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The Development of Mathematical Critical Thinking Instrument Assessment

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THE DEVELOPMENT OF MATHEMATICAL CRITICAL THINKING INSTRUMENT ASSESSMENT

Abstract: The research aims to determine the validity and effectiveness of the learning instruments developed. So far, the main purpose of the assessment is to determine the competence of students before and after learning, making it easier for teachers to provide feedback in order to improve the learning tools used and provide information to parents about education in schools. This research is a development research. The development model used is a 4-D model which consists of four stages, namely definition, design, development and dissemination. The results of the validation of the developed learning instruments were included in the valid category with the average validity of the total lesson plan = 4.45; and student books = 4.42.
Keywords: Assessment; Critical Thinking

Introduction

The success of an education whose main purpose is to increase human resources is influenced by the factors of the teacher's ability to conduct assessments. This ability is needed to determine whether the learning objectives that have been set in the existing curriculum have been achieved or not. In addition, this ability can also be used to improve or enhance the learning process that has been carried out by the teacher. Academic Qualification Standards and Teacher Competencies in Junior Secondary School Mathematics is developing an assessment instrument (Permendikbud, 2018).

The development of critical thinking skills assessment instruments is an effort to meet the needs of teachers in assessing critical thinking skills of students. In mathematics, development efforts are also carried out, given the need for critical thinking skills itself (Hakim *et al*., 2019). Critical thinking is needed, where every day individuals face unlimited information, complex problems, rapid technological and social changes (Vong & Kaewurai, Wareerat, 2017).

Mellanie L. Buffington in a research journal concludes that students' critical thinking skills can develop if the teacher in teaching and learning activities regularly displays critical thinking skills in every learning step which is useful as a provision for students (Sosilowati *et al*., 2017). 'life. Students need critical thinking skills in the 21st century, but the facts show that critical thinking skills have not become a special concern of teachers in the field, most teachers are still reluctant to assess students' critical thinking skills (W. Mabruroh, F & Suhandi, A. 2017).

Improving higher order thinking skills has become one of the priorities in school mathematics lessons. Students at the SMP / MTs level must begin to be trained in higher order thinking according to their age (Badan Standar Nasional Pendidikan (BNSP), 2018). Assessment is a very important activity in learning mathematics. Assessment can provide constructive feedback for teachers and students. The results of the assessment can also provide motivation to students to perform better. Even assessment can affect learning behavior because students tend to direct their learning activities towards the mouth of the teacher's assessment (Setiawan *et al*., 2017).

The position of the learning outcome assessment instrument is very strategic in making teacher and school decisions related to the achievement of student learning outcomes, including higher-order thinking skills (Kemendikbud, 2018).Teachers find it difficult to develop critical thinking assessments because of difficulties in analyzing possible errors and overcoming students' mental mismatches when faced with math-related problems (Putri *et al*., 2020). Efforts that need to be made by teachers to improve students' mathematical thinking ability are to improve the effectiveness of mathematics learning (Applebaum & Mark., 2016). In the learning process, we should apply and hone critical thinking skills (Fithriyah *et al*., 2016). Critical thinking skills are important because by thinking

critically a person will automatically be able to solve simple and complex problems in everyday life (Facione, Peter A, 2015).

Indicators of critical thinking skills used in this study are interpretation, analysis, evaluation, inference, explanation, and self-regulation. Interpretation is the ability to understand and express the meaning / meaning of the problem. Analysis is the ability to identify and conclude relationships between statements, questions, concepts, descriptions, or other forms. Evaluation is the ability to access the credibility of statements / representations and to be able to logically access the relationships between statements, descriptions, questions, and concepts. Inference is the ability to identify and obtain the elements needed to draw conclusions. Explanation is the ability to establish and provide logical reasons based on the results obtained. While the last indicator of self-regulation is the ability to monitor a person's cognitive activity, the elements used in problem solving activities, especially in applying the ability to analyze and evaluate (Chukwuyenum, Asuai Nelson., 2013).

Critical thinking is a skill activity that can be done well and good critical thinking will meet various intellectual standards, such as clarity, relevance, adequacy, coherence, etc. (A.Fisher., 2009). Thinking skills are one of the abilities that try to reason at the highest quality level by thinking fairly and independently (L. Elder and R. Paul, 2008). Thinking with argument and reflection by pressing decision-making about what to believe and do is part of critical thinking (I.Z. Hassoubah, 2004). The goal of critical thinking is to keep people from making mistakes and hasty decisions. So far, learning thinking exists 3 ways, they teach to think, teach to think and teach about thinking (M. Scriven and R. Paul, 1987).

