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DEVELOPMENT OF LEARNING INSTRUMENT BASED ON REALISTIC MATHEMATICS APPROACH TO IMPROVE MATHEMATICAL DISPOSITION ABILITY

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ABSTRACT. It has been an important part of the learning process in school using Learning Instrument. The existence of learning Instrument is an obligation that teachers must own. The completeness of learning Instrument is the main weapon of teachers in carrying out their duties. This is development research. This study aims to produce valid, practical, and effective mathematics learning Instrument through the Realistic Mathematical Approach to improve students' mathematical disposition abilities. This study was conducted in two stages, namely, the first stage is the development of learning Instrument based on a realistic mathematics approach by referring to the 4-D model (four D models), namely: define, design, develop, and disseminate. The second stage is the implementation of learning Instrument that is considered appropriate. The trial design used a one-group posttest-only design. The findings: 1) The learning Instrument produced has met the good/valid criteria; 2) The practicality of the learningInstrumentis concluded based on the opinion from the experts who state that the Instrument can be used with a little revision. The student response in the trial one obtained an overall average of 92.57% and the trial two obtained an overall average of 91.86% which means student response positive; 3) the effectiveness of the learningInstrumentis concluded based on classical student learning completeness in the trial one of 85.71% and 90%. and student responses to components and learning activities are positive

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1. INTRODUCTION

The curriculum In the 2000s era, such as the 2004 Curriculum (Competency-Based Curriculum), KTSP (School-Based Curriculum), and the 2013 curriculum. They are competency-based curricula with constructive learning. The implementation of the competency-based curriculum is largely determined by the teacher's ability to develop learning Instrument. The learning process in the classroom cannot be separated from the role of a teacher who is a professional educator. The professional ability of teachers is part of the competencies that teachers have. Teacher competence includes pedagogical competence, personality competence, social competence, and professional competence obtained through professional education [1].

With regard to the issues of critical thinking skills, the present study had carried out a need analysis on selected junior high schools in West Aceh. The result shows that: 1) Cognitive assessment instruments tend to emphasize the students' memorizing skills, rather than higher-order thinking skills; tests for examining these skills are yet available. 2) According to a report by PISA, the thinking skills of children in Indonesia are considered low. This situation blames several factors, one of which is that the students are not accustomed to solving contextual tests, which demand their reasoning, argument skills, and creativity. 3) Teachers have low competence in developing assessment instruments. 4) The assessment instruments for measuring students' critical thinking, especially in the context of HOTS, are yet available.

Another concern is the fact that Curriculum 2013 focuses on promoting students' skills in observing, asking, reasoning, and communicating everything they have learned. For this reason, it is suggested that the instruments for assessing mathematical critical thinking in the context of HOTS should enable the students to practice the skills previously mentioned. In Aceh, little is known about the assessment instruments for measuring students' critical thinking in HOTS context, since the only cognitive assessment instruments tend to emphasize the students' memorizing skills, rather than higher-order thinking skills. Such tests or assignments are, in fact, essential to help students retain their concentration in the class and, at the same time, discover their potential [2].

The enhancement of HOTS has been one of the main goals of teaching mathematics. In junior high schools, the students are supposed to start practicing thinking skills. Indeed, the skills should fit the capabilities of people in the students' age [3]. Assessment is simply defined as a comprehensive process to identify students' performance. This process is central to learning; it is regarded as one of the efforts to improve the quality of education. Recently, there has been a shift in the standard of learning assessment, from everything assessable to everything that must be assessed [4]. Assessment comes from a psychometric / measurement perspective, and is primarily concerned with scores of groups orindividuals, rather than examining students' thinking and communication processes [5]. Apsychometric perspective is concerned with reliably measuring the outcome of learning, rather than the learning itself [6]. 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 [7]. Critical thinking is needed, where every day individuals face unlimited information, complex problems, rapid technological and social changes [8]. Furthermore, assessment instruments play a strategic role in the decision-making process of teachers and schools regarding student learning outcomes, including the aspect of HOTS. Chief among the components of teaching are the mathematical critical thinking skills. These skills are not granted for granted. In fact, a student should go through intensive practices to master these skills. Before teaching the students, a teacher is demanded to demonstrate his or her mathematical critical thinking skills well. Simply put, critical thinking skills are defined as the highest intellectual activities in human interaction, which allow an individual to get involved in a meaningful decision-making process.

