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Development of Problem-Based E-LKPD Using FlipHTML5 to Enhance Critical Thinking Skills in Senior High School Economics

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ABSTRACT

The limited use of interactive learning media and the low level of students' critical thinking skills in economics learning highlight the need for innovative instructional tools. Integrating Problem-Based Learning (PBL) with digital media such as Electronic Student Worksheets (E-LKPD) offers potential to support more active and meaningful learning. This study employed a Research and Development (R&D) approach using the 4-D model (define, design, develop, disseminate). The product developed was a PBL-based E-LKPD assisted by FlipHTML5 for the topic of human needs. The feasibility of the product was evaluated through expert validation involving media, subject matter, and language experts. A limited trial was conducted with 27 tenth-grade students to assess practicality. Data were collected using validation sheets and student response questionnaires and analyzed descriptively using percentage scores. The validation results indicated that the E-LKPD achieved a high level of validity, with scores of 91% from media experts, 80% from subject matter experts, and 91% from language experts. The practicality test showed an average score of 92%, categorized as very practical. These findings suggest that the developed E-LKPD is appropriate in terms of content, design, and usability. The results indicate that the PBL-based E-LKPD assisted by FlipHTML5 is feasible as a digital learning medium and has the potential to support student engagement and learning activities in economics. However, further research is needed to examine its effectiveness in improving learning outcomes and critical thinking skills.

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1. INTRODUCTION

Educators today are required to be creative in presenting lessons that utilise appropriate media and teaching strategies so that the material is conveyed effectively. (Mustafa & Maming, 2024). The use of technological media is very important in education, especially in the context of independent/free curricula, where interactive learning is expected to connect various subjects and experiences. In line

with this, learning that utilises media and technology should not stop at attractive displays, but needs to be consciously designed to develop students' critical thinking skills. (Noviyanti & Mariana, 2025). Through the use of appropriate media and challenging learning activities, students are encouraged to analyse information, distinguish between facts and opinions, evaluate various sources, and construct arguments and conclusions logically. (Arni et al., 2024).

SMA Negeri 1 Batanghari is one example of a school facing problems related to the lack of utilisation of learning media and critical thinking skills. Based on interviews with economics teachers at the school, the learning media used is still limited to printed books and the use of smartphones, which is ineffective. In addition, students tend to be passive in the learning process and lack training in critical thinking; they tend to wait for instructions from teachers rather than constructing their own understanding. The fact that critical thinking skills are low is due to teachers often associating learning problems with understanding learning materials, while students find it difficult to understand complex and abstract material (Devi, 2022). In fact, critical thinking skills are essential to prepare students to face complex challenges in the digital age. (Cynthia & Sihotang, 2023). Therefore, there is a need for innovative learning media that is not only interesting but also encourages students to actively think and solve problems..

One approach that is considered effective for training critical thinking and problem-solving skills is the Problem-Based Learning model. (Rachmawati & Rosy, 2021), Conceptually, Problem-Based Learning uses real-world problems as the starting point for learning. Through these problems, students are encouraged to identify what they need to learn, search for and gather relevant information, develop and compare various alternative solutions, and then reflect on the process they have undertaken. In this way, students not only learn the content/material of the lesson, but also learn how to think and solve problems systematically. (Hmelo-Silver, 2004). Based on the findings (Anggraeni et al., 2023) melalui sebuah systematic review menunjukkan bahwa pembelajaran dengan Problem Based Learning In general, it can improve students' critical thinking skills. Almost all of the studies they reviewed reported that students who learned with PBL scored better in critical thinking than students who followed conventional learning, because during the learning process they were trained to analyse problems, search for relevant information, and develop solutions step by step. PBL has been proven to increase students' motivation to learn and their analytical skills. (Reski et al., 2019) However, the implementation of PBL requires interactive and easily accessible supporting media.

This is where the Electronic Student Worksheet (E-LKPD) assisted by FlipHTML5 can play a role. E-LKPD is a digital version of student worksheets that integrates text, illustrations, videos, and various interactive activities to support independent learning and teacher-guided learning. (Arini, 2023). According to (Ramadani, 2025) The Electronic Student Worksheet (E-LKPD) is a development of the conventional student worksheet (LKPD) that has been converted to digital format so that it can be used on various technological devices such as smartphones. The content of E-LKPD is not limited to a collection of questions and problems, but includes a series of learning activities that are systematically arranged, starting from the presentation of material, the provision of stimuli, to explanations of the steps that need to be taken by students. (Kamila, 2022).

