EMTEKA: Jurnal Pendidikan Matematika
Volume 6, No. 1, 2025. 330-341
DOI: https://doi.org/10.24127/emteka.v6i1.6957

e-ISSN 2746-5594
p-ISSN 2746-5608

DEVELOPMENT OF PROBLEM-BASED LEARNING E-LKPD ON LOGARITHMIC MATERIAL FOR TENTH GRADE STUDENTS OF SMAN 1 KUANTAN MUDIK

Noni Ramadanti[1], Anna Cesaria2*, Zulfitri Aima[3]

[1,2*,3]Universitas PGRI Sumatera Barat, Padang, Indonesia
*Corresponding author Department of Mathematics Education, PGRI University of West Sumatra, 25137

E-mail: ramadhantinoni@gmail.com[1]
annacesaria@upgrisba.ac.id [2*]
zulfitriaima@upgrisba.ac.id[3]

Received February 08, 2025; Received in revised form March 15, 2025; Accepted March 24, 2025

ABSTRACT
This research is a Research and Development study aimed at producing a product in the form of a Problem-Based Learning-based E-Worksheet (E-LKPD) on logarithmic material that is both valid and practical. The development model used is the Plomp model, which consists of three stages: 1. Preliminary research, 2. Prototyping phase, and 3. Assessment phase. The research method employed is a combination of quantitative and qualitative approaches. The study involved 12 tenth-grade students as samples, divided into four groups: one group for one-on-one testing and three small groups, each consisting of three students. This research was conducted at SMAN 1 Kuantan Mudik. Based on the validity test results, a final score of 83.33% was obtained, categorized as very valid. The practicality results from educators yielded a final score of 90%, also categorized as very practical. The one-on-one evaluation with three students resulted in a final score of 91.67%, indicating very practical. Similarly, the small group evaluation with nine students achieved a final score of 91.67%, categorized as very practical. These findings demonstrate that the developed E-Worksheet is suitable for use as teaching material in the learning process. The implication of this research is that the development of a valid and practical E-Worksheet can serve as an effective alternative teaching material to enhance student learning outcomes.
Keywords: e-lkpd; plomp model; problem based learning.

ABSTRAK
Penelitian ini merupakan penelitian pengembangan (Research and Development) yang bertujuan untuk menghasilkan produk berupa E-LKPD berbasis Problem Based Learning pada materi logaritma yang valid dan praktis. Model pengembangan yang digunakan adalah model Plomp yang terdiri atas tiga tahapan yaitu :1. Preliminary research, 2. Prototyping phase, dan 3. Assessment phase). Metode penelitian yang digunakan adalah metode kuantitatif dan kualitatif. Penelitian ini melibatkan 12 peserta didik kelas X sebagai sampel, yang terbagi menjadi empat kelompok, yaitu satu kelompok uji satu-satu dan tiga kelompok kecil, dengan beranggotakan tiga siswa tiap kelompok. Penelitian ini dilaksanakan di SMAN 1 Kuantan Mudik.Berdasarkan hasil uji validitas, diperoleh nilai akhir 83,33% dengan kriteria sangat valid. Hasil kepraktisan dengan pendidik memperoleh nilai akhir 90% dengan kriteria sangat praktis. Hasil evaluasi satu-satu dengan tiga peserta didik memperoleh nilai akhir 91,67% dengan kriteria sangat praktis. Sedangkan hasil evaluasi kelompok kecil kepada sembilan peserta didik memperoleh nilai akhir 91,67% dengan kategori sangat prajtis. Hal ini menunjukkan bahwa E-LKPD yang dikembangkan layak digunakan sebagai bahan ajar dalam proses pembelajaran. implikasi dari penelitian ini adalah pengembangan E-LKPD yang valid dan praktis dapat menjadi alternative bahan ajar yang efektif untuk meningkatkan hasil belajar siswa.
***Kata kunci**: e-lkpd; model plomp; problem based learning.*

e-ISSN 2746-5594
p-ISSN 2746-5608

Introduction

The Independent Curriculum has driven educational transformation in Indonesia, particularly in efforts to create more personalized learning tailored to the needs of each student. A key characteristic of the Independent Curriculum is that it empowers students to manage their learning, aiming to foster a sense of responsibility. However, in practice, many educators and students still lack a comprehensive understanding of the curriculum's core principles (Lestari, Asbari, & Yani, 2023). By implementing a differentiated learning approach, it is anticipated that learning gaps can be minimized, ensuring all students have equitable opportunities for development, especially in mathematics (Ryan & Bowman, 2022).

