

Implementation of PBL-Based Digital Worksheets to Improve Students' Problem-Solving Skills: A Literature Review

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DOI : <https://doi.org/10.26740/jdpe.2.1.52051>

Sections Info

Article history:

Submitted: March 10, 2026

Final Revised: April 19, 2026

Accepted: April 20, 2026

Published: April 23, 2026

Keywords:

Digital Worksheet;

Literature Review;

Problem Based Learning;

Problem Solving Skills.

ABSTRACT

Objective: This study aims to analyze previous research on the implementation of Problem-Based Learning (PBL)-based digital worksheets and examine their contribution to improving students' problem-solving skills, particularly in physics, where conceptual understanding and analytical reasoning are essential. **Method:** This research employs a literature review, analyzing 20 relevant articles published between 2021 and 2025 that discuss the integration of PBL and digital worksheets in educational contexts. Many studies focus on physics education topics such as motion, hydrostatic pressure, momentum, optical instruments, and global warming. The selected articles were systematically reviewed and synthesized to identify trends, findings, and the effectiveness of PBL-based digital worksheets in supporting students' problem-solving abilities. **Results:** The results of the review indicate that PBL-based digital worksheets positively impact students' problem-solving skills by providing structured activities through problem identification, investigation, analysis, and solution development. In physics education, these worksheets help students understand abstract concepts, connect formulas with real-world phenomena, and solve contextual physics problems more effectively. They also create interactive, student-centered learning environments that foster active participation and higher-order thinking. In addition, this review shows that digital worksheets have evolved from simple task sheets into adaptive learning tools that support feedback, collaboration, and independent learning. **Novelty:** The novelty of this study lies in highlighting PBL-based digital worksheets as not only instructional media but also as pedagogical innovation that integrates physics problem-solving processes with digital technology to improve students' problem-solving skills, conceptual understanding, and digital competence.

INTRODUCTION

Education in the 21st century requires students to develop higher-order thinking skills to face complex academic and real-world challenges. One of the most essential competencies is problem-solving, as it enables students to analyze situations, identify problems, and determine appropriate solutions through reasoning (Susanti et al., 2024). Problem-solving also involves logical, critical, and systematic thinking processes to address complex issues meaningfully (Wulansari et al., 2024). However, students' problem-solving abilities remain relatively low, as shown in international assessments such as the Program for International Student Assessment, where Indonesian students still struggle with reasoning-based tasks (OECD, 2023). This condition is influenced by learning practices that emphasize memorization rather than analytical thinking (Astuti et al., 2025). In the era of digital transformation, learning is expected to utilize digital media to support problem-solving, including through technology-based environments that require decision-making and information evaluation. Research shows that

integrating digital-based and problem-based learning can improve students' problem-solving abilities, although results are not yet optimal and require more structured implementation (Dwikoranto et al., 2024). Therefore, integrating problem-solving with digital learning environments is essential to better prepare students for complex real-world problems.

The development of students' problem-solving abilities requires learning strategies that actively engage students in meaningful learning processes. One learning model widely recommended to enhance problem-solving ability is Problem-Based Learning (PBL), as it emphasizes learning through authentic real-world problems (Indriani & Ananda, 2024). PBL positions problems as the starting point of learning, encouraging students to investigate, discuss, and develop solutions independently and collaboratively (Ulpiana et al., 2024). Through this process, students actively construct their understanding through problem analysis and decision-making (Sinuraya & Frisnoiry, 2023). However, recent studies indicate that PBL implementation is not yet optimal, affecting students' problem-solving performance. Many students still experience difficulties identifying problems, formulating strategies, and evaluating solutions, indicating low to moderate problem-solving ability (Chen et al., 2024; Ayari et al., 2025). This condition is influenced by limited learning support, lack of structured guidance, and challenges in implementing PBL effectively in the classroom (Lintangejayasukma et al., 2024; Alreshidi & Lally, 2024). Furthermore, ineffective implementation of PBL without proper scaffolding has been shown to result in less significant improvement in students' problem-solving abilities (Alreshidi & Lally, 2024). These findings highlight the need to optimize PBL implementation to improve students' problem-solving abilities effectively.

