Jurnal Theorems (*The Original Reasearch Of Mathematics*)
Volume 11, Nomor 1, Januari 2026
URL: http://ejournal.unma.ac.id/index.php/th

e-ISSN: 2528-102X
p-ISSN: 2541-4321

# DEVELOPMENT OF E-LKPD BASED ON PROBLEM LEARNING (PBL) TO IMPROVING STUDENTS' MATHEMATICAL PROBLEM-SOLVING ABILITY ON STATISTICS MATERIAL CLASS VIII JUNIOR HIGH SCHOOL

Jelika Panjaitan
State University Of Medan, Faculty Of Mathematic and Natural Sains, Indonesia;
jelikapanjaitan@gmail.com

***Corresponding Author**:**
Jelika Panjaitan
State University of Medan
Jln Williem Iskandar, Psr V Medan Estate
Jelikapanjaitan@gmail.com
Contact Person: 0822-7430-8306

***Article Info:***
Received 2025-10-24
Revised 2026-01-12
Accepted 2026-01-27

*How to Cite:*
Panjaitan, Jelika. (2026). Development Of E-Lkpd Based On Problem Learning (PBL) To Improving Students' Mathematical Problem Solving Ability On Statistics Material Class Viii Junior High School. *Jurnal Theorems (The Original Research of Mathematics)*, *11*(1), 73-89.

*ABSTRACT*

This research aims to develop an Electronic Learner Worksheet (E-LKPD) based on Problem-Based Learning (PBL) using Liveworksheet to improve students' mathematical problem-solving abilities. The study employed the ADDIE development model, which consists of five stages: analysis, design, development, implementation, and evaluation. The research subjects were 30 eighth-grade students at UPT SMP Negeri 35 Medan. The results indicated that the E-LKPD was valid, with an average score of 87% from media experts and 95% from material experts. The developed teaching module was also deemed valid, with an average score of 95%. The E-LKPD was considered practical, based on student responses (95%) and teacher responses (93%). Its effectiveness was demonstrated by an increase in learning outcomes from pretest to posttest by 28 points, with an N-Gain score of 0.66 (medium category). Students' mathematical problem-solving skills also improved, as shown by the increase in the number of students achieving mastery from 13% to 93%, and an increase in the average score from 59 to 87.

**Keywords**: E-LKPD, Problem Based Learning, Liveworksheet, Mathematical Problem-solving, ADDIE

## INTRODUCTION

The evolution of technology and information is currently experiencing rapid growth. This increase has a significant impact on various fields, especially in education, which is constantly innovating in the use of media and learning models. Evolving technology is also driving the world of education to create new breakthroughs and utilize technology in the learning process (Amanda et al., 2023). Education, as a fundamental aspect of life, must continuously adapt to technology to improve the quality of learning. The integration of ICT in education is an important step in improving the quality of learning and preparing a generation capable of competing in the era of globalization (Siregar & Marpaung, 2020).

e-ISSN: 2528-102X
p-ISSN: 2541-4321

As time goes on, technology in the world of education will continue to change and develop. Almost every aspect of life now utilizes technology to simplify work, including in the world of education. This is evident in the increasing advancement of educational technology in Indonesia, where schools have been using various tools and media in the learning process (Subroto et al., 2023). Technology is not only a teaching aid for teachers but also helps students achieve more optimal learning outcomes. Currently, the use of technology in learning is very widespread, both by teachers in teaching and by students in their learning process (Setiawan, 2022).

The word "mathematics" comes from various terms. Rahmah (2018) defines mathematics as the science of logic that deals with interconnected forms, arrangements, quantities, and concepts. Mathematics education emphasizes the importance of global educational transformation to address the challenges of social and digital divides and climate change (Daaliuwa, et al. 2023). However, in reality, many students do not enjoy this subject because it is considered boring and intimidating due to the numerous formulas and calculations involved. Mathematics continues to evolve over time. Learning mathematics is very necessary because it involves students' understanding of concepts. These students participate in the development and application of mathematics in daily activities (Chomsun et al., 2025).

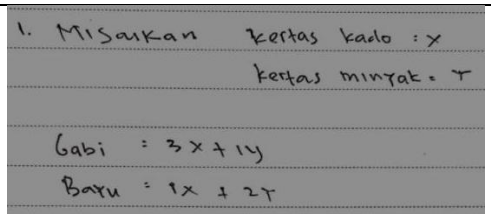
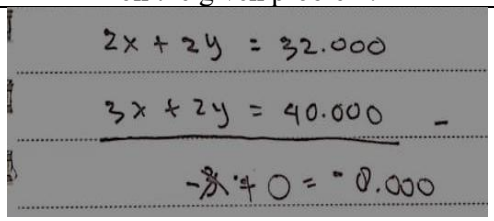
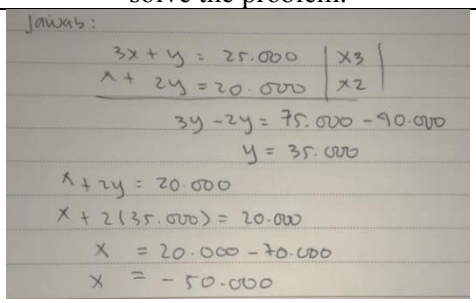
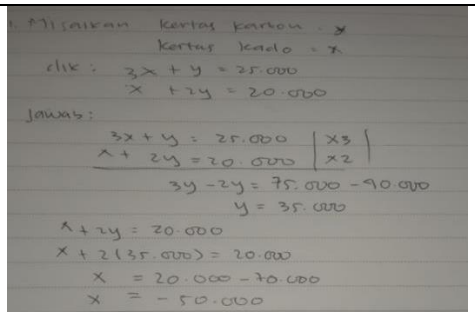
Problem-solving is students' effort to solve a problem, especially in mathematics learning. Problem-solving in mathematics emphasizes methods, procedures, and strategies whose correctness can be systematically proven (Rahmatiya & Miatun, 2020). Problem-solving skills are also one of the 21st-century competencies that students must possess to face future challenges (Putri et al., 2022). Problem-solving skills can also help learners improve their analytical abilities and apply the knowledge they have gained in various situations, especially in daily life (Nurhasanah & Luritawaty, 2021).

