Development of Interactive E-LKPD Based on Project-Based Learning to Enhance Self-Learning and Student Differentiation

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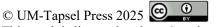State Polytechnic of Batam, Ahmad Yani street, Batam

Abstrak
Penelitian ini berfokus pada pengembangan Lembar Kerja Siswa Elektronik (LKPD) berbasis Project Based Learning (PBL) untuk mata pelajaran Bahasa Indonesia yang bertujuan untuk memastikan keabsahan, efektivitas, dan kepraktisan bahan ajar tersebut dalam meningkatkan hasil belajar siswa. Penelitian ini menggunakan pendekatan Penelitian dan Pengembangan (R&D) dengan model 4-D yang meliputi empat tahap yaitu pendefinisian, perancangan, pengembangan, dan penyebaran. LKPD yang dikembangkan dilakukan uji keabsahan, efektivitas, dan kepraktisan. Hasil penelitian menunjukkan bahwa LKPD materi keanekaragaman hayati memperoleh skor kevalidan sebesar 3,28 dari tim ahli materi dan validator desain. Selain itu, umpan balik dari siswa dan guru menunjukkan bahwa kepraktisan bahan ajar dinilai positif dengan skor rata-rata 3,5. Pada penilaian hasil belajar melalui penggunaan LKPD berbasis PBL, siswa memperoleh skor rata-rata 80,86 yang berarti siswa berada pada kategori sangat tinggi dengan persentase penguasaan sebesar 93%. Oleh karena itu, E-LKPD berbasis PBL dinilai layak untuk digunakan karena memenuhi kriteria validitas, efektivitas, dan kepraktisan. Implikasi dari pengembangan ini menunjukkan bahwa E-LKPD berbasis PBL dapat meningkatkan model pengembangan yang digunakan untuk menghasilkan produk pendidikan yang lebih berkualitas dan membantu proses pembelajaran.
Kata kunci: Belajar Mandiri, E-LKPD, Interaktif, Project Based Learning

Abstract
This research focuses on the development of an Electronic Student Worksheet (E-LKPD) based on Project-Based Learning (PBL) for Indonesian language subjects, aiming to ensure that it is valid, effective, and practical in enhancing student learning outcomes. The study employs a Research and Development (R&D) approach utilizing the 4-D model, which includes four stages: defining, designing, developing, and disseminating. The E-LKPD developed was subjected to validity, effectiveness, and practicality tests. The findings indicated that the E-LKPD on biodiversity materials achieved a validity score of 3.28 from a team of subject matter experts and design validators. Additionally, feedback from students and teachers showed that the practicality of the teaching materials was rated positively with an average score of 3,5. When assessing learning outcomes through the use of the E-LKPD based on PBL, students scored an average of 80.86, categorizing their performance as very high with a mastery percentage of 93%. Consequently, the E-LKPD based on PBL is deemed appropriate for use as it meets the criteria for validity, effectiveness, and practicality. The implications of this development suggest that the PBL-based E-LKPD can enhance the development model utilized to produce higher quality educational products that assist in the learning process.
Keywords: Self-Learning, E-LKPD, Interactive, PBL.

INTRODUCTION

Education plays a crucial role in the development of human life, enabling the transfer, preservation, and advancement of cultural ideas. In a developing society, education is a primary concern to ensure the progress of generations according to societal demands. The purpose of education is to enhance and improve human resources, with its success serving as a measure of its quality. This allows individuals to make meaningful contributions to themselves and society as a whole (Werkanis, 2003).

The rapid advancement of information and communication technology (ICT) is significantly impacting various sectors, particularly education. This technological progress continues to shape learning techniques and patterns, leading to new educational breakthroughs. ICT has the potential to expand learning activities, shifting some traditional classroom methods to more flexible, internet-based approaches. This enables children to learn independently both within and outside the classroom, often without the need for direct teacher supervision or guidance (Kristiyono, 2015; Setiawan, 2018; Jumaat, N. F., & Tasir, 2014).

The Indonesian language subject typically involves studying the Indonesian language, including its grammar, vocabulary, writing, and speaking skills. It often encompasses literature, cultural contexts, and communication practices in Indonesia. This subject helps students improve their proficiency and understanding of Indonesia's rich linguistic and cultural heritage (Mulyasa, 2017).

