The Development of SMP Statistics Learning Devices Using Realistic Mathematic Education Approach to Develop Students' Mathematical Literacy Ability

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Abstract: This study is aimed at producing a learning tool for statistics of junior high school using realistic mathematics education approach which includes valid and practical lesson plans (RPP) and students worksheets (LKS) to develop mathematical literacy skills. This development research refers to the 4-D development model from Thiagarajan which consists of *define, design, development,* and *disseminate* stages. The test subjects were seventh grader students of SMP Negeri 8 Pekanbaru. The data ware obtained using validation sheets by experts and students' response questionnaire sheets. It is found that the result of expert validation for RPP is 3.84 (very valid) and for LKS 3.52 (very valid). The students worksheet has suited the practicality requirements with the percentage of student responses reaching 88.57%. It can be concluded that the RPP and LKS have fulfilled valid and practical requirements.

Keywords: learning tools, realistic mathematic education approach, mathematicalliteracyability

1. Introduction

Kusumah (2018) states that one of the characteristics of the 21st century is the swift flow of information in life so that it is necessary to have the skill to select and sort information and data as a basis to make a precise and accurate conclusion of something. Frydenberg & Andone (2011) also explain that to face the 21st century, everyone must be having critical thinking skills, literacy skills and mastering information and communication technology. Therefore, literacy is one of the important competencies or skills that students must possess in facing the 21st century demands. One form of literacy is mathematical literacy.

According to Ojose (2011), mathematical literacy is the knowledge to know and use mathematical basis in everyday life. OECD (in Rosalia, 2015) defines mathematical literacy as a person's ability to formulate, use, and interpret mathematics in various contexts including mathematical reasoning and using mathematical facts, concepts, procedures, and principles in explaining and predicting phenomena. Thus, mathematical literacy helps a person to recognize the role of mathematics in the real contexts and make appropriate judgments and decisions.

From these opinions, mathematical literacy indicators are arranged as follows: (1) formulating real problems; (2) Using mathematics; (3) Interpreting results.

Mathematical literacy is one of the focuses of PISA (The Programme International Student Assement) assessment which is a study developed by several developed countries in the world which are members of the Organization for Economic Cooperation and Development (OECD). PISA is an international scale assessment program that aims to determine the extent to which 15 year old students can apply the knowledge they have learned at school. Indonesia has also participated in this program since it was first implemented in 2000. Every three years, 15-year-old students from the participating countries are randomly selected to join the PISA program. Since Indonesia's participation in the PISA event, Indonesia has always been in the bottom 10 and has never reached an international average score. This is in line with the results of a research conducted by Siregar and Solfitri (2017) showing that the literacy skills of state junior high school students in Pekanbaru city are still low.

According to Wardhani (2011), one of the causes of students' low mathematical literacy abilities is students lack of practices in solving problems or questions with such characteristics on PISA test. As an effort to develop literacy skills through the learning process, it is needed to have an approach that matches the characteristics of literacy abilities. The most important part of mathematical literacy is the mathematical process. In the implementation, the choice of method or representation is very dependent on the situation or context of the problem to be solved. This requires students' skills to apply it in various contexts (Amirullah et al., 2018).

In the reality, there are still many students who are troubled in mathematizing difficulties (Rosalia, 2015). The students who have been able to apply their knowledge to a problem are not necessarily able to apply it to different problems. Students need to experience the problem solving process in a variety of situations or different contexts in order to be able to use their skills. This experience can be facilitated through approaches or models that give students such experiences.

Realistic Mathematic Education (RME) is one of the approaches developed specifically for the learning of mathematics and has been adapted to the geographical and cultural conditions of Indonesia. One of the characteristics of this approach according to Graveimeijer (in Ariyadi, 2012) is a vertical instrument in which mathematical concepts or ideas are reconstructed by students through modeling that moves to formal form so that students find steps or concepts up to the formal stage. These characteristics help students better understand and recognize the role of mathematics in everyday life. Based on Nurdiansari's research (2015), it was found that RME learning in class VIII was effective. It was indicated by the proportion of students who reached KKM more than 75% and the average students' mathematics literacy skills increased. Thus, RME can improve students' mathematical literacy skills. Based on this explanation, the researcher views that it is necessary to develop learning tools using the RME approach to improve the mathematical literacy skills of junior high school students.

One of the materials or contents tested by PISA is Opportunities and Data. Therefore, the researcher chose Statistics material of grade eight on basic competencies 3.12 (analyzing data based on data distribution, average value, median, mode and data distribution to draw conclusions, make decisions and make predictions) and basic competencies 4.12 (presenting and solving related problems with data distribution, average value, median, and data distribution to draw conclusions, make decisions and make predictions). Thus, the purpose of this study is to produce a mathematics learning tool using the RME approach on Statistics material for junior high school grade VIII to improve students' mathematical literacy skills.

