

A systematic review of TArL-based and digital student worksheets for enhancing learning outcomes

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Abstract

Despite the widespread use of Student Worksheets (LKPD) in Indonesian classrooms, limited attention has been given to synthesizing how innovative LKPD designs, particularly those integrating differentiated instruction and digital technology, contribute to student learning outcomes. This study aims to systematically review the effectiveness of TArL-based and digital LKPD (e-LKPD) designs in enhancing learning outcomes across educational contexts. Employing the PRISMA framework, a systematic search was conducted in Google Scholar, Scopus, and JSTOR for studies published between 2013 and 2023. Of 30 studies meeting the inclusion criteria, data were synthesized using qualitative thematic analysis. The findings reveal that TArL-based LKPD facilitates differentiated learning by aligning materials with students' ability levels, while e-LKPD enhances flexibility, accessibility, and student engagement through interactive digital features. Both approaches were associated with improved conceptual understanding, critical thinking, and active participation. However, substantial variation in research designs and outcome measures limits the generalizability of findings. This review contributes to the educational literature by providing a comprehensive synthesis of LKPD innovations, identifying design features that effectively support 21st-century learning, and highlighting the need for cross-disciplinary research and more robust empirical designs. The implications suggest that educators and curriculum developers should prioritize adaptive, technology-integrated LKPD designs, while future research should employ longitudinal and comparative methods to establish causality.

Keywords: Student worksheets, TArL, E-LKPD, Learning outcomes

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INTRODUCTION

Despite the increasing use of LKPD in classroom instruction, many worksheet designs remain focused on conventional task completion and lack integration with technology-based and differentiated learning approaches. However, many conventional LKPD designs remain highly teacher-centered, less adaptive to students' diverse learning needs, and insufficiently integrated with digital learning environments. These limitations have become increasingly relevant in the

context of 21st-century education, which demands flexible, student-centered, and technology-supported learning approaches (Zou et al., 2025). To achieve more effective teaching, approaches that actively engage students and deepen their understanding of the material are essential (Doolittle et al., 2023). One such method that has been widely used to support in promoting more interactive and applied learning is the use of Student Worksheets (LKPD). LKPD serves as a tool that not only evaluates students' comprehension but also allows them to actively engage with the learning content (Sundari & Nugraha, 2021). A well-designed LKPD may facilitate both independent and collaborative work on problems relevant to the subject matter, potentially helping students achieve a deeper understanding of the concepts being taught (Praspita & Rosy, 2021).

However, despite the widespread use of LKPD in education, designing effective LKPDs that truly enhance learning outcomes remains a significant challenge (Kahar et al., 2021). Poorly designed or unengaging LKPDs can lead to misunderstandings of the material and decreased student motivation (Cicilia & Vebrianto, 2020). Therefore, developing more effective LKPD designs is crucial to support educational goals and improve student performance (Nurhalimah et al., 2025).

In recent years, the application of technology-based LKPD (e-LKPD) has shown considerable potential in improving the effectiveness of learning. e-LKPD provides students with greater flexibility in their learning, allowing them to study independently and access materials anytime and anywhere (Mustaqim et al., 2024). Furthermore, e-LKPD enhances student engagement through interactive digital resources, which assist in better understanding and retention of content (Fitrianingsih et al., 2025). Several studies suggest that integrating technology into LKPD not only improves the quality of learning but also accelerates students' comprehension of the material, leading to positive impacts on their learning outcomes (Triasari et al., 2022). Additionally, e-LKPD allows for the integration of various learning media, such as videos, simulations, and quizzes, making learning more engaging and easier to understand (Afnita et al., 2025).

Despite the promising potential of e-LKPD, research on the development of effective LKPD designs that can be adapted to different types of learning settings. However, limited attention has been given to how LKPD designs can be systematically adapted to support differentiated learning, technology integration, and diverse student learning needs across educational contexts. Furthermore, previous reviews have rarely integrated discussions on digital-based LKPD and adaptive approaches such as Teaching at the Right Level (TaRL). Therefore, a more comprehensive review is needed to clarify the characteristics of effective and adaptable LKPD design. Existing research tends to focus on LKPD for specific subjects like mathematics and science, while studies on how LKPD can be designed to improve learning outcomes across various subjects and cognitive levels are rare (Apreasta et al., 2023). This gap in the literature needs to be addressed through further research.