In the field of technology, the use of HTML5-based interactive content ecosystems (such as FlipHTML5) has been proven to increase engagement and, in certain contexts, learning outcomes in online learning, provided that it is supported by good instructional design. (Jacob & Centofanti, 2024)(Mutawa et al., 2023). FlipHTML5 is a web-based digital publishing platform that provides facilities for converting static teaching materials, such as printed documents or PDF files, into interactive flipbooks that resemble physical books but are enriched with multimedia elements, such as videos, audio, animations, and links. With a simple interface that does not require special programming skills, teachers can repackage teaching materials into digital pages that are more lively and engaging for students. (Jauharati et al., 2022). Fliphtml5 was chosen for its ability to convert static documents into interactive flipbooks with easy navigation. (Miranda, 2023). In this study, FlipHTML5 was used as a platform to present E-LKPD designed with a Problem-Based Learning (PBL) approach. FlipHTML5's

features, which allow the combination of text, images, infographics, and problem-triggering videos, are in line with the characteristics of PBL, which requires authentic problems and a focused investigation process. (Laili, 2023).

The development of E-LKPD in Economics subjects generally still focuses on product quality, without utilising interactive content ecosystems or targeting different levels and materials from Grade X Economics on the topic of Human Needs. First, Heyzine-based E-LKPD Economics (Daniyah & Yuni, 2024) developed for Grade XI students and proven to be highly valid, but it does not utilise the FlipHTML5 platform, does not focus on improving students' critical thinking, and does not examine material on human needs. Second, there is the development of E-LKPD based on Liveworksheets. (Mahombar & Mihardi, 2025) in other economic materials with a different design approach, so it does not yet represent the use of FlipHTML5. Third, in non-economic subjects or levels, E-LKPD is based on Problem Based Learning. (Arya & Rahmadina, 2024) has been proven to be valid and practical, but has not yet demonstrated a combination of PBL, E-LKPD, FlipHTML5, critical thinking, and Grade X Senior High School Economics subjects. Based on these conditions, it can be asserted that studies that integrate the Problem-Based Learning (PBL) approach, E-LKPD media, and the FlipHTML5 platform in senior high school economics learning, particularly in the subject of human needs, are still very limited. The limitations of this study indicate a gap in the development of learning tools that are truly in line with the demands of the Merdeka Curriculum and the need to strengthen students' critical thinking skills. Therefore, the development of PBL-based E-LKPD media using FlipHTML5 for the Human Needs material is a research need that has a strong scientific basis and offers practical contributions to senior high school Economics teachers in providing innovative digital teaching materials oriented towards critical thinking skills.

This study aims to develop PBL-based E-LKPD assisted by FlipHTML5 on Human Needs material for Grade X students at Batanghari 1 State Senior High School using the 4-D model Define–Design–Develop–Disseminate, as well as to assess its validity and practicality through expert review and testing on students. Theoretically, this study enriches the literature on interactive media development that combines PBL and critical thinking indicators; practically, it provides affordable media that is easily accessible on smartphones and is in line with the needs of teachers and students in senior high school economics learning.

2. METHOD

2.1 Development Method

This research is categorised as R&D development research aimed at designing and producing E-LKPD based on Problem-Based Learning (PBL) on human needs material in the form of a digital flipbook through the FlipHTML5 platform. Product quality is evaluated through two main aspects, namely validity testing and practicality testing. The development model used is the 4-D model (Define, Design, Develop, Disseminate). This model was chosen because it offers a coherent and structured work process: the define stage is used to conduct an initial analysis, including mapping the characteristics and needs of students. (Fenanlampir et al., 2021). The design stage focuses on designing prototypes by determining the format/media and compiling initial product designs (Ristanto et al., 2023), The development stage emphasises formative evaluation through expert validation and readability testing/limited trials as the basis for product refinement, (Wenno et al., 2022) This product will undergo a validation process involving three expert validators, namely Mr Febri Hartono, S.Pd., M.Pd., Gr, who is a lecturer and history teacher with expertise in media design and acts as a media expert validator; Ms Lady Thresya, S.Pd., who is an economics teacher acting as a subject matter expert; and Mr Ngalimanto, who is an Indonesian language teacher acting as a language expert validator. This product will be trialled on a limited basis in class XC, which consists of 27 students. The composition of the subjects includes 13 male students and 14 female students aged 15–16 years old, while the dissemination stage is directed at packaging and distributing or implementing the product on a limited

basis. (Yaniawati et al., 2022). In addition, the 4-D model has been widely applied in the development of problem-based digital worksheets, making it relevant as a procedural reference in the development of e-LKPD flipbooks in this study (Distrik et al., 2024). This study is limited to formative evaluation (validity and practicality); therefore, testing the effectiveness on learning outcomes is recommended for future research through implementation on a broader scale or experimental design.

