating Index Category [30]

Interval	Category
V ≤ 0,4	Less valid
0,4 < V < 0,8	Valid
V > 0,8	Very valid

There are 3 stages of research, namely preparation, implementation, and completion. At the preparatory stage, instruments are compiled and validated. The average result of validation by 3 validators is 0.76 with a valid category. The instrument that has been valid is then used at the implementation stage, namely analyzing the physics textbook for class XI High School. After completing the analysis, the third stage is completed, namely compiling a report on the results and making research conclusions.

The research data collection technique is a documentation study in the form of a physics textbook for class XI high school students to obtain analysis data on the availability. The data analysis technique is obtained by assessing each of the 4 indicators that appear in the book. The number of each item of the critical thinking skill indicator in the XI High School physics textbook that appears is calculated by the formula:

$$\frac{\sum indicator\ that\ appears}{total\ \sum indicator\ that\ appears}\ x\ 100\% \qquad (2)$$

Table 3. Criteria of Availability

Percentage Criteria	Category
81-100	Very Available
61-80	Available
41-60	Enough Available
21-40	Not Enough Available
0-20	Not Available

The criteria for the percentage of critical thinking skills are interpreted to form of words.

III. RESULTS AND DISCUSSION

The results of the analysis on 3 textbooks of physics textbooks for class XI were mostly found in Senior High School throughout the city of Padang and had used the revised 2013 curriculum, namely book X, book Y, and book Z. The scope of material in class XI books consisted of 12 KD. The average percentage of the availability of critical thinking skills indicators in the three books figure 1 displays this information.

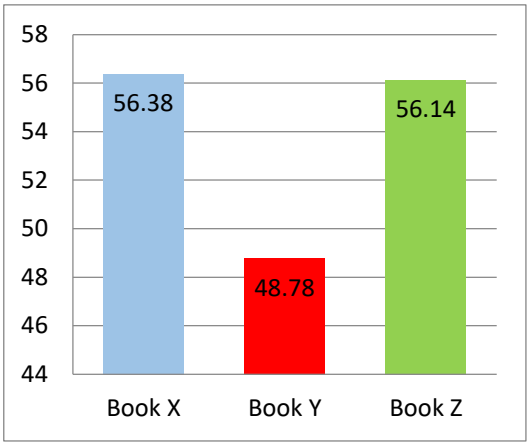

Figure 1. Average Percentage of Availability

Based on Figure 2, known average percentage availability of indicators in each class XI high school physics textbook varies. The highest percentage of book X is 56.38% in the "Sufficiently Available" category, while the lowest percentage is Book Y at 48.78% in the "Sufficiently Available" category. The availability of critical thinking skills indicators can help students motivate learning so that maximum results are obtained [1]. Meanwhile, the percentage of each indicator in the three printed books can be seen in Figure 2.