As the demand for 21st-century skills in education increases, LKPD designs must also support the development of critical thinking, creativity, and collaboration skills among students. LKPDs that not only focus on knowledge transfer but also promote higher-order thinking skills will be more effective in supporting holistic learning outcomes (Fauzi & Wisanti, 2025). Therefore, updating LKPD designs to make them more adaptable to technological advancements and the broader educational needs of today's learners is essential (Aldresti et al., 2023).

This literature review aims to examine various LKPD designs implemented in learning over the past decade. By studying the strengths and weaknesses of existing LKPD designs, this research seeks to provide insights into how LKPD design can be improved and enhanced to more effectively improve learning outcomes. The study will also explore the use of e-LKPD to enrich students' learning experiences and support the development of critical thinking skills necessary to prepare them for global challenges.

METHODS

Methods

This study employs a systematic literature review approach following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to collect, review, and analyze relevant articles on the use of Student Worksheets (LKPD) in learning and their impact on student learning outcomes. This literature review aims to identify, evaluate, and synthesize findings from articles published in the last ten years that focus on LKPD designs and their relationship with learning outcomes.

Article searches were conducted through major databases such as Google Scholar, Scopus, and JSTOR, using relevant keywords like "Student Worksheets", "LKPD", "Learning Outcomes", and "Student Worksheets". The article search covered publications from 2013 to 2023. Selected articles must meet the inclusion criteria, namely: (1) articles discussing the use of LKPD in the context of learning, (2) articles measuring student learning outcomes related to the use of LKPD, and (3) articles published in academic journals indexed in both national and international databases. In addition to the inclusion criteria, the selected studies were reviewed for methodological appropriateness, clarity of research objectives, and relevance to the focus of LKPD implementation and learning outcomes. Articles that did not meet these criteria such as those that did not directly discuss LKPD or did not provide relevant data were excluded from the analysis.

Data Search and Selection

The article selection process follows four main stages based on the PRISMA guidelines. First, articles were identified through database searches; second, articles were screened based on titles and abstracts to ensure relevance to the research topic; third, articles were selected according to the inclusion criteria; and fourth, eligible articles were included in the systematic literature analysis. This process resulted in 30 articles that met the inclusion criteria and were selected for further analysis. A PRISMA the flow diagram illustrating article selection process is presented in the following section:

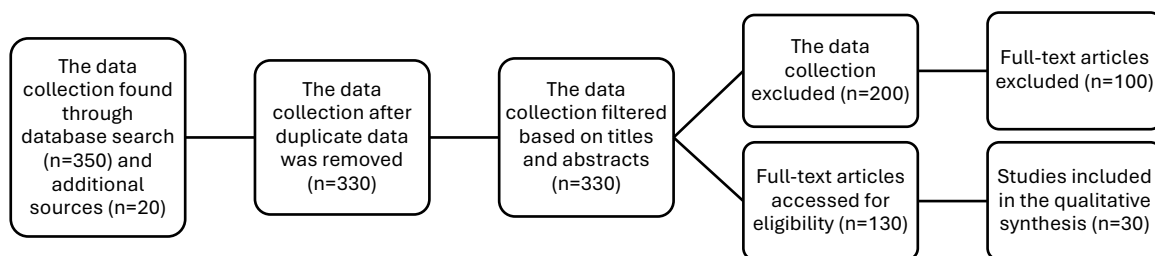


Figure 1. Flow Diagram Illustrating Article Selection Process

To analyze the selected articles, this study used a thematic synthesis approach, where data from the relevant articles were grouped and analyzed based on the main themes found in the literature concerning LKPD designs and their impact on student learning outcomes. The thematic synthesis process involved three stages: initial coding of study findings, categorization of similar concepts, and development of overarching themes related to LKPD design and learning outcomes. Articles were also reviewed based on their relevance, methodological clarity, and alignment with the inclusion criteria to enhance the credibility of the synthesis process. This analysis was conducted qualitatively, aiming to gain deeper insights into the relationship between LKPD design, the use of technology in LKPD, and the improvement of student learning outcomes. The results of this synthesis were presented in the form of a narrative discussing the main findings from various studies analyzed. The analysis procedure was carried out while considering the reliability and validity of the available data, and references to previous studies

were provided to strengthen the arguments and conclusions drawn from this research.

