



The Role of Student Worksheets in Deep Learning-Based Inquiry Learning Models in Physics Education: A Systematic Literature Review

Jihan Defina^{1*}, Phakrur Razi¹, Hufri¹, Hayyu Yumna¹

¹ Department of Physics, Universitas Negeri Padang, Jl. Prof. Dr. Hamka Air Tawar Padang 25131, Indonesia
Corresponding author. Email: definajihan192@gmail.com

ABSTRACT

Physics learning in schools is expected to facilitate not only the acquisition of conceptual knowledge but also the development of students' scientific reasoning and higher-order thinking skills. One learning strategy that has gained attention in physics education is inquiry-based learning, particularly when supported by appropriate instructional materials. Student Worksheets play an important role in guiding students through structured learning activities that encourage active engagement and conceptual construction. In addition, the deep learning approach emphasizes meaningful learning, reflection, and the integration of knowledge across concepts. This study aims to systematically examine the role of Student Worksheets within inquiry-based learning models that are integrated with a deep learning approach in physics education. A Systematic Literature Review (SLR) was conducted by analyzing 15 relevant national and international journal articles published over the last ten years. The findings indicate that inquiry-based Student Worksheets designed according to deep learning principles contribute positively to students' conceptual understanding, critical thinking skills, and learning engagement in physics. These results highlight the potential of integrating inquiry learning and deep learning approaches through well-designed Student Worksheets to enhance the quality of physics learning.

Keywords: Student Worksheet, Inquiry Learning, Deep Learning, Physics Learning



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I. INTRODUCTION

Physics is a branch of science that focuses on understanding natural phenomena and explaining the relationships among fundamental concepts that govern physical events. Within the context of school education, physics learning is not solely intended to ensure students master formulas or theoretical concepts, but also to cultivate scientific reasoning skills, critical thinking abilities, and positive scientific attitudes [1]. Ideally, physics instruction should provide students with opportunities to actively engage in constructing knowledge through observation, reasoning, and problem-solving. Nevertheless, in many classroom settings, physics learning is still predominantly characterized by teacher-centered approaches, where information is delivered in a one-way manner. Such instructional practices often result in students becoming passive recipients of knowledge and less actively involved in the learning process [2].

These conditions pose significant challenges, particularly because physics learning demands a deep conceptual understanding and the ability to relate abstract principles to real-world phenomena. When learning activities are not designed to encourage active engagement, students tend to rely on memorizing equations and procedures without truly understanding the underlying physical concepts [3]. As a consequence, students frequently encounter difficulties when required to apply physics concepts in problem-solving situations or to interpret physical phenomena encountered in everyday life. Therefore, it is essential to implement learning models that actively involve students in the process of constructing knowledge and understanding concepts meaningfully.

One instructional approach that has been widely recognized as capable of addressing these challenges is inquiry-based learning [4]. Inquiry learning places students at the center of the learning process by engaging them in activities such as formulating questions, conducting investigations, analyzing data, and drawing conclusions based on evidence. Through this process, students are encouraged to discover physics concepts independently and develop a deeper understanding of the subject matter [5]. However, the successful implementation of inquiry-based learning does not solely depend on the learning model itself, but is also strongly influenced by the availability of instructional tools that can systematically guide students' thinking processes throughout each stage of inquiry.

In this context, Student Worksheets play a crucial and strategic role in supporting inquiry-based physics learning [6]. Well-designed Student Worksheets function not merely as collections of tasks, but as structured learning guides that direct students through inquiry activities in a coherent and organized manner. These worksheets assist students in identifying problems, organizing observations, analyzing experimental data, and formulating scientific conclusions. Consequently, Student Worksheets help ensure that inquiry activities are conducted in a focused and meaningful way.

Furthermore, teachers' ability to design and develop instructional materials, including Student Worksheets, is a key factor that determines the effectiveness of the learning process [7]. Instructional materials that are aligned with learning objectives and inquiry stages can enhance student engagement and support meaningful learning experiences. This indicates that Student Worksheets should not be viewed as supplementary materials, but rather as essential components in the implementation of inquiry-based learning models in physics education.

