

Development of Contextual-Based Mathematical Problem Solving Modules to Improve Mathematical Problem Solving Skills for Class VII Junior High School on Integer and Fraction Operations Material

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Abstract—This study aims to produce valid and practical contextual-based mathematics learning tools to improve mathematical problem solving skills of seventh grade students of Junior High School. The development of this learning device uses the development of the Plomp model which consists of three phases, namely the initial investigation phase, the prototype development phase, and the assessment phase. In the first investigation phase, data collection is carried out which aims as a reference in designing learning tools. The prototype development phase aims to develop learning tools to produce valid and practical learning tools through formative evaluation stages, namely self-evaluation, one-on-one evaluation and small group evaluation. The test subjects in this study were seventh grade students and mathematics teachers at Al Ishlah Islamic Junior High School Bukittinggi in the 2021/2022 academic year. The instruments used during the study were observation sheets, interview guidelines, questionnaires and learning device validation sheets. The instruments used in data collection were first validated by the validator. The results of the analysis of the data from the RPP validation sheet and the mathematics module showed that the contextual-based mathematical tools developed were valid in terms of content and constructs. The contextual-based learning tools developed have been practical in terms of implementation and ease of use. This is based on the results of data analysis of observations on the implementation of learning, interviews with students and student response questionnaires.

Keywords— mathematical problem solving ability; CTL approach; contextual-based mathematical problem solving modules

I. INTRODUCTION

In the process of learning mathematics, the paradigm to improve problem solving skills through appropriate strategies must be maintained and developed. However, the reality is that this paradigm still does not attract attention of teachers in managing and implementing learning. One of the strategies can be done is to apply learning that can facilitate students in solving problems. The learning is contextual learning or Contextual Teaching and Learning (CTL). Contextual learning is able to involve students in learning activities that help students relate the subject matter to the real-life contexts in their daily experience.

The reality on the field shows that learning at school in learning mathematics and other subjects at the junior high school level and also at the high school / vocational school level has not fully supported the development of this problem solving ability. The fact that the researchers found above also happened at the Al Ishlah Islamic Junior High School in Bukittinggi. The results of observations and interviews conducted in July 2021 showed that students' problem-solving abilities were still low. Classically, the low problem-solving ability of these students can be seen from the data from the problem-solving ability test given to students in table 1 below:

TABLE I. Percentage Of Problem Solving Ability Test Results For Class VII Students Of Al Ishlah Islamic Junior High School Bukittinggi In 2021/2022 Academic Year

N o	Class	Total of Studen ts	The Result of Analysis of Question Item Indicators												Total of Class Score	Avera ge
			Question no 1				Question no 2				Question no 3					
			Indicator				Indicator				Indicator					
			1	2	3	4	1	2	3	4	1	2	3	4		
1	VII.A	30	44	37	61	43	54	51	63	34	52	49	55	23	566	52.4
2	VII.B	30	37	32	56	34	53	49	61	29	49	46	54	19	519	48.1
3	VII.C	29	41	34	58	40	50	46	59	28	48	44	54	20	522	50.0
4	VII.D	27	30	27	49	32	43	40	55	24	41	38	48	18	445	45.8
5	VII.E	26	16	11	43	27	31	25	67	28	33	23	67	34	405	43.3
6	VII.F	26	20	16	45	30	25	28	66	25	28	29	66	22	400	42.7
Total		168	188	157	312	206	256	239	371	168	251	229	344	136		47.0
Indicator Score Percentage			0.37	0.31	0.62	0.41	0.51	0.47	0.74	0.33	0.50	0.45	0.68	0.27		47%

The table above is the result of the problem solving ability test of seventh grade students of Al Ishlah Islamic Junior High School in 2021/2022 academic year classically which is calculated based on the problem solving indicators proposed by Polya, namely: (1) Understanding the problem, (2) Developing a settlement plan, (3) Implementing the plan of completion and (4) Re-checking the answers.

Based on table 1, it is known that the percentage of problem solving ability test results for class VII students is still not satisfactory. In table 1 we can see that the average percentage of problem-solving abilities for each class is below 50%. Overall 60% of students have not been able to understand the problem and solve the problem properly. On average, students have not been able to carry out coherent and systematic work steps, students have not been able to identify what they know and what they need in solving problems. In addition, students are also not able to choose the right strategy for solving the given problem so that students cannot answer the questions correctly.

Integers and fractions are one of the topics in mathematics learning in grade VII semester one for SMP/MTs level, which have an important role in everyday life. This is based on the fact that this topic discusses the general concepts of learning mathematics. The topic of integers and fractions has been presented in the form of textbooks that tend to be monotonous or mechanistic, namely given discussions, formulas, sample questions and exercises. If we look closely at the learning flow contained in the handbook, the flow does not contribute to the development of student learning, especially the development of mathematical problem solving abilities. Whereas the available textbooks in general tend to encourage teachers to teach mathematics mechanistically and algorithmically.