As a fundamental science, mathematics plays a crucial role in shaping the quality of human resources. The Independent Curriculum offers educators the opportunity to design more effective and student-centered mathematics instruction, thereby enhancing the overall quality of education (Subaidah, 2020). Mathematics extends beyond numbers and formulas; it is a powerful tool for developing systematic and rational thinking. These skills are invaluable across various aspects of life (Larama, Cesaria, & Yusri, 2023). Indeed, structured mathematics education begins as early as kindergarten, and mathematics is a vital component of the elementary education curriculum (Syar, Husniati, & Kristiawati, 2023).

Observations and interviews conducted by researchers with Mathematics teachers in class X of SMAN 1 Kuantan Mudik revealed that the teachers have not optimally implemented technology in learning media and primarily rely on printed books for providing student worksheets (LKPD). The use of printed books, limited to one-way communication, impedes students' thought processes and concept formation, leading to difficulties in understanding the material (Nurwijayanti & Sulisworo, 2022). Furthermore, learning remains teacher-centered, as many students struggle to grasp logarithms and tend to be passive during instruction (Hakim, Haling, Mawarni, & Aswan, 2023). The discrepancy between the intended mathematics learning objectives and the actual outcomes indicates that current teaching methods are less effective (Ramadan, 2021). This gap highlights the necessity for innovation in mathematics education (Rahmawati, Hidayati, Febriyani, & Ferryka, 2024). The Merdeka Curriculum enhances learning tools by integrating technology, such as the Merdeka platform, into the teaching and learning process. While the fundamental components are similar to the previous curriculum, the integration of technology is a defining characteristic of the Merdeka Curriculum (Soleh & Arifin, 2021).

Interviews with grade X students at SMAN 1 Kuantan Mudik revealed that mathematics learning is often perceived as boring due to educators' reliance on practice questions as the sole learning medium. Students expressed a need for more innovative and engaging teaching materials to enhance their comprehension of mathematical concepts. Therefore, educators must strive to provide diverse teaching materials that align with students' interests and levels of understanding.

In an effort to improve students' understanding, educators have attempted to implement Problem-Based Learning (PBL) and utilize printed books as guides. Through these books, students receive assignments in the form of Student

e-ISSN 2746-5594
p-ISSN 2746-5608

Worksheets (LKPD). However, educators acknowledge the difficulty in providing more varied teaching materials and optimally supporting PBL implementation. The lack of innovation in learning often leads to passive and monotonous learning, centered on the educator's explanation, while students tend to listen and take notes (Amnur & Yerizon, 2017).

The use of media in the learning process plays a crucial role in clarifying complex messages, overcoming spatial and temporal limitations, and stimulating students' learning enthusiasm (Masdar & Lestari, 2021). Furthermore, well-designed learning media can enhance interaction between teachers and students, thereby making the teaching and learning process more effective and efficient (Mawaddah & Siswanto, 2022). To ensure optimal learning outcomes, teachers must design learning meticulously and assess student achievement effectively (Jalal, Muhsinin, & Suryaningsih, 2021).

LKPD has become an integral component of mathematics education. With technological advancements, LKPD is no longer limited to printed formats. The incorporation of visual elements in learning media can significantly improve student learning achievement (Sahila Disti Safira El Tsani & Retno Mustika Dewi, 2024). E-LKPD emerges as a more modern and interactive alternative (Hayati & Budiyono, 2018). In the digital age, the use of E-LKPD is increasingly relevant as an adaptation to the demands of technology-integrated learning (Syafitri, Cesaria, & Juwita, 2023).

Moreover, E-LKPD offers the advantage of presenting learning materials more engagingly through the use of photos and videos. These interactive features enhance student engagement in the learning process (Kosasih, Sabila, & Saefuloh, 2022). Consequently, E-LKPD should be integrated with a learning model that fosters student involvement (Aisy & Khaerunnisa, 2024). Effective learning involves active participation, not passive knowledge absorption. Through guided activities, students can develop competencies and gain valuable problem-solving experience, often facilitated through collaboration with classmates (Abdillah & Astuti, 2021; Agustina & Vahlia, 2017).

