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THE DEVELOPMENT OF PROBLEM-BASED LEARNING LIVEWORKSHEETS TO IMPROVE MATHEMATICAL COMMUNICATION SKILLS ON JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

Communication skill is an ability that needs to be possessed by students. Through communication, students can express their opinions or ideas to their friends or to the teacher. The facts in the field show that students' mathematical communication skills are in the low category, therefore a solution is needed to improve students' mathematical communication skills. This research aims to produce problem-based learning-based LKPD assisted by liveworksheets to hone students' mathematical communication skills. This research was conducted at SMPN 1 Ngamprah. The subjects of this study amounted to 10 students on a limited trial. 34 students for a broad trial. The method used is development research according to Sugiyono which is modified into 7 stages carried out due to time constraints, namely: potential and problems, data collection, product design, design validation, design revision, product trial, and product revision. Data collection tools for this study are validation sheets, student response questionnaires, and 5 questions about mathematical communication skills in statistics material. Based on the results of value processing from validators, it shows that the developed LKPD is said to be suitable for use in learning, with an average percentage of assessment from validators of 85%. The results of the calculation of student answers show that the developed LKPD is effective for improving mathematical communication skills, with an average calculation of each indicator of 72.35%. It can be concluded that problem-based learning-based LKPD assisted by liveworksheets can be used in learning as an effort to improve students' mathematical abilities in statistics material.

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INTRODUCTION

Learning is an effort made to achieve basic competencies that have been planned by creating learning conditions for students through classroom interactions that involve the thinking process in understanding material with various learning resources (Suardi, 2018). In learning activities there is a communication process where the teacher conveys messages to students with the aim that students can receive messages properly (Masdul, 2018). Effective communication between teachers and students will result in good learning, and will achieve learning objectives. In learning for material that is considered difficult, good communication between teachers and students is needed. As in math learning, teachers must be able to build a classroom atmosphere where students can express their thoughts freely.

Mathematics is a subject that must be present in learning in every school from elementary to secondary level education. This is due to the importance of learning mathematics which is widely applied in everyday life (Maya & Setiawan, 2018). Daily activities that are examples of the implementation of math lessons are the buying and selling process, calculating profit and loss on sales, measuring distances and so on. In addition, mathematics is a science that is closely related to other sciences (Putri & Sundayana, 2021). According to Permendiknas No. 22 of 2006, the purpose of learning mathematics is so that students can explain situations or problems using symbols, tables, diagrams, or other media. The mathematical ability in question is mathematical communication ability.

Mathematical communication skills according to Ariani (2018) are the ability to communicate mathematical ideas or ideas through oral or written, as well as the ability to understand and accept other people's ideas to deepen understanding of the material. In line with Ahmad & Nasution (2018) who state that mathematical communication is an action that includes writing and expressing mathematical concepts using mathematical symbols or mathematical language. So it can be interpreted that mathematical communication ability is the ability to provide ideas in mathematical language. When students learn mathematics, they are expected to be able to communicate what they understand. Based on this, mathematical communication skills are an ability that must be mastered by students. By having good mathematical communication skills, students can solve math problems in various ways easily (Purnamasari & Afriansyah, 2021).

Communication that occurs during learning can be in the form of students conveying what they know, discussing with other students, or even asking the teacher when having difficulty understanding the material. With good communication during learning, students' understanding of the material can develop (Romlah et al., 2019). Communication in learning is important, with communication between teachers and students the transfer of knowledge will be conveyed properly and students' knowledge will increase. The role of communication in mathematics learning is: 1) Supporting students to foster critical thinking and optimize their ability to see the relationship between mathematical materials; 2) Serves as a measuring tool for students' mathematical understanding; and 3) Improve reasoning, social skills, and student confidence (Ariani, 2018).