HOTS are a set of thinking processes at a high cognitive level developed from various concepts and cognitive processes in the learning taxonomy, such as critical thinking skills, Bloom's taxonomy, and taxonomy of learning, teaching, and assessment. Through mastering HOTS, students can differentiate ideas and opinions, deliver good arguments, solve problems, construct explanations, formulate hypotheses, and comprehend complex ideas and interpret them into clear, more straightforward ideas. Students are considered to fully master HOTS once they demonstrate the capabilities to correlate new information with the one that they have stored in their memory. On top of that, the students are able to reconstruct

and develop everything they have learned to meet a particular goal or to find a solution to a specific, complex problem. The primary objective of teaching HOTS is to enhance students' thinking skills, bringing the skills to a new level, with an emphasis on critical thinking skills in learning information in various contexts. Today's learning evaluation is performed through the actualization of quality education in terms of the assessment standards. To this day, the improvement programs are carried out by adapting international assessment models gradually. The designed assessment is expected to assist students in shaping their HOTS better since these skills stimulate the way the students think everything they got from the class comprehensively. HOTS are a part of the revised Bloom's taxonomy; the skills comprise several action verbs, namely analyze (C4), evaluate (C5), and create (C6). All of which are applicable in designing a test.

2. METHOD

The present work applied a research and development (R&D) model by Dick and Carrey and was carried out in selected junior high schools in West Aceh regency. All quantitative and qualitative data were retrieved from the results of expert validation and trials, respectively. These data functioned to provide an overview of the developed products. The procedures encompassed (1) the analysis of learning assessment, i.e., determining the design of the developed assessment based on the HOTS and digital literacy principles. (2) Development of assessment tools of critical thinking in mathematics in the context of dan digital literacy the students. (3) Validation of the developed assessment; its steps encompassed empirical trials, limited trials, and field trials. (4) Evaluation of the data of trials. In this research, the data were retrieved from the validation sheets. The sheets were completed by material experts, instructional media experts, and assessment experts. Another data collection instrument involved questionnaires distributed to the students. Stages in collecting the data were: (1) designing research instruments, e.g., tests, scoring and assessment rubrics, (2) determining the validity, (3) revising the product based on the input from the validators, (4) trials of the research instruments, (5) examining the reliability and determining the difficulty and distinguishing features of the test items, and (6) revision based on the results of the trials.

3. Results and Discussion

The primary goal of the present study is to report the results of the development of assessment tools of critical thinking skills in the context of HOTS. It was also aimed at reporting the student activities when using the developed instructional media, the students' responses regarding the media, and the critical thinking learning outcomes. Observation of student activities is performed during learning processes for three times in trial I and trial II since the classes were also in three meetings. The result of the analysis of the student activities in trial I is displayed in Table 1, while the following Table 2 provides the data of Trial II.

Table 1. Summary of Validation Results

No	Components	Validation Mean	Category
1	Teacher's Book	4,19	Valid
2	Student Book	4,26	Valid
3	Student Activity Sheet	4,05	Valid
4	Learning Implementation Plan	4,25	Valid

The table above shows that the results of the validation for each component of the learning Instrumen tdeveloped using a realistic mathematics approach are in the "valid" category with the mean of each component, namely 4,19; 4,26; 4,05 and 4,25. But even though the components of the learning Instrument developed have met the validity criteria, there are a number of things that must be improved according to the notes provided by the expert team including language use, writing or typing, displaying images that must be in accordance with the conditions and clarified. So based on the results of notes from the expert team that this learning Instrument has met the validity criteria with the "valid" category with a few revisions notes.

Explanation at the previous discussion, to see the practicality of a material to be developed, it is seen from two indicators, namely the results of validation by the validator stating that the learning Instrument is valid with a slight revision, then it is reviewed from the results of student responses as learning Instrument users. From the results of student responses, it was found that student responses were positive towards this learning Instrument. From the results of the validation of the expert team and student responses, it can be concluded that the learning

Instrument based on a realistic mathematical approach is "practical" for use in learning.

