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Development of an Interactive Mathematics E-Worksheet (E-LKPD) on the Area of Plane Figures for Grade III Students at SDN 3 Panjerejo Using Liveworksheet

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Abstract - In today's evolving educational landscape shaped by Society 5.0, technology plays a vital role in making learning more meaningful, interactive, and accessible—especially for young learners. This research focuses on creating an Interactive Electronic Student Worksheet (E-LKPD) using the Liveworksheet platform, aimed at helping third-grade elementary students better understand the concept of area in plane figures. The development followed the 4D model by Thiagarajan, Semmel, and Semmel, which includes four core stages: Define, Design, Develop, and Disseminate.The study was conducted at SDN 3 Panjerejo, where early observations showed that many students faced challenges in understanding geometry due to a lack of visual learning tools and engaging activities. To address this, a digital worksheet was designed with a blend of images, text, interactive tasks, and real-time feedback to support student learning. Various tools were used to evaluate the product, including validation sheets from experts, questionnaires for students and teachers, and classroom observations. The results showed strong validation from material experts (94%), media experts (97%), and practitioners (92.5%), indicating high levels of reliability and relevance. In trials, students responded very positively—with 96.6% satisfaction in small groups and 97.7% in larger groups. These findings highlight the potential of interactive E-LKPDs to not only support conceptual understanding but also encourage student independence and motivation. This product aligns with the goals of the Kurikulum Merdeka and provides meaningful insights for the development of digital learning materials in primary education.

Keywords Interactive Worksheet, Mathematics Education, E-LKPD, Plane Figures, Liveworksheet, Society 5.0, Instructional Media, 4D Model)

I. INTRODUCTION

A. Background

Education is a fundamental aspect of human life and an essential means of developing competent and responsible individuals [1]. It is a conscious and planned effort to enhance one's potential, encompassing intellectual, moral, and social capacities [2]. The primary goal of education is the holistic development of human personality, enabling individuals to become religious, intellectual, creative, and cultured beings [3;4]. Teachers play a crucial role in achieving these goals by guiding students in knowledge and skill acquisition relevant to daily life, particularly mathematics.

Mathematics serves as a foundation for logical reasoning, problem-solving, and everyday applications, from basic calculations to measurements [5]. Its learning objectives include the ability to understand and apply concepts in daily activities and to foster persistence and confidence in solving problems [6; 7]. However, classroom observations at SDN 3 Panjerejo revealed that only 46% of third-grade students met the minimum mastery criteria in the topic of plane area. Interviews with teachers indicated that students struggled to understand abstract concepts and often lost focus during lessons. This low interest in mathematics negatively impacted learning outcomes [8].

Digital learning media such as electronic student worksheets (E-LKPD) have been shown to enhance student engagement and comprehension. Research highlights their practicality, interactivity, and effectiveness in supporting meaningful learning [9; 10; 11; 12]. The Liveworksheet platform, in particular, offers features that allow for real-time feedback and multimedia integration, making mathematics more accessible and stimulating.

Despite these benefits, many schools still lack curriculum-aligned and contextualized digital worksheets. At SDN 3 Panjerejo, the limited use of interactive media contributes to difficulties in learning geometry, especially in calculating plane area. To address this issue, this study seeks to develop an interactive mathematics E-LKPD using Liveworksheet, tailored to the needs of third-grade students.

B. Problem Formulation

Based on the background outlined above, the problems identified in this study revolve around the gap between the learning needs of students and the available instructional resources, particularly in learning mathematical concepts related to the area of plane figures. The lack of interactive, technology-supported learning media has resulted in low conceptual understanding and student engagement. Therefore, the present study is conducted to address these issues through the development of an interactive E-LKPD.

The formulation of the research problems is as follows:

1. How valid is the interactive E-LKPD on the area of plane figures developed using the Liveworksheet platform according to material and media expert evaluations?
2. How do teachers and students respond to the developed E-LKPD in terms of practicality, usability, and attractiveness?