PBL is an instructional method that challenges students to "learn to learn," working collaboratively in groups to solve real-world problems (Sugianto & Qohar, 2020). These problems are used to connect students' curiosity, analytical skills, and initiative with learning materials. PBL prepares students to think critically and analytically, and to identify and utilize appropriate learning resources (Nurwijayanti & Sulisworo, 2022). Given the challenges in making mathematics more engaging and relevant, PBL presents a promising alternative, where students learn through problem exploration and collaboration (Roza, Lufri, & Asrizal, 2023).

Previous research has demonstrated that the use of interactive learning media, such as E-LKPD, can enhance educator roles, promote student activity, facilitate knowledge acquisition, develop manual skills and creativity, and simplify lesson application in the classroom (Nurwijayanti & Sulisworo, 2022). However, most of these studies focus on concrete materials, while research on E-LKPD development for abstract materials, such as logarithms, remains limited (Hayati & Budiyono, 2018). Additionally, the application of the Problem-Based Learning model has been proven to improve student learning engagement (Abdillah & Astuti, 2021).

e-ISSN 2746-5594
p-ISSN 2746-5608

E-LKPD based on Problem-Based Learning offers several advantages, including the use of multimedia such as images, animations, and videos to facilitate the visualization and comprehension of logarithmic material (Maika & Tasman, 2024). Furthermore, the problems presented in E-LKPD are designed to relate to real-world situations, enabling students to see the direct application of logarithmic concepts in everyday life. Therefore, this study aims to produce a valid and practical E-LKPD product based on Problem-Based Learning for logarithm material.

Research Methods

This research employs a Research and Development (R&D) methodology. The development model utilized is based on Syamil, Vahlia & Sudarman (2024) in Branch, encompassing three distinct phases: preliminary research, the prototyping phase, and the assessment phase. The subjects of this study were 12 students from class X at SMAN 1 Kuantan Mudik, selected through purposive sampling. These students were divided into heterogeneous groups of three, based on the results of an initial diagnostic test that assessed their mathematical academic abilities. The rationale for selecting class X students as research subjects lies in their position at the early stage of high school education, where a solid understanding of fundamental mathematical concepts is crucial for subsequent academic success. The object of this study is the development of an Electronic Student Worksheet (E-LKPD) for Logarithm material, designed using a problem-based learning approach for grade X high school students. Data analysis included validity testing and practicality testing.

During the media validation stage, a validity sheet was used as the measurement instrument. This sheet comprised assessments from both material experts and media experts. Measured indicators included the attractiveness and relevance of the visual design, the clarity and comprehensibility of the language used, the ease of navigation and media usage, and the overall quality of the media. The collected validation data was then tabulated. The percentage for each aspect was calculated using the following formula:

$$\text{Validation Value (NV)} = \frac{skor\ yang\ diperoleh}{skor\ maksimal} \times 100\% \ldots\ldots\ldots \quad (1)$$

Based on the percentage results, each aspect can be categorized in Table 1.

Table 1. Validity criteria

Intervals (%)	Category
$80 < NV \leq 100$	Very Valid
$60 < NV \leq 80$	Valid
$40 < NV \leq 60$	Quite Valid
$20 < NV \leq 40$	Invalid
$0 \leq NV \leq 20$	Totally Invalid

EMTEKA: Jurnal Pendidikan Matematika
Volume 6, No. 1, 2025. 330-341
DOI: https://doi.org/10.24127/emteka.v6i1.6957
e-ISSN 2746-5594
p-ISSN 2746-5608

EMTEKA: Jurnal Pendidikan Matematika
Volume 6, No. 1, 2025. 330-341
DOI: https://doi.org/10.24127/emteka.v6i1.6957
e-ISSN 2746-5594
p-ISSN 2746-5608

Table 1 presents the validity criteria, categorizing the percentage results into five levels, ranging from "very invalid" to "very valid". These criteria are used to evaluate the validity of the developed PBL based E-LKPD, based on the percentages obtained from each assessed aspect.