Based on the results of observations and interviews with mathematics teachers at SMPN 1 Ngamprah, the data obtained that the mathematical communication skills of 8th grade students in statistics material are in the low category. Statistics is a mathematics subject that studies data and data presentation in the form of graphs, tables and diagrams. In statistics material, students have difficulty in reading tables and graphs, besides that students have difficulty in converting problems into mathematical models. Several studies in Indonesia show that the communication skills of junior high school students are still weak (Sundayana et al., 2017). The difficulties experienced by students are when solving story problems,

students often do not write what is known and asked in the problem so that students have difficulty in finding solutions, besides that students have difficulty presenting problems in mathematical models (tables, diagrams, and mathematical symbols) (Sugianto et al., 2022). This may occur because the characteristics of mathematics are filled with terms, notations, and symbols, so it is possible that students are able to answer math problems well but do not understand what they are doing (Lutfianannisak & Sholihah, 2018).

Based on the problems found, learning tools are needed that can support students to hone their mathematical communication skills, given the importance of these abilities to be possessed by students. One of the learning tools is LKPD, the use of LKPD during learning can help students understand the material and train students' critical thinking skills through activities in LKPD (Anggela et al., 2021). The results of research by Siregar & Pd (2021) show that the use of LKPD in learning activities is effective for training students' mathematical communication skills and improving students' ability to solve the problems given. In line with the research results of Kusumaningsih et al., (2019) there is an effectiveness of learning with the help of LKPD on mathematical communication skills. Based on this, it can be said that a well-prepared LKPD can help students in practicing students' mathematical communication skills.

The choice of learning model also needs to be considered well, the learning model chosen needs to be adjusted to the characteristics of the child and the learning objectives to be achieved. In this problem, the problem-based learning model was chosen because its characteristics are suitable for training students' mathematical communication skills. In PBL, students are divided into groups to solve problems by discussing them with their group members. This will encourage students to be able to express their ideas to their groupmates, so that students' communication skills can be trained. In line with some research results that have been conducted that the application of PBL during learning can improve students' mathematical communication skills (Rahmalia et al., 2020; Perwitasari & Surya, 2017; and Aufa et al., 2016).

Technological developments are increasingly rapid and are developing in all aspects, one of which is in the world of education. In schools, the use of technology makes it easier for students in the learning process to understand the material. Teachers are also required to be able to use technology to create innovative learning. Currently, there are many platforms and websites that can be used by teachers and students, one of which is Liveworksheets. Liveworksheets is a platform that can create interactive worksheets by accessing them through the website, so students can open them at any time.

With liveworksheets, teachers can turn printed LKPDs into online LKPDs. Supriatna et al., (2022) conducted research on the development of Problem Based Learning-based E-LKPD in mathematics subject content on the Liveworksheets website in elementary schools is valid and very feasible to be used by teachers in learning activities. Therefore, researchers are interested in developing PBL-based LKPD assisted by Liveworksheets on statistics material to hone the mathematical communication skills of grade 8 students.

METHOD

This research is a type of development research, as for what was developed was a student worksheet. The research procedure used refers to 10 steps according to Sugiyono (2013). Below are presented 10 stages of development research:

