



## Development of Problem-Based Learning (PBL) E-worksheet on Comparative Material

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**Key Words:**

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e-worksheet  
problem-based learning

**Abstract:**

This research was conducted to the lack of availability of teaching materials based on the student's need, namely variations in the use of teaching materials that are suitable for use in the learning process. This research aims to determine the feasibility of the developed e-worksheet. It used Research and Development (R&D) with a 4D development model. The subjects were 26 students of class VII.6 of Tanjungpinang 6 Junior High School (SMP). The data collection instrument was a validation questionnaire assessed by material expert validators, linguists and media experts. The results of the validation obtained regarding the eligibility information of the e-worksheet, with the assessment of material experts, obtained a percentage of 81% in the valid category, the assessment of language experts obtained a percentage of 76% in the very valid category, and the assessment of the media obtained a percentage of 73% in the valid category. Based on the overall data analysis results, it was concluded that the developed PBL-based e-worksheet was declared feasible and could be used in learning mathematics.

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### Introduction

Excellent education is a source of support for the progress of the nation. All countries definitely want the best education to get quality human resources (HR). Therefore a good education system is needed to implement learning runs systematically, effectively and efficiently ([Rahmat, 2013](#)). Education in the 21st century today wants students to have the common abilities referred to as 4C, namely Critical Thinking and Problem-Solving, Creativity, Communication Skills, and the Ability to Work Collaboratively ([Effendi et al., 2021](#)). This ability can be trained in mathematics because it is closely related to reasoning abilities to solve a problem ([Umaroh et al., 2020](#)). Mathematics is a universal science that plays a vital role in education as the basis for developing modern technology to develop human mindsets ([Mashuri, 2019](#)). Mathematics has an important role in solving problems in various fields ([Prastowo & Waluya, 2019](#)). Mathematics is fundamental because human activity is inseparable from calculating activities, so mathematics is very embedded in everyday activities. Thus, students need to be provided with the ability to think logically and systematically to solve problems found in daily activities.

One of the strategies that educators need to prepare is to develop teaching materials. Teaching materials can facilitate understanding concepts and solving problems, increase student activity, and make learning experiences more interesting and varied ([Umaroh et al., 2020](#)). Thus, one of the teaching materials that can be used when teaching is the Student Worksheet. Student Worksheets are teaching materials that can facilitate students in the learning process, so interactions between students and teachers are established and can increase student learning interest so that learning can be achieved and carried out correctly ([Umbariyati, 2016](#)). Student worksheets can ease educators in the assessment process as almost all student activity is recorded on the worksheet ([Kosasih, 2021](#)).

Based on the results of interviews conducted at SMP Negeri 6 Tanjungpinang on September 22, 2022, educators rarely develop teaching materials in the form of worksheet. The contents are in the form of questions and practice questions without explaining how the completion process was obtained. With worksheet, students' ability to interpret events can increase ([Aini et al., 2021](#)). Then, students also find it difficult to do practice questions, one of which is comparative material. Based on the results of the interviews, in the Comparative material, students find it difficult to distinguish the completion of comparison questions of equivalent and reversed values. If students have difficulty solving problems in the questions, their learning outcomes will be low ([Susanti et al., 2022](#)).

Efforts to develop student performance and abilities in learning activities are recommended to apply learning activities involving students to play an active role in solving problems in daily activities. An alternative worksheet that can overcome this problem is based on Problem-Based Learning (PBL). According to [Prastowo & Waluya \(2019\)](#) the Problem-Based Learning (PBL) model is a learning model with a characteristic that is centered on problems. The PBL model can also develop students' abilities in terms of creativity, both individually and in groups, because at every step, it requires students to be active ([Fitriyah & Ghofur, 2022](#)). Relevant studies in the development of Problem-Based Learning (PBL) e-worksheet by [Munika et al. \(2021\)](#), it was found that the PBL-based e-worksheet obtained a level of validity, feasibility,

effectiveness and increase students' critical thinking skills.

The worksheet that will be developed is based on technology. This time life is very sophisticated, and teaching materials should also progress to keep up with the times. According to [Yakin \(2021\)](#), using technology-based worksheet is an effort so that students can take advantage of technology. Through worksheet, students can play an active role during the learning process ([Nisa & Fitriani, 2018](#)). The worksheet is technology-based, which uses software capable of developing media and teaching materials interactively, one of which is using *Articulate Storyline 3*. Articulate Storyline 3 software can create innovative and interactive learning objects ([Sindu et al., 2020](#)). The advantage of this software is the ease of making navigation buttons without doing complicated coding ([Rianto, 2020](#)). The use of e-worksheet made using *Articulate Storyline 3* makes it easy for students to use it, motivates students' independent learning, and students are active in finding learning resources ([Indriani et al., 2021](#)). Using *Articulate storyline 3* can increase independent learning by students to develop student skills that do not always depend on educators ([Indriani et al., 2021](#)).