3. How effective is the developed E-LKPD in supporting students' understanding of the area of plane figures in mathematics learning?

C. Research Objectives

This study aims to develop a digital interactive learning medium in the form of an E-LKPD (Electronic Student Worksheet) for the topic of area of plane figures for third-grade elementary school students, utilizing the Liveworksheet platform to enhance conceptual understanding and engagement.

The specific objectives of this study are:

1. To design and develop an interactive E-LKPD on the area of plane figures that is aligned with the third-grade mathematics curriculum, particularly Basic Competencies (KD) 3.6 and 4.6.
2. To evaluate the validity of the developed E-LKPD based on assessments from subject matter experts, media experts, and classroom practitioners.
3. To measure the practicality of the E-LKPD based on responses from teachers and students during small- and large-scale trials.

To examine the effectiveness of the E-LKPD in improving students' understanding of the concept of area and their active participation during mathematics learning activities.

Through these objectives, the study seeks to contribute a validated and practical digital learning tool that meets the demands of modern pedagogy and supports the implementation of the Merdeka Curriculum and the principles of Society 5.0 in Indonesian primary schools.

D. Benefits of Research

This research provides meaningful contributions in theoretical, practical, and educational aspects. Theoretically, it expands the knowledge base in instructional media development by applying the 4D model in creating interactive digital learning tools. It also reinforces the use of constructivist learning approaches and multimedia learning theory, particularly in helping students understand abstract mathematical topics like the area of plane figures through visual and interactive media.

Practically, the resulting E-LKPD serves as a ready- to-use, valid, and curriculum-based learning tool that enhances the teaching and learning process in mathematics. With features such as interactive tasks and automatic feedback via the Liveworksheet platform, the product improves student engagement, supports independent learning, and simplifies classroom assessment for teachers.

Educationally, this research supports the Merdeka Curriculum's emphasis on student-centered and technology-integrated learning. It also aligns with the goals of Society 5.0 by helping students develop digital literacy, increase motivation, and build confidence in solving mathematical problems in a modern, accessible format.

II. RESEARCH METHOD

A. Research Types and Design

This study is a research and development (R&D) project aimed at producing an interactive E-LKPD for mathematics learning on the topic of plane figure area for third-grade students. The development process uses the 4D model by Thiagarajan, Semmel, and Semmel (1974), which consists of four stages: Define, Design,

Develop, and Disseminate. The study combines quantitative and qualitative descriptive methods. Quantitative data were collected through expert validations and student-teacher questionnaires, while qualitative data were obtained through observations during product trials. This approach ensures that the developed E-LKPD is both theoretically grounded and practically effective for classroom use.

In this research design, the study was carried out by developing a digital learning product using the 4D development model, which includes the stages of Define, Design, Develop, and Disseminate. The focus of the treatment was on the creation and implementation of an Interactive E-LKPD for mathematics, specifically on the topic of area of plane figures for third-grade students.

The E-LKPD was validated by material experts, media experts, and practitioners, and then tested in both small-scale and large-scale trials. The effectiveness of the product was assessed through student and teacher response questionnaires, as well as observations during classroom use. With this process, researchers were able to evaluate the feasibility, practicality, and attractiveness of the developed E-LKPD in supporting the learning process. The design of this study can be illustrated as follows:

Stage	Description	Output
Define	Analyze curriculum, student needs, tasks, and concepts to identify learning problems	Problem formulation, needs analysis, learning goals.
Design	Plan learning objectives, design E-LKPD layout, content structure, and storyboard	Product blueprint, draft E-LKPD, validation tools
Develop	Create the interactive E- LKPD, conduct expert validations, small-scale and large-scale trials	Revised E-LKPD, validation results, student feedback
Disseminate	Implement the final E-LKPD in classroom settings and gather user responses for broader use	Final product, teacher recommendation, conclusion

B. Research Procedures

The research procedures in this study follow the 4D development model consisting of four systematic stages: Define, Design, Develop, and Disseminate.