Next, the practicality test analysis aims to ensure the E-LKPD's practicality, ease of use, and suitability for student needs through one-on-one and small group evaluations. The instrument used is a practicality sheet, which serves as a measuring tool for the developed E-LKPD's practicality. The practicality sheet comprises separate sheets for educators and students. The measured indicators include the clarity of instructions for using the instrument, ease of understanding questions or assignments, time efficiency in using the instrument, and the ease with which teachers can integrate the instrument into learning activities.

The collected practicality data is then tabulated. The percentage for each aspect is calculated using the following formula:

$$Nilai\ Praltikalitas\ (NP) = \frac{Jumlah\ Semua\ Skor}{Skor\ Maksimal} \times 100\ \%\ldots\ldots\ldots \quad (2)$$

Based on the percentage results, each aspect can be categorized in Table 2.

Table 2. Practicality criteria

Intervals (%)	Category
$80 < NV \leq 100$	Very Practical
$60 < NV \leq 80$	Practical
$40 < NV \leq 60$	Quite Practical
$20 < NV \leq 40$	Not Practical
$0 \leq NV \leq 20$	Very Impractical

Table 2 presents the practicality criteria by categorizing the percentage results into five levels, ranging from "very impractical" to "very practical." These criteria are used to evaluate the practicality of the developed PBL-based E-LKPD, based on the percentages obtained from each assessed aspect.

Results and Discussion

The results of this study are an E-LKPD (Electronic Student Worksheet) based on Problem-Based Learning, which was subsequently tested for validity using a questionnaire on material and media validity. The validation was conducted by lecturers and teachers who are experts in the field. This research employed a Plomp development model, comprising three stages: (1) Preliminary Research; (2) Prototyping Phase; and (3) Assessment Phase.

Preliminary Research.

At this stage, researchers conducted various activities to gather relevant and foundational information as a basis for product design. The primary objective of this stage was to gain a deep understanding of the learning context, learner needs, and the characteristics of the material to be taught. The analysis performed included needs analysis, curriculum analysis, and learner characteristic analysis.

EMTEKA: Jurnal Pendidikan Matematika
Volume 6, No. 1, 2025. 330-341
DOI: https://doi.org/10.24127/emteka.v6i1.6957
e-ISSN 2746-5594
p-ISSN 2746-5608

The curriculum analysis revealed that to support active learning, students of SMAN 1 Kuantan Mudik generally require improvement in their digital literacy skills, as indicated by the student needs analysis. Furthermore, many students struggle to comprehend abstract concepts, particularly concerning logarithm material. Additionally, a significant disparity exists in the level of student understanding. Therefore, alternative teaching materials that accommodate diverse student ability levels are necessary. One such example is an E-LKPD, which can be accessed by most students through technology.

The curriculum analysis also demonstrated that SMAN 1 Kuantan Mudik has made substantial progress in implementing the Merdeka Curriculum. The presented learning materials are supported by adequate learning resources and align with students' needs. However, to achieve enhanced outcomes, greater efforts are needed to improve student engagement. This can be accomplished by actively involving students in the learning process and utilizing technology, such as E-LKPD, to refine teaching methodologies. Consequently, SMAN 1 Kuantan Mudik possesses the capacity to continuously elevate the quality of education.

The analysis of student characteristics indicated that a majority of students at SMAN 1 Kuantan Mudik perceive the concept of logarithms as having complex and confusing formulas, which hinders their ability to solve logarithm problems. Moreover, student confidence levels in learning mathematics vary considerably. While some students feel relatively confident, others experience a complete lack of confidence. An E-LKPD can be designed to facilitate collaborative learning, enabling students to learn from each other and share knowledge.

Prototyping Phase

The activities carried out at this stage involve designing the systematics and structure of a Problem-Based Learning (PBL) worksheet (LKPD) on logarithm material. The draft of this LKPD includes the title, learning outcomes, instructions for use, material descriptions, practice questions, and assessments. The material discussed is developed in accordance with the characteristics and stages of Problem-Based Learning (PBL). The presentation of the Problem-Based Learning (PBL) e-worksheet on logarithm material begins with a title page and instructions for use, where students are invited to understand real-life problems involving logarithms. This e-worksheet is designed to facilitate students' understanding of the concept of logarithms through a contextual problem-solving approach. The product are shown in Figure 1-8.

