Development of Mathematics Learning Tools Based on Realistic Mathematics Education for Vocational High School Students

W Doli¹ and A Armiati¹*

¹Mathematics Department, Universitas Negeri Padang, Padang, Indonesia

*corresponding author: armiati_math_unp@fmipa.unp.ac.id

Abstract. Based on the results of observation and experience of researchers as mathematics teachers in one of the vocational high schools in Indonesia, information are obtained that the average mathematics scores of students are still below the Minimum Mastery Criteria. This is caused by: the mind-set of students who think mathematics is not important compared to the subject of vocational specialization, the learning process is less engrossed and interesting because of the teacher's monotonous teaching style. As a result, students' interest in learning mathematics is low. To overcome this problem, the teacher must design a mathematics learning strategy in the form of a mathematics learning tool in the form of a learning implementation plan and a student worksheet based on Realistic Mathematics Education (RME). Because the RME-based learning approach starts from 'real' things for students. This type of research is development research with the Plump model consisting of the preliminary research phase, the prototype phase and the assessment phase. In this study researchers were only at the initial investigation stage, namely at the student analysis stage. The purpose of this study was to increase students' interest in learning mathematics. The instrument collection for initial investigation data was observation sheets, questionnaires and interviews with data analysis techniques namely descriptive techniques. The results of the initial investigation of the analysis of learners found that the interest in learning mathematics in vocational secondary school students is very low.

1. Introduction

Vocational high schools are schools that teach various fields of expertise competence. At vocational schools students are given guidance and skills in accordance with the competencies chosen. In addition to vocational content lessons, national subjects and territorial content are also taught. One of the subjects of national content taught is mathematics [1].

Mathematics is the subject most disliked by students because mathematics is an abstract science that contains many formulas and symbols which make it difficult for students to understand mathematics. In addition to learning mathematics required adequate intellectual and cognitive readiness. According to [2] learning mathematics is learning about mathematical concepts and structures contained in the material being studied and looking for relationships between the concepts and structures of a material so as to make the material understood more comprehensively. To comprehend comprehensively this is what makes students lazy to learn mathematics. There are even students who pull out when learning mathematics. Added to the teacher's teaching style that does not vary and uses conventional learning
methods, so that makes students feel bored to learn mathematics. As a result, students' learning outcomes in mathematics are low.

This also happened in one of the vocational high schools that the researchers taught, where the average score of students' mathematics daily tests was still much below the minimum completeness criteria. This is due to the fact that most students do not understand the given problem such as understanding the problem of the story. This can be seen from the results of daily mathematical test answers to the material system of two-variable linear equations from one of the students, namely:

![Figure 1](image)

Based on the facts above, it appears that the mathematical ability of students is very low, one of which is the ability to solve mathematical problems. The ability to solve mathematical problems in this study is the ability to solve mathematical problems based on Polka’s steps [3] namely: understanding the problem, designing a solution, implementing the completion plan, reviewing the completion steps. In addition, based on the results of research [4], [5], [6], [7] it can be concluded that the mathematical problem solving ability is very necessary to be owned and developed by students at the elementary, junior high and vocational level in order to achieve success in learning mathematics.

Based on the causal factors that have been outlined it appears that the most dominant cause is the learning strategy. The alternative mathematics learning strategy that is designed is the Realistic Mathematics Education approach. Realistic Mathematics Education is an approach in which mathematics is seen as a human activity [8]. Realistic Mathematics Education (RME) is an approach with the paradigm that mathematics is a human activity, and learning mathematics means working with mathematics (doing mathematics) [9]. According to [10] the learning approach with RME has five characteristics that construct ideas driven by situations that are understood by students, develop mathematics from concreteness to abstraction, encourage freedom to express ideas and reflections,
encourage social activities with interactions in learning, the interconnectedness of learning to see the unity of science.

