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Artificial Intelligence and the Development of Higher-Order Thinking Skills in Teacher Education: Challenges and Pedagogical Implications

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Abstract

Artificial Intelligence (AI) has emerged as a transformative force in contemporary education, significantly influencing teaching and learning practices across all levels, particularly in teacher education programs such as B.Ed. courses. The integration of AI tools like generative chatbots, intelligent tutoring systems, and adaptive learning platforms has created new opportunities for personalized and efficient learning. However, alongside these advantages, concerns have arisen regarding their impact on the development of Higher-Order Thinking Skills (HOTS), which include critical thinking, creativity, problem-solving, analysis, and evaluation. This thematic paper explores the relationship between AI and HOTS within teacher education. It highlights how AI can both support and hinder cognitive development depending on its pedagogical use. The paper further examines major challenges such as cognitive offloading, over-reliance on AI-generated content, reduced analytical engagement, and issues of academic integrity. In addition, it discusses the pedagogical implications for teacher educators and emphasizes the need for AI literacy, reflective practice, and inquiry-based learning. Finally, it suggests strategies for effective integration of AI in teacher education to ensure the balanced development of HOTS among B.Ed. trainees.

Keywords: Artificial Intelligence, Higher-Order Thinking Skills, Teacher Education, B.Ed. Trainees, Critical Thinking, Pedagogy, AI Literacy

Introduction

Artificial Intelligence has rapidly transformed the educational ecosystem by introducing intelligent systems capable of performing tasks traditionally associated with human cognition. In teacher education, AI plays an increasingly significant role in lesson planning, content generation, assessment, and personalized learning support. While these advancements improve efficiency and accessibility, they also raise concerns about their influence on the cognitive development of learner-teachers. Higher-Order Thinking Skills (HOTS) are essential for future educators as they enable analytical reasoning, reflective judgment, and creative problem-solving in classroom situations. However, the growing dependence on AI tools may alter the way these skills are developed. Therefore, it becomes crucial to examine

how AI influences HOTS within teacher education contexts and what pedagogical measures are required to maintain cognitive depth and intellectual independence among B.Ed. trainees.

AI in Education: Conceptual Perspective

Artificial Intelligence in education refers to the use of machine-based systems that simulate human intelligence to perform educational tasks such as content delivery, feedback generation, assessment, and learning support. In teacher education, AI technologies are used for developing lesson plans, supporting micro-teaching, generating instructional resources, and enhancing digital learning experiences. These systems enable adaptive learning environments that respond to individual learner needs and provide instant feedback. However, AI also represents a shift from traditional knowledge construction processes to technology-mediated learning, where learners may increasingly rely on automated systems rather than independent cognitive effort. This shift requires critical examination in the context of teacher preparation programs.

Higher-Order Thinking Skills (HOTS)

Higher-Order Thinking Skills refer to complex cognitive processes that involve analysis, evaluation, synthesis, and creation, as identified in Bloom's revised taxonomy. In teacher education, HOTS are essential for developing professional competencies such as lesson planning, classroom management, reflective teaching, and problem-solving in diverse educational contexts. These skills enable teacher trainees to move beyond memorization and engage in deeper conceptual understanding. HOTS also play a vital role in fostering innovation and adaptability in teaching practices. Therefore, the development of HOTS is a central objective of teacher education programs, making it important to examine how emerging technologies like AI influence these skills.

Challenges of AI in Developing HOTS

Despite its educational benefits, AI poses several challenges to the development of Higher-Order Thinking Skills. One major concern is cognitive offloading, where learners rely on AI tools to complete tasks that would otherwise require independent thinking. This reduces opportunities for deep cognitive engagement. Another challenge is over-dependence on AI-generated content, which may limit creativity and originality among B.Ed. trainees. Furthermore, the availability of instant answers can reduce critical thinking and analytical reasoning, as learners may accept AI outputs without questioning or evaluating them. Academic integrity is also a concern, as AI-generated assignments may blur the boundaries between original work and assisted content. Additionally, superficial learning may occur when learners prioritize quick outputs over meaningful understanding, ultimately affecting the development of HOTS.

Pedagogical Implications

The integration of Artificial Intelligence in teacher education requires a significant pedagogical transformation that moves beyond traditional teacher-centred instruction towards a learner-centred and inquiry-driven learning environment. In this changing scenario, teacher educators are expected to function as facilitators of critical thinking, reflective practice, and

active knowledge construction rather than mere transmitters of information. AI tools can support this transformation by offering personalized learning experiences, but their pedagogical use must ensure that learners remain cognitively engaged and do not become dependent on automated outputs. Therefore, the development of AI literacy becomes essential for B.Ed. trainees so that they can understand both the strengths and limitations of AI systems and use them responsibly in academic contexts. At the same time, reflective thinking should be continuously encouraged so that trainees critically analyze their own learning experiences while interacting with AI-based tools. In order to operationalize these ideas in classroom practice, certain pedagogical strategies become highly relevant.

