Research Article

Development of Project-based Mathematics Learning (PjBL) Using the Island Sea Context

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Abstract.
Implementing learning using the PjBL model will be meaningful for students if it is connected to the students' world. This research aims to produce a mathematics learning tool with the PjBL model that is valid, practical, and effective in the context of the island sea. This research is development research that aims to develop an island sea-based PjBL learning model. The development stages use a 4D model which consists of definition, design, development, and dissemination; however, in this research dissemination was not carried out. The research results show that the mathematics learning tools using PjBL are valid, practical, and effective. The learning tools used in learning are proven to be very practical for student activities and improve learning outcomes. The accompanying impact that emerges is communication skills and complex problem solving.

Keywords: project-based learning, island marine context, 4D model, problem solving

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1. Introduction

Mathematics is a science that plays an important role in technological development because mathematics is a basic science that is a benchmark for technological development and progress. According to Laamena, Hukom and Mataheru [1], Mathematics provides skills for someone to be able to think logically and systematically in solving problems. Based on the 2013 curriculum, the aim of learning mathematics is so that students can: (1) understand mathematical concepts; (2) using patterns as conjectures in solving problems, and being able to make generalizations based on existing phenomena or data; (3) using reasoning on properties, carrying out mathematical manipulations both in simplifying, and analyzing existing components in solving problems in the context of mathematics and outside mathematics; (4) communicate ideas, reasoning and be able to compile mathematical evidence using complete sentences, symbols, tables, diagrams or other media to clarify situations or problems; (5) have an attitude of appreciating the usefulness of mathematics in life; (6) have attitudes and behavior

that are in accordance with the values in mathematics and its learning; (7) carrying out motor activities that use mathematical knowledge; (8) using simple teaching aids or technological results to carry out mathematical activities [2].

The importance of mathematics does not necessarily make mathematics a favorite subject, on the contrary, mathematics is a subject that is considered difficult and is not liked by many students, because the mathematics learning process that occurs in class seems boring. This results in low student learning outcomes. The low student mathematics learning outcomes are also caused by the learning process which tends to be teacher-centred. Ratumanan and Laurens [3] found several causal factors related to learning, including: (1) mathematics teachers generally use a mechanistic approach and ignore contextual aspects, so that mathematics learning becomes uninteresting and less motivating for students, and (2) the learning process is generally dominated by lecture and a little practice. Teachers are too fixated on textbooks, concepts are taught according to the flow in the textbook, even the examples given also refer to examples written in the textbook. Teachers' ability to develop learning materials is still limited. enrichment activities are also relatively limited. In mathematics learning, the lack of connecting problems with students' real lives, so that it is only a scientific discipline, is also one of the causes of low mathematics learning outcomes.

The PjBL learning model is seen as an excellent learning model used to develop learning motivation, improve problem-solving abilities, and familiarize students with utilizing positive thinking skills. Abidin [3] views PjBL as a learning model that functions as the backbone for developing student experiences in learning and teachers in teaching. This model was developed based on the strong belief that learning by doing, discussing in groups, and learning through experience have a very important role as the main way to improve students' understanding and learning outcomes. Based on several opinions, the author can conclude that the Project Based Learning (PjBL) model is a learning model that emphasizes student activities in solving various problems, learning new skills through a series of activities designing, planning and producing certain products.

According to Ardianti, et al [4] Project Based Learning is a learning model with the special characteristic of designing and carrying out a project in it, to produce a product. According to Mahendra [5] project-based learning is a way of learning that uses problems as the first step in collecting and integrating new knowledge based on experience in real activities. In the teaching and learning process, this model is different from the traditional model. According to Wena [6] project-based learning is a learning model that provides teachers with the opportunity to manage learning in the classroom by involving project work. The Project Based Learning model is an

instructional technique that changes learning from "Teacher Telling" to "Student Doing" where students are given assignments based on challenging questions or problems that involve student problem solving, decision making, meaning making, investigative and reflection skills that include tools that are not facilitated. According to Kristianti, et al [7] the Project Based Learning model is quite useful in designing effective learning so that it has enough potential to meet demands. So, from the opinions above, project-based learning is a technique for applying problems in the learning process that has the final result in the form of a real product.