The handbooks used by teachers so far have not facilitated students in building their knowledge and have not helped develop meaningful mathematics learning activities. Students only receive an explanation from the teacher and then are asked to memorize the formula with the aim that they can do the given exercise. There are many things that are more important in the learning process than memorizing formulas so that learning can be more quality and meaningful, such as connecting each problem, and emphasizing the relationship between ideas.

Based on what has been described above, a solution is needed to overcome these problems. The solution offered is a module

using a contextual approach to learning mathematics with the topic of integers and fractions. The advantage is that the module really helps the implementation of learning that can be done anytime and anywhere, especially for students to study independently at home. Thus, learning that is carried out is full of limitations such as limited time, limited space and limited material taught only essential material (emergency curriculum in the new normal era) is no longer an obstacle for students in increasing their problem solving knowledge.

Efforts that can be made to overcome problems and improve learning in order to create graduates who have good problem solving skills are by developing teaching materials in the form of contextual problem-based modules. The development of this contextual problem-based module is carried out in contextual learning to train and improve students' mathematical problem solving abilities.

Based on the description above, the purpose of this research is to produce teaching materials in the form of modules in mathematics learning with contextual-based integers and fractions topics. The designed modules are implemented in class VII students.

II. RESEARCH METHODS

The development model used in this research is the Plomp development model. Design research was conducted by designing contextual-based learning on the topic of integers and fractions. The implementation of this research is assisted by using an instrument in the form of a module. The development procedure in this research is divided into three phases.

In the experimental preparation stage (preparing the experiment) there are several literature studies on the topics used to design the module. This aims to collect all the data and materials needed to design the module. The next activity is designing the module. This module is dynamic so it can be revised depending on the trial process.

At the experimental design stage (The Design Experiment) the module design was tested in a small group consisting of six students of class VII SMP Islam Al Ishlah Bukittinggi. At this stage, six students were divided into 2 groups, each group consisting of 3 students with high, medium and low abilities. The skills of the selected learners vary from high to low.

At the retrospective analysis stage (The Retrospective Analysis) the results of data analysis from the teaching experiment stage were used to develop designs for further learning. Data collection techniques in this study were field notes, video recordings of learning, photo documentation, observation, questionnaires and interviews. Data is collected to describe the implementation of the module. The scheme of this design research is illustrated in the following figure.

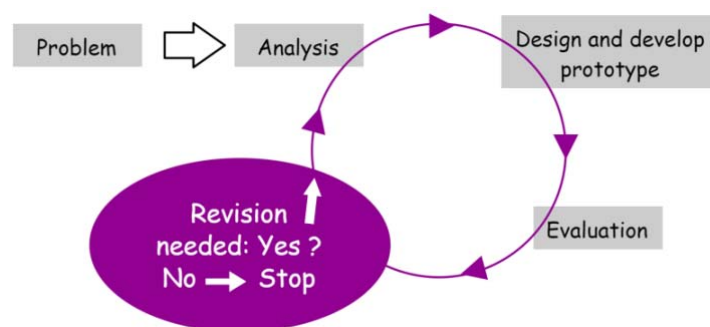


Fig. 1. Systematic design development cycle iteration

III. RESULTS AND DISCUSSION

The learning tools developed in this research are lesson plans and mathematical problem solving modules. RPP is prepared by taking into account the characteristics of contextual learning in the CTL model which has 7 syntaxes consisting of 1) Constructivism; 2) Inquiries; 3) Questioning; 4) Learning Community; 5) Modeling; 6) Reflection and 7) Authentic Assessment. As for the mathematical problem solving module, the characteristics of the module itself are considered. So that the resulting device in this study is in accordance with existing theories.

According to Nieven in Plomp (2013: 28), a quality product must meet 3 criteria, namely valid, practical, and effective. Based on the results of the research that has been carried out, information is obtained that the contextual-based mathematics learning tools have met the criteria of being valid, practical and effective. Device validity is related to the accuracy of a device in terms of content and also its construction. Content validity relates to the suitability of the product produced and the material, while construct validity relates to the suitability of the product produced and the developed model.

The learning tools developed were then tested for validity. To determine the level of validity of the device, a self-evaluation of the device that has been developed is carried out, then validated by the expert. The learning device that the researcher developed was validated by 5 validators, namely 3 mathematicians, 1 linguist and 1 educational technology expert. Before being validated by experts, self-evaluation activities are carried out, namely self-evaluation and revisions are made to the errors encountered. Then this learning tool is further validated by experts.

Based on the results of the validity test, it shows that this learning device meets the valid criteria with several parts that need to be revised. Improvements were made in relation to the accuracy in writing sentences and the problems that were raised in the designed module.

The results of the validation of the developed module obtained data in table 2.

TABLE II. The Result of the Validity of the Developed Module

No	Aspects Tested	Average Validity Index
1	Presentation	3.52
2	Content Eligibility	3.71
Average Validity Index		3.6
Criteria		Very Valid

The results of the product validity test in the form of the above module were obtained from an assessment questionnaire on the module to be developed. In table 2 above, information is obtained that the average validity index of the mathematical problem solving module developed is 3.6 with very valid criteria. Meanwhile, the RPP validation obtained an average validity index of 3.85 with very valid criteria. In this case, it can be concluded that the product of this research is feasible to be used for testing in the next research stage.