Based on the background, research is needed to produce a feasible PBL-based e-worksheet so that students can solve problems, especially in comparative material, by adjusting to the times, technology, and current learning conditions. So, researchers conducted research to development of e-worksheet based on Problem-Based Learning (PBL) on comparative material. This study aims to describe the development of a valid Problem Based Learning (PBL) e-worksheet.

## Research Method

This research is included in the *Research and Development* (R&D) research type. [Sugiyono \(2019\)](#) explains that development research makes a product through research, design, manufacture and validity testing. This study uses the 4D research model (Four D models). This research was put forward by [Thiagarajan \(1974\)](#) where the 4D model consists of 4 stages, namely *Define, Design, Development* and *Disseminate*. However, this research only reaches *Development* until the expert validation stage.

At the Define stage, defining what conditions are needed in learning by analyzing the boundaries and objectives of the material developed and described by ([Kristianti & Julia, 2017](#)). At the Design stage, researchers have to prepare, design and make teaching materials in the form of e-worksheet provided that they meet the criteria and are in accordance with what has been done before. The Development stage, researchers have produced learning tools in the form of worksheet, which have previously been revised and given input and suggestions by experts.

In the research, questionnaires are used for data collection techniques. The questionnaire sheet used is the validation sheet to see and know the validity of the e-worksheet. There are two data analysis techniques, namely qualitative descriptive analysis techniques, which contain input and suggestions from the validator, and descriptive statistical analysis techniques, whose data are obtained from questionnaires in the form of descriptive percentages. Data analysis is used to measure the validity of the products that have been developed, namely the *Likert* scale described by ([Sugiyono, 2017](#)). Data processing uses the following formula:

$$V = \frac{\sum x}{N} \times 100\%$$

Explanation :

V = score

$\sum X$  = acquired score

N = maximum score

The validity of the developed e-worksheet can be seen from the assessment criteria in the following Table 1.

**Tabel 1. Validation criteria**

Assessment	Kriteria
$80\% < x < 100\%$	Very Valid
$60\% < x < 80\%$	Valid
$40\% < x < 60\%$	Acceptable
$20\% < x < 40\%$	Less Valid
$0\% < x < 20\%$	Not Valid

([Riduwan and Akdon, 2013](#))

### Finding and Discussion

The research produced a product of e-worksheet Problem Based Learning (PBL) on comparative material. This e-worksheet is produced in an accessible application format for Android. The e-worksheet used uses PBL stages, such as (1) introduction of problems in material comparisons of value and comparison of value reversed; (2) organizing students to learn, which aims to identify the concepts contained in the questions given; (3) guiding investigations, aims to provide guidance in the form of additional information to solve problems; (4) present the results of the work, where the teacher guides students in solving the correct problems to use, and (5) evaluates the problem-solving process, where students provide conclusions to measure the level of understanding of students ([Rusmono, 2017](#)). In this research and development, researchers use the 4D model, the stages of which are Define, Design, and Development. The following is an explanation of the results of the development that researchers have carried out.

### Define Stage

In the define stage, the researcher analyzed the characteristics of the students through interviews with mathematics teachers at SMP (Junior High School) Negeri 6 Tanjungpinang. According to the interview results on September 22, 2022, during the teaching and learning process, educators use teaching materials, namely textbooks. The use of book only allow one-way communication and result the lack of students' opportunities to develop their understanding ([Basri et al., 2020](#)). Teaching material is a learning tool that can support the learning process so students are more creative and think critically when working on the questions given. Due to the unavailability of teaching materials in the form of worksheet, the learning atmosphere tends to be

boring and makes students' interest in learning decrease.

As a result, students have difficulty solving problems in questions, especially in comparative material. When studying Comparison material, students find it difficult to understand the formula concepts of Comparison of Values and Comparisons of Reversed Values. Then, students still find it difficult to distinguish between Value Comparison formulas and Reverse Value Comparisons. Next, to analyze the characteristics of students, the researcher analyzes the material and learning objectives. The material analysis aims to identify what material needs to be taught and classify material related to CP and TP so that it can then be organized and still follow the applicable procedures. Formulating learning objectives aims so that the discussion made by the researcher does not cross the boundaries of the problem or the boundaries of the goals that have been made before so that the researcher only focuses on the formulation of these objectives.

