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Development of Realistic Mathematics Learning Tools to Improve Students' Mathematical Literacy Ability

Riky Prasetia Wijaya[1], Mega Teguh Budiarto[2], Pradnyo Wijayanti[3]

[1]Programme on Pasca Educational Mathematics, Universitas Negeri Surabaya,
[2,3] Mathematic Department, Universitas Negeri Surabaya
Email : rikyprasetia55@gmail.com

Abstract

The purpose of this research to: (1) describe the development process and produce realistic mathematics learning tools that are good for improving students 'mathematical literacy, (2) describe the effectiveness of realistic mathematics learning to improve students' mathematical literacy. The research population was class X students of seniour high school in the 2020/2021 academic year and teachers who teach mathematics in that class. The following conclusions were obtained: (1) The process of developing realistic mathematics learning tools using the PLOMP development model (2010) and the results of developing realistic mathematics learning tools for the matter system linear equation three variables (SPLTV) using the Ploom development model resulted in learning tools (RPP, LKS, and TLM) qualify the criteria of good quality equipment. (2) Based on the results of descriptive analysis in the implementation class, it was found that realistic mathematics learning was effective in improving students' Mathematical Literacy.

Keywords: Realistic mathematics learning; Mathematical Literacy; SPLTV.

INTRODUCTION

Based on the results obtained by Indonesian students on PISA, they have conducted a survey since 2000 and it is be carried out every 3 years. It has always been a participant in every survey conducted by PISA and its participation, Indonesian students have low mathematical literacy skills. Based on the results of PISA (2015), Indonesia is included in the 10 countries with low literacy skills with only 69 out of 76 countries surveyed by PISA (OECD, 2016). The average score of Indonesian students for mathematical literacy skills is 375 (level 1) while the average international score is 500 (level 3). Level 1 is the lowest level of the 6 levels of mathematical literacy skills applied by PISA.

Mathematical literacy is the ability of students to formulate, use and interpret mathematics in various contexts, including the ability to carry out mathematical literacy and use concepts, procedures, facts, as a tool to describe, explain and predict an everyday event Wicaksana (2018). Its use mathematical thinking in everyday solving to be better prepared for life's challenges. The thought that is meant includes problem solving mindset, logical reasoning, communicating and explaining.

Mathematical literacy in this research is the ability of students to formulate, apply and interpret mathematics in various contexts, including the ability to reason

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mathematically, and to use concepts, procedures, facts and tools to describe, explain, or interpret a contextual problem. Mathematical literacy in this case the researcher focuses on mathematical literacy in writing, which is in the form of questions. In this study, the questions developed were focused on the category context societal and context-based question types using open-constructed responses. Because so that students are able to develop their potential and can solve problems by themselves in their lives. So that students do not have a sense of despair, lazy nature, indifferent to people. The type of context-based questions uses an open-constructed response so that researchers know the steps taken by students or explain how the answers were obtained.

Based on first observations at Senior high school which was carried out at the beginning of the even semester of the 2018/2019 academic year with an interview with a math teacher, it was found that several reasons have not been optimally implemented to improve students' mathematical literacy skills in learning mathematics, namely: (1) teacher limitations related to mathematical literacy, (2) there are no learning tools that support students' mathematical literacy skills, and (3) students have difficulty using mathematical literacy skills because most students only memorize formulas, making it difficult to apply these formulas in solving math problems.

In an effort to improve students' mathematical literacy skills in mathematics learning is very important, so in designing learning teachers must be careful in choosing a learning model that can provide space for students to improve their mathematical literacy skills. A learning model that can emphasize the relationship between mathematical concepts and students' daily experiences. One way that can be done is by applying a realistic mathematics learning model.

Realistic mathematics learning is one approach in learning that links subject matter with the real life of students. It must start from something real so that students can be involved in the learning process in a meaningful way. In the learning process, the role of the teacher is only as a guide and facilitator for students in the process of building mathematical ideas and concepts (Hadi, 2017). With this approach, students learn mathematical ideas and concepts through contextual problems related to everyday environments.

The researcher focuses on students' mathematical literacy in the context category. Because researchers develop realistic mathematics learning that uses contextual problems as a first step. Contextual problems in this study are in the form of questions. The function of contextual questions in this study is contextual questions that function to help form concepts, characteristics, or ways of solving early learning. In the midst of learning, it serves to strengthen mathematical concepts that have been built, discovered or obtained by students. At the end of the lesson, contextual questions help students apply the concepts they have learned.

Realistic mathematics learning in this research is a learning that uses contextual problems (contextual problems) as the first step in the learning process by emphasizing the activeness of students in building and discovering their own knowledge until they find a concept. The purpose of realistic mathematics learning

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in this study is for students to build mathematical concepts and ideas based on the process of rediscovery through exploration of contextual questions.