In addition to appropriate instructional models, the integration of innovative learning media also plays an important role in supporting effective learning. One of the learning media widely developed in technology-enhanced learning environments is the electronic student worksheet, commonly referred to as the electronic worksheet or e-worksheet (Mitasari & Hidayah, 2022). Electronic worksheets allow students to access structured, interactive learning activities supported by various digital learning resources, which can facilitate deeper conceptual understanding during the learning process (Winarsih & Desnita, 2024). The use of digital worksheets can also increase students' engagement in learning activities because these tools offer more engaging, interactive experiences than conventional printed worksheets commonly used in traditional classroom settings (Armanda & Putra, 2024).

The integration of the Problem-Based Learning model with digital worksheets represents an instructional innovation that could improve students' problem-solving skills. PBL-based electronic worksheets can present contextual problems that encourage students to analyze problems systematically and develop appropriate solutions based on the information they obtain during learning activities (Risamasu & Pieter, 2024). The use of digital worksheets integrated with the PBL approach can also support students in developing independent learning skills while simultaneously increasing their active

participation in classroom learning processes (Munawaroh & Emiliannur, 2024). Furthermore, several studies have shown that implementing PBL-based electronic worksheets is effective in improving higher-order thinking skills among students, including critical thinking and problem-solving, across various learning contexts (Subekti & Andriyani, 2023).

Although previous studies have demonstrated the potential of Problem-Based Learning and digital worksheets to improve students' problem-solving abilities, research specifically examining their integration remains relatively limited (Adawiyah et al., 2024; Mahfudhoh & Andrijati, 2024). Most previous studies tend to focus either on the development of learning media or on the effectiveness of instructional models within specific learning contexts, without providing a comprehensive synthesis of existing findings across studies (Winarsih & Desnita, 2025; Dewi et al., 2025). In addition, earlier research often reports positive outcomes of PBL or digital worksheets separately, yet lacks critical evaluation regarding the consistency of results, variations in implementation quality, and the extent to which these approaches effectively support different stages of the problem-solving process (Marlina et al., 2024). This indicates a clear gap in the literature, particularly in understanding how the integration of Problem-Based Learning-based digital worksheets can systematically enhance students' problem-solving abilities across diverse learning settings. Therefore, a systematic literature review is necessary to identify, analyze, and synthesize previous studies related to the implementation of Problem-Based Learning-based digital worksheets in improving students' problem-solving abilities.

Based on this background, the present study aims to analyze previous research related to the implementation of Problem-Based Learning-based digital worksheets and to examine their contribution to improving students' problem-solving abilities through a literature review approach. The novelty of this study lies in its comprehensive synthesis that not only compiles recent findings but also critically evaluates the effectiveness, limitations, and implementation challenges of integrating Problem-Based Learning with digital worksheets, particularly in relation to students' problem-solving processes (Adawiyah et al., 2024; Dewi et al., 2025). By addressing inconsistencies and gaps in prior studies, this research seeks to provide a more holistic understanding of how these integrated approaches function in practice. Furthermore, this study is expected to offer evidence-based insights to support the design of more effective learning strategies, thereby reinforcing the urgency of improving students' problem-solving abilities to address increasingly complex learning demands and the need for meaningful, student-centered learning environments.

RESEARCH METHOD

This study employed a qualitative approach, specifically a Systematic Literature Review (SLR), to examine studies on the implementation of Problem-Based Learning assisted by digital worksheets to improve students' problem-solving skills. The literature review

method involves reviewing, analyzing, and synthesizing previously published studies in order to obtain a comprehensive understanding of a particular research topic (Snyder, 2019). This method enables researchers to identify emerging research, discover patterns in findings, and systematically integrate results from previous studies (Paul et al., 2021).