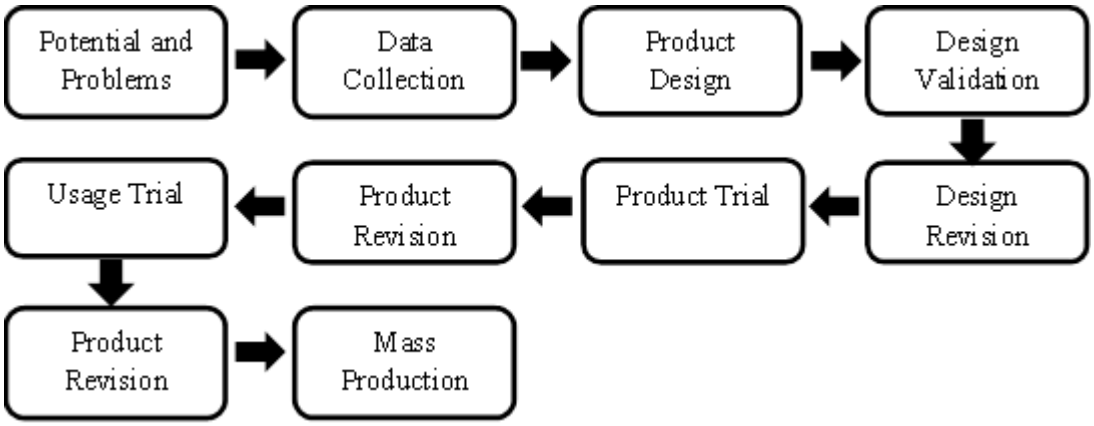

Figure 1. Research and Development Diagram

Of the 10 stages, this research was only carried out up to the seventh stage. This is due to the limited time, cost and energy of researchers. The seven stages carried out are: potential and problems, data collection, product design, design validation, design revision, product trial, and product revision.

To support the implementation of this research, research instruments for data collection were compiled in the form of validation sheets and test instrument questions in the form of 5 description questions that adjust to the indicators of mathematical communication skills. The validation sheet contains an assessment format filled in by the validator to assess the feasibility/validity of the developed LKPD. Five items of description questions are used to review the extent of the effectiveness of the products developed on students' mathematical communication skills on statistics material.

The indicators of mathematical communication skills measured, namely: connect real objects, images and diagrams into mathematical ideas about data and data presentation; explain mathematical ideas, situations and relationships orally or in writing or with real objects, images, graphs, and algebra to determine the average value of data; present everyday events in language or mathematical symbols about the median; present everyday events in language or mathematical symbols about the mode; explain and make questions about data distribution.

This research was conducted at SMPN 1 Ngamprah. The implementation of this research activity was in the even semester of the 2022/2023 academic year. The research subjects in the limited trial were 10 students in grade IX and the broad trial was conducted on 34 students in grade VIII. Validators in this study consisted of two mathematics lecturers and one mathematics educator.

The results of the assessment given by the validator are then processed using the following calculation (Fitriani et al., 2021):

$$V = \frac{Tse}{Tsh} \times 100\%$$

Description:

V : Percentage of validity

Tse : Total empirical score

Tsh : Total maximum score

The processing results of the validation assessment by the validator are then assessed with reference to the validity criteria according to Akbar (Fitriani et al., 2021):

Table 1. Criteria for Validity

Percentage of Validity	Criteria
81% - 100%	Very Valid
61% - 80%	Valid
41% - 60%	Moderately Valid
21% - 40%	Less Valid
0% - 20%	Invalid

To measure the effectiveness of the learner worksheet, the calculation below will be used based on the student test results that have been obtained after using the developed product during learning (Kadarisma et al., 2022):

$$E = \frac{f}{N} \times 100\%$$

Description:

E : Final Score

f : Total Score Acquisition

N : Maximum Score

The results of the effectiveness calculations that have been carried out are then analyzed with reference to the effectiveness category according to Widoyoko (Kadarisma et al., 2022):

Table 2. Criteria for the Effectiveness of LKPD

Value	Category
81% - 100%	Very Effective
61% - 80%	Effective
41% - 60%	Moderately Effective
21% - 40%	Not Effective
0% - 20%	Very Inffective

RESULTS AND DISCUSSION

Results

The results of the implementation of this study are in the form of problem-based learning (PBL) based student worksheets (LKPD) assisted by liveworksheets. The LKPD development process is in accordance with the research stages modified by Sugiyono, there are also these stages, namely, potential and problems, gathering information, product design, design validation, design improvement, product trials, and product revision. In the early stages of research, the steps taken were conducting interviews with mathematics teachers, from the results of the interviews it was known that teachers still used conventional methods, student worksheets purchased from publishers, students' mathematical communication skills were not good enough, and the use of technology in learning was not maximized. The potential in this study is to develop PBL-based statistics LKPD assisted by liveworksheets.

The next stage is to collect information about learning models that are suitable for the problems found by conducting literature studies. In the third stage, namely designing products, starting with compiling LKPD and test questions that refer to the Core Competencies (KI) and Basic Competencies (KD) in the curriculum used in the school where the research is carried out. After the product preparation is complete, the next step is the validation stage by the validator to determine its feasibility before being tested in the field. Validation was carried out by 2 mathematics lecturers and 1 mathematics teacher. From the results of the validation there were several suggestions and input for product improvement. LKPD can be accessed at the following link: https://www.liveworksheets.com/pd3326170qk

Below is presented the improvements made based on the input obtained from the validator.