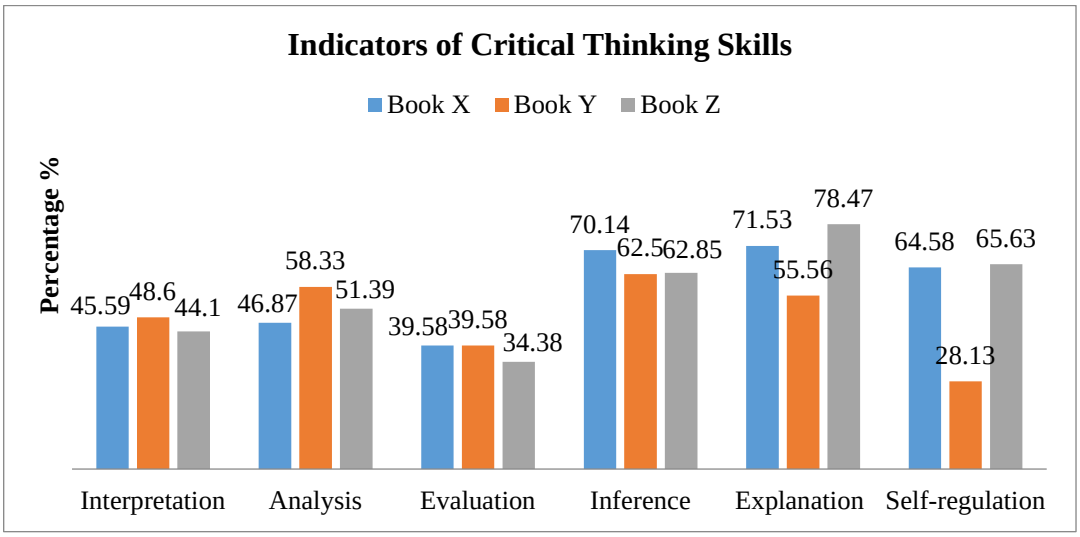

Figure 2. Percentage of Availability of Critical Thinking Skills Indicators

Based on Figure 2, known average percentage the availability of critical thinking skills indicators in each class XI high school physics textbook varies. In the interpretation indicator, it is known that the three books belong to the "Sufficiently Available" category with the highest percentage being Book Y at 48.6%, and the lowest percentage being Book Z at 44.1%. The availability of interpreted indicators can make students able to understand the meaning of learning material [11]. In the analysis indicators, it is known that the three books are classified as "Sufficiently Available" with the highest percentage being Book Y at 58.33% and the lowest percentage being Book X at 46.87%. The availability of analytical indicators can help students understand the presentation and interpret the sources of information presented [9]. In the evaluation indicators, it is known that the three books are classified as "Sufficiently Available" with the highest percentage of books X and Y amounting to 39.58%, and the lowest percentage being book Z of 34.38%. The availability of evaluation indicators will help students assess and conclude an information presentation [9]. In the inference indicator, it is known that the three books are classified as "Available" with the highest percentage being Book X at 70.14% and the lowest percentage being Books Y and Z at 62.5%. The availability of inference indicators will help students compare and consider an activity result [8]. In the explanation indicator, it is known that book X and book Z are in the "Available" category and book Y is in the "Sufficiently Available" category with the highest percentage being book Z at 78.47% and the lowest percentage being book Y at 55.56%. The availability of explanation indicators helps students assess the truth of an information presentation [11]. In the self-regulation indicator, it is known that book X and book Z are in the "Available" category and book Y is in the "Unavailable" category with the highest percentage being book Z at 65.63% and the lowest percentage being book Y at

28.13%. The availability of self-regulation indicators helps students to evaluate and correct their self-understanding [11].