Alongside the evolving demands of 21st-century education, the deep learning approach has increasingly gained attention in physics learning [8]. This approach emphasizes meaningful and reflective learning processes that promote deep conceptual understanding and long-term knowledge retention. Learning materials developed based on deep learning principles encourage students to connect new information with prior knowledge and apply concepts across different contexts. Previous studies have demonstrated that the development of instructional materials incorporating deep learning principles can significantly improve the quality of physics learning processes [9]. Instructional materials that are systematically and contextually designed are therefore considered highly appropriate for supporting effective and meaningful physics learning [10].

The combination of inquiry-based learning models with a deep learning approach is widely considered capable of creating more meaningful and engaging learning experiences for students, particularly in physics education. By encouraging students to actively investigate problems while simultaneously developing deep conceptual understanding, this integration has the potential to enhance both cognitive engagement and learning quality. However, despite its theoretical advantages, empirical studies that specifically explore how Student Worksheets function as instructional tools in systematically integrating inquiry learning and deep learning remain relatively limited. In response to this gap, the present study seeks to systematically examine and synthesize previous research concerning the role of Student Worksheets in supporting the implementation of deep learning-based inquiry learning models in physics education through a comprehensive literature review.

II. METHOD

This research adopts a qualitative approach by employing the Systematic Literature Review (SLR) method to examine existing studies related to physics education. The SLR method was selected because it enables a structured and transparent process for identifying, evaluating, and synthesizing previous research findings in a systematic manner. Through this approach, relevant studies concerning the role of Student Worksheets in the implementation of inquiry-based learning models integrated with a deep learning approach can be comprehensively reviewed. The use of SLR allows researchers to obtain a broad and in-depth understanding of research trends, dominant themes, key findings, and existing research gaps, which are essential for strengthening future studies in the field of physics education.

The data sources for this study consist of scientific articles published in both national and international journals that are relevant to physics education. The literature search process was carried out using several well-established academic databases, including Web of Science (WoS), Google Scholar, and national journal portals. Articles were retrieved by applying a set of keywords aligned with the focus of the study, such as Student Worksheets, inquiry-based learning, deep learning approaches, and physics learning. To ensure that the search results were closely related to the research objectives, these keywords were combined using appropriate search operators, allowing the identification of studies that specifically addressed the integration of instructional materials, learning models, and approaches in physics education.

Following the literature search, the retrieved articles were subjected to a selection process based on predetermined inclusion and exclusion criteria. Articles included in the analysis were those that discussed Student Worksheets, inquiry-based learning, or deep learning approaches within the context of physics or science education, were published within the last ten years, represented empirical research or literature reviews, and were accessible in full-text form. In contrast, articles that were not relevant to the research topic, consisted solely of opinions or non-scientific reports, or did not address physics learning or instructional tools were excluded from the analysis to maintain the rigor and relevance of the review.