Learning tools that have been validated are tested to find out their practicality. To find out the practicality of the learning tools, interviews with teachers and students were conducted as well as through an assessment of practicality questionnaires in the Small Group Evaluation activity. The interview covered several aspects related to the advantages of the tools developed. Meanwhile, the effectiveness of the learning tools was seen from the success of the students in answering the final test questions. The implementation of the product trials developed in this study relates to the material for operations of integers and fractions, namely the mathematics material for class VII of Junior High School.

The results of the product practicality assessment for the developed student responses can be seen in table 3 below.

TABLE III. The Results of the Practicality Questionnaire of Student Responses to the Module

No	Assessment Aspect	Rating Average
1	Presentation	92%
2	Ease of use	87%
3	Legibility	85%

N o	Assessment Aspect	Rating Average
1	Presentation	92%
4	Time	96%
Overall Average		90%
Criteria		Very Practical

In the table it can be seen that for each aspect assessed, the overall average result is 90%. This shows that the module being tested is very practical to use.

Meanwhile, the results of the practicality of the module for the teacher's response to the module can be seen in table 4 below.

TABLE IV. The Results of the Practicality Questionnaire of Student Responses to the Module

N o	Rating Time	Average Score
1	The first meeting	88%
2	The second meeting	90%
3	The third meeting	85%
4	The fourth meeting	90%
5	The fifth meeting	93%
Overall Average		89%
Criteria		Very Practical

In the table above, it can be seen that the overall average for five meetings or five times the teacher's assessment of the developed module, obtained an average of 89% with very practical criteria used.

Based on the results of the research conducted, it was found that this contextual-based learning tool was valid, practical and effective. The lesson plans and mathematical problem solving modules developed have an effect on increasing students' mathematical problem solving abilities. The characteristics of the module support the implementation of independent learning. The teacher is no longer the only source of learning but in this case the teacher only acts as a facilitator.

This mathematical problem solving module can be used in group learning as well as independent learning by students. This is because the characteristics of the module have self-instructional characteristics, which means that with the module students do not have to depend on other people. In addition, the characteristics of the module are self contained and also stand alone. This means that here with the module, all the material already exists and is complete so you don't have to use other learning resources because the module is a stand-alone teaching material.

IV. CONCLUSIONS AND RECOMMENDATIONS

Based on the development process that has been carried out, the results obtained in the form of contextual-based learning tools that have been developed are valid both in terms of content and constructs. The contextual-based learning tools developed have met the practical criteria in terms of implementation, convenience and time required. This can be seen from empirical data, namely practicality questionnaire data according to students, teacher response questionnaires and data from observations of learning implementation.

REFERENCES

- [1] A. Melsa and D. Permana, "Development of mathematical learning media based on contextual teaching and learning (CTL) to improve students' mathematical problem solving ability for grade VIII of junior high school", *International Journal of Progressive Science and Technologies*, 23(2), pp. 677 - 681, 2020.
- [2] Finariyati, A.A. Rahman, and A. Yuli, "Pengembangan modul matematika berbasis etnomatika untuk meningkatkan kemampuan pemecahan masalah siswa", *MAJU*, 7(1), pp. 89 - 97, 2020.
- [3] J. Elaide, "Contextual teaching and learning: menjadikan kegiatan belajar-mengajar mengasyikkan dan bermakna", Bandung: Kaifa, 2011.
- [4] K. Imas, and B. Sani, "Implementasi kurikulum 2013 konsep dan penerapan", Surabaya: Kata Pena, 2014.
- [5] Mariyam, M. Citroesmi, and R. Wahyuni, "Pengembangan kemampuan pemecahan masalah matematis siswa pada materi pertidaksamaan linier satu variabel melalui model problem based learning berbantuan modul", *Jurnal Pendidikan Matematika Indonesia*, 3(2), pp. 66 - 73, 2018.
- [6] N, Anita, "Pengembangan modul matematika berbasis masalah untuk meningkatkan pemecahan masalah matematika siswa", *Rekognisi: Jurnal Pendidikan dan Kependidikan*, 1(1), pp. 47 - 63, 2016.
- [7] F.D.P. Nesri and Y.D. Kristanto, "Pengembangan modul ajar berbantuan teknologi untuk mengembangkan kecakapan abad 21", *Aksioma: Jurnal Program Studi Pendidikan Matematika*, 9(3), pp. 480 - 492, 2020.
- [8] T. Plomp and N. Nieveen. "Educational design research", Enschede: Netherland Institute for Curriculum Development (SLO), 2013.
- [9] Sardiman, "Interaksi dan motivasi belajar mengajar, Jakarta: Raja Grafindo Persada, 2012.
- [10] Suhandri, and A. Sari, "Pengembangan modul berbasis kontekstual terintegrasi nilai keislaman untuk meningkatkan kemampuan pemecahan masalah matematis siswa", *Suska Journal of Mathematics Education*, 5(2), pp. 131 - 140, 2019.