The selected articles were then analyzed descriptively to identify key findings related to the use of Student Worksheets (LKPD) in learning, including LKPD design, the context of its implementation, and its impact on student learning outcomes. This study focuses on analyzing the diversity of LKPD designs used in learning and evaluating student learning outcomes, considering factors such as understanding levels, critical thinking skills, and the ability to apply the learned material

Data Analysis

The analysis was conducted to provide a more comprehensive picture of the effectiveness of LKPD in improving the quality of teaching and student learning outcomes across various educational contexts. This literature review is expected to offer deeper insights into the potential innovations in LKPD design and highlight the research gaps related to the application of LKPD in different learning contexts. The study is also expected to contribute to the development of more effective LKPD designs to improve overall student learning outcomes, both in academic learning contexts and 21st-century skills ([Sari et al., 2022](#)).

RESULTS AND DISCUSSION

Results

Based on the analysis of 30 articles reviewed, this study identified recent innovations in the implementation of Teaching at the Right Level (TaRL), which contribute significantly to the education literature. The key innovations discovered in this study involve the integration of technology, differentiated learning, and holistic approaches in developing 21st-century skills. The data from the 30 articles referenced in this research are summarized in Table 1

Tabel 1. Description of Selected Articles

Author	Year	Title	Findings
N. Aryanti	2024	The Effect of Applying the Teaching at the Right Level (TARL) Assisted by LKPD	TARL with LKPD significantly improves elementary students' learning outcomes in science.
RT Ustati, A Samsudin	2024	Pengembangan LKPD dengan Pendekatan TARL melalui Design Thinking Framework	LKPD with TARL improves student engagement and learning activities.
FE Pratiwi, A Afriatun	2024	Upaya Peningkatan Hasil Belajar IPAS Melalui Model Problem Based Learning Terintegrasi TARL	Integrating TARL in PBL positively impacts learning outcomes in science for grade IV students.
N. Asrobanni, H Lestari	2024	Penerapan Pembelajaran Model Problem Based Learning Dengan Pendekatan TARL	TARL enhances active participation and comprehension in PBL approaches.
D. Dinaramdani, A Zahra	2024	Pendekatan TARL untuk Meningkatkan Hasil Belajar Siswa Kelas XI	The TARL approach significantly boosts student outcomes in language and literature learning.
S. Sunarti, T Masfingatin	2023	Meningkatkan Keterampilan Kolaborasi Melalui Model PJBL dengan TARL	The TARL approach significantly enhances students' learning achievement in language and literature education
EF Subeqi, VD Susanti	2024	Penggunaan LKPD Berbasis TARL untuk Meningkatkan Hasil Belajar	TARL-based LKPD provides a structured method for improving students' mathematical reasoning skills.
S. Amalia, S.Safrida	2024	Culturally Responsive Teaching with LKPD	LKPD design paired with cultural contexts motivates learning and improves biology outcomes.
S. Komarayanti	2024	Biology Learning Through LKPD and TARL	TARL helps differentiate learning and reduces the knowledge gap among biology students
D. Rahmawati	2024	Cooperative Learning with TARL on Mathematics	TARL enhances peer collaboration and active engagement in solving math problems.
IE Lestari, S Maharani	2024	PBL with TARL: Enhancing Learning Outcomes	PBL with TARL provides an innovative method to boost conceptual understanding in various subjects.

