DEVELOPMENT OF MATHEMATICS LEARNING TOOLS BASED ON REALISTIC MATHEMATICS EDUCATION TO IMPROVE MATHEMATICAL CRITICAL THINKING ABILITY FOR CLASS VII MIDDLE SCHOOL

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ABSTRACT

This research aims to produce a learning tool that is valid, practical, and effective. This learning tool contains material for flat-sided shapes. This research is a development research using the Plomp model, which includes Preliminary Research, Prototyping Stage, and Assessment Stage. The instruments used in the study were learning device assessment sheets to measure validity, educator response questionnaires, student response questionnaires, learning implementation observation sheets to measure practicality, and tests of critical thinking skills to measure effectiveness. Learning devices are said to be valid and practical if they meet at least good criteria (average score more than 3.40) and the percentage of learning implementation is at least 70%, while it is said to be effective if the percentage of student completeness is more than 60%. The learning device was implemented at As-Salam Islamic Middle School, Tanjung Gadang, Sijunjung Regency with the object of research being students of class VII Marwah. This research produced a set of learning tools in the form of lesson plans and worksheets for six meetings. Learning tools meet valid criteria with an average score of 3.52 for lesson plans and 3.52 for worksheets from a maximum score of 4.00. Learning tools meet the very practical criteria with an average score of 80% for the teacher response questionnaire and 88.17% for the student response questionnaire with a maximum score of 100%, while the average percentage of learning implementation is 83.21%. Learning devices meet the criteria of effectiveness with a percentage of completeness of student learning outcomes of 75.57%.

Keywords: learning tools, based on RME, critical thinking skills

INTRODUCTION

Critical thinking is the process of seeking, obtaining, evaluating, analyzing, balancing, and conceptualizing information as a guide to developing one's thinking with self-awareness and the ability to use this information by adding creativity and taking risks (Yildirim & Ozkahraman, 2017). Based on the opinion of several experts, critical thinking skills are very necessary for students, considering that currently science and technology are developing very rapidly and make it possible for anyone to obtain information quickly and easily from various sources and anywhere in the world (Ennis, 2011; Hasratuddin, 2013; Hassoubah, 2004; Ikhsan & Rizal, 2014; Shaffer, 2020).

Based on UNESCO data, the quality of mathematics education in Indonesia is ranked 34th out of 38 countries observed (Alghafri & Ismail, 2014; Ministry of Education, 2013; Ngang et al., 2014; Sarimah & Shaharom, 2008). Therefore, critical thinking skills are needed to measure how to develop students' thinking in science lessons such as mathematics (Facione & Facione, 1992; Mapeala & Siew, 2015). Research conducted by previous researchers shows that junior high school students' mathematical critical thinking abilities are still low (Herdiana, 2013; Jumaisyaroh et al., 2015). The next problem, was when the author conducted a preliminary study at SMPN 12 Sijunjung, SMPN 20 Sijunjung, and SMP Islam As-Salam Kab. Sijunjung

obtained information that the results of students' initial mathematics learning and critical thinking ability tests were still low and many were below the Minimum Completeness Criteria (KKM).

Based on the description of the problem above, a learning tool is needed that can help mathematics teachers and students in the learning process in the classroom. The implementation of learning that is not yet optimal cannot be separated from the learning resources that are developed so that students are motivated to learn mathematics (Elvira Maylistiyana et al., 2017; Waluyo et al., 2016). Some of the learning resources needed are Student Worksheets (LKPD) and Learning Implementation Plans (RPP).

RPP is a planning program that is prepared as a guide for implementing learning for each learning process activity (Sanjaya, 2015). LKPD is teaching material that has been packaged in such a way that students are expected to be able to study the teaching material independently (Prastowo, 2015). Based on this opinion, the RPP and LKPD can help mathematics teachers and students in the learning process in the classroom. The author is interested in developing learning tools based on the Realistic Mathematics Education (RME) learning model. The Realistic Mathematics Education (RME) approach is a learning approach from Realistic Mathematics Education (PMR) which comes from the words Realistic Mathematics Education (RME), based on the view that mathematics is a human activity (Tim, 2001). So, the steps in the RME model can improve students' mathematical critical thinking abilities.