Method

This research is development research. The research was conducted at SMP Aceh Barat. The subjects of this study were students of class IX. The research subject was taken by students in high school / equivalent education units because according to Piaget's cognitive theory, at this level students were able to think at the formal operational stage.

The development model used to develop learning media is the 4-D model of Thiagarajan, Semmel, and Semmel. This model consists of 4 development stages, namely define, design, develop, and disseminate (Thiagarajan, S., Semmel, D.S. & Semmel, M., 1974).

After the experts decide that the test is valid, this test can be used at the field trial stage. Data on students 'critical thinking abilities were analyzed to see students' learning completeness. The completeness value of the competency of knowledge and skills is stated in the form of numbers and letters, namely 4.00 - 1.00 for numbers equivalent to letters A to D referring to the assessment in Permendikbud No.104 of 2014.

Table 1: Completeness value of knowledge competencies and skills

Completeness Value Knowledge and Skills Number Range	Letter
3,85 – 4,00	A
3,51 – 3,84	A-
3,18 – 3,50	B+
2,85 – 3,17	B
2,51 – 2,84	**B-**
2,18 – 2,50	C+
1,85 – 2,17	C
1,51 – 1,84	C-
1,18 – 1,50	D+
1,00 – 1,17	D

Result and Discussion

In the previous discussion, it has been described that the purpose of this study is to develop a valid and effective critical thinking instrument. The results of this research are described in several stages, as follows:

Validation Results of the Learning Implementation Plan

The results of expert validation on the lesson plans, namely the language, format and content are presented in table 2:

Table 2: Results of the learning implementation plan validation

No	Rated Aspect	Validator Value					Average of Each Indicator	Average of Each Aspect
		I	II	III	IV	V		
I	**FORMAT**							
	1. Clarity of material distribution	5	4	5	4	4	4,40	
	2. The numbering system is clear	5	4	5	4	4	4,40	4,35
	3. Room / layout arrangement	4	4	5	4	4	4,20	
	4. Type and font size accordingly	5	4	5	4	4	4,40	
II	**CONTENTS**							
	1. Completeness of RPP components	5	5	5	5	3	4,60	
	2. The truth of the content / material	5	5	5	4	4	4,60	
	3. Grouped in logical sections	5	4	5	4	5	4,60	
	4. Indicators and learning objectives are in accordance with KI and KD	5	5	5	5	3	4,60	
	5. The selection of strategies, approaches, methods and means of learning is carried out appropriately, allowing students to actively learn	5	5	4	5	4	4,60	
	6. Teacher activities and student activities are clearly formulated and operational, so that they are easily implemented by the teacher in the learning process in the classroom	5	5	5	4	4	4,60	4,64
	7. The suitability of the learning steps with the problem-based learning model.	5	5	5	4	5	4,80	
	8. Suitability of the order of the material	4	5	5	4	5	4,60	
	9. Suitability of the allocation of time used	5	4	4	5	5	4,60	
	10. Feasibility as a learning tool	5	5	4	5	5	4,80	
III	**LANGUAGE**							
	1. Grammatical correctness	5	5	4	5	4	4,60	
	2. Simplicity of sentence structure	5	4	4	4	4	4,20	4,35
	3. Clarity of instructions and directions	4	5	4	4	3	4,00	
	4. The communicative nature of the language used	5	5	4	4	5	4,60	
	Total Mean							**4,45**

Based on table 2 above, the total mean result of RPP validation is 4.45. With a mean of 4.45, the designed lesson plans are in the valid category.

Conclusion

The conclusion of this study indicates that the scientific literacy abilities of junior high school students, particularly in explaining scientific phenomena, are generally at a moderate level. While students have mastered the fundamentals of scientific literacy, their proficiency in the sub-indicators of explaining scientific phenomena varies, with aspects like scientific representation requiring more attention. The study highlights the importance of consistency between classroom teaching and final assessments, as discrepancies in instructional materials and evaluations can hinder students' development. Additionally, students' abilities to design and evaluate scientific investigations and utilize scientific information for decision-making positively impact their mastery of explaining scientific phenomena. Differences among schools also underscore the significance of contextual factors, such as teaching quality and resources, in supporting students' scientific literacy. Consequently, the study recommends enhancing teaching quality, employing more interactive learning methods, and implementing comprehensive assessments to improve overall scientific literacy among students effectively.

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