Author	Year	Title	Findings
H. Saulina	2024	Implementasi Permainan Edukatif dengan TARL	Educational games designed within TARL frameworks engage students more effectively in learning concepts.
L. Fitria, EF Sari	2024	Teaching at the Right Level and LKPD for Math Improvement	TARL application increases effectiveness of learning modules, particularly for math in elementary schools.
MC As, A Sulistyarsi	2024	Problem-Based Learning with TARL	Combining TARL with PBL drives innovation in teaching, particularly for cognitive outcomes in biology
L. Juniati	2020	Bahasa Indonesia Learning via TARL	Interactive LKPD improves student comprehension in language learning.
YS Edo	2023	E-LKPD for Dance Learning	E-LKPD facilitates creative learning in traditional arts and engages students through multimedia tools
EF Sari, ZF Khairunnikmah	2024	Penerapan TARL pada Pembelajaran Matematika	The TARL approach assists students in mastering fundamental math concepts with confidence.
A.Sulistyarsi	2024	Problem-Based Learning (PBL) and TARL Approach	PBL with TARL ensures deeper engagement and better knowledge retention among high school biology students.
L. Juniati	2020	Bahasa Indonesia Learning via TARL	TARL-based language learning modules foster critical thinking and active participation.
S. Erlinkha	2024	Biology Learning Using TARL Framework	TARL focuses on aligning teaching levels with students actual academic levels, bridging gaps in comprehension.
Y.F. Andini	2023	LKPD Development for Enhanced Learning Outcomes in Mathematics	Interactive LKPD combined with TARL improved problem-solving abilities in junior high school mathematics.
A.Nugraha, S. Budiarta	2023	Teaching Geometry with TARL and LKPD	TARL implementation in geometry increased student comprehension and engagement in spatial reasoning tasks.
R.A Sudarmono	2023	Exploring Cognitive Outcomes with LKPD in Biology	LKPD contextualized to biology improved retention of ecological concepts among high school students.
F. Hidayati, T. Rahma	2022	TARL-based Active Learning for Science	Active learning strategies utilizing TARL and LKPD led to higher engagement and conceptual clarity in physics lessons.
S. Wibisono	2021	Digital LKPD in Enhancing Collaborative Learning	Digitalized LKPD tools fostered better peer interaction and teamwork in project-based biology lessons.
M. Firdaus, Z. Rahmat	2023	Adaptive Learning Frameworks with LKPD for Language Arts	LKPD-based frameworks enhanced comprehension of literary texts, with significant improvements in narrative writing.
A.Gunawan, L. Suyadi	2022	Enhancing Physics Learning Outcomes through Problem- Solving LKPD	TARL and problem-solving focused LKPD modules improved critical thinking and application of physics concepts.
B. Astuti	2020	Integration of Local Wisdom in LKPD Design	Contextual LKPD modules integrated with local wisdom promoted cultural understanding and multidisciplinary learning.
H. Prasetya	2021	Strengthening STM Learning through LKPD.	LKPD in STEM disciplines encouraged experimentation and problem-solving among middle school student.
A.Syifa	2020	Mobile-based LKPD for Environmental Science Education.	Mobile-based LKPD applications enhanced understanding of environmental issues and fostered active participation in community projects.

According to Table 1, the use of Student Worksheets (LKPD) as a learning instrument has evolved considerably over the past decade, particularly through the integration of technology-based and differentiated learning approaches. Previous studies have reported that LKPD may support student engagement and structured learning activities. However, the effectiveness of

LKPD remains theoretically and empirically fragmented across studies, particularly regarding which design features most effectively promote student participation, conceptual understanding, and learning outcomes in different educational contexts. While some studies emphasize constructivist and technology-integrated approaches such as Teaching at the Right Level (TaRL), others report varying levels of implementation and effectiveness. This inconsistency highlights the need for a comprehensive review to synthesize current findings and identify unresolved dimensions in LKPD development and application (Busri et al., 2023).

Discussion

The reviewed studies suggest that the Teaching at the Right Level (TaRL) approach, supported by LKPD, may contribute to improved student learning outcomes in several educational contexts. TaRL adjusts the level of learning to students' actual abilities, creating a more personalized and relevant learning experience. For instance, research by Busri et al. (2023) shows that using LKPD based on TaRL in science education significantly enhances student learning outcomes. These findings align with Vygotsky's concept of the Zone of Proximal Development (ZPD) (Shabani et al., 2010), where learning facilitated with tools like LKPD can accelerate student development.

Innovation in LKPD design has emerged as a major focus of this study. Nata and Manuaba (2022) propose the use of the Design Thinking Framework in developing LKPD. Their findings suggest that this method not only improves student engagement but also fosters critical and creative thinking. This approach aligns with Bloom's Taxonomy, which promotes the development of higher-order thinking skills through task-based learning (Adams, 2015).

In the context of science education, Pratiwi and Lestari (2024) found that integrating Problem-Based Learning (PBL) with LKPD significantly improves students' understanding of scientific concepts. LKPD in this approach is designed to guide students in solving real-world problems that are relevant to their daily lives. This finding supports Bruner's argument on the importance of discovery-based learning in building new concepts.

The use of technology-based LKPD has added a new dimension to learning. Octaviana et al. (2022) show that digital LKPD promotes better collaboration among students in project-based learning. Digital LKPD enables students to access materials flexibly, accelerating content mastery, and providing real-time feedback. These findings support Siemens' connectivism theory, which argues that learning in the digital age must be based on connectivity and access to information.