Three principles related to RME, namely 1. Guided reinvention and progressive mathematization, 2. Self-developed models. 3. Real-world learning phenomena (didactical phenomenology) (Gravemeijer, 1994). In line with the three principles of RME outlined, there are five characteristics of RME, namely Use of Context, Use of models for progressive mathematization, Utilization of students' construction results, Interactivity, and interconnectedness (Wijaya, 2012).

Based on this description, the author conducted research on the development of RME-based learning tools to improve critical mathematical thinking skills with four steps in Realistic learning, namely, giving contextual problems to students, solving contextual problems, comparing and discussing answers, and concluding the solution to the problem.

METHOD

The development model applied is the Plomp model which consists of three phases, namely preliminary research, prototyping phase, and assessment phase (McKenney & Reeves, 2014). The initial investigation phase (preliminary research) consists of needs analysis, curriculum analysis, concept analysis, and student analysis. At the prototyping stage, formative evaluation is carried out in making the prototype. The development or prototype creation phase (prototyping stage) consists of prototype 1, namely self-evaluation and expert review; prototype 2 namely one-to-one; prototype 3 namely small group; prototype 4, namely field test. In the assessment phase, a field test was carried out in class VII D of As-Salam Islamic Middle School, Kab. Sijunjung to see practicality and effectiveness. Research data was collected through self-evaluation sheets, validation sheets, observation sheets, interview guidelines, teacher and student response questionnaire sheets, lesson plan implementation observation sheets, and the final test of critical thinking skills. Device validation was carried out by three

Mathematics lecturers, one Indonesian Language lecturer, and one Educational Technology lecturer.

RESULTS AND DISCUSSION

In the preliminary research, needs analysis, curriculum analysis, concept analysis, and student analysis were carried out. Needs analysis is carried out to obtain data on students and teachers in the learning process. The results obtained are conventional learning, the learning tools used so far are textbooks, many students think mathematics is difficult and there are lots of formulas so they are less active and interested and students' mathematical critical thinking abilities are still not optimal.

Curriculum analysis aims to analyze the curriculum for two supporting aspects, namely KI and KD. At this stage, a study was carried out on the 2013 curriculum for class VII mathematics in junior high school. This analysis was carried out to study the scope of material, learning objectives, and materials that can be used in the RME model. The results of the formulation of indicators and analysis of the mathematics syllabus for class VII SMP are arranged sequentially with indicators of competency achievement so that they are easy to understand.

Concept analysis aims to determine the content and subject matter needed in the development of learning tools. The results of the concept analysis based on the curriculum used are that there is 1 chapter studied in class VII Semester I, namely Social Arithmetic. Student analysis aims to determine individual qualities that can be used as guidance in designing learning tools. This analysis is used as a consideration in designing RME-based LKPD which includes how students learn, student participation, the importance of LKPD for students, and descriptions of LKPD that students like. In this research, the students who will be used as subjects are class VII middle school students.

The prototyping phase is the device design stage based on the characteristics of RME-based learning in the form of RPP and LKPD. This design is based on the results of a preliminary study that has been carried out and produced prototype 1. After the RME-based RPP and LKPD were produced, a self-evaluation was carried out by the researcher for construct validity and validated with experts for content validity. Construct validity means conformity between the product produced and the development elements that have been determined and content validity means conformity between the product produced and several specified criteria. In the self-evaluation, the errors that researchers found in the product included typing errors and punctuation errors. After conducting a self-evaluation, this RME-based product is validated by validators.

RPP validation is seen from subject identity, KD, formulation of learning indicators, formulation of learning objectives, selection of learning materials, selection of learning strategies, selection of learning resources, selection of learning media, steps in learning activities, assessment, language, and writing. The overall result of the RPP validation is 3.52 with a very valid category.

Overall, the RME-based LKPD validated by mathematics experts has met the valid criteria with a validity index in the presentation aspect and content feasibility aspect of 3.52 in the very valid category. This means that the characteristics and suitability of LKPD with RME-based learning can help students improve their critical mathematical thinking skills. This aspect of graphics or appearance was validated by one Educational Technology lecturer with the results

of data analysis obtained 3.29 with very valid criteria. Furthermore, the language aspect was validated by one Indonesian language lecturer with data analysis obtained 3.43 with very valid criteria. The overall validation results for each aspect can be seen in Table 1.