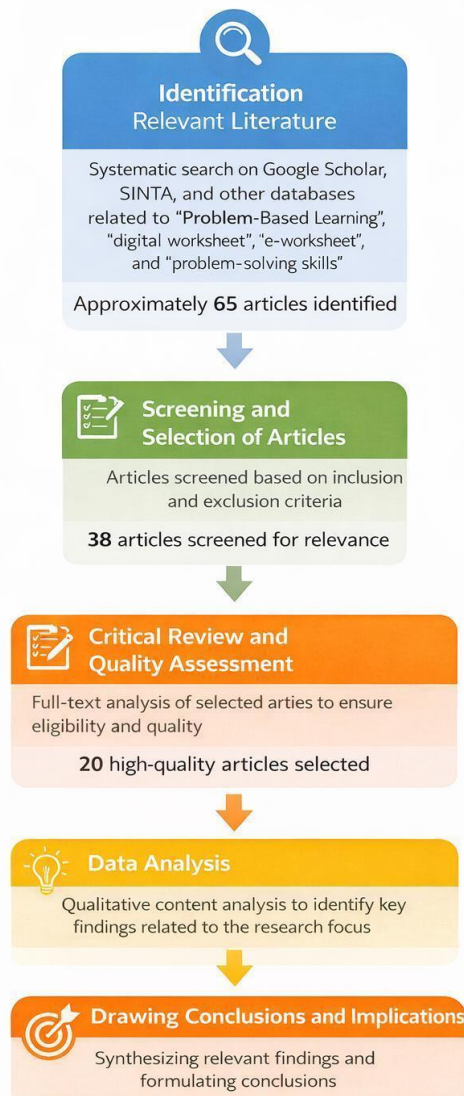


Figure 1. Flow of research methods

The data used in this study were secondary, drawn from national and international scientific journal articles relevant to the research topic. Data collection was conducted through a systematic literature review using Google Scholar, SINTA, and other relevant scholarly sources. The search process employed specific keywords, including "Problem-Based Learning," "digital worksheet," "e-worksheet," and "problem-solving skills." The initial search yielded approximately 65 articles, which were then screened based on predefined inclusion criteria, namely (1) articles published in peer-reviewed journals, (2) studies published within the last five years (2020–2025), (3) studies focusing on Problem-Based Learning and digital worksheets, and (4) studies addressing students' problem-solving abilities. This literature search strategy is a crucial step in ensuring the quality and relevance of the selected sources (Snyder, 2019).

After screening based on titles and abstracts, 38 articles were identified as relevant. These articles were further evaluated through full-text analysis to ensure their alignment with the research objectives, resulting in 20 articles that met all inclusion criteria and were selected for final analysis. The selected articles were then analyzed using a qualitative content analysis approach to identify key concepts, research methods, and findings related to the implementation of Problem-Based Learning assisted by digital worksheets. Content analysis enables systematic interpretation of research documents to produce valid and meaningful conclusions (Elo et al., 2020).

The analysis process involved thoroughly reviewing each selected article, categorizing important information based on the research focus, and synthesizing the findings to obtain a comprehensive understanding of how Problem-Based Learning-based digital worksheets contribute to improving students' problem-solving abilities. This systematic synthesis ensures that the conclusions are based on credible, relevant evidence aligned with the research objectives.

RESULTS AND DISCUSSION

Results

Problem-Based Learning (PBL) is a learning approach that encourages students to develop problem-solving skills through activities such as problem identification, investigation, and solution development (Sulistiani et al., 2022). The use of digital worksheets in PBL can support interactive learning and guide students through structured problem-solving activities (Zafitri et al., 2025). Furthermore, the development of PBL-based electronic worksheets provides students with opportunities to practice problem-solving skills in technology-supported learning environments (Winarsih & Desnita, 2024).

To obtain a comprehensive understanding of this topic, a systematic literature review was conducted. The process began with identifying relevant literature through database searches, yielding approximately 65 articles on PBL, digital worksheets, and problem-solving skills. These articles were then screened based on predefined inclusion and exclusion criteria, narrowing the selection to 38 relevant studies. Subsequently, a critical review and quality assessment were carried out through full-text analysis to ensure the eligibility and rigor of each study. As a result, 20 high-quality articles were selected for further analysis. The selected studies were then analyzed using qualitative content analysis to identify key findings and patterns regarding the implementation of PBL-based digital worksheets to improve students' problem-solving skills. The results of this review are summarized in Table 1.

Table 1. Summary of previous studies on the implementation of PBL-based digital worksheets to improve students' problem-solving skills