The low mathematical problem-solving abilities of students are evident in the observation results from one of the junior high schools in Medan, namely UPT SMP Negeri 35 MEDAN. The observation was conducted with the research subjects being eighth-grade students. The diagnostic test questions provided are as follows.

1. At a school supply store, Gabi bought 3 rolls of wrapping paper and 1 roll of tissue paper for Rp 25,000.00. Bayu bought 1 roll of wrapping paper and 2 rolls of tissue paper for Rp 20,000.00. What is the unit price of the wrapping paper and tissue paper?
2. Clara bought 2kg of apples and 2kg of mangoes and had to pay Rp 32,000.00, while Rubi bought 3kg of apples and 2kg of mangoes for Rp 40,000.00. What is the price of 5kg of apples and 3kg of mangoes?

e-ISSN: 2528-102X
p-ISSN: 2541-4321

**Table 1.** Student response indicators

| Indicator Problem-solving | Problem identification |
|---|---|
| Understanding the problem |  <br>In the first question, students was only able to write the assumption for the variable but was not yet able to write what was known based on the given problem. |
| Devising a plan |  <br>Students are not yet able to correctly outline the steps they will use to solve the problem. |
| Corying out the pan |  <br>From the answers to the questions above, it can be seen that students still lack understanding in arranging the steps for solving mathematical problems with the correct solution structure, resulting in incorrect answers. |
| Looking Back |  <br>The students did not draw a final conclusion from the given problem and did not solve the problem until the correct final answer was found. |

Based on the test results provided, it can be seen that the students are less capable of solving the problems presented. The observation results show that 60% of students completed the indicator of understanding the problem, 48% completed the indicator of planning a solution, 50% completed the indicator of executing the plan, and 49% completed the indicator of rechecking. These results indicate that the students' mathematical problem-solving abilities are still considered low. This is evident from

e-ISSN: 2528-102X
p-ISSN: 2541-4321

the students' inability to connect what is known with what is asked in the questions when converting the question sentences into mathematical sentences. This data is supported by the results of interviews with one of the mathematics teachers, Mr. Drs. Walhinson Saragih, a teacher at UPT SMPN 35 Medan, who stated that mathematics is one of the subjects that is difficult for students to understand and tends to be feared by students because they consider mathematics to be a boring and difficult subject for some students.

Based on the above problems, the efforts that can be made are the need to develop appropriate teaching media that have many benefits for learning activities, especially problem-solving skills. This is because modern learning, which already uses the Merdeka Curriculum that demands more creativity from educators, has transformed multimedia learning into an active and worthy endeavor to be developed. Therefore, this research develops electronic Student Worksheets (E-LKPD). Indriani et al. (2022) state that E-LKPD is an electronic student worksheet that can be opened anytime on a gadget with an internet connection. E-LKPD offers advantages for teachers. According to Syafitri & Tressyalina (2020), the advantages of E-LKPD are that it "can simplify and narrow space and time, making learning more effective. In addition, E-LKPD can be an interesting tool when students' learning interest decreases." The special feature of E-LKPD is its practical presentation, allowing students to learn independently at any time.

Narsamsu & Kusnafizal (2017) stated that as the Information Technology (IT) system advances, the world of education is constantly moving forward dynamically, particularly in creating engaging, interactive, and comprehensive learning tools. This aligns with the opinion of (Puriasih & Rati, 2022), which states that the development of interactive E-LKPD can help teachers overcome limitations in the variety of learning materials and increase student engagement in the learning process. Additionally, to create quality learning, it is necessary to design a learning model that is implemented to make students more actively engaged in learning. This aligns with the opinion of Solikin & Sukirman (2020) that "one model that provides opportunities for students to think creatively, express ideas, present results to peers, and develop problem-solving skills is Problem Based Learning.

Problem-Based Learning is a learning model that involves students in solving a problem. This aligns with Pitoyo et al. (2022), who state that PBL is a learning model that involves students in solving a problem thru scientific methods, allowing students to learn knowledge related to that problem. According to Hotimah (2020), the PBL model is considered capable of developing critical thinking skills and making it easier for students to master concepts in order to solve problems in everyday life. This aligns with Yustina et al. (2022), who state that learning that presents students with real-life problems to begin learning is an innovative learning model because it encourages students to be active.

e-ISSN: 2528-102X
p-ISSN: 2541-4321

## METHODS

This type of research is Research and Development (R&D) using the ADDIE model with the procedural steps of analyze, design, development, implementation, and evaluation. This research was conducted at UPT SMP Negeri 35 Medan, located at Jln. William Iskandar Pasar V Medan, Bandar Selamat, Kec. Medan Tembung, Kota Medan, Prov. North Sumatra. In the Second Semester of the 2024/2025 Academic Year. The subjects used in this study were the students of class VIII-6 at UPT SMP Negeri 35 Medan for the 2024/2025 academic year. The object of this research is the Electronic Student Worksheet (E-LKPD) based on Problem Based Learning to improve students' mathematical problem-solving abilities in statistics material for 8th-grade junior high school. The research instruments used in this study are expert validation sheets, E-LKPD practicality sheets, E-LKPD effectiveness sheets, and tests of students' mathematical problem-solving abilities.