2. Methodology

The type of this research is development research (research and development) using a 4-D development model worked by Thiagarajan et al. The 4-D model steps consist of four, namely *define, design, develop* and *disseminate*. The product resulted from this study is a learning tool in the form of Lesson Plans (RPP) and Student Worksheets (LKS) using the RME Approach in Statistics material of Grade VIII of junior high school.

The development test subjects were eighth grader students of SMPN 8 Pekanbaru. Five students were randomly selected for a limited trial and twenty students of class VIII3 of SMPN 8 Pekanbaru for an in-class test.

The research procedure consists of the following stages: (1) define: initial analysis, student analysis, task analysis, concept analysis, specification of learning objectives; (2) design: make a learning device design, design a learning device validation sheet and design a questionnaire of students' responses on the use of the LKS; (3) development: developing lesson plans and student worksheets, validation by experts, small and large group trials, data analysis of trials.

This research data are in the form of qualitative and quantitative. Qualitative data were obtained from the input / suggestions from validators, teachers, and students when assessing the readability of the device. Quantitative data were obtained from the score of the validator's assessment of the RPP and LKS.

The research instruments used in this study include: (1) instruments to measure the validity consisting of RPP validation sheets and LKS validation sheets; (2) instruments to measure practicality, namely the student response questionnaire sheets.

The data obtained from the results in the development stage were then analyzed to obtain validity and practicality criteria. The validity criteria for tne used learning tools are presented in Table 1. For practicality criteria, they are presented in Table 2.

Table 1. Validity Assessment Criteria for Learning Devices

Interval	Category
$3{,}25 \leq \bar{x} < 4$	Very Valid
$2{,}50 \leq \bar{x} < 3{,}25$	Valid
$1{,}75 \leq \bar{x} < 2{,}50$	Less Valid
$1 \leq \bar{x} < 1{,}75$	Not Valid

Source: Arikunto, 2010

Table 2. Practicality Criteria for Learning Devices

Interval	Level of Practicality
85,01% - 100%	Very Practical
70,01% - 85%	Quite Practical
50,01% - 70%	Less Practical
1,00% - 50%	Not Practical

Source: Akbar, 2013 (modified)

3. Result And Discussions

The tools developed in this study have been through several stages described as follows.

3.1 DefineStage

The define stage consists of five steps, namely doing the initial preliminary analysis, student analysis, concept analysis, task analysis and specification of learning objectives. The final preliminary analysis conducted by the researchers was to find out whether or not it is important to develop learning tools to develop mathematical literacy skills. The results of the initial preliminary analysis showed the low mathematical literacy skills of students.

According to Wardani (2011), one of the factors of the students' low mathematical literacy ability is because students are not used to working on problems with the characteristics of PISA questions. This is due to the limitations of learning tools that can develop the mathematical literacy skills. In developing learning tools, an approach or model that matches the mathematical literacy skills is necessary. One of the mathematics learning that can have a positive impact on students' literacy abilities is the RME Approach.

Based on the results of the analysis on students, it is obtained that the knowledge that is already owned by students related to statistics is the presentation of data in tables, lists, picture diagrams, bar charts and line diagrams that have been studied in class VII. As for the cognitive development of junior high school students is at the end of the concrete operational phase entering the formal operational stage. The results of the concept analysis resulted in the material being developed was statistics material for VIII grade of SMP / MTs on basic competencies (KD) 3.12 and 4.12. The prerequisite material is the number and presentation of the data. Taking into account the breadth of the statistical subject matter, the learning material was organized into 4 meetings which produced four packages of learning devices, namely analyzing data based on the data distribution, mean value, median and mode as well as the size of data dissemination.

Based on the analysis of tasks, during the learning activities students will conduct activities such as (1) understanding the problem by observing the presented problems / questions about the data shown in the form of tables or diagrams and identifying available information based on the problem / question given, (2) collecting more information that is needed and using facts, concepts, principles and procedures of mathematics to solve problems / question to obtain a mathematical solution, (3) interpreting the given mathematical solutions based on the problem / question given and (4) providing a conclusion of the problems related to statistics.In the final step namely specification of learning objectives, the researchers formulated learning objectives that are in accordance with the results of the analysis of the tasks and materials.

3.2Design Stage

In the design stage, the activities carried out are to make a design of learning tools, to design a validation sheet for learning devices, and design a questionnaire for student responses to the use of the LKS. In designing learning activities, the researchers designed the components contained in the RPP and LKS. The RPP components refer to the components listed in Permendikbud No 22 of 2016, while the LKS refers to the steps and characteristics of the RME and indicators of mathematical literacy abilities. Moreover, in developing LKS, it should also pay attention to didactic, construction, and technical requirements.

The RPP components developed based on Permendikbud No. 22 of 2016 consist of: (1) school identity; (2) subject; (3) class / semester; (4) subject matter (5) learning material; (6) time allocation; (7) Core Competencies (KI); (8) Basic Competencies (KD) and competency achievement indicators; (9) learning objectives; (10) description of learning material; (11) learning approaches / models / methods; (12) learning media / tools and materials; (13) learning resources; (14) learning steps; (11) assessment of learning processes and outcomes.

