

Development of Problem-Based Learning E-LKPD for Digital-Based Document

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Abstract – This research was conducted to determine the level of feasibility, student response, and the impact of students' critical thinking on the developed E-LKPD. The research was carried out using R&D (Research and Development) with the 4D development model from Thiagarajan. However, the researchers only conducted preliminary research in the define, design, and develop stages due to time constraints and the scope of the learning outcomes discussed. The average overall score obtained from the validation assessment by experts was 82%, using the interpretation criterion "Very Feasible". The student response questionnaire resulted in an overall score of 87% for the aspects of content, media, and the benefits of developing E-LKPD. Therefore, it can be concluded that the development of E-LKPD based on problem-based learning is highly feasible for use as a supporting teaching material in teaching and learning activities.

Keywords – teaching materials, E-LKPD, problem-based learning, liveworksheet.

1. Introduction

The curriculum in Indonesia has undergone multiple changes. The current curriculum in Indonesia is called the "Merdeka Curriculum," which has been in effect since February 2020 and was established by the Indonesian Ministry of Education and Culture (Kemendikbudristek).

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The renewal of the current curriculum opens up opportunities for students to enhance their knowledge and skills through learning activities, with educators as their supporters [1].

The advancement of technology is driving the development of learning media that maximizes the use of available technology. At the current stage of development, Indonesia faces challenges in addressing national education that will transform the national framework to have a better understanding and awareness of the importance of knowledge, thus requiring special attention [1]. One of these challenges is maximizing the use of technology to optimize the teaching materials used in the learning process.

Teaching materials facilitate students in understanding the structured content shared, enabling learners to comprehensively grasp each subject [2]. Learning activities require the use of teaching materials such as modules, textbooks, Student Worksheets (LKPD), instructional media, and others, while still adhering to the applicable curriculum and aligning with the abilities of the learners so that the learning objectives can be achieved optimally [3]. An optimal learning process will have an impact on the final outcomes, namely the grades of the students.

Teaching materials in the form of E-LKPD (Electronic Student Worksheets) can facilitate the teaching-learning process to be more directed, thus providing opportunities for students to be more active during the learning process. Using E-LKPD offers advantages in facilitating the learning process compared to conventional books/modules, supported by the use of appropriate themes to enhance students' interest in the learning activities [4].

The learning process involves several aspects that can impact the smooth delivery of the material, including internal aspects (student conditions), external aspects (environment), and factors of learning approaches to support students' understanding of the material in the learning activities [5]. Every educator has to understand each student's character to create a conducive learning process, thus initial observation regarding students' characteristics is necessary [6].

The process of addressing real-world problems, which involves multiple steps that have to be completed, is what defines problem-based learning (PBL): problem analysis, problem-related experiments (if necessary), and conclusion-and solution-drawing [7]. Students' eagerness to learn more about the material they have already learned is piqued by the PBL learning paradigm, which also helps them develop their critical thinking abilities when solving problems [8].

After conducting observation and interviews, it was found that there is a lack of socialization in comprehending and understanding the Merdeka Curriculum [9], which has been gradually implemented in each school, resulting in suboptimal learning processes. This has led to a shortage of teaching materials used as complements to the textbook in the learning process. Meanwhile, the module teaching materials used only cover the learning objectives flow, whereas a good module should contain complete teaching tools consisting of Syllabus, Lesson Plans (RPP), learning materials, and evaluations used to measure students' understanding of the delivered material [10]. This situation has prompted the development of E-LKPD as a supporting teaching material in the learning process. Teaching and learning activities require innovative teaching materials to optimize effectiveness and efficiency in the teaching and learning process [11]. Another issue related to curriculum change is the unclear allocation of teaching hours.

In the development of E-LKPD, assistance is provided by using a web-based platform called Liveworksheet, which can systematically and interactively organize E-LKPD with various images, audio, and even videos, as well as create various types of varied questions. This helps prevent boredom in the learning process [12].

2. Research Methods

The research was conducted using the Research and Development (R&D) method. The R&D method is used to create new products and measure the effectiveness of a product [13]. The product developed was an interactive E-LKPD using the problem-based learning (PBL) teaching model, aimed at determining the effectiveness of students' critical thinking at SMKN 2 Buduran Sidoarjo, especially in class X MP.

The development of E-LKPD utilized the 4D development model, which consists of the defining stage, planning stage, development stage, and dissemination stage.