Table 3. Analysis Results

Book Code	Material	Score (%)						Average	Average per book %
		Interpretation	Analysis	Evaluation	Inference	Explanation	Self-Regulation		
Book X	KD 3.1	50,00	37,50	25,00	83,33	75,00	75,00	57,64	56,38
	KD 3.2	53,13	50,00	25,00	66,67	50,00	62,50	51,22	
	KD 3.3	43,75	50,00	37,50	58,33	83,33	62,50	55,90	
	KD 3.4	34,38	37,50	25,00	83,33	83,33	62,50	54,34	
	KD 3.5	40,63	62,50	62,50	58,33	75,00	62,50	60,24	
	KD 3.6	50,00	58,33	62,50	87,50	83,33	62,50	67,36	
	KD 3.7	40,63	37,50	25,00	62,50	91,67	75,00	55,38	
	KD 3.8	53,30	50,00	62,50	50,00	33,33	62,50	51,94	
	KD 3.9	56,25	45,83	25,00	70,83	75,00	62,50	55,90	
	KD 3.10	50,00	50,00	50,00	83,33	83,33	62,50	63,19	
	KD 3.11	40,63	25,00	25,00	62,50	75,00	62,50	48,44	
	KD 3.12	34,38	58,33	50,00	75,00	50,00	62,50	55,04	
Book Y	KD 3.1	46,88	75,00	62,50	58,33	66,67	25,00	55,73	48,78
	KD 3.2	34,38	25,00	50,00	62,50	50,00	25,00	41,15	
	KD 3.3	59,38	58,33	25,00	62,50	25,00	25,00	42,54	
	KD 3.4	58,13	58,33	25,00	70,83	25,00	25,00	43,72	
	KD 3.5	68,75	70,83	25,00	83,33	100,00	62,50	68,4	
	KD 3.6	34,38	62,50	25,00	37,50	25,00	25,00	34,90	
	KD 3.7	43,75	75,00	62,50	62,50	75,00	25,00	57,29	
	KD 3.8	62,50	50,00	37,50	50,00	50,00	25,00	45,83	
	KD 3.9	34,38	37,50	25,00	37,50	25,00	25,00	30,73	
	KD 3.10	43,75	62,50	50,00	75,00	75,00	25,00	55,21	
	KD 3.11	53,13	62,50	62,50	100,00	75,00	25,00	63,02	
	KD 3.12	43,75	62,50	25,00	50,00	75,00	25,00	46,88	
Book Z	KD 3.1	43,75	41,67	62,50	62,50	75,00	62,50	57,99	56,14
	KD 3.2	25,00	50,00	25,00	41,67	75,00	62,50	46,53	
	KD 3.3	34,38	33,33	62,50	83,33	75,00	62,50	58,51	
	KD 3.4	43,75	50,00	25,00	62,50	75,00	62,50	53,13	
	KD 3.5	43,75	75,00	25,00	75,00	75,00	62,50	59,38	
	KD 3.6	34,38	62,50	25,00	62,50	50,00	62,50	49,48	
	KD 3.7	25,00	25,00	25,00	50,00	100,00	62,50	47,92	
	KD 3.8	50,00	50,00	62,50	62,50	100,00	62,50	64,58	
	KD 3.9	50,00	50,00	25,00	62,50	75,00	62,50	54,17	
	KD 3.10	66,67	66,67	25,00	75,00	91,67	100,00	70,84	
	KD 3.11	50,00	50,00	25,00	62,50	75,00	62,50	54,17	
	KD 3.12	62,50	62,50	25,00	54,17	75,00	62,50	56,95	
Average		46,10	52,20	37,85	65,16	68,52	52,80		

Table 3 provides the results of the analysis of indicators of critical thinking ability in Class XI Physics textbooks in particular, with 12 basic competition materials (KD) in each type of book. The bacic competition are KD 3.1 Balance and Motion, KD 3.2 Elasticity and Hooke's Law, KD 3.3 Static Fluids, 3.4 Dynamic Fluids, KD 3.5 Temperature, Heat and Heat Transfer, KD 3.6 Kinetic Theory of Gases, KD 3.7 Thermodynamics, KD 3.8 Wave Mechanics, KD 3.9 Moving and Stationary Waves, KD 3.10 Sound and Light Waves, KD 3.11 Optical Devices, KD 3.12 Global Warming. The explanatory aspect is the one that appears the most, with almost all

books showing a higher analytical aspect and dominating the percentage at 68.52%. These three books also pay attention to the inference aspect, although the percentage is lower than the inference indicator, which is around 65.16%. The Aspect of critical thinking skills that appears most rarely is evaluation, with a percentage of only 37.85%.

After analyzing the critical thinking ability indicators in three class XI physics textbooks, it was revealed that the percentage of critical thinking ability indicators was different in each textbook. The book then book Y has a critical thinking ability indicator of 48.78%, with the sufficient category available. Book Z has a critical thinking ability level of 56.13%, with sufficient criteria available.

Below the average percentage of critical thinking skills in book X the highest on the kinetic theory of gases and the lowest percentage on elasticity & Hooke's law. In the matter of gas kinetic theory, the inference indicator is the indicator with the highest percentage because printed books, it has led to finding information, conducting discussions/experiments, developing ideas/ideas, concluding the results of discussions/experiments/ideas developed, confirming the truth of the principle. the availability of inference indicators to improve the ability of students to consider the material obtained [8]. The lowest percentage of indicators is interpretation, because printed books, it does not lead to identifying solutions to a problem, clarifying facts, data from pictures/graphs/tables, explaining procedures, and recognizing problem definitions. The low availability of items on the interference indicator makes students unable to analyze data and facts situations [10].