Figure 2. Before Revisions

Figure 2 shows the LKPD that has not been revised. The input received by the validator is, first, to include learning objectives that match those in the lesson plan. Second, to increase the font size so that students will not have difficulty reading it and can be read clearly. Third, to change the command sentence into an invitation sentence.

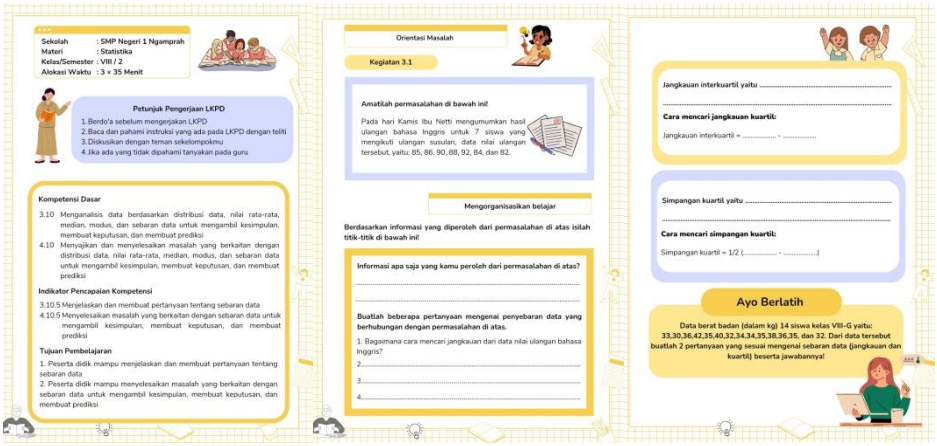

Figure 3. After revision

Figure 3 shows the results of the LKPD that have been revised as suggested by the validator. Since the improvements did not change the content of the material content, validation by the validator was not carried out again. Below are presented the results of the calculation of the assessment given by the validator.

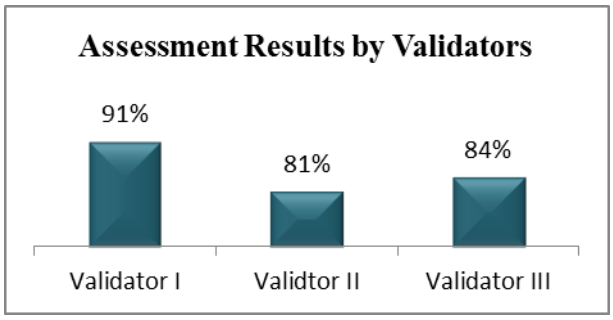

Figure 4. Assessment Results by Validators

From the results of the validation assessment by the validator, the average assessment is 85% with a very valid category so that the product can be tested in the field. After the product is said to be valid, the next step is to test the product to determine the effectiveness of the product developed on students' mathematical communication skills. The limited trial was conducted on 10 grade 9 students and the broad trial was conducted on 34 grade 8 students. Below are the results of the calculation of the effectiveness of the product on mathematical communication skills.

Table 3. Results of LKPD Effectiveness Calculation

No	Indicator	Percentage
1	Connecting real objects, pictures and diagrams to mathematical ideas about data and data presentation	69,12%
2	Explain mathematical ideas, situations and relationships orally or in writing or with real objects, pictures, graphs, and algebra to determine the average value of data	75%
3	Presenting daily events in language or mathematical symbols about the median	75%
4	Presenting everyday events in language or mathematical symbols about mode	69,85%
5	Explaining and making questions about data distribution	72,79%
	Average	72,35%

Table 3 shows the results of the effectiveness of the developed LKPD. The average of the calculation of the effectiveness of LKPD is 72.35% effective on students' mathematical communication skills in statistics material. So it can be concluded that PBL-based LKPD with the help of liveworksheets can be used in learning to train mathematical communication skills.