1. Define

   This stage involved conducting curriculum analysis, student analysis, task analysis, and concept analysis to identify the main problems in the learning process. The results indicated that students had difficulties understanding the concept of area due to abstract materials and lack of engaging media.

2. Design

   In this phase, the learning objectives and indicators were formulated based on the curriculum. A draft of the E-LKPD was designed using Canva with various

tasks, such as multiple-choice, matching, and short answer formats. The worksheet was then converted into an interactive digital format using the Liveworksheet platform.

3. Develop

The initial E-LKPD product was validated by material experts, media experts, and practitioners. After revisions, the product was tested through small-scale trials (5 students) and large-scale field trials (15 students). Data from expert validation and student-teacher feedback were collected and analyzed.

4. Disseminate

The final E-LKPD was implemented in classroom learning and introduced to other teachers for broader use. Recommendations were documented for potential wider application and product improvement.

C. Product Trial

The product trial phase was conducted to evaluate the functionality, clarity, and student response to the developed interactive E-LKPD. After undergoing expert validation and necessary revisions, the product was tested in two stages to ensure its feasibility and effectiveness.

1. Small-Scale Trial

The first trial was carried out with five third-grade students at SDN 3 Panjerejo. This stage focused on identifying technical issues, gauging student engagement, and assessing ease of navigation. Observations showed that students could use the E- LKPD independently and responded positively to the interactive features. Minor improvements were made based on this feedback.

2. Large-Scale Trial

The second stage involved 15 students from the same class, aiming to test the E-LKPD in a more realistic classroom setting. Data were collected through student response questionnaires and teacher feedback sheets. The results indicated a high level of satisfaction among students and positive perceptions from the teacher regarding its practicality, attractiveness, and support for independent learning. The outcomes of both trials confirmed that the E-LKPD was effective in improving student engagement and could be integrated into regular classroom instruction. These trials also provided useful insights for refining the final version of the product before broader implementation.

D. Data Collection Techniques and Instruments

This study employed both quantitative and qualitative data collection techniques to evaluate the validity, practicality, and effectiveness of the developed interactive E-LKPD.

1. Expert Validation Sheets

To assess the content accuracy, media design, and overall quality of the E-LKPD, validation instruments were distributed to three experts: one subject matter expert, one media expert, and one practitioner (class teacher). The validation sheets consisted of Likert-scale items covering criteria such as material relevance, clarity of instructions, interactivity, and alignment with curriculum objectives.

2. Student Response Questionnaire

A structured questionnaire was administered to students during the product trial phase to evaluate their satisfaction, engagement, ease of use, and visual appeal of the E-LKPD. The instrument consisted of multiple indicators measured on a four-point Likert scale, ranging from "Very Good" to "Poor." This provided quantitative data on students' perceptions of the digital learning experience.

3. Teacher Response Sheet

The class teacher involved in the trial was also asked to complete a response form to assess the practicality, classroom integration, and effectiveness of the E-LKPD. This instrument helped capture professional feedback on how well the product supported learning activities and classroom management.

4. Observation Sheet

During both small-scale and large-scale trials, researchers used structured observation sheets to document students' behavior, participation, and interaction with the media. These sheets provided qualitative data to support and enrich the interpretation of questionnaire results, especially regarding usability and engagement levels.

E. Data analysis techniques

The data collected in this study were analyzed using descriptive quantitative and qualitative methods.

1. Quantitative Data Analysis

Validation scores from experts, as well as student and teacher questionnaire responses, were analyzed using percentage calculations. The formula used is as follows:

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

Explanation:
$\bar{x}$ = Average score/percentage score to be found Σ = Total score.
N = Maximum score

The resulting percentages were then interpreted using predefined validity criteria to determine whether the product met the standards of being "Very Valid," "Valid," or "Fairly Valid." This analysis helped assess the feasibility and acceptability of the E-LKPD based on expert and user input.