| No. | Title (Researcher, Year Published) | Purpose | Method | Results |
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| 1. | Need Analysis to Develop Electronic Student Worksheet Based on Problem Based Learning to Improve Students' Problem-Solving Skills (Winarsih & Desnita, 2024). | This study aims to analyze the need for developing an electronic student worksheet based on the Problem Based Learning model to improve students' problem-solving skills in physics learning | The study employed a descriptive qualitative research method using a needs analysis approach. Data were collected through classroom observations, interviews with physics teachers, and analysis of existing teaching materials. | The results indicated that physics learning still relies on conventional worksheets and lacks digital learning resources. Therefore, the development of PBL-based electronic worksheets is needed to train students' problem-solving skills and improve active learning in physics classes. |
| 2. | Electronic Worksheet-Based Problem Based-Learning (PBL) Toward Problem-Solving in Science Education: Need Analysis (Ringo et al., 2023). | This study aims to analyze the need for teaching materials, especially student worksheets based on Problem-Based Learning to improve student problem-solving. | This research is qualitative and quantitative. The methods for data analysis Techniques for analyzing data include using qualitative methods to examine how curriculum, student characteristics, and learning resources are used and presenting the results in forms that may be used for descriptive statistics, such as graphs and standard tables. | Based on interviews, questionnaires, and observations on teaching materials, student characteristics, and the curriculum used. It can be said that, on average, 79.8% of students need additional electronic-based teaching materials on the topic of additives and addictive substances, and the unavailability of teaching materials in the form of electronic worksheets based on problem-based learning. |

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| 3. Enhancing Students Problem Solving Capability With Electronic Student Worksheet Based On Problem Based Learning (Risamasu & Pieter, 2024). | To determine the validity, practicality, and effectiveness of PBL-based electronic student worksheets in improving students' problem-solving abilities. | The research used a research and development (R&D) approach. Data were collected through validation questionnaires, practicality questionnaires, and problem-solving tests. | The developed electronic worksheet was highly valid (92.64% from experts), very practical (94.87%), and improved students' problem-solving skills with an N-gain of 0.73 in the high category |
| 4. The Effect Of Problem Based Electronic Worksheet With Problem-Based Learning Model On Student Competence Achievement In Physics Learning Class X SMAS Adabiah 1 Padang (Armanda & Putra, 2024). | The purpose of this study is to determine the effect of using electronic worksheets integrated with the Problem Based Learning model on students' learning competence in physics | The research used a quasi-experimental design involving high school students in class X. Data were collected using learning outcome tests and observation sheets to measure cognitive competence. | PBL - based electronic worksheets significantly improved students' learning achievement and problem-solving abilities compared with conventional learning materials. This confirms the effectiveness of integrating structured problem-solving activities into digital worksheets. |
| 5. Improvement of High School Students' Physics Problem Solving Skills Through Problem Based Learning Assisted by LKPD (Student Worksheets) (Simangunsong et al., 2024). | This study aims to improve high school students' physics problem-solving skills through the implementation of Problem Based Learning assisted by student worksheets | The research used classroom action research consisting of planning, action, observation, and reflection cycles. The subjects were 10th grade high school students learning measurement topics in physics | The results showed a significant increase in students' problem-solving abilities from the first cycle to the second cycle. The PBL approach combined with worksheets helped students analyze problems systematically and develop better conceptual understanding. |

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| 6. Electronic Student Worksheet for Solving Problems in Physics Material Based on Problem-Based Learning (Nenggala et al., 2024). | To develop electronic student worksheets based on PBL to facilitate problem solving in physics learning. | The research method used is based on the Analysis Design Development Implementation Evaluation (ADDIE) model of development. The instruments used for the research include validation sheets and questionnaires. | Found that the developed PBL-based electronic worksheet was valid and effective in helping students understand physics concepts while improving their ability to solve problems. This reflects the continued development of subject-specific digital learning resources. |
| 7. Effectiveness of Electronic Student Worksheets (LKPD) Problem-Based Learning (PBL) Based on Social Scientific Problems (SSI) in Improving Problem Solving Skills (Septiani et al., 2025) | Efforts to improve the quality of education can be made in various ways, one of which is the use of innovative and technology-based teaching materials. | Data collection techniques used questionnaires and written tests. Data analysis used validity, reliability, and N-Gain. | Technology-assisted PBL worksheets significantly enhanced students' critical thinking and problem-solving skills. This indicates that digital worksheet integration increasingly targets higher-order thinking competencies. |
| 8. The Development of Problem-Based Learning Worksheet for the Material of Optical Instrument (Khotimah, 2024) | To develop a PBL-based worksheet for optical instrument materials in physics learning. | The research used development research with validation by experts and testing with students. | Found that the developed PBL worksheet for optical instruments was valid, practical, and suitable for classroom use. This demonstrates the expansion of PBL-based worksheet development into specific physics topics. |