In addition, the Indonesian language subject requires students to engage their creative thinking skills. Creative thinking in the Indonesian language is crucial because it involves not only memorizing vocabulary and grammar but also enables students to develop their creativity in using the language. This approach ensures that their learning experience is engaging and dynamic (Sukmadinata, 2018).

The low level of students' creative thinking skills in the Indonesian language subject is due to students' habit of only memorizing vocabulary and grammar without developing their creativity in using the language. Another contributing factor is the lack of teaching materials specifically designed to foster creative thinking skills in Indonesian language. Although technology is utilized in learning media, students have not fully trained themselves by independently solving problems to enhance their creative thinking. Additionally, complex materials that require deeper understanding will naturally take longer for students to comprehend (Ika Melina Nur Fitriyah, 2021).

To address these challenges, one effective approach is to develop digital teaching materials that can engage students in the learning process, such as electronic student worksheets (E-LKPD). The integration of interactive E-LKPD into learning activities serves as a tool for teachers to convey information, attitudes, and skills, making the learning experience more interesting and appealing (Pribadi, Y. T., Sholeh, D. A., & Auliaty, 2021; Puspita, V., & Dewi, 2021). Students can access these interactive E-LKPD quickly through electronic devices like PCs, laptops, and mobile phones (Octaviana, F., Wahyuni, D., & Supeno, 2022; Ratnawati, 2021). The design of interactive E-LKPD includes engaging visuals and learning videos, along with links to Google Forms. This setup allows students to easily answer questions and communicate directly with their teachers via email.

In addition to utilizing suitable learning technologies, an effective learning model is essential to engage students in the learning process. The chosen learning model should align with the needs of 21st-century education, particularly focusing on student-centered learning (Dewi, 2019; Putera, Z. F., & Shofiah, 2021; Wahyuningsih, E. T., Purwanto, A., & Medriati, 2021). One effective approach is project-based learning (PBL). By integrating digital

technology with contemporary learning paradigms, creativity and innovation among students can be significantly enhanced (Syahputra, 2022).

The combination of interactive E-LKPD with the project-based learning framework enables students to actively engage in designing mathematics learning projects. This approach not only fosters collaboration but also encourages students to broaden their knowledge and tackle challenges independently (Gunawan, G., Sahidu, H., Harjono, A., & Suranti, 2017; Izati, S. N., Wahyudi, & Sugiyarti, 2018; Priatna, I. K., Putrama, I. M., & Divayana, 2017).

Based on the problems described above, the problem formulations that will be resolved in this study are: 1) How is the validity, practicality, and effectiveness of Interactive E-LKPD based on Project-Based Learning for enhancing self-learning and differential learning among students regarding culture and local wisdom?; 2) What is the level of effectiveness of Interactive E-LKPD based on Project-Based Learning for improving self-learning and differential learning among students concerning culture and local wisdom?

METHODS

a. Type of Research

The research conducted follows the research and development (R&D) method, which is specifically aimed at creating or validating educational products. The goal of R&D is to discover, develop, and validate a product (Sugiyono, 2016). The outcome of this research is the creation of teaching materials in the form of interactive E-LKPD based on Project-Based Learning, designed to enhance self-learning and differentiated learning students.

b. Development Model

In this development research, the 4D model is employed as the development framework, serving as a guide for generating learning tools (Rochmad, 2012). This model is commonly used in the development of teaching materials such as E-LKPD and textbooks (Endang Mulyatiningsih, 2011).

c. Development Procedure

The development procedure address to the 4D model, which stands for Define, Design, Develop, and Disseminate, as established by Thiagarajan (Thiagarajan, S., Semmel, D. S., & Semmel, 1974).

1) Define

The aim of this stage is to identify and clarify the learning requirements by analyzing the objectives and boundaries of the teaching materials being developed in the form of E-LKPD.

2) Design

a. Preparation of E-LKPD

During the preparation of E-LKPD materials, attention must be given to the following aspects:

1. The fundamental competencies that are intended to be achieved.

d. Research Instruments

Research instruments are tools used in collecting data or information related to research. The use of appropriate instruments greatly affects the quality of research results (Hartono, 2010). The research instruments used were in the form of questionnaires and tests. Questionnaires were used for students who had used the E-LKPD and experts to validate the developed E-LKPD. In this study, researchers used several development research instruments which included aspects of validity, practicality and effectiveness. The validity aspect was used to obtain data stating the validity of the content and construct of the E-LKPD developed.