2. Qualitative Data Analysis

Observational data collected during both the small- and large-scale trials were analyzed descriptively to capture insights about student behavior, engagement, and interaction with the E-LKPD. This qualitative interpretation supported the numerical findings by providing context and deeper understanding of the learning process as it occurred in the classroom.

III. RESEARCH AND DEVELOPMENT RESULTS

A. *Data Presentation, Problem Analysis Results, and Requirements*

1. Initial classroom observations were conducted at SDN 3 Panjerejo, particularly in the third-grade mathematics class, to identify learning challenges related to the topic of area of plane figures. The observations revealed several key issues:
   1) Low Student Engagement: Students appeared passive and less enthusiastic during mathematics lessons, especially when solving problems involving measurement and geometry.
   2) Lack of Interactive Media: Teaching was still largely dependent on traditional printed worksheets (LKPD), which provided limited visual aids and minimal student interaction.
   3) Abstract Learning Difficulties: Many students struggled to grasp abstract mathematical concepts such as calculating area, particularly when formulas were introduced without sufficient visualization or contextual examples.
   4) Limited Independence: Students relied heavily on teacher explanations and found it difficult to complete exercises on their own.

The results of the documentation of students' daily scores show:

Total Students	(≥ KKM)	(< KKM)	Mastery Percentage
15 students	7 students	8 students	46%

2. Interview Results with Classroom Teachers
   Interviews were conducted with the classroom teacher of Grade III at SDN 3 Panjerejo to gain deeper insights into the learning challenges faced by students in understanding the topic of area of plane figures. The teacher conveyed several key points:
   1) Students often struggle to understand the concept of area due to the abstract nature of the material and the lack of visual or interactive media.
   2) Learning materials used in class were mostly in the form of printed worksheets (LKPD), which were considered less engaging for students.
   3) There is a lack of media that supports independent learning, especially for mathematical topics requiring spatial reasoning.
   4) The teacher expressed a strong need for interactive digital tools that could help make the concept of area more concrete, engaging, and understandable.
3. Curriculum and Material Analysis
   Researchers analyzed the curriculum documents and syllabus for third-grade mathematics in accordance with the Merdeka Curriculum and found that the area of flat shapes is an important subject in the Learning Outcomes (CP) for Phase B. This subject cover:
   a) Understanding of flat shapes (squares, rectangles, triangles)
   b) Use of standard and non-standard units
   c) Systematic calculation of area.

   Learning outcomes require students to solve real problems related to area measurement, not just memorize formulas. Therefore, media that can:
   a) Visualizing flat shapes and their areas in concrete terms
   b) Stimulating interactivity (moving images, answering questions with immediate responses)
   c) Providing immediate feedback to enhance independent learning.

   The learning objectives are formulated based on the learning outcomes of the Merdeka Curriculum, namely so that students can:
   a) Explain the concept of area as the number of square units covering a plan.
   b) Use non-standard and standard units to measure area
   c) Calculate the area of squares, rectangles, and triangles correctly
   d) Solve contextual problems involving the area of flat shapes.
4. Character Analysis of Students
   The target users of the E-LKPD were third-grade students at SDN 3 Panjerejo, aged 8–9 years. At this stage, students are concrete thinkers who benefit from visual and interactive media to understand abstract mathematical concepts like area.
   They have a short attention span, making engaging and colorful content essential. Observations and teacher feedback also indicated that students are highly curious, enjoy using digital tools, and need clear guidance with immediate feedback to support independent learning.
   These characteristics were considered in designing the E-LKPD to ensure it was developmentally appropriate, motivating, and easy to use.

B. *Design Stage*

This stage involved systematic planning and preparation to transform identified needs into a concrete prototype of the E-LKPD.

1. Determining Learning Objectives and Indicators
   The learning objectives were aligned with the Merdeka Curriculum and aimed to help students:
   a) Understand the concept of area and its standard units (cm^2 and m^2),
   b) Apply appropriate formulas for calculating the area of plane figures (square, rectangle, triangle),
   c) Solve mathematical problems involving area in real-life contexts,
   d) Learn independently through interactive and visually supportive digital media.

