



Enhancing Higher Order Thinking Skills (HOTS) in Education: Strategies and Outcomes

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ABSTRACT

This study investigated the effectiveness of higher-order thinking skills (HOTS)-focused teaching strategies on the development of critical thinking skills among first-year students in the Department of Education Technology at Sebelas Maret University, Surakarta, Indonesia. Despite increasing recognition of HOTS in education, there is a gap in empirical research examining its impact in Indonesian higher education contexts. Employing a quasi-experimental design, the research involved an intervention group utilizing HOTS-focused project-based learning and a control group receiving traditional instruction. Quantitative data from pre- and post-tests demonstrated statistically significant improvements in the intervention group's critical thinking scores, with an average increase of 12.5 points compared to only 4.8 points in the control group. The effect size of 1.65 indicated a large and meaningful impact of the intervention. Qualitative feedback indicated higher engagement and enjoyment levels among students in the HOTS group. However, challenges such as time constraints and resource limitations were identified, highlighting barriers to effective implementation. The findings may not be fully generalizable to other settings due to the limited sample size and specific context of the study. Further research is needed to examine the effectiveness of other HOTS-focused teaching strategies and to address the challenges related to time constraints and resource limitations. These findings underscore the need for educational institutions to prioritize HOTS development through curriculum design and teacher training, paving the way for future research on long-term impacts and strategies for supporting educators.

Keywords: Education mixed-methods research; High order thinking skills; Student outcomes; Teaching strategies

INTRODUCTION

The global landscape of education is undergoing a significant transformation, driven by a demand for graduates equipped with higher-order thinking skills (HOTS) essential for navigating an increasingly complex world. The 21st century requires individuals capable of critical thinking, problem-solving, and creativity (Anderson & Krathwohl, 2001; Perkins, 1995). Traditional teaching methods often focused on rote learning and passive student engagement (Darling-Hammond, 2010), but there is a growing shift towards student-centered approaches that emphasize active learning and meaningful experiences (Ministry of Education and Culture, Republic of Indonesia, 2017; Ministry of Education Malaysia, 2015).

It is more crucial than ever to develop critical thinking and problem-solving abilities in the quickly changing educational environment of today. The ability to apply knowledge creatively and analytically is becoming a critical result of modern education as society shifts toward increasingly complex and technologically advanced environments. The development of Higher Order Thinking Skills (HOTS) is a crucial strategy for fostering these competencies. These competencies encourage students to participate in in-depth, reflective learning by encompassing skills like analysis, evaluation, and creation that go beyond fact recall and memorization (Anderson & Krathwohl, 2001).

The foundation of higher order thinking skills is Bloom's Taxonomy, a framework that Benjamin Bloom first presented in 1956 and that divides learning goals into tiers of complexity. According to Bloom (1956), the original model placed a strong emphasis on cognitive skills, with the higher tiers concentrating on more complex thought processes like synthesis and evaluation. Bloom's original taxonomy was expanded upon in the revised version by Anderson and Krathwohl (2001), who highlighted abilities like creating, evaluating, and analyzing as the highest forms of cognitive engagement. These higher-order cognitive functions are essential for equipping students to overcome obstacles in the real world and support their success in the classroom, in the workplace, and in their personal lives.

While the significance of HOTS is widely acknowledged, there is a need for more empirical research examining its impact within specific educational contexts, particularly in developing countries like Indonesia. This study addresses this gap by investigating the effectiveness of HOTS-focused teaching strategies on the development of critical thinking skills among first-year students in the Department of Education Technology at Sebelas Maret University in Surakarta, Indonesia. By focusing on a quasi-experimental design, the study aims to provide evidence-based insights into the potential of these strategies to enhance critical thinking skills and contribute to the development of a more skilled and adaptable workforce.

Problem Statement

Despite the growing emphasis on HOTS, challenges remain in effectively integrating these skills across diverse educational contexts. Research indicates that educators face obstacles such as limited access to resources, inadequate teacher training, and cultural differences in learning styles (Suherman et al., 2020; Seman, Yusoff, & Embong, 2017). For instance, studies have shown that Indonesian students' performance in mathematics and science literacy is significantly below the international average, as evidenced by their rankings in assessments like PISA and TIMSS (Palungan, 2014; Balitbang, 2015). This study examines the challenges and opportunities associated with fostering HOTS, focusing on the specific context of 10th-grade English language arts students in a suburban high school in Surakarta, Indonesia.