So learning mathematics will be more meaningful and interesting for students because of usefulness in their lives, especially for their expertise program. In addition, teachers focus more on students to remember the "ways" they teach in solving problems rather than stimulating them to construct The RME-based mathematics learning steps according to [11] are: understanding contextual problems, explaining contextual problems, solving contextual problems, comparing and discussing answers, and concluding. Problems and mathematical reasoning of students' [12].

The mathematics learning strategy is designed in the form of learning tools in the form of learning plans and student worksheets based on realistic mathematics education. This tool is designed based on the results of preliminary research analysis, one of which is student analysis. The purpose of analyzing students is to find out the characteristics of students in learning mathematics. So that the mathematics learning device developed is in accordance with the characteristics of students in vocational high schools.

Based on previous studies, research on the development of mathematics learning tools based on RME has not yet focused on how mathematics learning tools based on RME can increase students' interest in learning mathematics in vocational high schools with office management expertise programs. Starting from this problem, the development of RME-based mathematics learning tools for students in vocational high schools with office management expertise programs needs to be developed to grow the learning mathematics so that learning mathematics becomes interesting and enjoyable.

2. Research Methods

This type of research used is development research. According to [13] Research and development is a process for developing new products or perfecting existing products. The development model used is the Plump model. The development of the Plump model consists of three stages: Initial investigation stage in the form of curriculum analysis, concept analysis, needs analysis and student analysis. The prototyping stage consists of self-evaluation, one to one, small group and field test, and evaluation stage. In this study, researchers only conducted an initial investigation stage, namely the analysis of students with the aim to see the characteristics of students in learning mathematics. Where the results of this analysis are used as one that must be considered when designing RME-based mathematics learning tools. The subjects of the study were students of state vocational high school 4 Rambah Kab. Rokan Hulu Riau Province tenth grade Office Management expertise program. This research belongs to descriptive qualitative research. Where this qualitative data is taken from the results of interviews and observations and student questionnaire responses. The instruments used in the initial investigation stage were observation sheets, interview guidelines and student questionnaire responses. The data analysis technique used is descriptive technique to analyze the results of interviews, observations and questionnaire responses of students. The results of qualitative research emphasize the results of students' interest in mathematics and how students see mathematical problems in accordance with the real contexts encountered in their lives.

3. Research Investigation

The data obtained by researchers based on the results of preliminary analysis of students' interest in learning mathematics at one of the vocational high schools in Indonesia are as follows:

Respondents : Students in tenth grade of Office Management expertise
Number of Respondents : 32 people
Table 1. Mathematics lessons conveyed by the teacher are easy to understand.

|                        |        |
|------------------------|--------|
| Very difficult to understand | 5      |
| Hard to understand     | 17     |
| Easy to understand     | 10     |
| Very easy to understand| -      |

Conclusion: Students assume math lessons that are difficult to understand.

Table 2. Like working on problem solving problems (one of them is in the form of a story)

|        |        |
|--------|--------|
| Yes    | 5      |
| No     | 27     |

Conclusion: Learners do not like problem solving problems.

Table 3. Math material used in daily life and department conference

|                      |        |
|----------------------|--------|
| Very used            | 6      |
| Enough used          | 10     |
| Un used              | 16     |
| Very un used         | -      |

Conclusion: Generally, the students do not get to sense using math in daily life and department conference.

Table 4. I encourage to follow math learning in the class.

|      |        |
|------|--------|
| Yes  | 13     |
| No   | 19     |

Conclusion: Most of students do not encourage to math learning in the class.

Table 5. Source of learning that I used in math learning (may choose more than I choosen)

|                                      |        |
|--------------------------------------|--------|
| Book study                           | 32     |
| Students book exercise students (LKPD)| -      |

Conclusion: The students never use LKPD yet in processing learning.