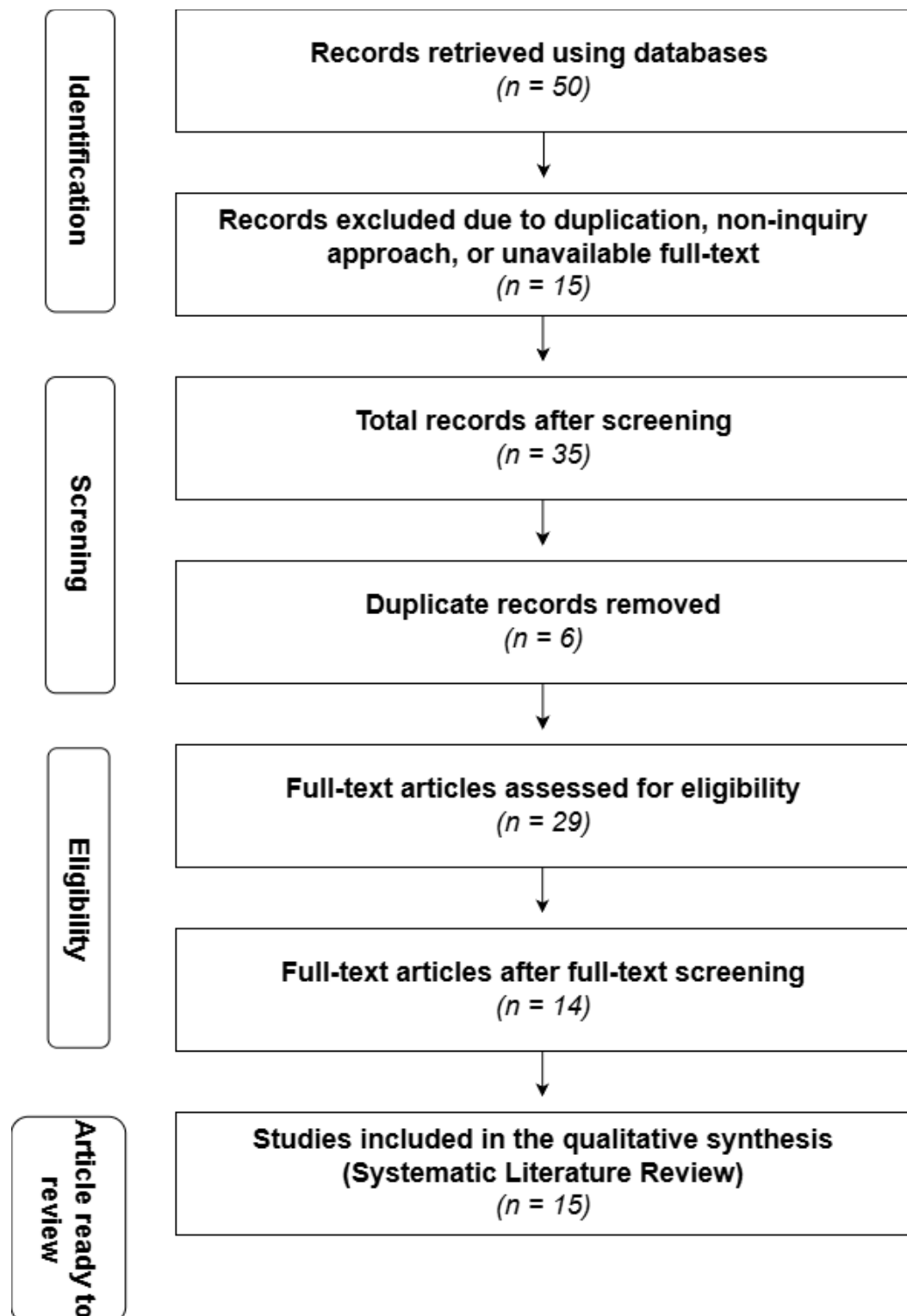


Fig. 1. Flow Diagram of the Literature Selection Process

The article selection process was conducted through several systematic stages. Initially, relevant studies were identified by searching predetermined academic databases. The screening process was then performed by examining the titles and abstracts to assess their relevance to the research objectives. Articles that were considered relevant subsequently

underwent a full-text review to ensure alignment with the established inclusion criteria. Only studies that satisfied all predetermined criteria were included as primary data sources in this research.

Data analysis was carried out using a content analysis approach. Each selected article was examined to identify its research focus, methodological design, and key findings, particularly in relation to the role of Student Worksheets in inquiry-based learning and the application of the deep learning approach in physics education. The results of the analysis were organized into thematic categories, including the contribution of Student Worksheets to supporting inquiry activities, the effectiveness of deep learning in fostering meaningful learning experiences, and its implications for enhancing the quality of physics learning. These findings were then synthesized narratively to develop a comprehensive and in-depth understanding, which served as the foundation for the research discussion.