Discussions

The first step taken by the researcher was to conduct interviews with mathematics educators to identify problems encountered during learning activities, especially on statistics material. In

addition, researchers sought information about the teaching materials used and the selection of learning models chosen by educators. From the results of the interview, it was found that the teaching materials used were in the form of package books and printed worksheets produced by publishers. According to Nuraini et al., (2023) LKS prepared by publishers is not effective enough because it does not adjust to the needs of students and the appearance is not attractive because it uses opaque paper so that it will make students bored.

In learning activities, it is known that the teacher still uses the lecture method. Teachers choose the lecture method because it is considered the most suitable method to use and saves a lot of time. This is in line with Darmawani (2018)that the lecture method is widely chosen because it does not require a lot of preparation and can reach all students in the class because the teacher's role is to deliver the material and students simply listen.

Students' communication skills in statistics material are in the deficient category. It was found that students still had difficulty in reading tables and graphs and had difficulty in converting problems into mathematical models. This is in line with the results of research (Niasih et al., 2019) that students' mathematical communication skills are in the low or poor category, the causes are lack of mastery of the material, students' ability to draw conclusions that are still low, and lack of student accuracy in reading questions.

The next stage is to collect information for the development of LKPD by conducting a literature study. After that, researchers began designing LKPDs whose material content adjusted to the Core Competencies (KI), Basic Competencies (KD), learning objectives and syllabus. The steps in the LKPD are adjusted to the characteristics of PBL, with the presentation of problems at the beginning and the process of evaluating learning activities at the end of the LKPD work. This LKPD is assisted by liveworksheets, the selection of liveworksheets based on the results of interviews with teachers at school that students can use cell phones during learning. In addition, liveworksheets has several advantages including, being able to create interactive worksheets, many interesting features, and can assess automatically (Fuada, 2021). After designing the LKPD, researchers compiled learning tools, such as lesson plans, learning media, test instruments, and data collection instruments.

Before testing the product in the field, the researcher validated the LKPD to the validator. Validation is carried out to determine the feasibility of LKPD and get input from validators to improve LKPD so that it can produce a feasible LKPD (Robiana & Handoko, 2020). Validation was carried out by 2 lecturers and 1 math teacher. From the validation results, there were several inputs from the validators. First, include learning objectives in the introduction. Second, increasing the font size so that it can be read clearly by students, this is in line with Klarisya et al., (2019) clear writing will not make it difficult for students to read and read it. Third, changing the command sentence in filling out the questions with an invitation sentence.

After making improvements to the LKPD in accordance with input from validators, the next step is the limited product trial stage. The limited trial was conducted on 10 ninth grade students. Students were given the opportunity to use the developed LKPD, after which students were given a student response questionnaire to the PBL-based LKPD assisted by liveworksheets. From the results of the questionnaire obtained a positive response from students regarding the LKPD developed. This is in line with the results of research conducted by Ratnasari & Wulanningtyas (2022) using PBL-based LKPDs assisted by liveworksheets to get a good response from students.

The next stage is the broad trial. Broad trials were conducted with 34 students in grade VIII. At this stage students carry out learning for 5 meetings using the developed LKPD. After 5 meetings, students worked on mathematical communication skills questions as many as 5

description questions. The giving of these questions is to determine the effectiveness of the LKPD on students' communication skills. The results of student answers were then processed, from the results of data processing it was found that PBL-based LKPD assisted by liveworksheets proved effective on students' mathematical communication skills.

CONCLUSION

The process of developing problem-based learning worksheets assisted by liveworksheets refers to 7 stages modified by Sugiyono, namely potential and problems, gathering information, product design, design validation, design improvement, product trials, and product revision. The results of the assessment from the validator show that the LKPD developed is very feasible so that it can be used in learning. The results of this study also show that PBL-based LKPDs assisted by liveworksheets are proven effective for honing students' mathematical communication skills. Therefore, teachers can make the results of this study as a reference in preparing interactive LKPDs that will be used during classroom learning. Suggestions that can be given by researchers are, when students work on LKPDs assisted by liveworksheets in groups, it is better to access liveworksheets using a laptop/computer so that the LKPD display will be clearly visible to all group members.

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