Based on the background that has been stated, the research questions can be formulated as follows: (1) describe the development process and produce realistic mathematics learning tools that are good for improving students 'mathematical literacy, (2) describe the effectiveness of realistic mathematics learning to improve students' mathematical literacy.

RESEARCH METHOD

Based on the first research purpose, this study includes the type of development research. This research, which is developed is a learning device. The learning tools in this study include Learning Implementation Plans (RPP), Student Worksheets (LKS), and Test Mathematical Literacy (TLM). The development model used by researchers is the development model developed by Plomp. The development model consists of three stages, namely preliminary research, prototyping phase and assessment phase. Good quality learning tools are learning tools that meet the criteria of validity, practicality, and effectiveness.

The second research purpose in this research is descriptive research. It describes the effectiveness of Realistic Mathematics learning in the matter of system linear equations three variables. The learning effectiveness referred to includes: 1) the ability of the teacher to manage learning well, 2) student activity during the effective learning process, 3) student response to positive learning, 4) classical student learning completeness attainment, and 5) increased students' mathematical literacy.

The research population was class X students of seniour high school in the 2020/2021 academic year and teachers who teach mathematics in that class. During the Covid-19 virus pandemic, the learning process continued with online learning through application the Microsoft Teams and Whatsapp. The researcher took the subject of 20 students who were divided into 3 groups for the test class of learning devices and 35 which were divided into 5 groups for the implementation class. Usefulness of the trial class for the process of developing learning tools in getting good quality learning tools and from the implementation class for the effectiveness of device development.

Data collection techniques in this study: validation, observation, student responses, mathematics literacy test. Validation is used to obtain data about the results of expert validation regarding learning devices. This observation is used to obtain data on the teacher's ability to manage learning according to the lesson plans and student activities during the learning process. Student responses to obtain data about student opinions about learning activities. The mathematical literacy test (TLM) was used to obtain information about the validity, reliability and sensitivity of the items. In addition, It is used to determine the completeness of classical learning and to see the increase in students' mathematical literacy skills.

In this research, researcher used a one-group pretest-postest design and analysis description. It to find out that realistic mathematics learning can improve students' Mathematical Literacy. He only conduct research in the implementation

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class. Then analyzed using the N-Gain formula. Before the analysis is carried out with the N-Gain formula, it is necessary to test statistically using the two-mean similarity test for paired data (Dependent). It aims to determine the positive impact of realistic mathematics learning on students' Mathematical Literacy.

RESULTS AND DISCUSSION

Plomp (1997) menyatakan "*we characterized educational design in short as method within which one is working in systematic way towards the solving of a make problem*", This means that the design characteristics of education as a method in which people work systematically towards solving problems are created. This development model has three stages, namely preliminary research, prototyping phase, and assessment phase. It activities carried out at the preliminary research stage are gathering information, analyzing information, and compiling a work plan. At the prototyping phase, the design of learning tools in the form of lesson plans, worksheets and TLM was carried out. At the assessment phase, field trial activities were carried out from the revised prototype. The revised learning tools were tested on 20 students of class X Senior high school 3 Surabaya for the 2019/2020 year. Researchers tested the device on 20 students because of the effects of the symptoms of the Covid-19 Virus pandemic. During the Covid-19 Virus pandemic, Senior high school 3 Surabaya only conducted online learning using applications the Microsoft Teams and Whatsapp. From this stage, a good learning tool is obtained. The recapitulation of the achievement of the criteria for good realistic mathematics learning tools for the material of system linear equation three-variable is presented in Table 1.

Tabel 1 Achievement of the Criteria for Good Learning Devices in the Trial Class

No.	Criteria	Aspect	Explanation
1	Valid	Expert Validation	Valid
		Question Validity Test	High
		Reliability Test	Moderate
		Test Item Sensitivity	Sensitive
2	Practical	Teacher activities manage learning	Good
		Student activities	Active
3	Effective	Student response	Positive
		Student learning completeness	Reached

Based on table 1, the validator's assessment states that each component in each device developed is in the minimal good category, based on the item eligibility criteria, the level of validity in the high category is presented in Table 2.

Tabel 2 Results of Question Item Validity Analysis

Number Test	1
r_{xy}	0,7587
Interpretation	High

Based on the results of the calculation of the reliability of the test, it was obtained that the reliability coefficient of the questions was 0.453, so it had medium category test reliability. Meanwhile, the test item is said to be sensitive if the

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sensitivity index meets the criteria $S \geq 0{,}30$. The results of calculating the sensitivity of each item are presented in Table 3.

Tabel 3 Results of Problem Sensitivity Analysis

Noumber Test	**1**
Sensitivity (S)	0,418
Explanation	Sensitive

Based on the table above, it can be seen that the item sensitivity level is ≥ 0.30, so the item is said to be sensitive to learning and is suitable for use without revision.