Figure 1. Cover View

Figure 2. Display of the foreword

EMTEKA: Jurnal Pendidikan Matematika
Volume 6, No. 1, 2025. 330-341
DOI: https://doi.org/10.24127/emteka.v6i1.6957
e-ISSN 2746-5594
p-ISSN 2746-5608

Figure 3. Standard curriculum view

Figure 4. Display of instructions for use

Figure 5. Problem View

Figure 6. Identifying Problems View

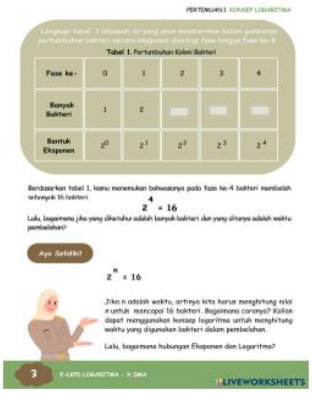

Figure 7. Completion Activity Screenshot

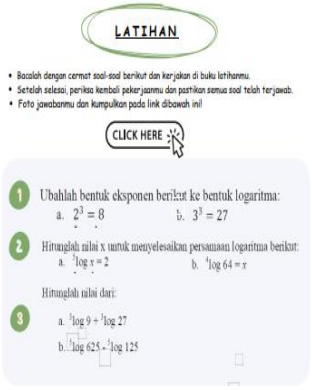

Figure 8. Exercise View

From the series of images above, it is evident that this learning process is structured, with students guided to identify information, formulate questions, plan problem-solving strategies, implement the strategies, and ultimately reflect on the process and draw conclusions. Overall, this E-LKPD is designed to make learning logarithms more relevant and meaningful for students.

The developed E-LKPD underwent validation by material experts and learning media experts. The validity test of the E-LKPD was conducted by two mathematics subject experts, Mrs. Yulia Haryono, S.Si., M.Pd., a Lecturer in Mathematics Education at the University of PGRI West Sumatra, and Mr. Drs.

e-ISSN 2746-5594
p-ISSN 2746-5608

Delfair, M.Pd., a senior educator at SMAN 1 Kuantan Mudik, as well as one learning media expert, Mrs. Rahayu Trisetyowati Untari, M.Kom., a Lecturer in Information Technology at the University of PGRI West Sumatra. The percentage obtained from the results of the validation sheet can be seen in Table 3.

Table 3. Validity Test Results

Assessment Aspects	Final score			Category
	Subject Matter Expert 1	Subject Matter Expert 2	Media Expert	
Content suitability	87.5%		-	Very valid
Presentation eligibility	87.5%		-	Very valid
Language eligibility	87.5%		75%	Very valid
Appearance	-		75%	Valid
User convenience	-		75%	Valid
Validator Final Value	**87.5%**		**75%**	**Very valid**
Final Validation Value	**83.33%**			**Very valid**

Table 3 presents the results of the validity test, which was conducted to ensure the accuracy and relevance of the data collected for this study. Based on expert validation, the final value obtained was 83.33%, placing it in the 'very valid' category. Therefore, it can be concluded that the Problem-Based Learning (PBL) E-LKPD demonstrates overall good quality and is suitable for use. The PBL E-LKPD was assessed across various aspects, including content appropriateness, presentation, language, appearance, and usability.

Assessment Phase

At this stage, a practicality test is carried out with two evaluations, namely one-on-one evaluation and small group evaluation.

a. One-on-one evaluation

At this stage, an evaluation of the practicality of the E-LKPD that has been developed was conducted on an educator and three students with different cognitive levels who already have an initial understanding of the logarithm material. After use, the educator and three students were asked to fill out a practicality questionnaire to provide a practicality assessment. The results of the one-on-one evaluation of mathematics educators can be seen in Table 4.