Research Objectives

This research aims to:

1. Identify and analyze HOTS strategies implemented within the Department of Education Technology at Sebelas Maret University.
2. Investigate the perceptions of students regarding the effectiveness of these strategies in fostering HOTS, identifying key factors contributing to their perceived effectiveness.
3. Explore the challenges educators face when integrating HOTS strategies within the Department of Education Technology and propose solutions through teacher training and professional development initiatives.

Significance of the research

This research contributes significantly to the field of education in Indonesia by

addressing the critical need for a more nuanced understanding of HOTS implementation in a university setting. Drawing upon research findings that highlight the importance of HOTS for 21st-century success (Hammond & Falk, 2013; Haniah & Setiawan, 2020; Sani, 2019), this study seeks to:

- **Identify Effective Strategies:** By examining the strategies employed in the Department of Education Technology, the research will provide valuable insights into practical approaches that promote HOTS development.
- **Address Challenges:** The study will shed light on the obstacles educators face in effectively integrating HOTS into their teaching and propose solutions tailored to the unique context of the department.
- **Support Policy Development:** The findings will inform policy development and professional development initiatives within Sebelas Maret University, potentially leading to improved educational outcomes for students in the Department of Education Technology.

Literature review

The literature indicates a pressing need for effective strategies to enhance HOTS in educational settings, particularly in Indonesia, where students' performance in international assessments is lacking. The integration of inquiry-based learning models, such as guided and free inquiry, has shown promise in fostering HOTS (Hendryarto, 2013; King, Goodson, & Rohani, 2017). This study aims to fill the gap in understanding how these models can be effectively implemented in the context of Indonesian education, thereby contributing to the development of a more skilled and competitive workforce.

The importance of Higher-order thinking skills (HOTS)

A robust body of research underscores the importance of developing higher-order thinking skills (HOTS) in students, highlighting the need to move beyond rote learning and encourage deeper, more critical engagement with knowledge (Bloom, 1956; Anderson & Krathwohl, 2001; Perkins, 1995). HOTS are crucial for students to succeed in an increasingly complex and rapidly changing world. These skills empower students to analyze information critically, solve problems creatively, and adapt to new challenges. They are essential for navigating the demands of higher education, the workplace, and everyday life.

Bloom's Taxonomy, a framework that divides learning goals into tiers of complexity, emphasizes the importance of HOTS, including analysis, evaluation, and creation, in cognitive development (Krathwohl, 2002). This framework provides a valuable tool for educators to understand the cognitive processes involved in HOTS and to design instructional strategies aimed at cultivating these skills (McNeil, 2011; Facione, 2011).

Effective teaching practices

Research consistently highlights the essential role of educators in fostering Higher Order Thinking Skills (HOTS) (Perkins, 1995; Darling-Hammond, 2010; Baker & Brown, 1984). Effective educators move beyond traditional rote learning and passive learning environments, creating spaces that encourage active participation, critical thinking, and deep engagement with knowledge. They understand that students need to be challenged to think for themselves, analyze information, and apply their knowledge in real-world contexts. Effective pedagogical practices that foster HOTS include scaffolding learning experiences by providing structured support to help students gradually develop their HOTS, modeling critical thinking processes by explicitly demonstrating how to analyze information, evaluate arguments, and solve problems, facilitating meaningful discussions that allow students to share their perspectives, challenge assumptions, and refine their understanding of complex issues, providing authentic and challenging contexts such as real-world problem-solving scenarios, research projects, or simulations, promoting metacognitive skills through

techniques like think-alouds, reflective journaling, and peer feedback, and utilizing technology effectively to provide interactive learning experiences that encourage students to analyze data, conduct research, and communicate their ideas in creative ways. By incorporating these effective pedagogical practices, educators can cultivate a learning environment that promotes HOTS and empowers students to become more critical, creative, and independent thinkers.

Assessment and Metacognition

Traditional assessment methods often fail to adequately measure HOTS (Wiggins & McTighe, 2005). These methods often focus on recall of facts and basic knowledge, failing to capture students' ability to analyze information, evaluate evidence, and generate creative solutions. To effectively assess HOTS, educators need to shift towards authentic assessments that provide students with opportunities to demonstrate their higher-order thinking skills in real-world contexts. These assessments include performance-based tasks that require students to apply their knowledge and skills in a practical setting, open-ended questions that encourage students to go beyond simple recall and demonstrate their ability to analyze, synthesize, and evaluate information, and portfolios that allow students to showcase their work over time, demonstrating growth in their critical thinking abilities and reflecting on their learning process. The development of HOTS is also intricately linked to metacognitive skills and self-regulated learning (Flavell, 1979; Zimmerman, 2002). Metacognition refers to students' awareness of their own thinking processes and their ability to monitor and regulate their learning. This includes understanding their strengths and weaknesses, identifying effective learning strategies, and adapting their approaches based on their needs. Instructional strategies that promote metacognition include think-alouds, where students verbalize their thinking processes and become more aware of their strategies, reflective journaling, where students can reflect on their learning experiences, analyze their thought processes, and identify areas where they need to develop their HOTS, and peer feedback, which allows students to understand different perspectives, analyze their own work critically, and refine their learning strategies. By incorporating these assessment methods and metacognitive strategies, educators can effectively measure and cultivate HOTS, helping students become more self-directed and effective learners.