**Table 2.** Research instrument

| No | Quality standards | Indicator | Research instrument |
|---|---|---|---|
| 1 | Validity | Content validity | Validation Sheet for Teaching Modules |
| | | Construct validity | Validation Sheet for Material Experts |
| | | Media Validity | Validation Sheet for Media Experts |
| 2 | Practicality | Useable | Practicality questionnaire for teachers and students |
| | | Easy to use | |
| 3 | Effectility | Positive student response | Student response questionnaire |
| | | Improved problem-solving skills | Pretest-posttest |

In this study, data is collected through observation, interviews, and questionnaires. After the required data has been collected, analysis is carried out. The analysis technique used is the N-Gain Test. The validity of the E-LKPD and the mathematical problem-solving ability test were measured using a four-point Likert scale, ranging from a score of 1 for a very negative response to a score of 4 for a very positive response.

## FINDINGS

### Analyze Stages

#### *Analyzing Student Needs*

Students at UPT SMPN 35 Medan need engaging learning that can increase student activity, interesting content presentation, and practice questions tailored to individual needs. Based on this, the researcher created E-LKPD teaching materials using Live worksheets, which contain practice questions

e-ISSN: 2528-102X
p-ISSN: 2541-4321

that students must answer and short videos from YouTube that provide topic explanations. Thus, it is hoped that students can participate more actively in learning. The e-LKPD is designed to align with indicators of mathematical problem-solving ability and is created with reference to the Problem Based Learning model.

***Analysis of Curriculum***

Learning in class VIII of UPT SMPN 35 Medan has been based on the implementation of the Merdeka Curriculum. One of the materials developed in this E-LKPD is statistics, which is included in the scope of the second semester for class VIII. The selection of statistics material is based on its characteristics, which require critical thinking, analysis, and contextual understanding of concepts, aligning with the principles of the Merdeka Curriculum, which focuses on strengthening student competencies and meaningful learning. Additionally, statistical material is highly relevant for application in the Problem Based Learning (PBL) model, as it allows learners to learn thru solving real-world problems related to data processing and intervention.

***Analysis of Student Character***

Based on the observation results, the students in the class are between 13 and 14 years old. In this age range, students' cognitive abilities are generally at the formal operational stage according to Piaget's theory of development, characterized by the ability to think logically about abstract concepts. However, students still need support in the form of concrete objects and real-life experiences to better understand mathematical concepts.

**Design Stage**

***Choosing the Format***

The format used in preparing the learning materials refers to the Merdeka Curriculum. The format for preparing these materials is as follows: the preparation of Teaching Modules and E-LKPD refers to the problem-based learning model, and the preparation of problem-solving ability tests refers to mathematical problem-solving indicators.

***Creating Test Items***

The test instrument used in the present research was structured in the form of an essay consisting of three pretest questions and three posttest questions. Before being used in the trial, the questions underwent a validation process by experts to ensure content validity and alignment with learning objectives. After being declared valid, the instrument was then administered to the students during the research implementation phase.

***Designing the beginning point***

The Teaching Module is designed for 4 meetings. The four meetings are structured with times of 3 x 40 minutes and 2 x 40 minutes. The Teaching Module developed aligns with the characteristics of module development in the Merdeka Curriculum, namely, it is structured with module identity, core components, learning activity sequence, and assessment.

e-ISSN: 2528-102X
p-ISSN: 2541-4321

Then, the E-LKPD design was prepared based on the books used by teachers and students in the classroom and was PBL-based. In the E-LKPD, students will be trained to communicate their ideas to solve problems related to daily life, thus training students in problem-solving. The E-LKPD developed in this study consists of 3 E-LKPDs, corresponding to the number of meetings in the Teaching Module. The E-LKPD contains problems whose solutions are designed in such a way as to train students' mathematical problem-solving abilities.

The test instruments prepared consist of a pretest and a posttest, which refer to the grid and indicators of mathematical problem-solving ability. Students' mathematical problem-solving ability can be measured for improvement using the prepared instruments.

**Development Stages**

***Validation Result of E-LKPD***

**Table 3.** Results of E-LKPD Validation by Media Experts

| Aspect | Indicator | Validator | | | | Average Indicator | Average in each aspect | Classification |
|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | | | |
| Sistematika E-LKPD | 1 | 4 | 4 | 4 | 4 | 100% | 89% | Very Valid |
| | 2 | 3 | 4 | 3 | 3 | 81% | | |
| | 3 | 3 | 4 | 3 | 4 | 87,5% | | |
| | 4 | 3 | 4 | 4 | 4 | 94% | | |
| | 5 | 3 | 3 | 4 | 3 | 81% | | |
| Estetika E-LKPD | 6 | 3 | 4 | 3 | 4 | 87,5% | 85% | Valid |
| | 7 | 3 | 3 | 3 | 3 | 75% | | |
| | 8 | 3 | 4 | 4 | 4 | 94% | | |
| | 9 | 3 | 4 | 3 | 3 | 81% | | |
| | 10 | 4 | 3 | 3 | 4 | 87,5% | | |
| Desain dan fasilitas E-LKPD | 11 | 3 | 4 | 4 | 3 | 87,5% | 89% | Very Valid |
| | 12 | 4 | 4 | 4 | 4 | 100% | | |
| | 13 | 4 | 3 | 3 | 4 | 87,5% | | |
| | 14 | 3 | 3 | 4 | 4 | 87,5% | | |
| | 15 | 3 | 3 | 4 | 3 | 81% | | |
| | 16 | 3 | 3 | 3 | 4 | 81% | | |
| | 17 | 3 | 4 | 4 | 4 | 94% | | |
| **Amount** | | | | | | | 262% | |
| **Average overall** | | | | | | | 87% | Very Valid |