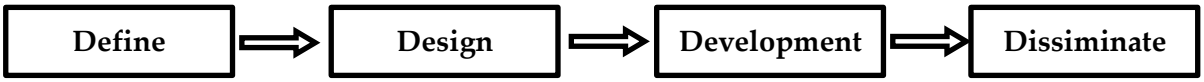


Figure 1. Development of the 4-D model

2.2 Development Procedure

2.2.1 Define

This stage seeks to identify and specify the learning requirements. The steps include:

1. **Analysis of Front-end*:*** Front-end analysis aims to identify the main issues that arise in economics learning at Batanghari 1 State Senior High School, particularly on the topic of human needs. The researcher conducted a pre-survey of tenth-grade students through initial observation and information gathering on the implementation of learning. This information was used to map needs and became the starting point for designing E-LKPD that was relevant to the actual conditions in the classroom.
2. **Student and Teacher Analysis**: At this point, the investigator examined the characteristics of students, such as their initial abilities, interests and attitudes towards economics lessons, and their level of independence in learning. On the other hand, the researcher also examined the obstacles experienced by teachers, such as limited media, students' inadequate capacity for critical thought, and the underutilisation of smartphones as a learning tool. The results of this analysis are used to adjust the teaching material design to the needs, characteristics, and learning environment of the students.
3. **Concept Analysis*:*** Concept analysis is conducted to select and organise the material to be presented in the E-LKPD, namely material on human needs. Key concepts are arranged sequentially with reference to the Merdeka Curriculum and various relevant references, so that the flow of material in the E-LKPD helps students understand the interrelationships between concepts in stages.
4. **Task Analysis**: At this stage, researchers identify the types of tasks that can develop the main and supporting skills targeted in learning. Tasks are designed in line with PBL syntax, thereby encouraging students to actively examine problems, discuss, and formulate solutions. All tasks are ensured to be in line with learning outcomes and the requirements of the Merdeka Curriculum on human needs material.
5. **Specification of Objectives*:*** In light of the findings of the four previous analyses, the researcher set specific development objectives, namely to produce a PBL-based E-LKPD on human needs material that is valid and practical, and able to help students be more active, focused, and trained in critical thinking. These objectives became the reference in compiling the content, activities, and appearance of the E-LKPD that was developed.

2.2.2 Design

The design stage is focused on developing a preliminary draft of the PBL-based E-LKPD, which will be further developed through a series of steps, including the following:

1. **Format Selection*:*** At this stage, the final form of the E-LKPD is determined, starting from the selection of content that focuses on human needs material along with case studies and supporting exercises, the preparation of main components (such as the cover, foreword, learning objectives, core material, activity sheets, and report format), to the visual layout so that it is easy to read and attractive to students. All E-LKPD content is compiled in line with the five main steps of the PBL model, so that the sequence of learning activities flows from problem introduction to reflection

activities. The finished product is then uploaded and processed through the FlipHTML5 platform, transforming it into an interactive digital flipbook that can be easily accessed by students, both for independent learning and face-to-face learning.

2. **Initial Design**: This stage focuses on preparing the first draft of PBL-based LKPDs with reference to the planned format. The draft contains an introduction, presentation of main material, student assignment or activity sheets, and a template for work reports. Each section is designed to follow the sequence of problem-based learning phases, starting from the introduction and formulation of problems, grouping and directing students, the investigation process, the compilation and presentation of results, to assessment and reflection activities. In addition, the integration of material flow, clarity of work steps, and the suitability of tasks with learning objectives and critical thinking indicators to be developed are also reviewed.

2.2.3 Development

This stage realises the product design into PBL-based E-LKPD. The LKPD components (cover, introduction, material, PBL phase, project procedures) are systematically arranged and enriched with attractive images. The product is then validated:

a. Media Expert Validation: Assessment of media suitability by Economics Education lecturers for product improvement.
b. Content Expert Validation: Assessment of the quality and suitability of the material by experts for content refinement.
c. Language Expert Validation: a process of linguistic assessment or examination to ensure that the language used is communicative, appropriate to the students' level of thinking, and does not cause ambiguity.
d. Product Testing: Offline testing of PBL-based E-LKPD on for tenth-grade students at SMA N 1 Batanghari to obtain feedback on ease of use.