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| 9. | Development of Problem-Based E-Worksheet to Train Problem-Solving Skills in Reaction Rate Material (Fadilah & Bertha, 2025) | This research aims to develop a PBL-based E-Worksheet to train problem-solving skills in reaction rate materials. | The research method employed is the ADDIE model R&D, excluding the implementation stage. | The implications of this study suggest that PBL-based E-Worksheets can serve as an alternative teaching material that supports the development of 21st-century skills, particularly in problem-solving related to reaction rate materials. |
| 10. | Development Of Digital Student Worksheet Based On Problem Based Learning On Hydrostatic Pressure Material At SMA Negeri 2 Binjai (Anggreiny & Ramadhani, 2025) | To develop PBL-based digital student worksheets for hydrostatic pressure material in physics learning. | This research is a Research & Development (R&D) study using the ADDIE model which consists of stages (Analyze, Design, Development, Implementation, and Evaluation). | The results indicated that the digital worksheet developed is valid and effective in supporting students' understanding of hydrostatic pressure concepts. |
| 11. | Development of Augmented Reality Integrated Physics E-Worksheet to Improve Students' Problem-Solving Skills (Suryanto et al., 2022) | To develop an augmented-reality-integrated electronic worksheet to enhance students' problem-solving skills in physics learning. | The type of research used is research and development (R&D) with a 4D model (define, design, develop and disseminate). | The results showed that the AR Physics E-Worksheet was effective in improving problem solving skills so that it could be used as a learning medium for the Momentum and Impulse topic by class X science students. |

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| 12. | Design of Electronic Education Worksheets Integrated with Problem Based Learning to Facilitate Critical Thinking Skills of High School Students (Munawaroh & Emiliannur, 2023) | To design electronic worksheets integrated with the PBL model to facilitate students' critical thinking skills in physics learning. | The research method used is development research with the ADDIE model, which includes analysis, design, development, implementation, and evaluation. | The development results show that E-student worksheet can increase student involvement and independence in the learning process. Thus, this PBL-integrated E-student worksheet is expected to be an effective and interesting learning resource, as well as help students in understanding physics concepts. |
| 13. | Development E-Worksheet Based on Problem Based Learning to Improve Students' Metacognitive Ability (Mitasari & Hidayah, 2022) | To develop PBL-based electronic worksheets aimed at improving students' metacognitive abilities in science learning. | The research used a research and development approach involving expert validation and implementation in classroom learning. | The results indicated that the developed e-worksheet was valid, practical, and effective in improving students' metacognitive abilities and learning independence. |
| 14. | The Effect of Problem-Solving-Based Physics Liveworksheets on Improving High School Students' Critical Thinking Skills (Pelani et al., 2024) | To investigate the effect of problem-solving-based liveworksheets on improving students' critical thinking skills in physics learning. | The research applied an experimental design using pretest and posttest instruments to measure students' critical thinking ability. | The findings showed that the use of problem-solving-based liveworksheets significantly improved students' critical thinking skills compared to conventional learning methods. |

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| 15. Boosting Students' Mathematical Problem-Solving Skills with PBL-Based LiveWorksheets: Focus on Whole Numbers and Fractions Topic (Usqo et al., 2024) | This research aims to produce PBL-based electronic student worksheets (e-worksheets) on the topic of whole numbers and fractions that are valid, practical and effective to improve students' mathematical problem-solving skills | The development of e-worksheets uses a 4D development model involving seventh-grade students from one of the junior high schools in Rokan Hulu, Riau, Indonesia as field test subjects. | The results of data analysis show that the e-worksheet developed using LiveWorksheet application has met the valid criteria based on experts judgement and practical based on the practicality questionnaires. E-worksheets have also been proven effective in improving students' mathematical problem-solving skills with an average N-gain at high criteria. |
| 16. The Importance of Innovative Electronic Worksheets in 21st Century Learning (Suryaningsih & Nurlita, 2021) | To examine the role of innovative electronic worksheets in supporting 21st-century learning skills. | The study used literature review and descriptive analysis of various electronic worksheet implementations in learning. | The results showed that electronic worksheets play an important role in facilitating digital learning, improving student engagement, and supporting the development of critical thinking and problem-solving skills. |
| 17. Improving Problem-Solving Skills Through Technology-Assisted Problem-Based Learning in Physics Education (Saputri et al., 2023) | To investigate the effectiveness of technology-assisted problem-based learning in improving students' problem-solving skills in physics education. | The research used an experimental approach involving control and experimental groups with pretest and posttest measurements. | The findings revealed that technology-assisted PBL significantly improved students' problem-solving abilities and conceptual understanding in physics learning. |