Table 6. LKPD used today

|                                      |        |
|--------------------------------------|--------|
| Making with teacher or MGMP          | -      |
| Buy teacher                          | -      |
| No used LKPD                         | 32     |

Conclusion: No yet using LKPD
Table 7. I need LKPD to help comprehending material math.

| Yes   | 32 |
|-------|----|
| No    |    |

**Table 7.**

The development of RME-based mathematics learning tools namely the learning implementation plan and RME-based student worksheets will be able to attract students' interest in learning mathematics in vocational high schools with office management expertise programs. Because learning with the RME approach will invite students to learn mathematics with the problems around them, so learning mathematics becomes real and useful in their lives. According to [15] in realistic philosophy, the real world is used as a starting point in the development of mathematical concepts and ideas. Where according to [16] in [15] writes that contextual problems in the realistic curriculum are useful for the determination of concepts, the formation of mathematical models, applicability and practice as well as the training of specific abilities in applied situations.

### 4. Conclusion and recommendation

Based on the initial investigation phase, it was concluded that the development of mathematics learning tools based on realistic mathematics education was valid and practical used to increase students' interest in learning mathematics in vocational high schools, especially office management expertise programs. The RME-based mathematics learning tool is recommended so that it can also be used by high school or equivalent students and vocational high schools with expertise programs other than Office Management. Further product development can be done on one basic competency as a whole and adapted to the characteristics of students. The preparation of the Learning Implementation Plan (RPP) and the Student Worksheet (LKPD) also needs to pay attention to the time allocation and learning model/approach used.

### References

[1] Directorate of Vocational Development Technical Guidance for the Implementation of Instructors and Training GS 2013 *Curriculum Spectrum of Vocational Secondary Education Skills. Directorate of SMK Development* (Jakarta: Ministry of Education and Culture)

[2] Herman H 1990 *Mathematics Teaching and Learning Strategies* (Malang: Malang State University)

[3] Polya G 1973 *How to Solve It* (Princeton and Oxford: Princeton University Press)

[4] La’la T H 2018 *Preliminary Analysis On Development Of Mathematics Learning tools Based Competence Profession In Trigonometry Topic for Vocational High School Majoring Of Information and Communication Technologies* (Padang: Universitas Negeri Padang)

[5] Fadillah S 2009 *Ability to Solve Mathematical Problems in Mathematics Learning* (Pontianak: STKIP PGRI Pontianak)

[6] Irnawati 2017 *Development of Mathematics Learning Tools Based on Realistic Mathematics Education Approach Cooperative Setting Type of Student Teams Achievement in the Division of Linear Equation Subjects Two Variables in Class VII students of SMP I UIN* (Makassar: Universitas Alauddin Makassar)

[7] Inayati M dkk 2013 *Development of Learning Tools for Triangle and Quadrilateral Material with RME Approach for Class VII students of MTsN Rejosari Madiun Ahun District 2012/2013 Lessons* (East Java: FMIPA IKIP Madiun)

[8] Fauzan dkk 2006 *Development and Implementation of RME-Based learning tools for elementary schools in West Sumatra Province* (West Sumatera: Directorate General of Higher Education Ministry of Education)

[9] Fauzan A & Yerizon 2013 *Proceedings of Semirata FMIPA* (Lampung: University of Lampung) 7-14
[10] Tasman F dkk 2017 Students' Understanding of Integral as Anti Turunan A Rise in Integral Calculus (Padang: UNP Padang)
[11] Soedjadi R 2007 Basics of realistic mathematics education in Indonesia Journal of Math Education 1 2 - 9
[12] Fauzan A dan Yerizon 2013 Effect of RME Approach and Learning Ability on Students' Mathematical Capabilities in 2013 (Padang: UNP) .
[13] Sutama 2015 Research methods Kuantitatif Qualitative PTK R and D (Surakarta: Fairus Media)
[14] Putri DP 2019 Development of RME Based Teaching Materials IAIN (Bengkulu: Curup Bengkulu)
[15] Suherman E dkk 2003 Contemporary Mathematics Learning Strategies (Bandung: UPI Bandung)
[16] Treffers A & Goffree F 1985 Proceeding og Ninth International Conference for the Psychology of Mathematics Education (Noordwijkerhout) pp97121