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Advancing SDG 4 through Deep Learning Approaches: Reconstructing Student Learning from Metacognitive and Higher-Order Thinking Skills Perspectives

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DOI : <https://doi.org/10.63230/jocsis.2.3.248>

Sections Info

Article history:

Submitted: February 3, 2026

Final Revised: May 1, 2026

Accepted: June 10, 2026

First Available Online: July 14, 2026

Publication Date: Desember 27, 2026

Keywords:

Higher-Order Thinking Skills;

Higher Education;

Metacognition;

Sustainable Education; SDG 4;

Transformative Learning.

ABSTRACT

Objective: To reconstruct student learning within the context of sustainable quality education by exploring the integration of deep learning approaches, metacognition, and Higher-Order Thinking Skills (HOTS) in higher education. The study responds to the persistent dominance of memorization-oriented and procedural learning practices that limit students' cognitive development and lifelong learning capacities.

Methods: A qualitative conceptual design was employed using thematic analysis of scholarly literature published between 2022 and 2026. Relevant studies on deep learning, metacognition, HOTS, and sustainable higher education were systematically reviewed to identify key themes and conceptual relationships. **Results:** The analysis demonstrates that deep learning promotes meaningful cognitive engagement, reflective awareness, and active knowledge construction. Metacognitive regulation functions as a central mechanism linking deep learning and HOTS through planning, monitoring, and evaluating learning processes. Furthermore, inquiry-based learning, reflective activities, and authentic problem-solving experiences enhance students' analytical reasoning, creativity, adaptability, and critical thinking, which are essential competencies for sustainable learning and future workforce readiness. **Novelty:** The proposes an integrated conceptual framework that connects deep learning, metacognition, and HOTS within the broader agenda of Sustainable Development Goal 4 (Quality Education). The framework offers a comprehensive perspective for transforming student learning from surface-level knowledge acquisition to meaningful and reflective learning, while providing theoretical insights for educators and researchers seeking to promote sustainable and transformative educational practices in higher education.

INTRODUCTION

The transformation of higher education in the twenty-first century has fundamentally changed the orientation of learning. Universities are no longer expected merely to transfer knowledge, but also to cultivate students who are capable of critical thinking, reflective reasoning, problem solving, and adaptive decision-making in complex professional contexts (Fullan et al., 2023; Huang et al., 2023). In this situation, learning outcomes are not sufficiently measured through memorization or procedural competence alone, but through students' ability to construct meaning, regulate their own thinking processes, and apply knowledge in authentic situations. Consequently, the discourse surrounding *deep learning*, metacognition, and Higher-Order Thinking Skills (HOTS) has become increasingly central in contemporary educational research.

The growing emphasis on deep learning, metacognition, and Higher-Order Thinking Skills (HOTS) is closely aligned with the global agenda of Sustainable Development Goal 4 (SDG 4), which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (UNESCO, 2024; OECD, 2023). Contemporary higher education institutions are expected not only to equip students with disciplinary knowledge but also to foster critical thinking, reflective