The 4D development model can be used in preparing learning materials in the classroom, facilitating researchers in conducting field trials, and enabling them to revise the development results repeatedly. The model used by the researchers is the 4D development model, adapted to the conducted research. However, in this study, it stopped at the development stage conducted at SMKN 2 Buduran Sidoarjo due to time constraints and the competency limitations found in the E-LKPD.

During the development process, once the E-LKPD product has been completed and has passed the validation stage by experts (subject matter experts, language experts, and graphic design experts), as well as deemed suitable for implementation, and the next step is to conduct limited testing with students. This trial aims to measure student responses to the E-LKPD, obtain feedback to assist in product development, and evaluate its effectiveness in enhancing students' understanding and skills. With the results from this limited testing, the product can be further refined and adjusted before widespread implementation.

The development of E-LKPD involves several data collection instruments, including interviews, expert validation sheets (feasibility, language, and graphic design), student response sheets, and student learning achievement sheets. The following are the data collection techniques used in the research:

1. Expert validation analysis

The results of the E-LKPD validation analysis can be viewed using the formula below (Izza & Pahlevi, 2019):

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

Explanation:

- P = Percentage of feasibility criteria
- f = Total score obtained
- N = Total highest score of all items

2. Analysis of student responses

The results of the analysis of student response sheets in the development of E-LKPD can be viewed using the formula below (Riduwan 2022):

$$\text{Percentage} = \frac{\Sigma \text{ student score}}{\Sigma \text{ highest score}} \times 100\%$$

The total score of the overall percentage from the expert validation sheet and the questionnaire responses of the students is determined using Likert scale score calculation as follows:

Table 1. Likert Scale Assessment

Criteria	Score
Very Good	5
Good	4
Fair	3
Poor	2
Very Poor	1

Source: adapted from Riduwan (2022)

Table 1 forms the basis for the measured assessment completed by validators and learners on the development of E-LKPD based on problem-based learning using the Liveworksheet platform according to the questions provided. Once the result has been obtained, then the score will be converted into the following statement:

Table 2. Interpretation of Percentage Score Results

Percentage	Criteria
81% - 100%	Very Good
61% - 80%	Good
41% - 60%	Fair
21% - 40%	Poor
0% - 20%	Very Poor

Source: adapted from Riduwan (2022)

Table 2 serves as the basis for determining the conclusion of the results of expert validation assessment and student responses regarding the development of problem-based learning-based E-LKPD using the Liveworksheet platform. Therefore, it can be concluded that the development of E-LKPD is considered "Feasible" or "Good" if it obtains a total overall assessment $\geq 61\%$.

3. Analysis of learning achievement

The results of learning achievement can be obtained using pre-test and post-test questions with the criteria of Learning Objective Achievement (KKTP) score. The KKTP set at SMKN 2 Buduran for the Office Management program is ≥ 80 . If students obtain a score ≥ 80 from the overall average score, then they are considered to have achieved the target. The impact of critical thinking can be determined through pre-test and post-test results, using the following formula:

$$\text{Percentage} = \frac{\sum \text{student score}}{\sum \text{highest score}} \times 100\%$$

3. Results and Discussion

The initial stage conducted was a preliminary study or initial analysis of the problems at SMKN 2 Buduran, as well as the characteristics of the students. In the initial analysis, a problem was found in the learning process at SMKN 2 Buduran, namely the uneven implementation of the curriculum. Class X already uses the Merdeka curriculum, while classes XI and XII still use the 2013 curriculum. This causes the teaching materials used by class X to be incomplete and only rely on PowerPoint presentations and textbooks, as well as incomplete modules that should contain syllabi, lesson plans, materials, and evaluations [16]. Meanwhile, the modules used at SMKN 2 Buduran only contain Learning Objective Flow. Therefore, SMKN 2 Buduran requires teaching support materials that can be used effectively and efficiently, and the material can facilitate students in mastering the subject matter on digital-based documentation, covering sub-topics such as understanding basic document procedures, types of equipment in managing documents, and procedures for storing documents in a digital format adapted to systems that will be beneficial in the working world. One of them is by developing teaching materials used in the learning process, namely interactive E-LKPD. Using electronic E-LKPD will enhance students' creativity in working on exercises provided flexibly within a predetermined time frame [14]. After conducting the initial stage of identifying the problems, the next stage is the design stage.