2.2.4 Disseminate

The final stage aims to disseminate the E-LKPD product. Dissemination is carried out by distributing the product to 10th grade students at SMA N1 Batanghari and submitting it to the school for wider use.

2.3 Data Collection Instruments

1. **Observation*:*** The observation technique was used by directly observing the learning process in the classroom and the learning behaviour of the students. Through this activity, the researcher recorded the classroom situation, the level of student activity, the way the teacher delivered the material, and the use of available media. The data from the observation was then used as a basis for determining the actual learning conditions before the E-LKPD was implemented.
2. **Interviews**: The next instrument was face-to-face interviews with the economics teacher, Mrs Ledy Tresya, S.Pd, and several students from Batanghari 1 State Senior High School. These interviews aimed to explore more in-depth information regarding the difficulties experienced by students, their learning media needs, and their responses to the ongoing learning process. The interview results helped the researcher adjust the E-LKPD design to the needs of teachers and students in the field.
3. **Documentation**: The documentation technique was carried out simultaneously with the observation and interviews, both with the economics teacher and the Year 10 students of SMA Negeri 1 Batanghari. The researcher collected various supporting documents, such as photos of learning activities, copies of teaching materials, and other relevant notes during the research process. These documents were used as complementary and supporting evidence for the findings obtained from the observation and interviews.
4. **Questionnaire*:*** In this study, 27 for tenth-grade students at SMA N 1 Batanghari became respondents who filled out questionnaires face-to-face with researchers in a conducive atmosphere

so that the data obtained was valid and objective. To analyse the respondents' answers, the researcher employed a Likert scale. As stated by (Riduwan & Akdon, 2020),), the Likert scale serves to measure the beliefs and viewpoints or opinions of people or groups regarding a social phenomenon. This scale breaks down variables into several indicators that form the basis for compiling items in the form of questions or statements, which are then presented in a table where respondents mark (√) the option that best reflects their views. The following is a grid table for interpreting scores.

Table 1. Score Interpretation List using the Likert Scale

Answer Criteria	Score
Very Valid	5
Valid	4
Fairly valid	3
Not valid	2
Not valid	1

In this study, the questionnaire was analysed using a Likert scale in accordance with the guidelines in the score interpretation table. Each response option was given a different value, namely 'Very valid' with a value of 5, "Valid" with a value of 4, 'Quite valid' with a value of 3, 'Not valid' with a value of 2, and 'Not valid at all' with a value of 1. These scores were used to facilitate the researcher's interpretation of the respondents' answer trends. The higher the score obtained, both for a single statement and for the accumulation of all items, the stronger the indication that the respondents considered the measured aspect to be valid. Conversely, a low score indicates that the respondents' assessment tends to be in the invalid category.

2.4 Data Analysis Techniques

Data analysis was conducted through qualitative and quantitative analysis. Qualitative data was obtained from observations, interviews, and suggestions/improvements from validators, while quantitative data was obtained from validator assessment scores (validity test) and student response questionnaires (practicality test). The results of the analysis were used to determine the feasibility of the product and the basis for improving the E-LKPD that was developed.

2.4.1 Validity Test

Validity analysis was conducted based on the validator's assessment of the indicators on the validation sheet (e.g., media aspects: appearance, readability, navigation; material aspects: suitability of achievements, accuracy of concepts, depth; language aspects: clarity of instructions, standardisation, and readability). Scores were given on a scale of 1-5. The validity percentage was calculated with reference to Riduwan and Akdon (2020) as follows:

$$\text{Percentage} = \frac{\sum score\ given\ by\ the\ validator}{\sum maximum\ score} 100\%$$

∑ The score given by the validator is the total actual score of all items assessed.∑ The maximum score is the highest score that can be achieved, which is the number of items × the maximum score on the scale × the number of validators (for example, on a scale of 1–5, the maximum score = 5). The result is multiplied by 100% to give a percentage. The closer the score is to 100%, the more suitable/valid the product is according to the validator.

The validity criteria for the resulting product are determined based on the percentage score as presented in Table 2. Revision decisions are made by considering the results of each aspect and qualitative input from validators; if there are aspects that fall into the 'sufficiently valid' category ($41 < N \leq 60$) or lower, improvements are made before the product is used in the trial phase.