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| 18. Development of Student Worksheets Integrated with PBL-STEM on Temperature and Heat Material (Rochman et al., 2024) | The purpose of this study is to develop student worksheets that integrate the Problem Based Learning model with STEM approaches to improve creative and analytical thinking skills in physics learning. | This study used Research and Development with the 4-D model (define, design, develop, disseminate). Data were collected using validation sheets, student response questionnaires, and learning outcome tests. | The results indicate that the developed worksheet is valid, practical, and effective in improving students' creative thinking and problem-solving skills, particularly in the topic of temperature and heat. |
| 19. Electronic student worksheet (E-LKPD) based on the Problem-Based Learning (PBL) model using the Wizer.me platform for teaching momentum and impulse in physics learning (Septiana et al., 2023) | This study aims to develop an electronic student worksheet (E-LKPD) based on the Problem-Based Learning (PBL) model using the Wizer.me platform for teaching momentum and impulse in physics learning. | The research method used is research and development (R&D) with the ADDIE development model. | The results showed that the PBL-based electronic worksheet using the Wizer.me has a high level of validity and practicality. The worksheet effectively supports physics learning by helping students better understand momentum and impulse concepts while increasing student engagement during the learning process. |
| 20. Development Of E-Lkpd Based On Problem Based Learning (PBL) To Improve Physics Problem-Solving Abilities (Amanda, 2025) | This research aims to develop a valid and practical PBL-based E-LKPD to improve physics problem-solving skills on global warming material. | This type of research is development with the Research and Development (R&D) research model, a product development research category adapted from Thiaragajan (1974) which consists of 4 stages of the 4D development model, namely define, design, development, and disseminate. | PBL based E-LKPD has been produced to improve physics problem solving skills on global warming material which is valid and practical so that it can be used as multimedia to support learning. |

Discussion

The results of the reviewed studies indicate that research on the implementation of Problem-Based Learning (PBL) integrated with digital worksheets has shown progressive development, particularly in its focus on improving students' problem-solving skills across various learning contexts. Earlier studies mainly examined the general effectiveness of PBL in classroom instruction. In contrast, more recent studies increasingly emphasize the use of digital worksheets as structured and interactive learning media that support each stage of PBL, including problem identification, information gathering, data analysis, and solution formulation. This development reflects a broader shift toward technology-enhanced learning environments that promote student-centered, inquiry-based, and collaborative learning processes. In science and physics education, digital worksheets are increasingly used to help students understand abstract concepts and apply them to authentic situations, making learning more meaningful and contextual (Siringo Ringo et al., 2023; Risamasu & Pieter, 2024; Nenggala et al., 2024).

A clear trend emerging from the reviewed literature is the increasing integration of digital technology into PBL implementation. Recent studies no longer position worksheets merely as supporting documents, but as interactive platforms that can include multimedia content, simulations, hyperlinks, automated feedback, and collaborative tasks. This indicates that instructional design is moving away from conventional paper-based learning resources toward more adaptive, technology-driven formats. In addition, many studies report that the use of digital worksheets has expanded across different educational levels and subject areas, especially in STEM-related learning, where students are required to analyze problems systematically and construct evidence-based solutions. These patterns suggest that future PBL research will likely continue to focus on more personalized, flexible, and digitally connected learning models aligned with 21st-century educational demands (Winarsih & Desnita, 2024; Armanda & Putra, 2024; Mitasari & Hidayah, 2022).

The reviewed studies also show that e-worksheets play an important role in supporting student engagement and independent learning. Through digital formats, students can access learning materials anytime and interact more actively with the content than with conventional worksheets. Several studies demonstrate the use of e-worksheets in the form of Live Worksheets, digital flipbooks, and augmented-reality-based worksheets, which enrich learning experiences through visual and interactive features. For example, Live Worksheets can provide immediate feedback on student responses, digital flipbooks can present step-by-step problem scenarios in an organized format, and augmented reality can help visualize scientific concepts that are difficult to observe directly. These examples show that e-worksheets function not only as task sheets but also as learning environments that guide students through structured inquiry and problem-solving processes (Suryanto et al., 2022; Pelani et al., 2024; Damaiyanti et al., 2025).