The design stage is carried out by compiling the necessary materials so that students can understand the distributed material well, tailored to the characteristics of the students [3]. The selection of formats is adjusted to digital-based document materials for class X MP 2 at SMKN 2 Buduran. The design steps of the E-LKPD are carried out using design applications such as Canva, then saved in PDF, PNG, JPG, or JPEG format.



Figure 1. Liveworksheet editing interface

In Figure 1, the development stage is carried out by processing the E-LKPD in PDF format using the Liveworksheet platform. So, the editing process can be done to fill out the E-Lkpd digitally/online. The Liveworksheet platform is used to convert printed exercise sheets into digital form that can include images, audio, and even videos to maximally support the learning process [15]. The use of Liveworksheet can enhance teachers' creativity and innovation in teaching and create an engaging learning process. Liveworksheet has several advantages and disadvantages in its use. Its advantages include flexibility, various learning media, the ability to work on exercises directly, and instant score viewing [16]. However, its disadvantage is that a stable internet connection is required. The initial step is to sign up as a teacher to be able to develop the prepared concept. Then, in the Liveworksheet main display, select Create, and then choose My Worksheet to edit the E-LKPD. Upload the E-LKPD in the add worksheet section and begin editing the LKPD according to the prepared concept. In the Liveworksheet platform, you can add images, audio, or even videos. There are various options for evaluation editing.

The next step after the development stage is validation by experts. Validation is carried out by 2 teachers from SMKN 2 Buduran and 1 lecturer from the Faculty of Electrical Engineering at University of Surabaya. The validation process is conducted to assess the development of the E-LKPD that has been created. The experts will provide assessments, comments, and suggestions so that the product can be revised to improve it for usability, allowing students to understand the material easily. The validation by the Subject Matter Expert was conducted by Mrs. Dra. Diah Primuarini, M.M., an Office Management teacher for class X at SMKN 2 Buduran.

Table 3. Expert Material Validation Data

No	Aspect	High est score	Assess ment	%	Remaks
1.	Content suitability	35	30	85,7	Very Feasible
2.	Presentati on suitability	65	56	86,2	Very Feasible
Average Percentage		85,9%			Very Feasible

Source: compiled by the researcher (2024)

The summary of the expert material validation results in Table 3 above is 85.9%, using the percentage criteria "Very Feasible," because the material is deemed to be feasible for learning needs.

The validation by the Language Expert was conducted by Mr. Jaka Subari, S.Pd., M.Pd., an Indonesian Language teacher at SMKN 2 Buduran.

Table 4. Language Expert Validation Data

No	Aspect	High est score	Assess ment	%	Remaks
1.	Student development suitability	5	4	80	Very Feasible
2.	Effectiveness of language used	15	11	73,3	Very Feasible
3.	Ability to motivate students	5	3	60	Fair
4.	Language fluency	5	4	80	Very Feasible
5.	Adherence to Indonesian language rule	10	8	80	Very Feasible
6.	Use of terms and symbols/ images	10	8	80	Very Feasible
Average Percentage		75,3			Very Feasible

Source: compiled by the researcher (2024)

The summary of the language expert validation results in the Table 4 above is 75.3%, using the percentage criteria "Feasible," because the material contained in the E-LKPD is easy to understand.

The validation by the Graphic Design Expert was conducted by Mr. Yuli Sutoto Nugroho, S.Pd., M.Pd., an Electrical Engineering lecturer at the Faculty of Engineering, University of Surabaya.

Table 5. Graphic Design Expert Validation Data

No	Aspect	High est score	Assess ment	%	Remaks
1.	E-LKPD Size	10	10	100	Very Feasible
2.	E-LKPD Cover Design	35	33	94,2	Very Feasible
3.	E-LKPD Content Design	30	28	93,3	Very Feasible
Average Percentage		95,8			Very Feasible

Source: compiled by the researcher (2024)

In Table 5, the summary of the graphic design expert validation results is 95.8%, using the percentage criteria "Very Feasible", indicating that the material in the E-LKPD is deemed very suitable for use in teaching and learning activities to enhance student motivation in understanding the material.

In the student response results, a limited trial was conducted with 20 students from class X MP 2 at SMKN 2 Buduran on January 25, 2024, with a 90-minute class allocation. Before distributing the student response questionnaire, the researcher first administered pre-test and post-test questions to assess the students' responses to the E-LKPD. The results of the student response questionnaire yielded a percentage score of 87.6% for the media aspect, a percentage score of 86.8% for the content aspect, and a percentage score of 86.6% for the benefit aspect.