Table 4. Results of one-on-one evaluation of educators

Assessment Aspects	Final score	Category
Ease of Use	85%	Very Practical
Learning Time Efficiency	100%	Very Practical
Benefits Obtained	90%	Very Practical
Final Practicality Grade	**91.07%**	**Very Practical**

Based on Table 4, it can be seen that the practicality of E-LKPD based on Problem Based Learning by mathematics educators obtained a final value of

e-ISSN 2746-5594
p-ISSN 2746-5608

91.07% with a very practical category and is suitable for use by students for learning logarithms. Then for one-on-one evaluation to students can be seen in Table 5.

Table 5. Results of one-on-one evaluation of students

Assessment Aspects	Final score	Category
Ease of Use	91.67%	Very Practical
Learning Time Efficiency	89.58%	Very Practical
Benefits Obtained	93.75%	Very Practical
Final Practicality Grade	**91.67%**	**Very Practical**

Based on Table 6, the small group evaluation results indicate that the developed E-LKPD has a very high level of practicality. The average score of 91.67% across all assessed aspects falls into the 'very practical' category. This demonstrates that students generally found the Problem-Based Learning-based E-LKPD on logarithm material easy to use, efficient in learning, and significantly beneficial.

This study successfully developed a valid and practical Problem-Based Learning-based E-LKPD. The validity of this E-LKPD is supported by the content's alignment with the curriculum and learning objectives, as well as the clarity of instructions. The practicality of this E-LKPD is evidenced by its user-friendly interface design, ease of access, and efficient use of time. The main findings of this study are that the developed E-LKPD meets high validity and practicality criteria, enhances student motivation and learning outcomes, and facilitates teachers in implementing problem-based learning. Factors contributing to these results include the problem-based learning design, the use of engaging digital media, and field trials involving teachers and students. This E-LKPD excels in presenting interactive and engaging content, and it facilitates independent student learning. However, this study has limitations in terms of sample size, which may limit the broad generalizability of the findings. The results of this study are consistent with research conducted by (Bay, Kurniati, Lu'luilmaknun, & Azmi, 2024), which also found that problem-based E-LKPD can increase student learning motivation. However, this study differs from research conducted by (Rahma, Ningsih, & Dewi, 2024), which found that E-LKPD requires more intensive technical support. This study contributes to the development of innovative and effective digital teaching materials and can serve as a reference for teachers in developing PBL based E-LKPD.

Conclusion and Suggestions

Based on the validity test results, a final score of 83.33% was obtained, with a 'very valid' criterion. The practicality results from educators yielded a final score of 90%, also with a 'very practical' criterion. The one-on-one evaluation with three students resulted in a final score of 91.67%, categorized as 'very practical'. Similarly, the small group evaluation with nine students also achieved a final score of 91.67%, categorized as 'very practical'. Based on these research findings, it can

e-ISSN 2746-5594
p-ISSN 2746-5608

be concluded that the Problem-Based Learning (PBL) based E-Worksheet (E-LKPD)

e-ISSN 2746-5594
p-ISSN 2746-5608

on logarithm material for class X at SMAN 1 Kuantan Mudik is considered valid and practical for use by both educators and students in mathematics learning.

Based on the results of this research, several suggestions can be proposed for the development and utilization of this PBL based E-LKPD. Firstly, for educators, it is hoped that this E-LKPD can serve as an alternative, varied, and engaging learning medium. It is crucial for educators to maximize the potential of this E-LKPD by combining it with other teaching methods to make the learning process more effective and enjoyable. Secondly, for students, it is expected that this E-LKPD can encourage active and independent learning. With the PBL-based E-LKPD, students are expected to be more involved in problem-solving processes and develop critical thinking skills. Lastly, for future researchers, it is recommended to continue developing this PBL based E-LKPD, not only for logarithmic materials but also for other mathematics materials. This aims to produce more innovative learning resources that align with the needs of 21st-century learning.