### **Design Stage**

At this stage, the aim is to prepare and design teaching materials in the form of e-worksheet. The steps stage are:

a. Media selection

This stage aims to select the media that fits the needs of students for the learning environment and material characteristics.

b. Media design

At the media design stage, a design is carried out to create a PBL-based e-worksheet.

c. Media creation

At the stage of making this media is making PBL-based e-worksheet on comparative material from all the materials designed to become one to become teaching materials that have been conceptualized.

### **Development Design**

At this stage, the PBL-based e-worksheet was made on comparative material. Based on the design in the previous stage, this e-worksheet includes:

a. E-worksheet Cover Design Section

The cover display uses pictures and colors that match the students' characters, as shown in Figure 1. Then, there are columns for the name and number of absences that students must fill in to enter the e-worksheet of comparative material. Then, after students click the "save and next" button, the main menu slide will be displayed, as shown in Figure 2.



Figure 1. Cover display E-worksheet



Figure 2. Main Menu

### E-worksheet Content Design

The content section shows an example of a PBL-based worksheet, where the instructions for doing this are under the syntax in PBL, as shown in Figure 3 until 7. Here students are directed to solve the problems in comparison questions in e-worksheet.



Beikut ini harga buku dan banyak buku yang dapat dibeli.

Banyak Buku	2	5	8
Harga Buku	Rp 5.000	Rp 12.500	Rp 20.000

Jika Rani membeli 10 buah buku dengan uang Rp 50.000, berapakah uang kembalian yang diterima Rani?

Number of books

Prices of books

Following are the prices and the number of books that can be purchased

If Rani buys 10 books with Rp. 50.000,00, how much change did Rani receive?

Figure 3. PBL-Based Worksheet Page Display

Ayo Berpikir!

Dasar permasalahan di atas, informasi apa saja yang kamu ketahui?

Tuliskan jawabannya disini!

Write your answer here!

Let's think!

From text above, what information do you get?

Figure 4. PBL-Based Worksheet Page Display

Ayo Rencanakan!

Tuliskan langkah-langkah yang digunakan untuk memecahkan masalah!

Tuliskan jawabannya disini!

Write your answer here!

Let's plan!

Write procedure to problem solving!

Figure 5. PBL-Based Worksheet Page Display

## Development of Problem-Based Learning...



Figure 6. PBL-Based Worksheet Page Display



Figure 7. PBL-Based Worksheet Page Display

### E-worksheet Closing Menu

In this closing menu section, if students have completed the questions on the e-worksheet, as shown in Figure 8. Then click the "X" button, the e-worksheet will automatically close.