Based on the table presented above, it can be seen that the E-LKPD meets the valid criteria with a score of 87%. All four experts stated that the E-LKPD can be used with revisions according to the suggestions provided.

e-ISSN: 2528-102X
p-ISSN: 2541-4321

**Table 4** Results of E-LKPD Validation by Material Experts

| Aspect | Indicator | Validator | | | | Average Indicator | Average in each aspect | Classification |
|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | | | |
| Alignment of material with Basic Competencies | 1 | 3 | 4 | 4 | 4 | 94% | 94% | Very Valid |
| Accuracy of the material | 2 | 4 | 4 | 4 | 4 | 100% | 98% | Very Valid |
| | 3 | 3 | 4 | 4 | 4 | 94% | | |
| | 4 | 4 | 4 | 4 | 4 | 100% | | |
| Material Updates | 5 | 4 | 4 | 4 | 4 | 100% | 93,75% | Very Valid |
| | 6 | 3 | 4 | 3 | 4 | 87,5% | | |
| Completeness and accuracy of the Problem-based learning flow | 7 | 3 | 4 | 4 | 4 | 94% | 97% | Very Valid |
| | 8 | 4 | 4 | 4 | 4 | 100% | | |
| Suitability of problem-based learning activities | 9 | 4 | 4 | 4 | 4 | 100% | 94% | Very Valid |
| | 10 | 4 | 3 | 4 | 4 | 94% | | |
| | 11 | 4 | 3 | 4 | 3 | 87,5% | | |
| Alignment of learning activities with the characteristics of Problem-Based Learning using E-LKPD | 12 | 4 | 4 | 4 | 4 | 100% | 92% | Very Valid |
| | 13 | 3 | 3 | 3 | 3 | 75% | | |
| | 14 | 4 | 4 | 4 | 4 | 100% | | |
| Alignment of learning activities with the stages of Problem Based Learning using E-LKPD | 15 | 3 | 4 | 3 | 4 | 87,5% | 93,75% | Very Valid |
| | 16 | 4 | 4 | 4 | 4 | 100% | | |
| | 17 | 3 | 3 | 4 | 4 | 87,5% | | |
| | 18 | 4 | 4 | 4 | 4 | 100% | | |
| The principles of Problem-Based Learning are contained in the E-LKPD. | 19 | 4 | 3 | 4 | 4 | 94% | 92% | Very Valid |
| | 20 | 3 | 4 | 3 | 4 | 87,5% | | |
| | 21 | 3 | 4 | 4 | 4 | 94% | | |
| | 22 | 4 | 3 | 4 | 4 | 94% | | |
| The principles of learning to improve problem-solving skills are contained in the E-LKPD. | 23 | 4 | 3 | 4 | 4 | 94% | 94% | Very Valid |
| | 24 | 3 | 4 | 4 | 4 | 94% | | |
| Straightforward | 25 | 4 | 4 | 4 | 4 | 100% | 100% | Very Valid |
| | 26 | 4 | 4 | 4 | 4 | 100% | | |
| Communicative, dialogic, interactive | 27 | 3 | 4 | 4 | 4 | 94% | 96% | Very Valid |
| | 28 | 4 | 4 | 4 | 4 | 100% | | |
| | 29 | 3 | 4 | 4 | 4 | 94% | | |
| Grammatically correct | 30 | 4 | 4 | 4 | 4 | 100% | 100% | Very Valid |
| Supporters of the Presentation | 31 | 3 | 3 | 3 | 4 | 81% | 81% | Very Valid |
| Presentation technique | 32 | 4 | 4 | 4 | 4 | 100% | 91% | Very Valid |
| | 33 | 3 | 3 | 4 | 3 | 81% | | |
| Correctness of font usage | 34 | 4 | 4 | 4 | 4 | 100% | 100% | Very Valid |
| Color selection's suitability | 35 | 4 | 4 | 4 | 4 | 100% | 100% | Very Valid |
| | 36 | 4 | 4 | 4 | 4 | 100% | | |
| The balance of each part | 37 | 3 | 4 | 4 | 4 | 94% | 92% | Very Valid |
| | 38 | 3 | 4 | 3 | 3 | 81% | | |
| | 39 | 4 | 4 | 4 | 4 | 100% | | |

e-ISSN: 2528-102X
p-ISSN: 2541-4321

| Aspect | Indicator | Validator | | | | Average Indicator | Average in each aspect | Classification |
|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | | | |
| The interconnectedness of all components is consistent in improving mathematical problem-solving abilities. | 40 | 4 | 4 | 4 | 3 | 94% | 96% | Very Valid |
| | 41 | 3 | 4 | 4 | 4 | 94% | | |
| | 42 | 3 | 4 | 4 | 4 | 94% | | |
| | 43 | 3 | 4 | 4 | 4 | 94% | | |
| | 44 | 4 | 4 | 4 | 4 | 100% | | |
| **Amount** | | | | | | | 1705% | |
| **Avarage Overall** | | | | | | | 95% | Very Valid |

Based on the table above, it was found that the quality of the E-LKPD based on expert assessment showed valid criteria with an average of 95% out of 100%. Therefore, it can be concluded that the developed E-LKPD is suitable for use with revisions based on the suggestions of the experts. The suggestions obtained from the experts were used as a guide for revising the device.