Furthermore, the literature demonstrates that PBL-based digital worksheets contribute not only to academic achievement but also to the development of essential 21st-century skills, including critical thinking, creativity, collaboration, communication, and problem-solving. Through authentic problem scenarios, students are encouraged to investigate issues, evaluate information, exchange ideas in groups, and design possible solutions. These learning experiences are closely aligned with current educational priorities that emphasize competency development rather than memorization alone. Several studies reported that students who learned through PBL-integrated digital worksheets achieved higher levels of critical thinking and problem-solving performance than those taught through conventional methods, indicating the effectiveness of this instructional approach in fostering higher-order thinking skills (Septiani et al., 2024; Simangunsong et al., 2024; Saputri et al., 2023).

Based on the overall findings, it can be concluded that integrating PBL and digital worksheets is an effective strategy for enhancing students' problem-solving abilities while supporting active, meaningful learning. The combination of structured problem-solving stages and interactive digital media enables students to engage more deeply in the learning process and connect concepts to real-world applications. Therefore, this approach has strong potential for widespread implementation in modern classrooms, particularly in science and physics learning contexts that require analytical reasoning and conceptual understanding (Saputri et al., 2023; Suryaningsih & Nurlita, 2021; Ady et al., 2024).

Despite these positive findings, several limitations remain in the current body of research. Many studies are conducted on small samples, with short intervention periods, or on specific subjects, which may limit the generalizability of the results. In addition, differences in digital infrastructure, teacher readiness, and student technological literacy can influence the success of implementation. Future research is recommended to examine long-term impacts, compare different e-worksheet platforms, and investigate how PBL-based digital worksheets can be adapted to diverse educational settings. Further studies may also explore teacher-training models and scalable implementation strategies to ensure broader, more effective adoption of this approach.

CONCLUSION

Fundamental Finding: This literature review synthesizes findings from previous studies and shows that implementing Problem-Based Learning (PBL) digital worksheets significantly improves students' problem-solving skills. Through structured learning stages such as problem identification, investigation, analysis, and solution formulation, digital worksheets integrated with PBL encourage active participation, inquiry-based learning, and the development of higher-order thinking skills. **Implication:** These findings highlight that integrating PBL with digital worksheets can be an effective instructional strategy to create more interactive, student-centered, and technology-supported learning environments, thereby supporting the development of essential 21st-

century competencies, particularly students' problem-solving abilities. **Limitation:** Nevertheless, this study is limited by the scope of the reviewed literature, which focuses on selected articles within a particular time range and diverse educational contexts, potentially affecting the generalizability of the findings. **Future Research:** Therefore, future studies are recommended to investigate the implementation of PBL-based digital worksheets across broader educational contexts, different subject areas, and various educational levels, as well as to examine their long-term impact on students' problem-solving skills and other higher-order thinking abilities through empirical research.

AUTHOR CONTRIBUTIONS

Katarina Sanca contributed to the conceptual framework, research design, and validation process; **Rahmatta Thoriq Lintangesukmanjaya** was sourcing references, and drafting the manuscript; **Dwikoranto** handled methodology development, and project coordination. **Neisya Azaria Adinda Putri** handled data management, and project coordination. All listed authors have reviewed and approved the final version of this submission.

CONFLICT OF INTEREST STATEMENT

The authors confirm that there are no conflicts of interest, either financial or personal, that may have influenced the content or outcome of this study.

ETHICAL COMPLIANCE STATEMENT

This manuscript complies with research and publication ethics. The authors affirm that the work is original, conducted with academic integrity, and free from any unethical practices, including plagiarism.

STATEMENT ON THE USE OF AI OR DIGITAL TOOLS IN WRITING

The authors acknowledge the use of digital tools, including AI-based technologies, as support in the research and writing stages of this article. Specifically, ChatGPT (OpenAI) was used to assist in language refinement, paraphrasing, and improving the clarity of academic writing. Additionally, Google Scholar and Mendeley Reference Manager were used to search, organize, and manage scholarly references. All outputs generated with digital assistance were critically evaluated, revised, and validated by the authors to ensure academic rigor and adherence to ethical standards. The final responsibility for the manuscript rests entirely with the authors.

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