Table 2. Product validity assessment criteria

Answer Criteria	Rating Scale	Assessment
Highly valid	5	81 <*N*≤ 100
Valid	4	61 <*N*≤ 80
Sufficiently Valid	3	41 <*N*≤ *60*
Not Valid	2	21 <*N*≤ *40*
Highly Invalid	1	0 <*N*≤ *20*

Based on Table 2, the product is declared suitable for use in the trial phase if it obtains a minimum validity percentage in the 'valid' (61 < N ≤ 80) or 'highly valid' (81 < N ≤ 100) category. If the validity score for one aspect has not reached the 'valid' category, the product is revised according to the validator's comments until it meets the eligibility criteria. The category determination refers to Riduwan and Akdon (2020).

2.4.2 Practicality Test

Practicality was analysed based on student response questionnaires using a 1-5 Likert scale. Scores were calculated as averages per item and per aspect, then converted into percentages. Percentage calculations referred to Riduwan and Akdon (2020:18) as follows:

$$\text{Percentage} = \frac{\sum scores\ given\ by\ students}{\sum maximum\ score} 100\%$$

The practicality criteria of the product are determined based on the percentage score as presented in Table 3. For more informative reporting, it is recommended that the practicality results be presented in the form of mean and standard deviation (SD) per aspect. If necessary, the internal consistency of the questionnaire can be tested using a reliability coefficient (e.g. Cronbach's alpha) to ensure measurement stability.

Table 3. Product practicality criteria

Answer Criteria	Rating Scale	Assessment
Very practical	5	81 <*N*≤ 100
Practical	4	61 <*N*≤ 80
Fairly practical	3	41 <*N*≤ 60
Impractical	2	21 <*N*≤ 40
Very impractical	1	0 <*N*≤ 20

Based on Table 3, a product is considered practical if it achieves a minimum percentage within the "practical" category (61 < N ≤ 80) or the "very practical" category (81 < N ≤ 100). If the results fall below these categories, revisions are made based on students' feedback before the product is used more broadly. The interpretation categories refer to Riduwan and Akdon (2020:18).

3. FINDINGS AND DISCUSSION

3.1 Findings

The digital learning media developed in this study utilised the 4D development model. This model comprises four main stages, namely definition, design, development, and dissemination (Thiagarajan et al., 1974). During the definition stage, it was found that Grade X students still needed more interesting and contextual learning media that could increase active engagement. Therefore, the development of Problem-Based Learning-based E-LKPD was chosen as the solution. The design stage produced a preliminary product design that included learning objectives, E-LKPD format, and PBL-based materials and questions compiled with reference to the curriculum and relevant learning resources.

Next, during the development stage, the E-LKPD that had been compiled was validated by media experts, subject matter experts, and language experts, with assessment results ranging from valid to highly valid. It was then tested on students to determine its practicality. Meanwhile, the dissemination

stage is planned as a step to utilise the media more widely through teachers and schools, so that the PBL-based E-LKPD produced is not only used by the test subjects, but also has the potential to be applied in other similar learning contexts. A more detailed description of each stage of the 4D model and the research findings is presented in the following subsection.

3.1.1 Define

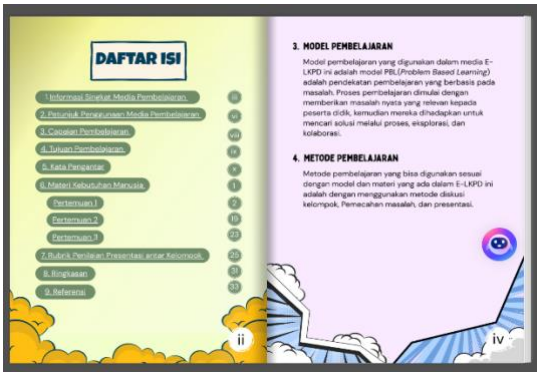
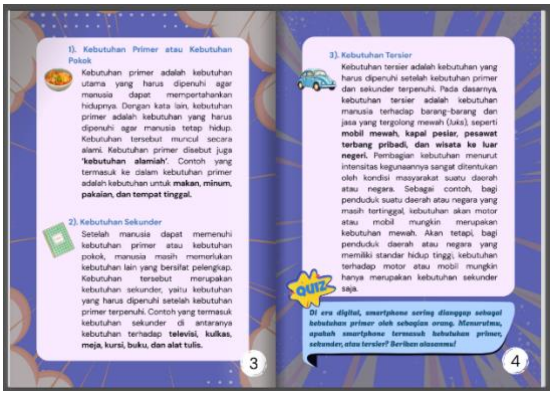
A series of activities in this stage included observing the learning process in Grade X, interviewing students, and interviewing the economics teacher, Mrs Ledy Tresyha, S.Pd. In the define stage, five types of analysis were carried out, namely front-end analysis, student analysis, task analysis, concept analysis, and learning objective specification. Based on the five stages carried out in this study, it can be concluded that Grade X students at SMA N 1 Batanghari require effective learning media to solve the problems faced by students and encourage active involvement in the learning process. Therefore, the development of E-LKPD media based on Problem Based Learning (PBL) is seen as a relevant and appropriate solution to meet these needs.