Table 1. RME LKPD Validation Results

No.	Aspect Validation	Validity Index	Category
1.	Presentation	3,52	Very Valid
2.	Didactics and Content (Material)	3,52	Very Valid
3.	Graphics (Display)	3,29	Very Valid
4.	Language	3,43	Very Valid
Average Validity Index		**3,44**	**Very Valid**

Based on Table 1 it can be seen that the average LKPD validation as a whole is 3.44 with very valid criteria. In the validity process, there are several revisions of the device produced in prototype 2. In the RPP it is suggested and revised, namely, the steps that are integrated must be visible, the steps for solving questions are written in the form of questions, setting indicators of KD to be achieved, namely, there are on KI-3 and KI-4. In the LKPD, there were several revisions including changes to the cover and the preface changed. In the assessment, there are several revisions including on the assessment sheet it must be clear the achievement of the assessment, and the areas assessed with measurable data. The results of valid mathematics learning tools were then carried out with one-to-one evaluation with three students at As-Salam Islamic Middle School, Sijunjung District who had high, medium, and low abilities.

The results of the one-to-one evaluation are that there are revisions to the LKPD regarding questions that are not understood by students. Based on the suggestions from the one-to-one evaluation, revisions were made. The revised results of the one-to-one evaluation were tested on a small group consisting of 6 students. The results of the revision at the small group stage included the added time because the students took a little longer in the discussion. Some of the questions have also been replaced and removed, because if they are still used then the time available is not enough.

After revising the results obtained in the small group evaluation (prototype 3), it was tested on a large group, namely class VII students at As-Salam Islamic Middle School, Kab. Sijjung. From the results of the large group, it was found that the RME-based mathematics learning tool was stated to be practical and effective.

The practicality of this device can be seen in the teacher response questionnaire, student response questionnaires, and lesson plan implementation sheets.

The average results of the teacher's response questionnaire practicality test gave a practicality value of 83.82%. Based on the criteria that have been made, the practicality of RME-based learning tools is declared practical.

This shows that RME-based mathematics learning tools are easy to use by teachers in terms of attractiveness, process of use, ease of use, and time.

The average value of implementation in each meeting is very practical. This shows that the lesson plan using the theory-based multiple intelligences has been implemented according to what was designed. In line with that, the learning process will work well if the teacher can condition learning activities effectively from the start (Dahar, 1989).

The effectiveness of learning devices is how much learning using the developed devices achieves indicators of learning effectiveness (Nieveen, 1999). In this study, the RME-based mathematics learning tool for Social Arithmetic material was used in learning because it met the indicators of learning effectiveness from learning outcomes, namely cognitive learning outcomes, affective learning outcomes, and psychomotor learning outcomes.

Cognitive learning outcomes can be seen from the results of the final test showing that 17 of the 22 students scored above the KKM. The results of the completeness of student learning is 75.57%. This shows that RME-based learning tools have been effective in achieving the competencies students must achieve.

In practicality, there was an increase through three stages carried out, one-to-one evaluation stage, small group evaluation (small group evaluation), and large group (field test). Meanwhile, the effectiveness of learning tools is obtained from cognitive assessment, namely giving a final test of mathematical critical thinking abilities.

CONCLUSION

Based on the validation results conducted by experts, it has been ascertained that the development process of RME-based learning tools, specifically in the form of Rencana Pelaksanaan Pembelajaran (RPP) and Lembar Kerja Peserta Didik (LKPD), has successfully met the criteria for validity, practicality, and effectiveness. First and foremost, the validation process assessed the validity of these learning tools. Experts rigorously examined the content, alignment with curriculum standards, and the appropriateness of the materials about the RME (Realistic Mathematics Education) approach. The tools were found to be logically structured, free from errors, and aligned with educational objectives, thus ensuring their educational validity.

The practicality of these tools was assessed. Practicality encompasses aspects such as ease of use, feasibility in a classroom setting, and adaptability for both teachers and students. The RPP and LKPD were evaluated positively in terms of user-friendliness, clear instructions, and the ease with which they can be incorporated into actual teaching practices. The effectiveness of the RME-based learning tools was scrutinized. The validation results indicated that these tools are likely to significantly enhance the teaching and learning process, promoting a deeper understanding of mathematical concepts among students and facilitating more engaging and interactive classroom experiences.

In conclusion, the validation outcomes underscore that the RME-based RPP and LKPD are robust educational resources that meet the stringent criteria of validity, practicality, and effectiveness. These tools hold great promise for educators seeking to implement the RME approach effectively in their classrooms, ultimately benefiting the quality of mathematics education.

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