III. RESULTS AND DISCUSSION

Result

This study is grounded in the findings of a systematic literature review involving 15 scientific articles aligned with the keywords student worksheets or learning materials, inquiry learning, deep learning, and physics learning. The review provides an overview of research trends and key findings related to physics learning. The analyzed articles consisted of international publications indexed in Web of Science (WoS) as well as accredited national journals that address inquiry-based learning integrated with a deep learning approach and the development of physics instructional materials, particularly Student Worksheets.

The analysis focused on identifying the research emphasis, learning approaches implemented, and the principal outcomes reported regarding the effectiveness of physics learning. The results indicate that inquiry-oriented learning combined with a deep learning approach, supported by structured instructional materials such as Student Worksheets, plays a significant role in enhancing students' conceptual understanding, critical thinking abilities, and active engagement in physics learning.

Table 1. Summary of Research Findings on Inquiry Learning, Deep Learning Approach, and the Use of Student Worksheets in Physics Education

Author	Year	Article type	Focus	Results
Norsyazwani et al.	2024	International	Inquiry Learning	Inquiry-based learning was found to enhance students' science concept understanding when each phase of the inquiry process, from orientation to conclusion, was implemented systematically and consistently during instruction.
Tonje Tominne et al.	2023	International	Inquiry-based learning in	The study indicates that physics learning conducted through inquiry-based approaches leads

				teacher education	to significantly better conceptual understanding than direct instruction, particularly in supporting active knowledge construction.
Indah Selviandri et al.	2025	National	Worksheet and inquiry	The developed LKPD demonstrated a high level of validity and practicality, received positive responses from students, and contributed to improvements in conceptual understanding and analytical thinking skills.	
Fitrah Andriadi et al.	2025	National	Learning model and deep learning	The implementation of deep learning-oriented learning models supports deeper conceptual understanding in physics, enabling students to move beyond memorization toward meaningful learning processes.	
Muhammad Ilahi et al.	2023	National	Inquiry as an approach	Students who participated in inquiry-based experimental learning activities showed significantly higher critical thinking abilities compared to those taught using conventional learning approaches.	
Sulistia Ningsih et al.	2025	National	Deep learning	Research trends over the past five years reveal that deep learning approaches in physics education increasingly emphasize the development of conceptual understanding and higher-order thinking skills.	
M. A. R. Febriyanto & Titin Sunarti	2024	National	Inquiry-based learning and teaching methods	The implementation of inquiry-based LKPD effectively improves students' ability to represent physics concepts and demonstrates strong learning effectiveness based on student responses.	
K. Rath et al.	2024	National	Worksheets and Inquiry	The inquiry-oriented worksheets developed in this study were found to be feasible and effective, particularly in	

Dina Suradin et al.	2025	National	Deep learning and learning models	supporting the improvement of students' science process skills during physics learning. Deep learning based instructional models contribute positively to students' conceptual understanding in physics, especially when applied to abstract and complex subject matter.
A. A. Isdiyanti et al.	2025	National	Deep learning	The application of deep learning in physics learning improves overall learning outcomes and supports better retention of physics concepts over time.
R. Lintangsekarjati et al.	2025	National	Inquiry learning	Inquiry learning enhances students' analytical and evaluative thinking abilities while simultaneously increasing active participation throughout the physics learning process.
Deni Irdiansyah et al.	2025	National	Inquiry worksheet	Inquiry-based worksheets facilitate the development of students' critical thinking skills and mathematical representation abilities, particularly in solving physics-related problems.
Devi Safitri et al.	2025	National	Worksheet and Inquiry	Worksheets integrated with inquiry learning improve students' inquiry skills, especially in formulating hypotheses and interpreting experimental data in physics learning.
Ria Asep Sumarni et al.	2025	National	Deep learning	The integration of AI-assisted deep learning environments promotes higher student engagement, strengthens conceptual understanding, and enhances critical thinking in physics learning.
Riska Putri et al.	2022	National	Deep learning	The integration of AI-assisted deep learning environments promotes higher student

engagement, strengthens conceptual understanding, and enhances critical thinking in physics learning.