***Validation Result of Teaching Module***

**Table 5.** Results of Teaching Module Validation by Validators

| Indicator | Number | Aspects are being evaluated. | Validator | | | | Average in each aspect |
|---|---|---|---|---|---|---|---|
| | | | I | II | III | IV | |
| Format | 1 | Clarity of material distribution | 4 | 3 | 4 | 4 | 93,75% |
| | 2 | Space arrangement and layout | 4 | 4 | 3 | 4 | 93,75% |
| | 3 | Font type and size | 4 | 4 | 4 | 4 | 100% |
| Langague | 1 | Grammatical correctness | 3 | 4 | 4 | 4 | 93,75% |
| | 2 | Simplicity of sentence structure | 4 | 4 | 4 | 4 | 100% |
| | 3 | Kejelasan petunjuk atau arahan | 4 | 4 | 4 | 4 | 100% |
| | 4 | The communicative nature of the language used | 4 | 4 | 4 | 4 | 100% |
| Content | 1 | Truth of the material or content | 3 | 3 | 4 | 4 | 87,5% |
| | 2 | Grouped into logical sections | 4 | 4 | 4 | 4 | 100% |
| | 3 | Alignment with the current curriculum | 4 | 4 | 4 | 4 | 100% |
| | 4 | The suitability of mathematics learning with the Problem Based Learning (PBL) model | 4 | 4 | 4 | 4 | 100% |
| | 5 | Presentation method | 4 | 4 | 4 | 4 | 100% |
| | 6 | Eligibility for learning materials | 3 | 4 | 4 | 4 | 93,75% |
| | 7 | The suitability of the time allocation used | 4 | 4 | 3 | 4 | 93,75% |
| **Amount** | | | | | | | **1356,25%** |
| **Average** | | | | | | | **96,88%** |

e-ISSN: 2528-102X
p-ISSN: 2541-4321

Based on the data generated in the table above, it can be seen that the E-LKPD is in the very valid criteria with a score of 96.88%. All four experts stated that the Teaching Module can be used with revisions according to the suggestions that have been given.

**Implementation Stages**

Field trials are the testing phase conducted in a real classroom setting. This activity is conducted over three meetings. In the first meeting, students were given a pretest, followed by a learning process based on the teaching module and the distribution of E-LKPD. The second meeting focused on learning activities according to the teaching module and the distribution of E-KPD. Meanwhile, the third meeting involved learning according to the teaching module, the distribution of E-LKPD, and the administration of a posttest. Thirty students from class VIII-6 participated in this trial, where the researcher acted as the instructor. Pretests and posttests at the beginning and end of the learning session are used to collect data on how learning is implemented and how well students solve mathematical problems. Here is a description of the field test results.

***Description of the Practicality of E-LKPD Based on Problem Based Learning in Learning***

**Table 6.** Results of Student and Teacher Response Analysis to E-LKPD

| No | Question | Questionnaire of Responses | |
|---|---|---|---|
| | | 30 Students | One Teacher |
| 1 | E-LKPD can be used to stimulate students to learn actively. | 87 | 4 |
| 2 | E-LKPD can be used to help students achieve learning goals. | 87 | 3 |
| 3 | Activities designed for E-LKPD can be used to build knowledge. | 84 | 4 |
| 4 | The components presented in the E-LKPD are used to help students formulate mathematical situations. | 83 | 4 |
| 5 | The steps in the activities on the E-LKPD can be applied to provide solutions for solving problems. | 79 | 4 |
| 6 | Activities on E-LKPD can be applied to stimulate students to reapply mathematical concepts. | 82 | 4 |
| 7 | E-LKPD components can be used to visualize abstract objects and make them more concrete. | 81 | 3 |
| 8 | The learning flow designed in the E-LKPD can be used to improve mathematical problem-solving abilities. | 79 | 4 |
| 9 | The problems presented in the E-LKPD can be used to improve mathematical problem-solving skills. | 84 | 3 |
| 10 | Instructions for using the E-LKPD can be easily understood. | 88 | 4 |
| 11 | The features available in the E-LKPD can be easily accessed. | 86 | 4 |
| 12 | The learning steps in the E-LKPD can be easily understood. | 87 | 3 |
| 13 | Learning activities on the E-LKPD are ready to be applied. | 87 | 4 |

e-ISSN: 2528-102X
p-ISSN: 2541-4321

| | | | |
|---|---|---|---|
| 14 | E-LKPD can be easily operated thru both laptops and mobile phones. | 88 | 4 |
| 15 | E-LKPD can be used repeatedly with easey | 86 | 4 |
| 16 | E-LKPD can be used without time or space limitations. | 86 | 4 |
| 17 | E-LKPD can be accessed via mobile phone or laptop, making it easy to carry and work on anytime, anywhere. | 86 | 4 |
| 18 | E-LKPD can be used easily to achieve learning objectives. | 85 | 4 |
| 19 | The time required to use the E-LKPD is in accordance with the lesson hours provided. | 82 | 3 |
| 20 | The duration of time for conducting learning in each phase does not exceed the set time. | 80 | 4 |
| 21 | By using E-LKPD, learning time becomes efficient. | 82 | 4 |
| 22 | By using E-LKPD, the time required to achieve learning objectives becomes more efficient. | 85 | 3 |
| **AMOUNT** | | 1874 | 82 |
| **PERCENTAGE** | | **95%** | **93%** |

***Description of the Effectiveness of E-LKPD Based on Problem Based Learning***

The effectiveness of E-LKPD can be seen from the positive impact they have on the learning process. One indicator of this positive impact is the improvement in students' mathematical problem-solving abilities before (pretest) and after (posttest) participating in learning using E-LKPD based on Problem Based Learning.