Implementing learning using the PjBL model will be meaningful for students if it is connected to the students' world. PjBL learning needs to raise real problems that occur in society, because the aim of PjBL is to connect the knowledge gained by students in class to be published in the real world by creating solutions to existing problems. Students in Maluku, where 90% of the territory is sea, are very familiar with the sea. Therefore, learning must touch on students' experiences so that they need to be given the opportunity to create projects based on island seas. Maluku, as a province of a thousand islands with rich seas, is an important asset, including in learning. This research aims to produce Mathematics Learning Tools using the PjBL model that are valid, practical and effective.

2. Methods

This research is development research (Development and Research) which aims to develop an island sea-based PjBL learning model. This model can be used for various forms of product development such as models, learning strategies, learning methods, media and teaching materials. In this research, a Learning Plan (RPP) and Student Worksheet (LKPD) will be developed using the 4D development stages (definition, design, development and dissemination). This article only discusses the development stage. The research was conducted on grade 7 students of State Middle Schools in West Seram Regency.

The learning device developed must meet the criteria of Valid, practical and effective. The device is said to be valid if the expert validation results are at the interval $3 \leq x \leq 4$; RPP and LKPD are said to be practical if they can be applied in the classroom, namely teachers and students give a positive response of at least 80%. Effectiveness is determined by the increase in final test results from the initial test. At the validation stage, the validator provides an assessment of the learning tools by filling in the instrument using a Likert scale with criteria 1: not good; 2 is sufficient; 3 good; 4 very good. Student

test results will be classified according to the Benchmark Assessment (PAP) proposed by Ratumanan and Laurens [8] as in Table 1

TABLE 1: Classification of Student Learning Outcomes.

Score	Information
$x < 40$	Very low
$40 \leq x < 55$	Low
$55 \leq x < 70$	Currently
$70 \leq x < 85$	High
$x \geq 85$	Very High

3. Results and Discussion

3.1. Definition Stage

At this stage, researchers identify the problems faced by students, analyze student teaching materials and textbooks that teachers use, learning implementation plans and student worksheets (LKPD). The analysis results show that:

1. Students' abilities in social arithmetic material are still low.

2. The learning process always begins with the teacher's explanation of the material, students are only given the opportunity to practice questions. The cooperative learning model is still only a design in the RPP but has not been implemented properly.

3. Teaching materials are informative, students are not given the opportunity to construct their own knowledge

4. LKPD is only limited to completing practice questions, not as a guide for students to discover new concepts

5. The teacher has not used the island sea as a context for learning

Based on the results of the analysis, the researchers decided not to develop teaching materials, but only RPP and LKPD, so that students could explore and build new knowledge. PjBL is designed using the context of the island sea in Maluku so that students better understand what they will learn.

3.2. Design Stage

Researchers designed social arithmetic lesson plans and worksheet for 4 meetings. The project design uses the method of selling fish in Maluku in the form of piles called

'tampa' instead of kilos. Students will create a project selling fish at the market to discover the concept of profit and loss and their percentages. The lesson plans are prepared so that students carry out projects outside of school hours, are recorded and will be presented. The LKPD is designed to be filled out by students based on the project they are working on, so that students will construct their knowledge about profits, losses and percentages.

Development Stage

At the development stage, researchers provide the RPP and LKPD that have been prepared to the validator for assessment. Assessment is based on the suitability of the learning stages with the PjBL learning model and students' initial knowledge, the suitability of the language to the students' level of thinking as well as the stages of questions on the LKPD which will guide students in knowledge construction. The validation results are explained in Table 2.

TABLE 2: Expert Validation Results.