In the online learning process, students are grouped into 3 study groups, each group consisting of 6 and 7 students with different academic abilities, so that in each group there are students with high abilities, moderate abilities and low abilities. The grouping is based on the final semester assessment (PAS) score and consultation with the math teacher who teaches the class. After students are grouped, students are asked to join the Whatsapp application group so that student activities can be observed.

Teacher and student activity data were obtained through observations during learning by joining the Microsoft Teams application and carried out by one observer using the teacher activity observation sheet instrument managing learning during two meetings. Student activities are observed by the researcher himself using student activity observation sheets. Observations were made on a group consisting of four students with high, medium and low academic abilities in each meeting. The following are some pictures in the process of managing online learning in the trial class, which can be seen in Figure 1 and Figure 2.

Figure 1. The process of managing online learning

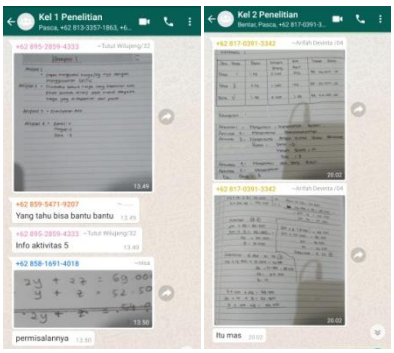

Figure 2. Students discuss online learning

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Student response data were collected using a questionnaire via google form which was given to students at the end of learning activities. The instrument used was a student response questionnaire.

Classical learning completeness data and students' Mathematical Literacy data were collected by giving TLM questions in the form of descriptions before and after the learning took place. Student Learning Outcomes in the Trial Class are presented in table 4.

Table 4 Student Learning Outcomes in Trial Class

No.	Description	Result
1	The highest score	100
2	Lowest Value	60
3	Average value	86
4	Many students have finished studying	17
5	Many students do not complete their studies	3
6	Percentage of students completing their studies (%)	85%

Based on the data in Table 4, the percentage of students who achieved completeness was 85%, it was concluded that the learning completeness of the students in the classical trial class was achieved.

According to Slavin (2009) the effectiveness of learning consists of four indicators, *quality of instruction*, *appropriate level if instruction*, *incentive*, and *time*. Based on the opinion of Kemp (1985), the effectiveness of learning emphasizes the achievement of learning objectives within a predetermined time. Furthermore, according to Djamarah (2002) interest affects the process and student learning outcomes. In addition, according to Uno (2012) learning is considered effective if the goals that have been set can be achieved by students. Based on the above opinion, the effectiveness of learning in research is a measure of the success of a learning that meets the indicators: (1) teacher's ability to manage good learning, (2) effective student activities, (3) classical student learning completeness, (4) student response to positive learning , (5) increasing students' Mathematical Literacy.

Based on the third research objective, the data obtained from the implementation class research: 1) the implementation of learning by teachers and students fulfills the criteria well done so that it can be concluded that the learning carried out is easy for students and teachers. 2) Student response to learning is positive because the percentage of each aspect is more than or equal to 80%, 3) Classical mastery of learning is achieved because the percentage of students who achieve completeness is 88.57%, 5) Realistic mathematics learning to improve students' Mathematical Literacy is achieved. The data on the results of students 'Mathematical Literacy were obtained through the implementation of the pretest and posttest written tests in the form of TLM to students which were used to see whether realistic mathematics learning could train students' Mathematical Literacy. Based on the results of the t-test statistical analysis, the results were obtained $t_{hitung} > t_{tabel}$ (13,618> 2,032) with (α=0,05 dan $db = n - 1$). These results can be said that the

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initial hypothesis(H_0) is accepted. It is concluded that realistic mathematics learning has a positive impact on students' Mathematical Literacy. Furthermore, the description of the calculation of data on the improvement of students' Mathematical Literacy results for the implementation class can be seen in Table 5.

Table 5 N-Gain Value of Implementation Class Students

Explanation	Percentage of Total Students (%)
N-Gain ≥ 0,70	49 %
0,30 < N-Gain < 0,70	49 %
N-Gain ≤ 0,30	3 %

Based on the data in Table 5, realistic mathematics learning is said to be able to improve students' Mathematical Literacy if at least 70% of students who take part in learning get N-Gain ≥ 0,3. It is concluded that realistic mathematics learning can improve students' mathematical literacy skills.

CONCLUSION

The following conclusions were obtained: (1) The process of developing realistic mathematics learning tools using the PLOMP development model (2010) and the results of developing realistic mathematics learning tools for the matter system linear equation three variables (SPLTV) using the Ploom development model resulted in learning tools (RPP, LKS, and TLM) qualify the criteria of good quality equipment. (2) Based on the results of descriptive analysis in the implementation class, it was found that realistic mathematics learning was effective in improving students' Mathematical Literacy.

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