Reference

Abdillah, D. M., & Astuti, D. (2021). Development Of Student Worksheets (LKPD) Based On Problem-Based Learning (PBL) On The Topic Of Angles. Pythagoras: *Journal of Mathematics Education,* 15(2), 190–200. https://doi.org/10.21831/pg.v15i2.36444

Agustina, R., & Vahlia, I. (2017). Pengembangan Bahan Ajar Berbasis Masalah Pada Mata Kuliah Matematika Ekonomi Program Studi Pendidikan Matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *5*(2), 152-160. https://doi.org/10.24127/ajpm.v5i2.668

Aisy, S. R., & Khaerunnisa, E. (2024). The Influence Of LKPD Based On Traditional Banten Games To Support Students' Mathematical Problem Solving Abilities, *Nabla Dewantara: Jurnal Pendidikan Matematika,* 9(1), 34–44. https://doi.org/10.51517/nabla.v9i1.383

Amnur, R., & Yerizon. (2017). Based Learning On The Material Of Two Linear Equation Systems, JEPM : Jurnal Edukasi dan Penelitian Matematika, 9(4), 129–133. http://doi.org/10.24036/pmat.v9i4.10546

Bay, R. L., Kurniati, N., Lu'luilmaknun, U., & Azmi, S. (2024). Efektivitas Model Problem Based Learning (PBL) Berbantuan Lembar Kerja Peserta Didik Interaktif untuk Meningkatkan Kemampuan Pemecahan Masalah Matematika Siswa Kelas VII SMPN 23 Mataram Tahun Ajaran 2023/2024. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, *9*(2), 2898-2912. https://doi.org/10.23969/jp.v9i2.13997

Hakim, A., Haling, A., Mawarni, S. & Aswan, D. (2023). E-LKPD Development Workshop Using Liveworksheet for Teachers of SMAN 1 Majene, West Sulawesi Province. *Paramacitra: Community Service Journal*, 01(01), 9–14. https://orcid.org/0000-0002-3623-6993

Hayati, I. N. & Budiyono, B. (2018). Analysis of Students' Difficulties in Logarithm Material at SMA Negeri 1 Kedungwuni. *Journal of Mathematics and Mathematics Education*, 8(2), 115–124. https://doi.org/10.20961/jmme.v8i2.25844

Jalal, M., Muhsinin, U., & Suryaningsih, I. (2021). Increasing Students' Interest in Learning by Implementing Student Worksheets (LKPD) in Thematic Learning

e-ISSN 2746-5594
p-ISSN 2746-5608

at the Mahadil Islamiyah Elementary School, Muaro Jambi. *Primary Education Journal (PEJ)*, 5(2), 22–32.https://doi.org/10.30631/pej.v5i2.84

Kosasih, U., Sabila, N. W. & Saefuloh, N. A. (2022). Logarithm Learning Design Based on Mathematical Games. *Journal of Authentic Research on Mathematics Education (JARME)*, 4(1), 46–56.https://doi.org/10.37058/jarme.v4i1.4069

Larama, A., Cesaria, A., & Yusri, R. (2023). Analysis of students' mathematics learning difficulties in linear equations material for grade VIII. *Tambusai Education Journal,* 7(2), 15729–15734. https://doi.org/10.31004/jptam.v7i2.8860

Lestari, D., Asbari, M., & Yani, EE (2023). Independent Curriculum: The essence of curriculum in education. *Journal of Information Systems and Management (JISMA)*, 2(6), 85–88. https://doi.org/10.4444/jisma.v2i6.840

Maika, Y., & Tasman, F. (2024). Development of Electronic Student Worksheets Based on Problem Based Learning Assisted by Desmos on Quadratic Function Material for Grade X of Senior High School. *Journal of Mathematics Education and Research*, 13(1), 209–213. http://dx.doi.org/10.24036/pmat.v13i1

Masdar, M., & Lestari, N. (2021). Development of Student Worksheets Based on Problem Based Learning in Mathematics Subjects, Addition Material for Grade II Elementary Schools. *Pedagogy: Scientific Journal of Education*, 8(1), 16–21. https://doi.org/10.47662/pedagogi.v8i1.239

Mawaddah, M., & Siswanto, R. D. (2022). Development of E-Worksheet To Improve Students' Mathematical Problem Solving Ability. *Mathline: Journal of Mathematics and Mathematics Education*, 7(2), 298–314. https://doi.org/10.31943/mathline.v7i2.296

Nurwijayanti, S., & Sulisworo, D. (2022). Development of E-LKPD Based on Problem Based Learning (Pbl) to Improve Students' Mathematical Communication Skills on Straight Line Equation Material Assisted by the Liveworksheet Website. *AdMathEduSt: Scientific Journal of Mathematics Education Students*, 9(2), 41-51. https://doi.org/10.12928/admathedust.v9i2.23255

