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Bibliometric Analysis of Reflective Practices in Physics Learning: Trends, Challenges, and Future Directions

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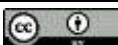
ABSTRACT

Objective: *This study aims to provide a comprehensive bibliometric analysis of reflective practices in physics education, identifying global trends, research gaps, and future directions. The focus is to map the development of reflective practices as a key 21st-century skill in physics learning and to highlight their role in strengthening conceptual understanding, metacognitive awareness, and student autonomy.* **Method:** *A bibliometric research design was employed using the Scopus database as the primary source. Data were collected from 1995 to 2025, filtered according to inclusion criteria, and analyzed using performance analysis and science-mapping techniques. Tools such as VOSviewer and Biblioshiny were used to visualize publication trends, collaboration networks, and keyword co-occurrences, ensuring validity and replicability.* **Results:** *The findings indicate significant growth in publications since 2015, peaking in 2024. Conference proceedings dominate research outputs, while reputable journals play a more minor yet influential role. The United States, China, and Indonesia emerge as leading contributors, with varying levels of international collaboration. Keyword analysis highlights "students," "reflection," and "deep learning" as dominant themes, reflecting a shift toward student-centred and technology-enhanced pedagogies.* **Novelty:** *Unlike prior studies that focused mainly on classroom implementation or teacher training, this research systematically maps reflective practices in physics education through bibliometric analysis. It provides the first global overview of research trends and offers strategic recommendations for advancing reflective practices as a transformative approach in 21st-century physics education.*

INTRODUCTION

In the 21st century, physics education is expected not only to equip students with mastery of formulas and problem-solving routines but also to foster critical, reflective, and adaptive thinking skills (Alanazi et al., 2025; Heldalia et al., 2025; Musengimana et al., 2025; Susanti et al., 2021; Worku et al., 2025). Reflection in learning is considered one of the key competencies that helps students make sense of their learning experiences, identify misconceptions, and strengthen metacognitive abilities. This expectation aligns with the modern education paradigm, which emphasizes learning how to learn and shaping lifelong learners (Baker et al., 2021; Mukherjee et al., 2024; Hussein, 2025). Consequently, reflective practices in physics classrooms are envisioned as a bridge to deepen conceptual understanding while cultivating awareness of scientific ways of thinking.

In practice, however, physics learning remains largely dominated by a cognitive orientation, focusing primarily on memorizing formulas and repetitive exercises (Schöllhorn et al., 2022; Sengul, 2024; Li et al., 2023; Hussein, 2025). Teachers often rely on lectures and problem drills, leaving little room for students to reflect on their learning. Recent studies also indicate that although reflective practices have been widely discussed