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DEVELOPMENT OF E-LKPD BASED ON PROBLEM BASED LEARNING (PBL) ON SEQUENCES AND SERIES FOR GRADE X

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Abstract

This study was conducted in response to the fact that the teaching materials used in mathematics instruction at SMA Negeri 1 Sitiung have not yet fully addressed students' learning needs. The objective of this research is to develop a valid E-LKPD (Electronic Student Worksheet) based on Problem-Based Learning (PBL) for the topic of sequences and series in grade X. This study employs a Research and Development (R&D) approach, utilizing the Plomp development model. The validation results of the PBL-based E-LKPD obtained a score of 89.8%, categorized as very valid. These findings indicate that the PBL-based E-LKPD for the sequences and series material in grade X at SMA Negeri 1 Sitiung is valid and suitable for use by both teachers and students during the learning process.
Keywords : E-LKPD, Problem Based Learning, Sequences and Series

INTRODUCTION

Mathematics plays a crucial role in various aspects of daily life, as almost all human activities directly or indirectly involve the application of mathematical concepts. According to Savitri (2017), mathematics is considered a fundamental science that serves not only as the basis for logical, systematic, and critical thinking, but also for the development of other disciplines. This is supported by the findings of Rahma and Rahaju (2020), who emphasize the important role of mathematics in the development of science and technology, as the development of various applied fields such as physics, chemistry, economics, and information technology is inextricably linked to the application of mathematical principles. Therefore, mathematics education in schools not only aims at mastering formulas and calculation procedures but also aims to enable students to relate the learned concepts to real-life situations in their everyday lives. Amanda and Haryono (2024) point out that this approach enables students to connect formal knowledge acquired in class with real-world contexts and interdisciplinary knowledge. This makes mathematics a truly applicable and relevant thinking tool that promotes the development of problem-solving and decision-making skills. One of the main goals of learning mathematics is to develop problem-solving skills.

Problem-solving is one of the main goals of mathematics learning. Through this skill, students must not only master theoretical concepts but also be trained to apply their knowledge in addressing various complex real-world problems (Siswanto and Meiliasari, 2024). In the context of mathematics education, the mathematical reasoning process includes five standard skills that serve as a measure of success, including problem-solving, which is considered the core of mathematics learning (Zulmaulida et al.,

2021). The low level of students' problem-solving skills has serious consequences for the quality of future human resources, as the quality of critical, creative, and adaptive thinking that enables them to address global challenges is also largely determined by these skills. This fact is reflected in the research of Delyana et al. (2018), which shows that the low level of students' problem-solving skills has a direct impact on the quality of human resources, both academically and in terms of higher-order thinking skills. The main reason for this limited capacity is that learning methods in schools have so far tended to focus on teaching material and memorizing procedures. This leaves students with little room to develop critical thinking and problem-solving skills (Hulu et al., 2024). Research by Yusri et al. (2019) and Rahmawati et al. (2020) confirms that learning with minimal opportunities to improve problem-solving skills makes it difficult for students to gain meaningful learning experiences. They are therefore not trained to tackle non-routine and context-specific problems, which should be part of developing mathematical skills today.

Observations at Sitiung 1 Public High School from January 13 to 17, 2025, revealed that the curriculum was already based on the self-directed program. In this program, students are encouraged to actively participate in the learning process. However, the teaching and learning process often remains teacher-centered, which prevents students from learning completely independently and developing optimal problem-solving skills. Textbooks are used as teaching materials, but these are not yet tailored to students' needs and do not introduce them to contextual problems.

Given these existing problems, efforts to overcome them include the development of instructional materials tailored to students' needs. Current technological advances and the ease with which students can access the internet mean that the teaching materials that researchers focus on are in the form of LKPD that are packaged electronically or often referred to as E-LKPD. E-LKPD are an electronic version of LKPD that were originally printed but designed in digital format (Suryaningsih and Nurlita, 2021). These materials were developed to facilitate independent and collaborative learning for students through a more engaging and interactive presentation (Limbong et al., 2022). E-LKPD are a form of presentation of instructional materials that are sequentially organized into learning units presented in electronic format and include material, images, animations, and videos (Maharani and Hakim, 2022).

Furthermore, to improve students' problem-solving skills, appropriate learning methods such as the problem-based learning (PBL) model are required (Azura et al., 2024). Problem-based learning (PBL) is a learning model consistent with the cognitive approach because it uses real-world problems as a context in which students actively learn, develop critical thinking, and develop intellectual skills for mathematical problem-solving (Darwati & Purana, 2021). Problem-based learning (PBL) can also help students actively learn through solving problems, thus improving their problem-solving skills (Cannavaro et al. 2024). Arends emphasized that problem-based learning (PBL) is designed to help students develop their thinking, problem-solving, and intellectual skills (Cahyani and Setyawati, 2016). The following are the learning steps using the problem-based learning model proposed by Putra (Firdaus et al. 2021) namely: (1) orienting students to problems, (2) organizing students' learning, (3) guiding individual and group investigations, (4) developing and presenting work products, (5) analyzing and evaluating the problem-solving process.