   Indicators of success included the ability to:
   a) Recognize different plane shapes,

b) Choose and apply area formulas correctly,
c) Interpret and complete tasks using digital tools independently

2. Product Planning and Storyboarding

A storyboard was created to guide the layout and sequence of the content. The E-LKPD was designed to include:

a. Interactive tasks, such as drag-and-drop, multiple choice, and matching activities,
b. Illustrations and diagrams to support visual learning,
c. Step-by-step guidance for each sub-topic.

Design tools such as Canva were used to ensure visual consistency and student-friendly interfaces. All elements were arranged to encourage exploration and minimize cognitive overload.

3. Platform Selection: Liveworksheet

The worksheet was uploaded and configured on Liveworksheet, an online platform that supports:

a. Real-time feedback,
b. Audio and image embedding,
c. Auto-grading for multiple choice and text entry questions,
d. Accessibility via computers, tablets, and mobile phones.

This platform was selected for its ease of use, interactive capabilities, and compatibility with classroom devices.

4. Development of Evaluation Instruments

Several instruments were prepared to support product evaluation:

a. Material expert validation sheet: to assess the relevance and accuracy of content
b. Media expert validation sheet: to review interface design and functionality,
c. Practitioner validation sheet: to evaluate usability and integration into teaching,
d. Student and teacher response questionnaires: to capture perceptions and experiences using Likert-scale items.

5. Develop Stage

This stage focused on developing, validating, revising, and testing the prototype.

a. Expert Validation

The initial E-LKPD prototype was evaluated by:

1) A material expert (curriculum content and accuracy),
2) A media expert (digital design and interactivity),
3) A third-grade teacher (classroom integration and ease of use).

Validator	Max Score	Score Obtained	Percentage	Interpretation
Material Expert	36	34	94%	Very Valid
Media Expert	36	35	97%	Very Valid
Practitioner (Teacher)	40	37	92,5%	Very Valid

All validators rated the product as "Very Valid". They provided suggestions such as simplifying task instructions, improving layout readability, and checking technical links.

b. Revision Based on Feedback

Following expert input, several revisions were made:

1) Enlarged fonts for readability,
2) Adjusted spacing and image-text alignment,
3) Refined task instructions for clarity,
4) Fixed broken hyperlinks and interactive button errors.

c. Small-Scale Trial

The revised E-LKPD was tested on 5 students. The goal was to evaluate usability, clarity, and interest.

Total Items	Max Score	Score Obtained	Percentage	Category
15	75	72	96,6%	Very Good

The students found the media enjoyable, visually appealing, and helpful in understanding the material.

d. Field Trial (Large-Scale)

The E-LKPD was then trialed in a real classroom with 15 students. After completing the worksheet, students filled out a 12-item response questionnaire.

Total Items	Max Score	Score Obtained	Percentage	Category
12	180	176	97,7%	Very Good

Students reported that the worksheet helped them understand the topic better, was fun to use, and easy to navigate.

e. Teacher Response

The class teacher assessed the practicality of the product using a 12-item instrument.

1) Score: 43.75 out of 48
2) Percentage: 91.16%
3) Interpretation: Very Valid

The teacher noted improvements in student autonomy, focus, and comprehension when using the E-LKPD.