1) **Result of Students' Classical Mastery**

The table below illustrates how comprehensive students' mathematical problem-solving abilities are.

**Table 7.** Percentage of Students' Classical Mastery

| Description | Pretest | | Posttest | |
|---|---|---|---|---|
| | Amount of Students | Percentage | Amount of Students | Percentage |
| Completely | 4 | 13,3% | 27 | 90% |
| Incomplete | 26 | 86,7% | 3 | 10% |
| Jumlah | 30 | 100% | 30 | 100% |

2) **Achievements of Indicator**

**Table 8** Achievement Results of Indicators

| No | Indicator | *Pretest* | | *Posttest* | |
|---|---|---|---|---|---|
| | | Percentage | Description | Percentage | Description |
| 1 | Understanding the problem | 77% | Completely | 84,81% | Completely |
| 2 | Planning for Completion | 47,8% | Incomplete | 88,89% | Completely |
| 3 | Executing the Plan | 61% | Incomplete | 91,85% | Completely |
| 4 | Checking Again | 49,26% | Incomplete | 79,25% | Completely |

e-ISSN: 2528-102X
p-ISSN: 2541-4321

**3) Students Respon**

After field trials were conducted, students filled out a response questionnaire regarding the E-LKPD, which aimed to assess the ease and interest of students in the learning and learning materials developed. The student response questionnaire included positive statements.

**Tabel 9.** Student Response to the Effectiveness of E-LKPD

| No | Statement | Students | Percentage |
|---|---|---|---|
| 1 | I feel happy using this E-LKPD. | 28 | 93% |
| 2 | I feel happy doing learning activities according to the flow in this E-LKPD. | 29 | 96% |
| 3 | I feel motivated to work on the questions in this E-LKPD. | 30 | 100% |
| 4 | I feel motivated to apply the mathematical concepts found in the E-LKPD. | 30 | 100% |
| 5 | I became motivated to learn with the features available in the E-LKPD. | 28 | 93% |
| 6 | I am motivated to learn because of the images in the E-LKPD. | 30 | 100% |
| 7 | I like the way the questions are presented in the E-LKPD. | 30 | 100% |
| 8 | I am motivated to do the test questions in the E-LKPD. | 28 | 93% |
| 9 | I am interested in using this E-LKPD in the next meeting. | 28 | 93% |
| 10 | I am pleased with the variety of question presentation in the E-LKPD. | 27 | 90% |
| 11 | I am pleased with the level of effectiveness in the E-LKPD. | 30 | 100% |
| 12 | I feel quite satisfied with how the E-LKPD presents information in the questions. | 28 | 96% |
| 13 | I am happy with the opportunity provided by E-LKPD to practice and review the material. | 28 | 96% |
| | AVERAGE AMOUNT | | 96 % |

From the table above, the results of the student questionnaire show that (96%) of the student statements chose Yes and (4%) of the student statements chose No. Based on the effectiveness indicator for student response, which is positive if 80% of the students participate in the learning and respond in the minimum good category, then the developed learning materials are considered effective based on the student response indicator in the field trial.

***Description of Improving Students' Mathematical Problem-Solving Abilities Using Problem-Based Learning-Based E-LKPD***

The improvement in students' mathematical problem-solving abilities after being taught using E-LKPD based on Problem Based Learning in the trial can be seen from the results based on the pretest and posttest scores of the students. The results of the students' problem-solving ability improvement from pretest to posttest in the field trial are presented in the table:

e-ISSN: 2528-102X
p-ISSN: 2541-4321

**Tabel 10.** Improving Mathematical Problem-Solving Abilities

| Description | Pretest | Posttest | Improvment |
|---|---|---|---|
| Highest score | 75 | 100 | 25 |
| Lowest score | 0 | 60 | 60 |
| **Average mathematical problem-solving ability** | **37,5** | **80** | **42,5** |

From the table above, it can be seen that students' mathematical problem-solving abilities after using the developed device increased by 42.5. The average score for students' mathematical problem-solving abilities, which was initially 37.5 on the pretest, increased to 80 on the posttest. Next, we can see the improvement in mathematical problem-solving ability when examined by each indicator.

**Table 11.** Improvement in Mathematical Problem-Solving Ability for Each Indicator

| No | Indicator | Average | | N-Gain | Category |
|---|---|---|---|---|---|
| | | *Pretest* | *posttest* | | |
| 1 | Understanding the problem | 2,31 | 2,54 | 0,34 | Middel |
| 2 | Planning for Completion | 1,43 | 2,67 | 0,78 | High |
| 3 | Execution The Plan | 1,83 | 2,75 | 0,79 | High |
| 4 | Checking Again | 1,47 | 2,38 | 0,59 | Middle |

Based on the data in the table above, there is an observed improvement in mathematical problem-solving abilities from pretest to posttest for each indicator. This improvement includes: (1) understanding the problem indicator by 0.34; (2) planning the solution indicator by 0.78; (3) executing the plan indicator by 0.79; and (4) reviewing the solution indicator by 0.59.