Current scholarly evidence suggests that the efficacy of physics education is heavily dependent on the systematic organization of instructional models. Research indicates that students' conceptual mastery is significantly bolstered through inquiry-based learning, provided that every phase from orientation to final conclusion is executed with consistency and rigor [11]. When contrasted with conventional direct instruction, this inquiry-centric approach offers a superior framework for facilitating active knowledge construction among both students and pre-service teachers [12]. This pedagogical success is further amplified by the deployment of valid and practical Student Worksheets (LKPD), which have been empirically shown to sharpen students' analytical thinking capacities [13].

A primary focus in contemporary science education reform is the depth of cognitive engagement. The integration of instructional models oriented toward deep learning assists learners in transcending rote memorization, guiding them toward a more profound and meaningful understanding of physical phenomena [14]. Furthermore, learners who participate in inquiry-driven experimental activities exhibit significantly higher critical thinking faculties compared to those subjected to traditional methodologies [15]. Recent investigative trends confirm that deep learning strategies are increasingly prioritized to cultivate both sophisticated conceptual insights and higher-order thinking skills within the physics curriculum [16].

The strategic selection of instructional instruments also serves as a critical determinant of academic achievement. Inquiry-based worksheets have proven highly effective in refining a student's ability to accurately represent complex physical concepts [17]. The feasibility and design of these worksheets are vital, particularly in fostering essential science process skills throughout the instructional period [18]. For physics topics characterized by abstraction and complexity, deep learning models provide a transformative impact on student mastery [19]. In the long term, these strategies are proven to solidify conceptual retention, ensuring that students maintain a robust understanding over time [20].

Moreover, inquiry based frameworks not only stimulate active engagement but also enhance evaluative thinking skills within the physics classroom [21]. Specifically, the use of specialized inquiry worksheets facilitates the development of mathematical representation skills, which are indispensable for solving intricate physical problems [22]. By integrating worksheets with inquiry methods, students are better equipped to master core scientific competencies, such as hypothesis formulation and the interpretation of experimental data [23]. As a modern innovation, the convergence of deep learning environments with Artificial Intelligence (AI) has been shown to simultaneously elevate student engagement, reinforce conceptual foundations, and sharpen critical inquiry [24], [25].

Discussion

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indicates that students conceptual mastery is significantly bolstered through inquiry based learning, provided that every phase from orientation to final conclusion is executed with rigor and consistency [11]. When contrasted with conventional direct instruction, this inquiry centric approach offers a superior framework for facilitating active knowledge construction among both students and pre service teachers [12]. This pedagogical success is further optimized by the deployment of valid, practical, and contextual Student Worksheets or LKPD [13].

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Moreover, inquiry based frameworks stimulate active participation and enhance evaluative thinking skills within the classroom [21]. Specifically, the use of specialized inquiry worksheets facilitates the development of mathematical representation skills, which are indispensable for solving intricate physical problems [22]. By integrating worksheets with inquiry methods, students are better equipped to master core scientific competencies, such as hypothesis formulation and the interpretation of experimental data [23]. Finally, modern innovations that converge deep learning environments with artificial intelligence have been shown to simultaneously elevate student engagement, reinforce conceptual foundations, and sharpen critical inquiry [24], [25].

IV. CONCLUSION

Research indicates that systematic inquiry based physics instruction significantly bolsters conceptual mastery by engaging students in active knowledge construction. The integration of valid and practical Student Worksheets or LKPD optimizes this process, sharpening analytical skills, data interpretation, and mathematical representation. Furthermore, the deep learning approach shifts the focus from rote memorization to profound conceptual understanding and interrelationships between ideas. This strategy effectively enhances long term retention and fosters higher order thinking skills among learners. Ultimately, the synergy of inquiry

methods, LKPD, and deep learning promotes higher engagement and active participation in solving complex physics problems.

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