Table 6. Student Responses Data

No	Aspect	Highest score	Assessment	%	Remaks
1.	Media	300	263	87,6	Very Good
2.	Content	700	608	86,8	Very Good
3.	Benefit	500	433	86,6	Very Good
Average Percentage		87 %			Very Good

Source: compiled by the researcher (2024)

In Table 6, the overall average percentage result is 87%, which is rated as "Very Good" according to the criteria "Very Strong" as suggested by Riduwan [15]. It can be concluded that the problem-based learning-based E-LKPD assisted by the Liveworksheet platform can be used as teaching materials in teaching and learning activities.

The students' learning achievement can be seen from the results of the pre-test and post-test questions that have been distributed. The questions distributed have been analyzed using ITEMAN 3.00, with the following results: 1) Validity test resulted in 19 valid questions and 6 invalid questions; 2) Reliability test resulted in an Alpha of 0.606, indicating reliability with a "Moderate" criterion; 3) Difficulty test resulted in 2 very difficult questions, 2 difficult questions, 12 moderate questions, 7 easy questions, and 2 very easy questions; 4) Discrimination test resulted in 14 very good questions, 6 good questions, 2 fair questions, and 3 poor questions. Based on the analysis above, 25 questions will be used for a limited trial.

Obtained results of pre-test and post-test above, then the results of the accuracy analysis of the student's learning values can be found in the following Table 7:

Table 7. Data Pre-test and Post-test Results

No	Aspect	The Number of Students		Score (%)
		C	I	
1.	Pre-test	17	3	56,8
2.	Post-test	0	20	95.6
The Difference				38,8

Source: compiled by the researcher (2024)

Explanation:

C : Completion

I : Incomplete

The next step involved conducting a limited trial at SMKN 2 Buduran specifically in class X MP 2, in the learning process with an allocation of 2×45 minutes (90 minutes) on January 25, 2024. After the limited trial process, there was an increase of 38,8% with the given questions. This is supported by Rina Agustina & Vahlia (2016) which stated that with the development of products, student were able to develop critical thinking skills with an average score of 66,85 compared to classes without experiments, which only obtained an average score of 63,45.

Problem-based learning and critical thinking skills are interconnected in training students' thinking processes in solving a problem by linking it to existing theories and providing explanations that align with those theories [8]. In implementing the PBL model, it requires the ability to determine the level of critical thinking called Higher-Order Thinking Skills. HOTS is a tool used to measure the agility of thinking, in terms of remembering, repeating, or restating information [18], [19].

This is highly relevant to the development of E-LKPD using the Liveworksheet platform, where worksheets will be engaging and facilitate students in solving each problem tailored to real-world issues using a variety of learning media within Liveworksheet.

Those who discuss the advantages and disadvantages of Liveworksheet include: a) advantages; including flexibility, diverse learning media, questions can be answered directly (online), scores can be viewed immediately, and exercise questions are more varied, b) disadvantages; including the requirement for smartphones or PC s to be connected to the internet [17].

4. Conclusion

This research was conducted using the Research and Development (R&D) method with the 4D research model, namely Define, Design, Development, and Disseminate. However, the research stopped at the development stage due to time constraints and limitations on the materials to be developed.

The suitability of the E-LKPD as a supporting teaching material for digital-based documentation subjects in class X MP (Office Management) obtained a percentage score of 85.9% from the expert material validator, a percentage score of 75.3% from the language expert validator, and a percentage score of 95.8% from the graphic design expert validator. Thus, the average percentage score obtained in the development of the E-LKPD is 82%, with the interpretation criteria "Very Feasible" for use as teaching support materials during the learning process.

Student responses were obtained from a limited trial conducted at SMKN 2 Buduran, specifically in class X MP 2, with a percentage score of 87%, interpreted as "Very Good," indicating its suitability for use in teaching and learning activities by students. Students mention that the development of E-LKPD is easy to understand and offers a variety of exercises that facilitate their understanding of the learning material.

Learning achievement in the learning process increased by a margin of 38.8%. The development of E-LKPD has a positive impact on improving students' understanding of the presented material.

The conclusion is the answer to the problem formulation, product development, and research implementation. Suggestions for further research on deepening the use of Liveworksheet are recommended.

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