Validated device	Validator					Average	Qualification
	1	2	3	4	5		
RPP	4	4	3	4	4	3.8	Very good
LKPD	3	3	4	4	4	3.6	Very good
Average						3.7	Very good

The validation results show that the RPP and LKPD developed are in the very good category so they can be used. Apart from that, the validator also provided several inputs for improving the RPP and LKPD regarding the language and stages of questions on the LKPD.

Next, to find out the practicality and effectiveness of the RPP and LKPD, a trial was carried out on their use in learning. There were 22 students who used the development results. The practicality test results and test results are presented in Tables 3 and 4

TABLE 3: Practical Analysis of RPP and LKPD.

Meeting	Aktivitas Siswa	Aktivitas Guru	Respon Siswa	Respon Guru
First	86	83	92	95
Second	90	89	95	95
Third	88	90	98	98
Fourth	93	86	98	95

Table 4: Student Learning Results.

Score	Number of Students	Description
$x < 40$	2	Very low
$40 \leq x < 55$	4	Low
$55 \leq x < 70$	11	Currently
$70 \leq x < 85$	4	High
$x \geq 85$	1	Very High

The increase in learning outcomes shows that the PjBL learning model has a positive impact on the learning process. Learning through doing makes learning more meaningful. Student activities in organizing projects, allocating time, and managing resources such as equipment and materials to complete assignments provide learning experiences that remain longer in students' memories. This is in accordance with David Ausubel's theory of meaningful learning which emphasizes mathematics learning oriented towards students' real lives [9]. With meaningful learning, students' memory becomes stronger, so that students can construct the knowledge and learning experiences they have experienced to solve everyday problems related to mathematics. Students associate new experiences, phenomena, and facts into their knowledge system to solve everyday problems [10].

PjBL also increases students' motivation to learn and encourages them to do important work. According to Kamaludin [11], when someone has high motivation for something he will prefer to do it compared to other things; do so with passion, enthusiasm, and interest; set high standards for the goals to be achieved; and do it over and over again with pleasure. It was further emphasized that effective learning which can help increase students' learning motivation and at the same time make the learning process optimal will occur when teachers can manage the class well and provide opportunities for students to learn optimally; designing specific learning objectives as learning outcomes that students will obtain in the learning process that day; using varied learning methods and learning resources; using high-level questions or problems, namely those that can provoke students to think and be motivated to solve them; and always provide positive feedback and appropriate praise for what students achieve in learning activities. According to Lumuly [12] motivation influences mathematics learning outcomes.

Student activity makes students able to solve complex problems. Students are not only taught to solve simple or routine problems, but must be trained to solve complex problems. According to Siswanto [13] , students should be given regular opportunities to identify, challenge, and solve complex problems that require extra effort, and then

encouraged to reflect on their thinking processes. In learning problem solving, students should develop critical thinking, habits of perseverance, curiosity, and confidence in dealing with unfamiliar situations, which will be useful outside the classroom environment. Solving problems is an integral part of the mathematics learning process and should be well integrated in the curriculum. The source of problems according to NCTM [14] can come from students' personal experiences, everyday situations, to application contexts in the real world or in the workplace.PjBL Encourages students to practice communication skills so that interaction and cooperation occurs so that active and enjoyable learning occurs for students. Refwalu's research results [15] confirm that communication is very important in mathematics learning as a communication tool that is strong, short and clear and can present mathematical information in various ways. Students need to be accustomed in learning to providing arguments for each answer and providing responses to other people's answers, so that what they learn becomes more meaningful. Through PjBL, students can communicate ideas or thoughts on completed projects, because many problems are presented in mathematical language, for example presenting problems in the form of mathematical equations, tables, graphs or diagrams.

4. Conclusion

The development of the tools carried out resulted in valid, practical and effective lesson plans and LKPD in improving student learning outcomes. The PjBL Learning Model uses the Maluku context to make learning more meaningful, increase student learning motivation, encourage student communication and activity and make students have better mathematical abilities.

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