3.1.2 Design

The design stage is the initial stage in the product design process, which is formulated based on the results of problem identification and requirements in the previous stages (Waruwu, 2024) .At this stage, it was determined that the learning media to be developed would be PBL-based E-LKPD as a solution to the problems identified. The design of this media includes various important elements, such as the compilation of material content, visual layout, and the application of PBL syntax, which will serve as the basis for the overall development of E-LKPD.

1. Determining Learning Objectives
   The formulation of learning objectives is compiled by considering the alignment between the learning outcomes in the curriculum and the selected material. This adjustment is intended so that the designed E-LKPD can support the achievement of the targeted competencies and be able to fulfill the needs of students in understanding the material more comprehensively and contextually.
2. Format Selection
   In this study, the researcher developed an E-LKPD format design that integrates the (PBL) approach, taking into account the content of the material to be presented. The format chosen is a PBL-based E-LKPD with specific characteristics, which is specifically designed to support the learning of tenth-grade students.
3. Formulating PBL-Based Material and Questions in Learning Media
   Researchers compiled materials and questions in E-LKPD learning media based on PBL with a focus on the topic of human needs, which covers two main sub- topics: product packaging design and animal food processing. The content development refers to the Merdeka Curriculum Craftsmanship and Entrepreneurship e-book and is supported by various reliable online sources, so that the material developed is comprehensive, up-to-date, and in line with students learning needs.
4. Creating E-LKPD Products
   In designing and developing a learning product, researchers utilised the Canva platform as a design tool to design all the main components needed. These components included determining the E-LKPD title, setting the visual layout, selecting and compiling teaching materials, formulating learning objectives and outcomes, and compiling the PBL learning model stages. The researchers also equipped the E-LKPD with supporting features such as interactive quizzes, a chat boot feature to make it easier for users to ask questions and find answers, additional information, PBL-based assignments, additional materials and reading materials, and final evaluation questions. After all parts were thoroughly designed, the E-LKPD was converted into a flipbook format using flipHTML5. Here, I will present the initial design of the E-LKPD and the design of the E-LKPD that has undergone revision by language, material, and language experts as follows:

Table 4. Comparison of E-LKPD design before and after expert validation

	Before	After
1.	 The layout of the images is not neatly arranged.	 Image layouts that have been grouped according to need.
2.	 The table of contents is not yet interactive and the media is still monotonous.	 An interactive table of contents using hyperlink features and a chat bot feature that assists students in asking questions and finding answers.
3.	 Content that is still raw in terms of accuracy and language.	 Content that has undergone revision and includes supporting materials accessible via QR code

3.1.3 Development Stage

At this stage, researchers carried out the development of learning media designed in accordance with the initial design and research objectives, namely to create valid and easy-to-use learning media. After obtaining input from the supervising lecturer, the product that had been compiled was then evaluated through a validation process by media experts, subject matter experts, and language experts to assess its validity. To assess its practicality, the researcher conducted a trial with 17 tenth-grade students at SMA N 1 Batanghari using a questionnaire developed with a Likert scale. The data from the

questionnaire was analysed using validity and practicality formulas based on the method from Riduwan and Akdon. Broadly speaking, this stage covers two main procedures, namely expert validation and practicality testing.