In mathematics education, Putri et al. (2024) emphasize that TaRL helps teachers adjust the difficulty level of materials to students' abilities, aligning with personalized learning approaches. In this study, LKPD plays a crucial role in ensuring a personalized learning experience. These findings demonstrate the effectiveness of personalized learning in improving student performance, especially when combined with tailored learning tools such as LKPD.

In biology education, Ambarwati and Wilujeng (2023) found that LKPD integrating local culture increases student motivation to learn. This finding is consistent with Moll et al. (1992) cultural learning theory, which emphasizes the importance of contextualizing education based on students' cultural experiences. The inclusion of cultural elements in learning materials can significantly improve student engagement and the relevance of content.

Another study by Triwahyudianto et al. (2024) highlighted that integrating LKPD with PBL enhances students' critical thinking skills. In their research, LKPD was designed to help students analyze and solve problems in local contexts, in line with the learning approaches applied by Lave and Wenger (Sholihah & Faizah, 2025). This emphasizes the importance of integrating problem-solving tasks that reflect students' everyday experiences, enhancing both critical thinking and practical skills.

Research in the arts also shows significant benefits from LKPD innovation. Kusumayanti et al. (2022) developed e-LKPD for traditional dance learning, demonstrating that multimedia-based LKPD significantly increased student engagement. This approach supports Putra and

Dewantoro (2022) theory of multiple intelligences, emphasizing the need to diversify teaching methods to cater to students' various learning preferences.

In STEM education, Aisyah et al. (2024) found that experiment-based LKPD encourages students to understand abstract concepts through a hypothesis-driven approach. This finding aligns with Dewey's experiential learning theory (Roberts, 2003), which stresses the importance of hands-on experiences in understanding complex ideas.

In conclusion, this review shows that LKPD is a versatile and adaptable tool for various teaching approaches. The most notable innovation is the integration of TaRL with digital LKPD, which facilitates personalized technology-based learning. This innovation offers solutions to modern educational challenges, particularly in improving the quality of teaching and student learning outcomes across different educational contexts. The findings align with various educational theories and approaches, demonstrating the transformative potential of LKPD in enhancing student engagement and learning in a wide array of subjects.

CONCLUSION

This review suggests that Student Worksheets (LKPD), particularly TaRL-based and digital LKPD designs, may support student engagement, conceptual understanding, and differentiated learning within the contexts examined in the reviewed studies. A systematic analysis of 30 articles reveals that innovative designs, such as TARK-based LKPD and e-LKPD, have significantly increased student engagement, conceptual understanding, and critical thinking skills. By aligning learning materials with students' abilities through TARK, LKPD promotes personalized and differentiated instruction, narrowing gaps in heterogeneous classrooms. Additionally, e-LKPD offers flexibility and accessibility, allowing students to study independently while integrating interactive multimedia tools to improve engagement and retention. These findings emphasize the relevance of LKPD in addressing the challenges posed by the evolving demands of 21st-century education.

However, challenges remain in making LKPD universally applicable across various subjects and cognitive levels. The integration of cultural elements and higher-order thinking skills has proven beneficial but requires broader implementation across disciplines. Furthermore, equitable access to technology-based LKPD in resource-limited areas and ongoing teacher training are crucial to maximizing their potential. Future research should focus on developing cross-disciplinary and adaptive LKPD frameworks to meet diverse educational needs, ensuring that LKPD continues to function as an effective instrument for achieving holistic and sustainable learning outcomes. However, the reviewed studies varied considerably in research design, sample characteristics, and outcome measurements, which limits the generalizability of the findings.

Future studies should also focus on developing comprehensive and cross-disciplinary LKPD frameworks that integrate critical thinking, creativity, and collaboration skills, enabling broader implementation across various subjects and educational levels. Efforts should be directed toward improving the accessibility of e-LKPD in schools with limited resources to ensure equitable learning opportunities. Moreover, professional development programs for teachers are essential to enhance their ability to design, use, and adapt LKPD effectively in diverse educational environments. Integrating advanced technologies, such as artificial intelligence and augmented reality, could further enrich LKPD by creating more interactive and immersive learning experiences. Finally, future research should explore how LKPD designs can better support holistic educational goals, including emotional intelligence, communication skills, and ethical reasoning, in addition to academic achievement, to align with the ever-evolving needs of modern education.

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