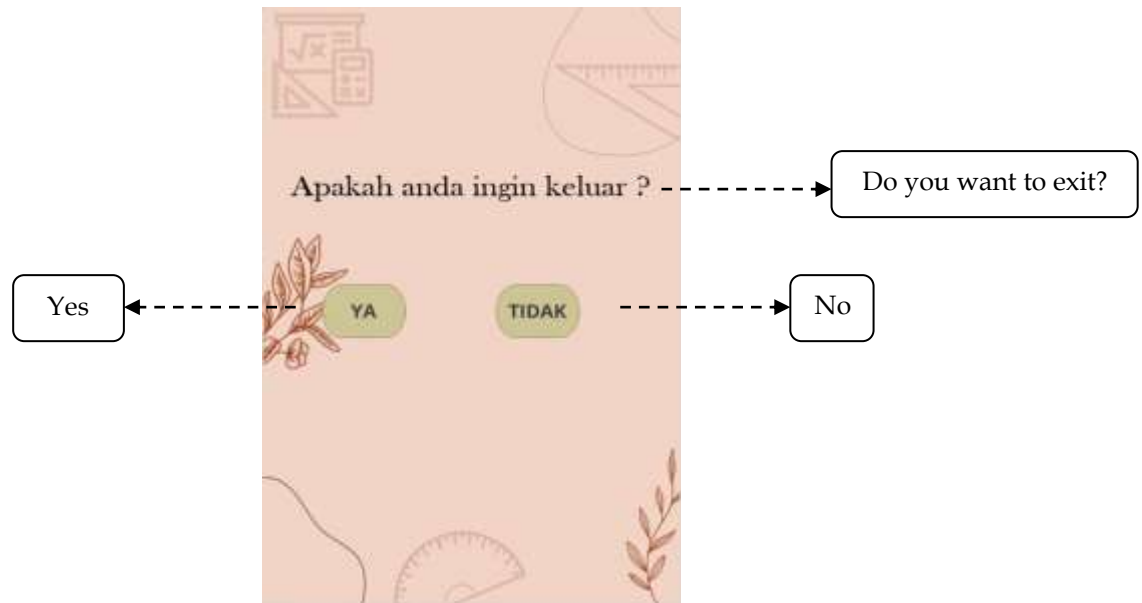


Figure 8. Closing Display

After the e-worksheet was developed, the results were obtained through expert validation, namely the validation of media, material, and language experts.

### Media expert

Validation by media experts aims to obtain assessments, suggestions and input for improvements related to the media presented in the e-worksheet. In this stage, the expert validator fills out a validation questionnaire consisting of 7 aspects of assessment with 17 questions. Based on a questionnaire filled out by media experts, the researcher obtained a total score of 62, while the percentage of the overall assessment obtained was 73%, included in the "Valid" category. Based on usability, color, language, balance, shape, integration and quality of program processing, each obtained an assessment percentage of 80%; 60%; 90%; 60%; 71%; 73% and 80%. So the media presented in the PBL-based e-worksheet is valid and can be continued to the following process. This is in line with [Weli \(2021\)](#) that a learning device is said to be valid if the learning device is of good quality, namely focusing on the material and approach used. Then, in line with the opinion of [Riza et al. \(2022\)](#), a good e-worksheet is the compatibility of the learning objectives with the material and clarity of work instructions.

### Material expert

Validation by material experts aims to obtain assessments, suggestions and input for improvements related to the material presented in the e-worksheet. In this stage, the expert validator fills out a validation questionnaire which consists of 4 aspects of assessment with 14 questions. Based on a questionnaire filled out by material experts, the researcher obtained a total score of 57. In contrast, the percentage of the overall assessment obtained was 81%, included in the "very valid" category. Based on content feasibility, PBL, language and presentation quality, each gets an assessment percentage of 80%, 93%, 73% and 80%. So the material presented in the PBL-based e-worksheet is valid and can be continued to the following process.

In the line with the statement of [Fitriyah & Ghofur \(2022\)](#), the quality of learning material can be seen from the display aspect, the appropriateness and picture quality, and the use of colour and writing font.

### Linguist

Validation by linguists aims to obtain assessments, suggestions and input for improvements related to the language presented in the e-worksheet. In this stage, the expert validator fills out a validation questionnaire consisting of 1 assessment aspect with 6 questions. Based on a questionnaire filled out by material experts, the researcher obtained an overall score of 23, while the overall percentage of the assessment obtained was 76%, included in the "Valid" category. Based on the aspect of language feasibility, a rating percentage of 76% is obtained. So the language presented in the PBL-based e-worksheet is valid and can be continued to the following process. According to the [Ministry of National Education \(2003\)](#), one of the preparations of teaching materials is related to easy sequences, clear cognitive structures, summaries, and easy-to-understand language. In line with the opinion of [Riza et al. \(2022\)](#) that language feasibility in the e-worksheet is perfect if there is ease in understanding information and the effectiveness of sentences.

Regarding the validation results above, from the media expert validation, a score percentage of 73% is included in the Valid category, which can be used without revision. The material expert validation obtained a score percentage of 81% which is included in the very valid category and can be used without revision. Then, linguist validation obtained a score percentage of 76% included in the valid category and can be used without revision. Based on the validation results, it can be concluded that the Problem-Based Learning (PBL) e-worksheet is declared valid and can be used without revision. In line with the results of research by [\(Umaroh et al., 2020\)](#) PBL-based e-worksheet obtains a level of validity and practicality that facilitates students' reasoning abilities.

### Conclusion

Based on the research objectives and the validity of teaching materials in the form of Problem-Based Learning (PBL) e-worksheet on Comparative Materials, it is feasible to use in the learning process. As for the suggestions given by researchers as material for improvement and consideration in the teaching and learning process, namely (1) Researchers hope that the PBL-based e-worksheet on Comparative Material can be used as a support and teaching material in learning mathematics in schools; (2) Continuation of research that applies PBL-based e-worksheet teaching materials to different applications and materials is needed.

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