In determining the effectiveness of a material being developed, it can be seen from three aspects, namely the results of classical completeness, the achievement of learning objectives and the achievement of the ideal percentage of student activity time. In the following, a discussion of each indicator will be presented in measuring the effectiveness of learning Instrument based on a realistic mathematics approach. It has been stated previously that the classical completeness obtained during the first trial of 35 students was 85.71% and in the second trial with 30 students was 90%. Overall, this achievement has met the classical completeness criteria, namely at least 85% of the total number of students completing with a score of 75. The following will describe the number of students who achieved completeness for each meeting in trial I and trial II.

TABLE 2. Number of Students Who Completed in Trial I and Trial II

No	Explanation	Trial I	Trial II
1	Completed	30	27
2	Uncompleted	5	3
	Total	35	30

By lookingat the results of completeness individually and classically student learning , it can be concluded that the learning Instrument based on the realistic mathematics approach have met the effectiveness criteria, so that this learning Instrument has been effective for use in learning. Furthermore, the description of students 'mathematical dispositions can be seen through the mean of the first trial and second trial of students' mathematical dispositions for each indicator.

Based on the criteria for achieving student learning objectives on the results of the test I question number I post-test results amounted to 75.71%. Achievement of learning objectives in question number 2 post-test results amounted to 91.43%. Achievement of learning objectives in question number 3 post-test results amounted to 95.71%. Achievement of learning objectives in question number 4 post-test results is 67.86% and the achievement of learning objectives in question number 5 post-test results is 46.43%.

In accordance with the achievement of learning objectives, it is said to be achieved by the criteria of 75% of the maximum score for each item. Thus, the achievement

TABLE 3. Mean of Students' Mathematical Disposition for Each Indicator Trial I and Trial II

Indicator	Mean of Mathematical Disposition	
	Trial I	Trial II
Confidence	18,4	20,4
Curiosity	18,7	20,73
Perseverance	19,4	20,2
Flexibility	17,8	20,1
Reflective	20	20,33
Application	20,5	21,03
Appreciation	13,5	13,57

of learning objectives on student post-test results has not been achieved, namely in questions number 4 and number 5. In the second trial, based on the criteria for achieving student learning objectives on question number I the post-test results were 79.17%. Achievement of learning objectives in question number 2 post-test results amounted to 91.67%. The achievement of learning objectives in question number 3 post-test results is 93.33%. Achievement of learning objectives in question number 4 post-test results is 78.33% and achievement of learning objectives in question number 5 post-test results is 75.83%.

In the achievement of the learning objectives, it is said to be achieved by the criteria of 75% of the maximum score for each item. Thus the achievement of learning objectives on student posttest results is achieved on each item of the question.

A questionnaire for student responses to learning that has been implemented is given at the end of learning trial I and trial II which aims to see or find out student responses after learning has been applied using learning Instrument based on a realistic mathematics approach. This questionnaire contains positive and negative statements that consist of four aspects of the question. The results show the questionnaire responses given to students, overall the students felt happy with the learning Instrument based on the realistic mathematics approach that was developed, in other words, the responses given by students after being given learning using this learning Instrument were very positive. The following results of the student response questionnaire in trials I and trials II

TABLE 4. Mean Percentage of Student Responses.

No	Aspects	Trial	
		Trial I	Trial II
1	Happy statement towards the learning Instrument	95,43%	93,33%
2	A new statement on the components of a learning Instrument	90,29%	89,33%
3	Statement of interested in learning Instrument	94,29%	93,33%
4	Learning instruments that are easy to apply	90%	93,33%
5	Statement of fascinated in learning Instrument	92,86%	89,99%

The table above can be seen that the responses of students in the first trial and in the second trial to the components of the learning Instrument developed using a realistic mathematics approach met the criteria for a positive response.

CONCLUSION

Based on the data and study has been conducted, it can be concluded that the mathematical disposition ability of students who are given learning Instrument developed based on a realistic mathematics approach experienced enhancement from the trial I to the trial II.

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