The front page of the LKS consists of the title of the learning material, student identity, time, supporting illustrations, learning objectives and instructions. The contents of the Worksheet (LKS) are developed in accordance with the steps and characteristics of the RME.

The RPP validation sheets were designed based on several aspects, referring to Permendikbud No. 22 of 2016 including: (1) completeness of RPP components; (2) suitability of GPA with KD and can be operationalized; (3) suitability of learning objectives with GPA; (4) learning material contains concept facts, principles and procedures; (5) the learning approaches and models used encourage the achievement of learning objectives; (6) suitability of learning tools / media with learning material; (7) suitability of learning resources with learning material; (8) learning activities emphasize more on student experience (9) suitability of learning activities with RME steps; (10) learning activities reflect the characteristics of the RME; (11) learning activities involve mathematical literacy skills and (12) suitability of assessment of learning outcomes and assessment involving mathematical literacy skills. LKS validation sheet refers to didactic, constructive, and technical requirements, namely: (1) display of LKS cover; (2) Suitability of material with KD that must be mastered by students; (3) learning activities can develop mathematical literacy skills; (4) learning activities reflect the characteristics of RME; (6) the suitability of LKS with construction requirements and (7) the suitability of LKS with technical requirements. Meanwhile, the student response questionnaire is designed based on several aspects, namely: (1) instructions on LKS; (2) content / material on LKS and (3) display on LKS.

3.3 DevelopStage

At this stage, activities to develop RPP and LKS in accordance with the designs and validation by experts and testing of small and large groups were carried out. The RPP and LKS activities were developed so that students are able to solve real problems that are in accordance with the characteristics on PISA test covering problems that use personal, social, working, and scientific contexts. After the lesson plans and worksheets were developed, then validation activities were carried out by the validators consisting of two Mathematics Education lecturers and one Mathematics teacher. The results of the validation can be seen in the following table.

Table3.The Validation Score Average of Learning Devices

Learning Devices	Validator's average scorefor Each Device				Average	Category
	1	2	3	4		
RPP	3,68	3,73	3,85	3,76	3,74	VeryValid
LKS	3,62	3,60	3,51	3,64	3,59	VeryValid

Although the developed devices have fulfilled the very valid category, there were some suggestions given by the validators for the improvement of the devices that have been developed. The validators' comments and suggestions for RPP were (1) skills assessment questions in RPP 1 should be improved because they are too difficult and will take a lot of time; (2) Apperception in RPP 2 and 3 is less precise because there is no relationship between

'fraction' and 'average' materials; (3) Apperception in RPP 3 is incomplete, it should be made real and not need to give apperception about 'mode' because there is no connection between mode and quartile; (4) the outline of the learning in RPP 4 is too long; (5) the calculation of the final value in the assessment should only be in the from of symbols. Validator's comments and suggestions on LKS were regarding the sentences on LKS since many languages were not recognized by students. In addition, problem contents should be corrected; RME steps in LKS should be paid attention as well as to the writing/text because there were some writings that are cut off because of the images.

After the RPP and LKS were revised and declared valid and suitable for the next trial, the researchers conducted a trial to a small group. The research subjects in this small group trial were 5 students of class VII SMPN 8 Pekanbaru who were randomly selected. In this trial, students were asked to do and complete the activities in the LKS. After students finished working on the LKS, the researchers distributed the student response questionnaire. During the small group pretest, some students experienced some difficulties in solving the problems because they are not used to working on non-routine questions. However, the researchers could provide directions to the students so that they were able to solve the problems in the LKS. The researchers also conducted an analysis based on the results of the small group trial and it was found that there were not enough answer columns provided in the LKS to load the students' answers. The researchers revised it by increasing the size of the answer columns.

After revising the worksheets in the small group trial, the researchers conducted a large group trial by taking a sample of 20 students from $VIII_3$ Class of SMP Negeri 8 Pekanbaru. From the results of the large group trial, the percentage of students' responses to the practicality of LKS was obtain and it can be seen in the following table.

Table4. The Percentage of Student Response to LKS Practicality in Large Group Trial

Learning Device	Percentage of Students' Response Questionnaire (%) to each LKS				Average	Category
	1	2	3	4	88,57%	Very Practical
LKS	88,21%	93,93%	87,50%	84,64%		

Based on Table 4, it is found that the practicality assessment by students achieves the very practical criterion. In the large group trial, the students were enthusiastic about the learning activities. In addition, some students had some difficulties since they were not used to working on problems with the characteristics of PISA questions. However, this can be overcome by giving directions to students in order for them to be able to solve the questions contained in the LKS.

In this development research, the researchers have not carried out the effectiveness tests because of time constraints. For further research, the effectiveness test will be conducted to determine the effectiveness of this device in developing mathematical literacy skills.

4. Conclusions

Based on the results and discussions that have been described, the study produced a product in the form of mathematics learning tools for junior high school statistics using the RME approach

to improve the mathematical literacy skills of students which have fulfilled valid and practical requirements with very valid and very practical criteria.

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