Rahma, S., Ningsih, S., & Dewi, RM (2024). Development of E-LKPD Based on Problem Based Learning in Economics Learning to Train Critical Thinking Skills. *Edukatif: Journal of Educational Sciences*, 6(2), 1675–1685. https://doi.org/10.31004/edukatif.v6i2.6562

Rahmawati, L. Y., Hidayati, C. Febriyani, N. P. & Ferryka, P. Z. (2024). Pelatihan Pembuatan e-LKPD Inovatif menggunakan liveworksheet pada Mata Pelajaran Matematika SD. *Jurnal Ilmiah Pengabdian Pada Masyarakat*, *1*(3), 161–164. Retrieved from https://jurnal.ittc.web.id/index.php/jipm/article/view/64

Ramadhan, I. (2021). The Use of Problem Based Learning Methods to Improve Student Learning Activeness in Class XI IPS 1. *Cetta: Journal of Educational Sciences*, 4(3), 358–369. https://doi.org/10.37329/cetta.v4i3.1352

Roza, M., Lufri, L., & Asrizal, A. (2023). Meta-Analysis of the Effect of STEM Integrated Problem Based Learning Model on Science Learning Outcomes. *Journal of Mathematics and Science Education*, 14(1), 16-32. https://doi.org/10.26418/jpmipa.v14i1.51678

Ryan, J., & Bowman, J. (2022). Teach cognitive and metacognitive strategies to support learning and independence. In *High Leverage Practices and Students*

e-ISSN 2746-5594
p-ISSN 2746-5608

with Extensive Support Needs, 170-184. Taylor and Francis. https://doi.org/10.4324/9781003175735-15

Sahila, D. S. E. T. & Dewi, R. M.. (2024). Development of Electronic Student Worksheets (E-Lkpd) Using the Kvisoft Flipbook Maker Application in Economics Subjects. *Edunomic Journal of Economic Education*, 11(2), 113–124. https://doi.org/10.33603/ejpe.v11i2.10

Soleh, A., & Arifin, Z. (2021). Integrasi Keterampilan Abad 21 dalam Pengembangan Perangkat Pembelajaran Pada Konsep Community of Inquiry. *QALAMUNA: Jurnal Pendidikan, Sosial, Dan Agama*, *13*(2), 473-490. https://doi.org/10.37680/qalamuna.v13i2.995

Subaidah. (2020). Kemampuan Memecahkan Masalah Matematika Kelas X IPS SMA Wijaya Putra Surabaya Pada Materi Sistem Persamaan Linear Tiga Variabel Dengan Teori Polya. *Ed-Humanistics : Jurnal Ilmu Pendidikan*, *5*(1), 674–680. https://doi.org/10.33752/ed-humanistics.v5i1.710

Sugianto, I. U., & Qohar, A. (2020). Mathematical Connections in Mathematics Learning Logarithm Material for Grade X Students. *Square: Journal of Mathematics and Mathematics Education*, 2(1), 82-92. https://doi.org/10.21580/square.2020.2.1.5323

Syafitri, N., Cesaria, A., & Juwita, R. (2023). Development of Student Worksheets Based on Problem Based Learning on Two-Variable Inequality System Material. *Scientific Journal of Mathematics Education)*, 12(1), 215–230. Retrieved from http://e-journal.unipma.ac.id/index.php/jipmhttps://doi.org/10.24036/pmat.v12i1.14362

Syamil, M. F., Vahlia, I., & Sudarman, S. W. (2024). Pengembangan Media Pembelajaran Berbantu Aplikasi Powtoon Disertai Nilai-Nilai Islam Pada Materi Segiempat Dan Segitiga. *EMTEKA: Jurnal Pendidikan Matematika*, 5(1), 95-108. https://doi.org/10.24127/emteka.v5i1.4255

Syar, M. N., Husniati, A., & Kristiawati. (2023). Effectiveness of Implementing Problem Based Learning Model Assisted by Lkpd Liveworksheet on Mathematics Learning Outcomes of Class IV Students of UPT Spf Sd Inpres Barombong 3. *Journal of Education and Counseling*, 1(2), 303–312.https://doi.org/10.58738/compass.v1i2.388