Table 1. Criteria of Validity

Value	Criteria
$3,5 \leq V \leq 4$	Very valid
$2,5 \leq V < 3,5$	Valid
$1,5 \leq V < 2,5$	Quite valid
$0 \leq V < 1,5$	Invalid
(Widiyoko, 2013)	

2) Effectiveness Data Analysis

The effectiveness of the developed LKPD was analyzed through learning outcomes tests. Data on students' learning outcomes were analyzed quantitatively with descriptive statistics to measure students' mastery of the material after completing the learning process. learning. Learners' abilities can be categorized on a scale of five based on a standard categorization technique set.

Table 2. Category Score Determination of Learner Learning Outcomes

Value	Category
0-34	Very low
35-54	Low
55-64	Medium
65-85	High
85-100	Very high
(Tiro, 2008)	

3) Practicality Test Data Analysis

Learner response questionnaires were analyzed by percentage. Activities carried out to analyze learner response data.

Table 3. Learner Assessment Criteria

Value	Category
$2,6 \leq Xi \leq 3,5$	Positive
$1,6 \leq Xi \leq 2,5$	Quite positive
$0 \leq Xi \leq 1,5$	Not positive
(Harsono, 2010)	

RESULT AND DISCUSSION

1. Stages of Learner Worksheet Development

The development of E-LKPD based on Project Based Learning refers to the 4-D model, which consists of four stages 4-D model which consists of 4 stages, namely the defining stage (define), the design stage (design), the development stage (develop) and the dissemination stage (disseminate).(design), the development stage (develop) and the dissemination stage (disseminate). The steps taken in the development process are described as follows:

a) Defining Stage

The defining stage is used to determine and define the needs in the learning process and collect information related to the product that will be developed.

b) Design Stage

This stage contains product design activities that will be made in the form of prototype I of the Learner Worksheet in the form of prototype I of the Learner Worksheet. This stage consists of 4 stages, namely test preparation, selection of suitable media, format selection and initial design.

c) Development Stage (Develop)

Development Stage (Develop) At this stage, the development of Project-based E-LKPD is carried out. Based Learning on the material of the Two-variable linear equation system, where the development is based on the initial design so as to produce an initial product called prototype I, at this stage also made research instruments that will be used later. prototype I, at this stage also made research instruments that will be used in the research process. Based on the improvement suggestions given by the two validators, prototype I was improved with reference to the improvement suggestions given and resulted in prototype II. Changes from prototype I to prototype II. After making improvements to the shortcomings contained in prototype I in accordance with the suggestions of the validators, the resulting prototype II was then started by the validators. The assessment results can be seen with the following summary:

Table 4.

Average Validator Rating Results

Assessment	Assessment Results	Category
Content Appropriateness	3,25	Valid
Accuracy and Correctness of Materials	3,25	Valid
Component Presentation	3,5	Very Valid
Language Use Component	3,25	Valid
Component Completeness	3,3	Valid
Graphic Feasibility	3,3	Very Valid
Average	**3,30**	**Valid**

Based on table 4 above, the average result of the validator's assessment of the Project Based Learning-based E-LKPD developed is 3.30 which is in the valid category. These results concluded that the Project Based Learning based E-LKPD could be used with minor revisions. The research instrument in the form of a questionnaire was first validated before use. The questionnaires made are student response questionnaires and teacher response questionnaires. After the questionnaire is made, the questionnaire is then validated by the validator by providing suggestions and input to the questionnaire, then giving an assessment of the questionnaire based on the aspects on the validation sheet in order to obtain a valid questionnaire.

Table 5.
Description of the Validation Results of the Learner Response Questionnaire

Assessment	Assessment Results	Category
Aspect Guidance aspect	3,5	Very valid
Response Coverage Aspect	3,5	Valid
Language Aspect	4	Very valid
Average	**3,67**	**Very valid**

Table 6. Description of Teacher Response Questionnaire Validation Results

Assessment	Assessment Result	Category
Aspect Guidance	3,5	Very valid
Response Coverage	3,5	Valid
Language	4	Very valid
Average	**3,67**	**Very valid**

Based on the table above, the validator's assessment of the student response questionnaire shows a value of 3.67, which is included in the very valid category. Thus, it can be concluded that the student response questionnaire can be used with slight revisions. Meanwhile, the validator's assessment of the teacher response questionnaire also obtained a score of 3.67, which is in the very valid category, so it can be concluded that the teacher response questionnaire can also be used with slight revisions.