In terms of elasticity & Hooke's law in book X, the highest percentage of inferences in books is already available for conducting discussions/experiments, concluding the results of discussions/experiments, finding information, and making projects. The achievement of inference indicators is able to make students draw conclusions from the observed events [14]. The lowest percentage of indicators is evaluation because the book has not assessed the truth of a concept, assessed two/more statements, and compared the results of discussions/experiments. The low percentage of evaluation indicators makes students unable to compare data and facts [13].

In book Y, the average percentage of critical thinking skills is highest on the material of temperature, heat, and heat transfer and the lowest on the material of traveling and stationary waves. In the matter of temperature, heat & heat transfer, the explanatory indicator is the indicator with the highest percentage because the printed book has been guided to design the display of the results of discussions/experiments/projects/ideas, present the results of discussions/experiments/projects/ideas, and provide an argument. the availability of explanation indicators makes students able to re-explain the material being studied [12]. The lowest percentage of indicators is evaluation because the book, they have not assessed the truth of a concept, assessed two/more statements, and compared the results of discussions/experiments. The low achievement of evaluation indicators makes students unable to judge a truth [11].

On the traveling & stationary wave material in book Y, the highest percentage is analysis and inference. Analysis indicators in printed books have led to choosing from several statements, inference indicators in printed books, have found information, and conducted discussions/experiments. The achievement of analytical indicators can lead students to choose claims and the achievement of inference indicators is able to complete the elements needed to draw conclusions [11]. The lowest percentage of indicators is evaluation, explanation, and self-regulation. Indicators in printed books have not taken steps to assess the truth of a concept, evaluate two/more statements, compare the results of discussions/experiments and explanation indicators in books, have not guided to design the display of discussion/experiment results, present the results of discussions/experiments, provide arguments, on self-regulation indicators in the book, have not led to reviewing related material and developing an understanding of the material. The low achievement of self-regulation indicators makes it difficult for students to motivate themselves in understanding [10].

In book Z, the average percentage of critical thinking skills is highest on sound and light waves and the lowest on elasticity and Hooke's law. In the material of sound and light waves, the indicator with the highest proportion is self-regulation because, in the book, it has led to reviewing related material and its relation to understanding the material. The achievement of self-regulation indicators for students who can correct and monitor themselves [11]. The lowest percentage of indicators is evaluation because, in the book, it has not taken steps to assess the truth of the concept, judge two/more contradictory or contradictory, and compare the results of discussions/experiments.

In the material of elasticity and Hooke's law in book Z, the highest percentage of indicators is an explanation because, in printed books, it has been guided to design the display and present the results of discussions/experiments/projects/ideas. The lowest percentage of indicators is interpretation because, in the book, it does not lead to recognizing a problem in a general way application, a solution idea, clarifying the facts found, determining data from a question, determining data based on pictures/graphs/tables, explaining meaning/graphics/picture tables, explaining procedures, and differentiating criteria for a problem. In addition, the other lowest percentage on elasticity and Hooke's law is evaluation in printed books, not assessing the truth of a concept, judging two or more contradictory or not, or comparing the results of discussions/experiments.

One of the limitations of this study is that it is difficult to objectively measure the indicators of critical thinking skills in physics textbooks. This is because the measurement can be subjective, depending on the interpretation of the researcher.

IV. CONCLUSION

The results of the analysis showed that in three textbooks of high school physics class XI the three books were categorized as sufficient to facilitate critical thinking skills. The highest percentage of critical thinking skills in book X is 56.38% and the lowest percentage in book Y is 48.78%. Meanwhile, the highest indicator of critical thinking skills is an explanation in book Z of 78.47% and the lowest indicator is self-regulation in book Y of 28.13%. In book X the percentage of availability of the highest indicator is the explanation and the lowest percentage is evaluation. In book Y the percentage of availability of the highest indicator is an analysis and the lowest percentage is self-regulation. Future research should expand the measurement of critical thinking skills to include more comprehensive methods, such as the use of reliable and valid assessment instruments.

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