- Teacher education should shift from lecture-based teaching to learner-centred and activity-based pedagogy.
- AI tools must be used as supportive learning aids rather than replacements for independent thinking.
- Classroom tasks should include critical evaluation of AI-generated responses to develop analytical skills.
- Assignments should require justification, reasoning, and explanation instead of direct answers.
- Collaborative learning activities using AI platforms should be encouraged to promote discussion and peer learning.
- Reflective journals should be integrated to help trainees analyze their AI-assisted learning experiences.
- Teaching-learning processes should emphasize application, analysis, evaluation, and creation rather than memorization.
- Assessment practices should focus on process-oriented evaluation rather than only final outputs.
- Ethical guidelines for responsible use of AI should be explicitly taught and followed.
- Continuous professional development of teacher educators is necessary to adapt to evolving AI technologies.

In this way, pedagogical practices in teacher education can ensure that Artificial Intelligence functions as a cognitive support system rather than a substitute for thinking, thereby strengthening Higher-Order Thinking Skills among B.Ed. trainees.

Strategies for Teacher Education

To ensure the effective development of Higher-Order Thinking Skills (HOTS) in the AI-driven educational environment, teacher education programs must adopt innovative and learner-centred pedagogical strategies. In the present context, where Artificial Intelligence is increasingly influencing teaching and learning processes, it becomes essential to design instructional approaches that promote deep thinking, inquiry, and active engagement among B.Ed. trainees. Inquiry-based learning emerges as a foundational strategy in this regard, as it encourages learners to explore educational problems, ask meaningful questions, and develop analytical understanding through investigation. Similarly, problem-based learning plays a crucial role in connecting theoretical knowledge with real-life classroom situations, enabling

trainees to develop practical reasoning and decision-making abilities. In addition to these approaches, collaborative learning strategies such as group discussions, peer teaching, and cooperative tasks can significantly enhance critical engagement and collective knowledge construction. Reflective practices, particularly reflective journals, further support metacognitive development by helping trainees analyze their own learning experiences, especially when interacting with AI-based tools. Alongside these pedagogical approaches, assessment practices also require meaningful transformation to ensure alignment with HOTS development.

- Inquiry-based learning should be emphasized to encourage exploration, questioning, and analysis of educational problems.
- Problem-based learning should be used to connect theoretical concepts with real classroom situations and practical challenges.
- Collaborative learning activities such as group discussions and peer teaching should be promoted to enhance critical engagement.
- Reflective journals should be implemented to develop metacognitive awareness of AI-assisted learning experiences.
- Assessment methods should focus on reasoning, justification, and application of knowledge rather than memorization or rote responses.
- Creative and analytical tasks should be included in evaluation to measure Higher-Order Thinking Skills effectively.
- Learners should be encouraged to explain and defend their answers to strengthen conceptual understanding.
- AI tools should be integrated in a way that supports learning but still requires independent thinking and reflection.

Through these integrated strategies, teacher education programs can effectively ensure that the development of HOTS is not compromised in the AI era but rather strengthened through meaningful pedagogical innovation.

Future Directions

The integration of Artificial Intelligence in teacher education and the development of Higher-Order Thinking Skills requires continuous research, innovation, and policy support. In the future, teacher education must evolve in response to rapidly changing technological environments while maintaining a strong focus on cognitive and ethical development.

- AI integration frameworks should be developed specifically for teacher education programs to guide structured and ethical use of technology.
- Continuous professional development programs should be organized for teacher educators to enhance AI literacy and pedagogical adaptability.
- Curriculum reforms should include dedicated modules on Artificial Intelligence and digital pedagogy in B.Ed. programs.
- Future research should focus on the long-term impact of AI usage on Higher-Order Thinking Skills among pre-service teachers.

- Assessment systems should be redesigned to evaluate creativity, reasoning, and problem-solving rather than rote learning.
- Ethical guidelines for the use of AI in academic work should be clearly defined and strictly implemented.
- Blended learning models combining traditional pedagogy and AI tools should be further explored and refined.
- Institutions should promote student awareness about responsible and critical use of AI in learning.
- Comparative studies should be conducted across different teacher education institutions to understand AI effectiveness.
- Policy-level interventions should ensure balanced integration of AI without compromising human cognitive development.

Conclusion

Artificial Intelligence presents both opportunities and challenges for the development of Higher-Order Thinking Skills in teacher education. While AI enhances accessibility, efficiency, and personalized learning, it also raises concerns related to cognitive dependency, reduced critical engagement, and academic integrity. The development of HOTS among B.Ed. trainees requires a balanced pedagogical approach that integrates AI as a supportive tool rather than a replacement for human thinking. Teacher educators play a crucial role in guiding this integration through reflective, inquiry-based, and ethical teaching practices. Ultimately, the success of AI in education depends on its ability to enhance, rather than diminish, the intellectual capacities of future teachers.

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