The improvement in mathematical problem-solving abilities, as seen from the pretest and posttest results, can also be observed based on the gain analysis presented in the following gain score table.

**Table 12.** N-gain Analysis Results

| Gain | Category | Stundents | Percentage | Avarage of N-gain | Category |
|---|---|---|---|---|---|
| g>0,7 | High | 16 | 53,3% | 0,66 | **Middle** |
| 0,3≤g≤0,7 | Middle | 12 | 40% | | |
| g≤0,3 | Low | 2 | 6,67% | | |
| **Amount** | | **30** | **100%** | | |

The data analysis results show that after participating in learning using the developed device, namely problem-based learning E-LKPD, there was an improvement in students' mathematical problem-solving abilities. This improvement is reflected in an average N-Gain score of 0.66, which falls into the moderate category. This finding identifies that the implementation of problem-based learning E-LKPD makes a positive contribution to the development of students' mathematical problem-solving abilities. The data analysis results show that after participating in learning using the developed device, namely problem-based learning E-LKPD, there was an improvement in students' mathematical

e-ISSN: 2528-102X
p-ISSN: 2541-4321

problem-solving abilities. This improvement is reflected in the average N-Gain score of 0.66, which falls into the moderate category. This finding identifies that the implementation of problem-based learning E-LKPD makes a positive contribution to the development of students' mathematical problem-solving abilities.

**Evaluation Stages**

The evaluation stage is carried out with the aim of refining the learning materials that have been developed. In this stage, various shortcomings and errors found are thoroughly analyzed and then used as a basis for making improvements.

There are shortcomings in the content of the E-LKPD and teaching modules, both in terms of language use, writing accuracy, and the instructions for completing the tasks presented. This is adjusted based on the directions and input provided by the validators to improve the readability and appeal of the device for students. The pretest and posttest instruments developed were also deemed to still need improvement. Some test items were considered less suitable or did not optimally reflect the learning indicators, so they were revised according to the validator's suggestions.

By making improvements based on the results of this evaluation, the developed learning materials are expected to become more suitable, of higher quality, and aligned with the designed learning objectives.

## DISCUSSION

Based on the results of the validation process conducted on the learning materials, which include Teaching Modules, E-LKPD, and problem-solving ability instruments in the form of pretests and posttests, it was found that all components were declared "valid." Meanwhile, the validation results for the E-LKPD also showed excellent quality, with a percentage of 87% from media experts and 95% from content experts. These two scores place the E-LKPD in the very valid category based on the assessment criteria for learning development instruments. Thus, based on the validator's assessment, the developed learning materials have met the eligibility criteria in terms of content and media validity, and are ready for use in further trial stages.

The practicality of the learning device was assessed thru an analysis of the questionnaire results completed by teachers and students. Based on the responses obtained, several important points were found as follows: (1) The E-LKPD designed using the Problem Based Learning (PBL) approach received a score percentage of 95% out of 100% from the students. This value indicates that the E-LKPD is in the excellent category, so it can be declared "practical" from the perspective of the students as direct users. (2) Teachers' responses to the PBL-based E-LKPD showed a score percentage of 93%, which is also categorized as excellent. This result indicates that the learning device was assessed as "practical" by educators. Overall, based on the responses from both teachers and students, it can be

e-ISSN: 2528-102X
p-ISSN: 2541-4321

concluded that the Problem-Based Learning-based E-LKPD that has been developed meets the criteria for practicality and is suitable for use in classroom learning activities.

This aligns with the research findings by Prastika & Maniladevi (2021) titled "Development of Interactive Regular and Irregular Polygon E-LKPD Based on Liveworksheets on the Learning Outcomes of Elementary School Grade VI Students." The results of this study indicate that the developed LKPD is valid, practical, and effective for improving student learning outcomes. However, there are noticeable differences compared to the research conducted. Previous research has not used the problem-based learning model. Furthermore, it focused on regular and irregular polygons and aimed to improve learning outcomes. In contrast, the research conducted aimed to enhance students' problem-solving abilities.

Research by (Saragih, 2024) titled "Development of Problem-Based Learning-Based Worksheets with Canva Assistance to Improve Students' Mathematical Problem-Solving Abilities in Flat-Sided Solid Geometry." Based on the validation results of lesson plans (RPP), student worksheets (LKPD), and mathematical problem-solving ability tests (pretest and posttest), it is known that all instruments are valid. The validation results of the student worksheets by the validator have a score of 4.25 out of 5.00, which is categorized as valid. The practicality obtained based on students' responses to the Problem-Based Learning-based student worksheets developed has a score of 3.6 out of 4.00, which means it is in the very good category. And the effectiveness of learning materials in field trials has been proven to increase student learning mastery. And the learning time has also met the effectiveness criteria.

## CONCLUSION AND SUGGESTION

The Problem-Based Learning (PBL) e-LKPD developed with the help of live worksheets on statistics material was declared valid by media experts and content experts. Furthermore, the teaching module used was declared valid by experts. Then, regarding the practicality of the product, results were obtained from teacher response questionnaires and student response questionnaires, and it was declared practical. Furthermore, the product developed in terms of effectiveness was found to be effective in improving mathematical problem-solving abilities in statistics material.

