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

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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

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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

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