2. Validation Results of the Learning Independence Questionnaire (KKB)

The Learning Independence questionnaire that has been created is then validated by the validator using a validation sheet to determine the good validity and reliability of Learning Independence in order to obtain valid Learning Independence results.

Table 7. Description of Validator Assessment Results on the Learning Independence Questionnaire

Assessment	Assessment Result	Category
Initiative	4	Very valid
Responsibility	4	Very valid
Self-control	4	Very valid
Self-determination	4	Very valid
Average	**4**	**Very Valid**

Based on the table above, the results of the validator's assessment of the Learning Independence Questionnaire are 4 which are in the appropriate category, so it can be concluded that Learning Independence can be used with slight revisions.

3. Level of Effectiveness of E-LKPD Based on Project Based Learning

The level of effectiveness of ELKPD based on Project Based Learning can be seen from the results of the student learning outcomes test after the E-LKPD is tested in the classroom. The test given in the form of multiple-choice questions totaling 20 items. The learning outcomes test is given to students to determine the level of students' ability to the material provided by using E-LKPD based on Project Based Learning. Based Learning. The learning outcomes of students can be seen in the table as follows:
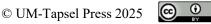
Table 8. Percentage of Completeness of Learning Independence

Category	Frequency	KKM
Learning Independence	27	75
Lack of independence in learning	3	
Percentage of student completion	**90 %**	

Based on table 8, it can be concluded that the number of students who obtained learning completeness above the KKM was 27 people with the KKM standard of 75. While students who obtained completeness below the KKM were 3 people. The percentage of students' completeness obtained is 90% which is in a very high category. Based on the data above, it can be that E-LKPD based on Project Based Learning is effectively used in the learning process. learning process.

4. Practicality Level of E-LKPD Based on Project Based Learning
The level of practicality of ELKPD based on Project Based Learning can be seen from the results of student response questionnaires and teacher response questionnaires containing statements of responses to E-LKPD developed by researchers. The results of the student response questionnaire and teacher response questionnaire can be seen in the following table:

Table 9. Overall Response Results

No	Types of Assessment	Average
1	Teacher Response	3,65
2	Student Response	3,35
Average Total		**3,5**
Assessment Criteria		**Positive**

Based on the table above, it can be concluded that the assessment category obtained from the results of the students' questionnaire is positive towards the E-LKPD developed and students are interested in participating in learning activities with the help of ELKPD based on Project Based Learning. The criteria for the practicality of ELKPD based on Project Based Learning can be said to be achieved and practically used in the learning process.
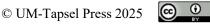
CONCLUSIONS

Based on the results of research and discussion in this study, the following conclusions can be drawn:

1. How to develop Project Based Learning Based Electronic Learner Worksheets (E-LKPD) refers to the 4-D development model which consists of 4 stages, namely the defining stage (define), the design stage (design), the development stage (develop) and the dissemination stage (disseminate).
2. The validity of E-LKPD based on Project Based Learning with 2 revisions, fulfils the valid category with an average score of 3,28.
3. The practicality of the Project Based Learning-based E-LKPD developed is in the positive category with an average score of 3,5.
4. The effectiveness of the Project Based Learning-based E-LKPD developed is in a very high category with a percentage of learning completeness of 90,65% with the number of students who are complete as many as 27 students out of 30 students.

SUGGESTIONS

Based on the research and discussion, the following recommendations can be made:

1. For E-LKPD developers utilizing project-based learning, implement ongoing assessment of the materials and methodologies employed. Implement ongoing assessment of the materials and processes used by E-LKPD developers who are using project-based learning. This aims to increase the quality and relevance of E-LKPD in relation to curriculum development and student requirements. Surveys or interviews with students and teachers after implementation might provide useful feedback for future changes.
2. Teachers applying E-LKPD built in project-based learning could provide increased assistance to students within the process of learning. Increased monitoring will be expected to facilitate students' comprehension of the subject and increase their critical thinking abilities, given that the very effective outcomes indicate significant potential in this approach.
3. Schools need to educate teachers using technology and project-based learning techniques. The material in this course will help teachers in optimizing their use of E-LKPD, increasing student learning outcomes, and creating a more engaged and enjoyable learning environment.
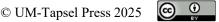
4. It is recommended that future researchers implement more research on the long-term effects of using E-LKPD based on project-based learning on student learning outcomes at various levels of education. This research could provide additional information on the method's future usefulness in a larger educational context.

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