Students' mathematical problem-solving abilities improved after the implementation of E-LKPD based on Problem Based Learning. This is evident from the pretest results, which showed that only 4 students achieved mastery learning, while 26 students did not. After instruction, the posttest results showed a significant improvement, with 28 students achieving mastery and only 2 students not yet mastering the material. Based on the achievement of students' mathematical problem-solving ability indicators in the high category.

e-ISSN: 2528-102X
p-ISSN: 2541-4321

## REFERENCE

Amanda. R, Lubis, S. A., Maha, S., & Yuliana. (2023). Peran Teknologi Informasi Dalam Dunia Pendidkan. *Proceding International Seminar on Islamic Studies*, *4*(1), 1133–1139. https://doi.org/10.3059/insis.v0i0.14166

Chomsun, S., Pratiwi, D., & Rosa, F. O. (2025). E-LKPD Based on Socio-Scientific Issues : A Means of Developing Science Literacy and Critical Thinking in The Era of The Independent Curriculum. *Jurnal Penelitian Pendidikan IPA*. *11*(1), 895–903. https://doi.org/10.29303/jppipa.v11i1.9973

Daaliuwa, I. P., Ismail, S., & Takaendengan, B. R. (2023). Peningkatan pemahaman konsep matematika padaMateri relasi dan fungsi melalui pendekatan Realistic Mathematics Education (RME). *Jurnal Pendidikan Matematika RAFA*, *9*(2), 194-206. https://doi.org/10.19109/jpmrafa.v9i2.20540

Indriani, S. ., Nuryadi, N., Marhaeni, N. H. ., & Kurniati, R. . (2022). Efektivitas Penggunaan E-LKPD Untuk Meningkatkan Kemampuan Pemahaman Konsep Segiempat dan Segitiga. *Jurnal Pendidikan Tambusai*, *6*(1), 3959–3966. https://doi.org/10.31004/jptam.v6i1.3480

Nurhasanah, D. S., & Luritawaty, I. P. (2021). Model Pembelajaran REACT Terhadap Kemampuan Pemecahan Masalah Matematis. *PLUSMINUS : Jurnal Pendidikan Matematika*, 1(1), 71–82. https://doi.org/10.31980/plusminus.v1i1.1027

Nursamsu, N., & Kusnafizal, T. (2017). Pemanfaatan Media Pembelajaran ICT Sebagai Kegiatan Pembelajaran Siswa Di Smp Negeri Aceh Tamiang. *Jurnal IPA & Pembelajaran IPA*, *1*(2), 165–170. https://doi.org/10.24815/jipi.v1i2.9691

Prastika, Y., & Masniladevi. (2021). Pengembangan E-LKPD Interaktif Segi Banyak Beraturan Dan Tidak Beraturan Berbasis Liveworksheets Terhadap Hasil Belajar Peserta Didik Kelas IV Sekolah Dasar. *Journal of Basic Education Studies*, *4*(1), 2601–2614. https://ejurnalunsam.id/index.php/jbes/article/view/3817

Puriasih, L. P., & Rati, N. W. (2022). E-LKPD Interaktif Berbasis Problem Solving pada Materi Skala dan Perbandingan Kelas V Sekolah Dasar. *Jurnal Pedagogi Dan Pembelajaran*, *5*(2), 267–275. https://doi.org/10.23887/jp2.v5i2.48848

Rahmah, N. (2018). Hakikat Pendidikan Matematika. *Al-Khwarizmi: Jurnal Pendidikan Matematika Dan Ilmu Pengetahuan Alam*, *1*(2), 1–10. https://doi.org/10.24256/jpmipa.v1i2.88

Rahmatiya, R., & Miatun, A. (2020). Analisis Kemampuan Pemecahan Masalah Matematis Ditinjau Dari Resiliensi Matematis Siswa Smp. *Teorema: Teori Dan Riset Matematika*, *5*(2), 187. https://doi.org/10.25157/teorema.v5i2.3619

Saragih, B. M. (2024 Pengembangan LKPD Berbasis Problem Based Learning Dengan Bantuan Canva Untuk Meningkatkan Kemampuan. Skripsi. Universitas Negeri Medan. Medan

Setiawan, T. Y. (2022). *Peran Teknologi Pendidikan dalam Perspektif Merdeka Belajar pada Abad 21 di Sekolah Dasar*. *3*(2), 125–130.

e-ISSN: 2528-102X
p-ISSN: 2541-4321

Siregar, Z., & Marpaung, T. B. (2020). Pemanfaatan Teknologi Informasi dan Komunikasi (TIK) Dalam Pembelajaran di Sekolah. *BEST Journal (Biology Education, Sains and Technology)*, *3*(1), 61–69. https://doi.org/10.30743/best.v3i1.2437

Sukirman, S., & Solikin, M. (2020). Penerapan Model Pembelajaran Problem Based Learning Untuk Meningkatkan Keaktifan Dan Hasil Belajar Peserta Didik. *Jurnal Pendidikan Vokasi Otomotif*, *2*(2), 49–60. https://doi.org/10.21831/jpvo.v2i2.33552

Subroto, D. E., Supriandi, Wirawan, R., & Rukmana, A. Y. (2023). Implementasi Teknologi dalam Pembelajaran di Era Digital: Tantangan dan Peluang bagi Dunia Pendidikan di Indonesia. *Jurnal Pendidikan West Science*, *1*(07), 473–480. https://doi.org/10.58812/jpdws.v1i07.542

Yustina., Mahadi, I., Ariska, D., Arnentis., & Darmadi. (2022). The effect of e-learning based on the problem-based learning model on students' creative thinking skills during the covid-19 pandemic. *International Journal of Instruction*, 15(2), 329-348. https://doi.org/10.29333/iji.2022.15219a