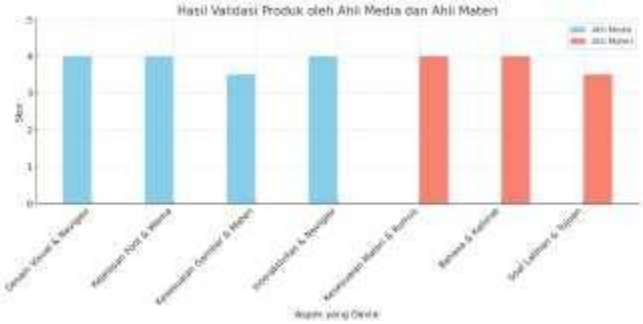

Figure Bar Chart of Product Validation Results

6. Disseminate Stage
   The final stage of development involved disseminating the E-LKPD for broader use.
   a. Distribution and Promotion
      1) The final version of the E-LKPD was presented in a local teacher workshop involving educators from nearby elementary schools.
      2) A Liveworksheet access link and QR Code were distributed.
      3) Colleagues were encouraged to try the product and provide feedback.
   b. Feedback from Fellow Teachers
      Informal feedback was collected via interviews and written notes. Teachers highlighted:
      1) The worksheet's ease of use and clarity,
      2) Its alignment with curriculum goals,
      3) The potential for use as both a teaching tool and a homework alternative.
   c. Impact and Potential Adoption
      The E-LKPD demonstrated the potential to be scaled across other elementary schools. It offered a model for integrating technology into curriculum delivery in ways that are engaging, independent, and teacher-friendly.

IV. CONLCUSION AND SUGGESTIONS

A. Conclusion

This study focused on developing an interactive electronic student worksheet (E-LKPD) on the topic of plane area, aimed at supporting the conceptual understanding of third-grade students at SDN 3 Panjerejo. The development process followed the 4D model (Define, Design, Develop, Disseminate) proposed by Thiagarajan, Semmel, and Semmel (1974) (cited in Sugiyono, 2015), which provides a structured and iterative approach to designing educational products grounded in real classroom needs.

At the Define stage, preliminary observations showed that only 46% of students reached the Minimum Mastery Criteria (KKM), indicating a significant gap in conceptual understanding. Interviews with teachers further confirmed that students often found it difficult to grasp abstract mathematical material and required instructional tools that were more visual, interactive, and stimulating [8; 9]. These findings formed the basis for designing a digital learning product that enhances visualization and encourages independent learning.

At the Design stage, learning objectives and indicators were formulated in alignment with the Kurikulum Merdeka (Kemendikbud, 2022). Storyboards were developed, and the E-LKPD was constructed using Canva, incorporating colorful visuals, interactive tasks, and an accessible layout. The worksheets were then published through the Liveworksheet platform, which enables real-time feedback, multimedia support, and cross-device accessibility. Evaluation instruments for expert and user validation were also designed at this stage.

At the Develop stage, the E-LKPD was validated by material experts, media experts, and practitioners (teachers). The validation results demonstrated very high validity, with scores of 94%, 97%, and 92.5%, respectively. After revisions based on expert feedback, the product was tested in a limited trial with five students, yielding a positive response of 96.6%, and in a field trial with 15 students, producing a satisfaction score of 97.7%. Teachers also gave a positive evaluation with a score of 91.16%, confirming the practicality and effectiveness of the product in classroom use [10; 11; 12].

At the Disseminate stage, the E-LKPD was shared with other educators through informal workshops and teaching forums. The positive reception from fellow teachers highlighted the product's potential for broader implementation. They appreciated its clarity, interactivity, alignment with learning objectives, and suitability for digital learning environments.

In conclusion, the developed E-LKPD proved to be valid, practical, and effective in improving students' understanding of plane area. Moreover, the E-LKPD encouraged independent learning, enhanced engagement, and aligned with the objectives of the Kurikulum Merdeka and the spirit of Society 5.0, which emphasizes the integration of technology into the learning process (Astuti, 2021; Nurdin, 2022).

B. Suggestions

1. For Teachers: Integrate digital tools like E-LKPD to enhance engagement and comprehension, especially for abstract content.
2. For Students: Use E-LKPDs regularly to develop independence and digital skills.
3. For Future Researchers: Expand the product to other subjects and enhance features like audio support or gamification.

For Stakeholders: Support digital integration through infrastructure, training, and policy alignment to promote innovative learning environments.

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