1. Expert validation

After the product has been developed, the next stage is to conduct validation by experts to evaluate the validity of the learning media that has been designed. This validation involves three validators from different fields of expertise. The first validator, Mr Febri Hartono, S.Pd, is a teacher from SMA N 1 Batanghari who acts as an expert in the field of media. The second validator, Mrs. Ledy Treshya, S.Pd., is an economics teacher who provides an assessment from the perspective of material substance. The third validator is Mr. Drs. Ngalimanto, an expert in language. The validation was conducted through a series of structured steps to ensure the quality and suitability of the learning media that has been developed, with the following results:

a. Media expert validation data

The researcher underwent validation by the media expert, Mr. Febri Hartono, S.Pd. This validation aimed to evaluate the quality and validity of the developed product. The assessment results from the media expert, obtained through a questionnaire, are presented in the following table:

Table 5. Data from the Media Expert Validation Questionnaire

Number of Aspects	Number of Scores	Average Score	Percentage	Criteria
17	78	4.58	91%	Highly Valid

From the table, it can be seen that the total score given by the validator reached 78 with a percentage of 91%, thus falling into the highly valid category and suitable for use. With the validation results from this media expert, it can be concluded that it has met the validity criteria and is ready to be tested on students.

b. Subject matter expert validation data

The E-LKPD product was then tested for validity by subject matter experts to ensure that its quality met optimal standards. The data from the subject matter experts validation assessment is presented in the following table:

Table 6. Data from the Expert Validation Questionnaire

Number of Aspects	Number of Scores	Average Score	Percentage	Criteria
17	68	4.00	80%	Valid

According to the information in the table, validation was carried out using 17 assessment criteria. The validator gave a total score of 68 with a percentage of 80%, which falls into the valid category. The results of the validation recapitulation by subject matter experts show that the learning media has a validity level of 80%, so it is considered valid and suitable for testing on students.

c. *Language Expert Validation Data*

The E-LKPD product was then tested for validity by language experts to ensure that its quality met the optimal standards. The data from the linguistic specialists' validation evaluation is presented in the following table:

Table 7. Data from the Language Expert Validation Questionnaire

Number of Aspects	Number of Scores	Average Score	Percentage	Criteria
17	77	4.52	91%	Highly Valid

Based on the data in the table, validation was carried out using 17 assessment criteria. The validator gave a total score of 77 with a percentage of 91%, which falls into the highly valid category. The results of the validation recapitulation by subject matter experts show that the learning media has a validity level of 91%, so it is considered highly valid and suitable for testing on students.

2. Product trial

After the learning media was declared valid by the validators, the next step in this study was to test the media. The trial was conducted in tenth-grade students with the aim of assessing the practicality of using E- LKPD in the learning process. Through this stage, the researcher obtained an overview of the actual application of learning media in teaching and learning activities. The trial data was collected by distributing practicality questionnaires to 27 tenth-grade students at SMA N 1 Batanghari on Friday, 21 November 2025. Of this total, 27 students were selected as samples to complete the questionnaire, which contained 17 assessment aspects. This questionnaire contained statements designed to measure the practicality of the learning media developed. The results of the practicality questionnaire completed by the students The table above shows you that:

Table 8. Data from the Student Response Questionnaire

Total Respondent	Total Score	Average Score	Percentage	Criteria
17	1.349	79.35	92%	Very Practical

Based on Table 8, the test results showed an average practicality percentage of 92% with a category of very practical. These findings indicate that E-LKPD is easy to use by students in the learning process, both in terms of appearance, usage instructions, and activities presented.

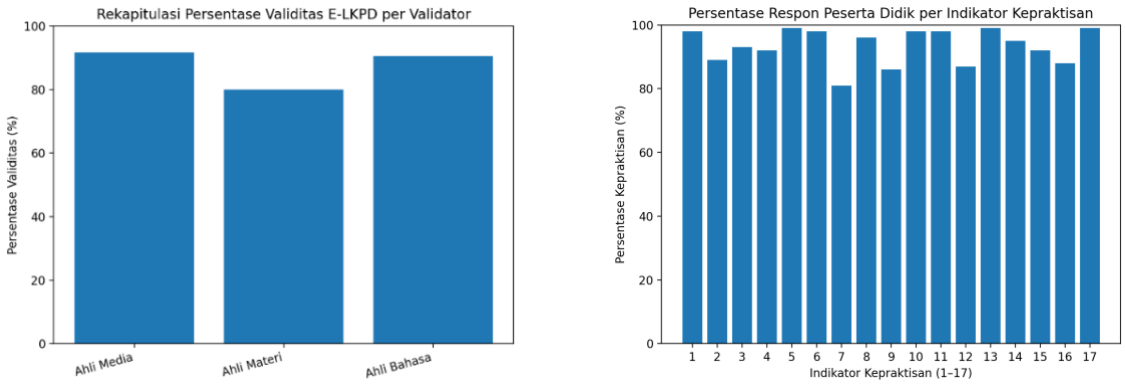


Figure 2. Recapitulation of E-LKPD validity percentage per validator and percentage of student responses per practicality indicator