Based on the above description, a study entitled “Development of E-

LKPD based on Problem-Based Learning (PBL) using Sequence and Serial Materials for Grade X of SMA Negeri 1 Sitiung" was conducted

METHOD

This study employs a Research and Development (R&D) approach. The R&D method is utilized to design, develop, and evaluate a product to determine its effectiveness. (Sudaryono, 2017). In this study, validation tests were carried out on the products developed as shown in Table 1 below:

Table 1. Validation Procedure

No		Validation Procedure	Activity
1		Expert Review	Materials Expert 1
			Materials Expert 2
			Media Expert

Source: Researcher's Modification adapted by Tjeerd Plomp, 2010 (Hafis 2012:93)

An expert review was conducted to gather assessments and suggestions for the developed E-LKPD. Validation activities included discussions and obtaining expert reviews through the completion of the E-LKPD validation form. This form included assessments of the completeness of the E-LKPD's content components, language, presentation, appearance, and usability. Validation was performed by three validators: two mathematics experts and one technology expert. The E-LKPD was revised as necessary. Following these changes, the validators provided an assessment. The e-LKPD was thus declared valid.

The data in this study were analyzed using a validation technique. The results of the validity assessment of the problem-based E-LKPD, as evaluated by the validators across all aspects, are displayed in a table presenting the outcomes of the validity analysis.

The results of E-LKPD validation were analyzed according to the following steps:

a. Evaluate each validated item using the following rating scale:

Table 2. Rating scale for validation items

Alternative Response	Rating
Strongly agree	4
Agree	3
Undecided	2
Disagree	1
Strongly disagree	0

Source: Modified (Riduwan, 2019)

Calculating the level of validation.

Validation score

$$= \frac{\textbf{\textit{Total Score}}}{\textbf{\textit{Maximum score}}} \times 100\%$$

To measure the validity of the product developed in this study, the percentages in the following table are interpreted.

Table 3. E-LKPD validation criteria

Percentage	Category
80<NV≤100	Very Valid
60<NV≤80	Valid
40<NV≤60	Fairly Valid
20<NV≤40	Invalid
0≤NV≤20	Very Invalid

Source: Modified from (Riduwan, 2019)

RESEARCH RESULTS

The data presented in this section are from the data collection conducted during the development of the E-LKPD based on problem-based learning with a focus on series and sequences for Class X SMA Negeri 1 Sitiung. The data are classified according to their type and the development stage of the Plomp model. Based on the results of this research, the validity of the E-LKPD based on problem-based learning with a focus on series and sequences was verified by two materials experts and one media expert. The validation results by the three validators are presented in the following table:

Table 4. E-LKPD Validation Results

Assessment Aspects	Validator(%)			Final Score (%)	Category
	1	2	3		
Content Appropriateness	93,8	100		96,9	Very Valid
Presentation Appropriateness	100	91,7		95,8	Very Valid
Language Appropriateness	87,5	100		91,6	Very Valid
Appearance			81,3	81,3	Very Valid
Ease of Use			83,3	83,3	Very Valid
Final Score Validation				**89,8**	**Very Valid**

The table above shows that the content validation achieved a final score of 96.9% (highly valid). The validation results demonstrate that the content of the E-LKPD corresponds to the acquired skills. Regarding presentational usability, the final score of 95.8% (highly valid) indicates a systematically structured presentation. Regarding linguistic usability, the final score of 91.6% (highly valid) indicates linguistic compliance with Indonesian rules. Regarding appearance, the final score of 81.3% (highly valid) indicates an appealing presentation. Regarding usability, the final score of 83.3% (highly valid) indicates the ease of use of the E-LKPD.

The validity of the E-LKPD is assessed using materials and a material validation questionnaire. The E-LKPD, which is based on problem-based learning, designed using a storyboard, and self-assessed, then entered the validation phase, which aims to test its validity. The validity of the E-LKPD is assessed using materials and a material validation questionnaire. According to Ayunda et al. (2023), the product validity test of the E-LKPD achieved satisfactory results using a validity measurement questionnaire. This questionnaire describes the product to be developed to create a valid E-LKPD. The material validation questionnaire is evaluated based on several

criteria: content feasibility, presentation feasibility, and language feasibility. The material validation questionnaire is evaluated based on appearance, usability, and language feasibility.

The content feasibility assessment received an overall rating of "very good." The validation results show that the content of the E-LKPD is comprehensive and consistent with the desired learning objectives, is systematically structured, the problem-solving involves problem-based learning, and the questions are relevant. The presentational feasibility assessment received an overall rating of "very good." The learning objectives are clearly presented, the concepts of the E-LKPD are clearly presented, and the practice presentations correspond to the content. The linguistic feasibility assessment received an overall rating of "very good." The language used in the E-LKPD conforms to the rules of the Indonesian language, the language used in the learning materials is easy to understand and appropriate to the students' comprehension level, and the writing rules of the E-LKPD conform to the rules of the Indonesian language. The overall rating for the design was "very good." The presentation of the E-LKPD is appealing, the design is harmonious, the presentation is simple, and the images are appealing. In terms of usability, the final validation result was rated "very satisfactory." The validation results show that the operating instructions of the E-LKPD are clear and the developed E-LKPD is easy and convenient to use.

The overall validation score of the problem-based learning aspects of E-LKPD for sequences and series reached a final value of 89.8%, indicating that E-LKPD is valid and worth testing.

CONCLUSION

Based on the research results and data analysis, it can be concluded that the Problem-Based Learning-based E-LKPD for sequences and series is categorized as very valid with a percentage of 89.8% and is suitable for use by educators and students in the learning process. This research was conducted only at the validation stage. For other researchers, the PBL-based e-LKPD development research on sequences and series can serve as a new reference and be further tested until its effectiveness is more thoroughly proven.

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