3.1.4 Dissemination

After the product has been validated by media and material experts and has demonstrated a high level of practicality based on the results of a trial questionnaire by students, the next step in the 4D development model is the dissemination stage. At this stage, the developed learning media is

disseminated by conducting teaching and learning activities using media that have been validated and proven practical for students, as witnessed by the economics teacher at the school, Mrs. Ledy Thresya, S.Pd. Media that have passed the validity and practicality stages are also submitted and disseminated to economics teachers as learning media for human needs material.

3.2 Discussion

The findings of this study indicate that the developed Problem-Based Learning (PBL)-based E-LKPD assisted by FlipHTML5 achieved high levels of validity and practicality. In development research, these two aspects are widely recognized as essential indicators of product quality, particularly in formative evaluation stages (Nieveen, 1999). The high validity scores across media, material, and language aspects suggest that the product aligns well with instructional design principles, content accuracy, and linguistic clarity.

From a theoretical perspective, the strong validity of the developed media can be explained through multimedia learning theory. According to Richard E. Mayer, meaningful learning occurs when learners actively process information through both verbal and visual channels in a well-structured environment (Mayer, 2009). The integration of text, images, and interactive elements in the FlipHTML5-based E-LKPD is consistent with these principles, potentially reducing extraneous cognitive load and supporting more efficient knowledge construction. This is also supported by cognitive load theory, which emphasizes the importance of well-designed instructional materials in optimizing learners' cognitive processing (Sweller, 1988).

Furthermore, the high practicality score (92%) indicates that the developed E-LKPD is perceived as easy to use and accessible by students in real learning contexts. This finding is particularly relevant in the implementation of PBL, where the effectiveness of learning is influenced not only by the instructional model but also by the usability of supporting media. PBL emphasizes student-centered learning through authentic problem-solving processes, including problem identification, information gathering, and reflective thinking (Hmelo-Silver, 2004). In this regard, the E-LKPD can function as a scaffolding tool that facilitates students' engagement in these processes, thereby supporting more active participation in learning.

In comparison with previous studies, the results of this research are consistent with findings that report high validity and practicality of PBL-based E-LKPD in various subject areas (e.g., Safitri, 2022; Sani & Ambarwati, 2024; Sumandya et al., 2025). However, this study extends prior research by integrating PBL with the FlipHTML5 platform within the context of economics education, which remains relatively underexplored compared to science-based disciplines. This indicates the adaptability of digital worksheet innovations across different subject domains.

Despite these promising findings, several limitations should be acknowledged. First, the study involved a relatively small sample size from a single school, limiting the generalizability of the results. Second, the evaluation was restricted to validity and practicality aspects, without examining the effectiveness of the product in improving learning outcomes or critical thinking skills. Therefore, claims regarding its impact on higher-order thinking should be interpreted with caution. Future studies are recommended to employ experimental or quasi-experimental designs with larger and more diverse samples to provide stronger empirical evidence regarding the effectiveness of PBL-based E-LKPD in enhancing students' learning outcomes and critical thinking abilities.

4. CONCLUCION

This development research produced an E-LKPD based on Problem-Based Learning (PBL) assisted by FlipHTML5 on human needs material for grade X students at Batanghari 1 State Senior High School using the 4D development model (define, design, develop, disseminate). The validation results showed that the product was in the valid–highly valid category, with a percentage of 91% (media experts), 80%

(subject matter experts), and 91% (language experts), making it suitable for use in limited trials. A trial involving 27 students showed a level of practicality with an average percentage of 92% (very practical category), indicating that the E-LKPD is easy to use and supports problem-based learning. At the dissemination stage, the product has been applied in learning and submitted to teachers as an alternative media for human needs material. Further research is recommended to test the effectiveness of E-LKPD through experimental/quasi-experimental designs with control groups (e.g., pretest–posttest and random assignment where possible) to compare its impact on learning outcomes and/or critical thinking more objectively, as well as to expand trials to various classes and schools. Pedagogically, this E-LKPD is recommended to be adopted as supplementary teaching material in the implementation of PBL in the senior high school curriculum, both for independent learning and for discussion and problem-solving activities in class.

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