The integration of technology

Educational technologies can provide interactive learning experiences that enhance creativity, critical thinking, and problem-solving skills (Cuban, 2001; Selwyn, 2011). However, technology should be used intentionally and strategically to support, rather than replace, sound pedagogical practices (Hodges, 2014). While technology alone cannot guarantee the development of HOTS, it can serve as a powerful tool when integrated effectively into a well-designed learning environment. Technology can enhance HOTS by providing interactive simulations and games that challenge students to apply their critical thinking and problem-solving skills in a real-world context, facilitating collaboration and communication through online platforms and tools that enable students to work together on projects, share ideas, and receive feedback from their peers, offering access to diverse resources such as online libraries, databases, and research tools that allow students to research complex topics, explore different perspectives, and develop their critical thinking skills, and personalizing learning experiences through adaptive learning platforms and personalized learning tools that can help students engage with content that is challenging and relevant to their interests. However, it's important to remember that technology should be used intentionally and strategically. It should not replace sound pedagogical practices that foster critical thinking and engagement. For instance, educators should not simply replace traditional lectures with online videos but should carefully consider how technology can be

integrated into a more interactive and student-centered learning environment.

Conceptual Framework

This study employs a conceptual framework that illustrates the interconnected relationship between the implementation of HOTS strategies, student engagement, and educational outcomes. The framework highlights how effective teaching practices, assessment methods, and the strategic use of technology can interact to foster higher-order thinking skills among students. Specifically, the framework posits that the successful implementation of HOTS-focused teaching strategies, characterized by active learning, inquiry-based approaches, and authentic assessments, leads to increased student engagement, as students become more actively involved in the learning process, find the content more relevant to their lives, and feel a sense of ownership over their learning. This enhanced engagement, in turn, contributes to improved educational outcomes, as students develop critical thinking skills, problem-solving abilities, and the ability to analyze information and generate creative solutions. The framework emphasizes the role of technology as a supportive tool to enhance these processes, providing interactive learning experiences, facilitating collaboration, and offering access to diverse resources that can further empower students to develop their HOTS. By considering the interplay of these factors, this research aims to provide a comprehensive understanding of the impact of HOTS strategies on student learning.

METHOD

This study investigates the impact of higher-order thinking skills (HOTS)-focused teaching strategies on the development of critical thinking skills in first-year students enrolled in the Department of Education Technology at Sebelas Maret University in Surakarta, Indonesia. This research adopts a constructivist epistemological stance, recognizing that knowledge is not passively received but actively constructed by learners through their interactions with the world. This perspective aligns with the belief that students are not empty vessels to be filled with information, but active participants in the learning process, shaping their understanding through their experiences. This study employs a quasi-experimental design, where a project-based learning approach incorporating HOTS-based activities was implemented in five classrooms, while five other classrooms served as a control group receiving traditional instruction. Students in the HOTS group engaged in activities such as analyzing complex texts, designing and conducting research projects, and participating in debates on relevant social issues.

Results from a standardized critical thinking assessment revealed statistically significant gains in critical thinking scores for students in the HOTS group compared to the control group. The HOTS group's average increase in scores was 12.5 points, while the control group showed a 4.8-point increase. Additionally, student surveys indicated significantly higher levels of engagement, interest in the subject matter, and a more enjoyable learning experience among students in the HOTS group. Both students and teachers in the HOTS group reported a greater sense of ownership and responsibility for their learning. The study also identified challenges educators faced when implementing HOTS instruction, including time constraints for lesson planning and implementation, a lack of adequate resources for project-based activities, and a need for additional training on effective HOTS strategies.

Participants

The study involved first-year students from the Department of Education Technology at Sebelas Maret University in Surakarta, Indonesia. Participants included students such as Hilya, Bella, Tawfiq, Bagas, Purwanto, Tasya, Hani, Seftia, Andrew, Aulia, Azzura, Tika, Rindang, and Maya, among others. They were randomly assigned to either an intervention

group (n=50) or a control group (n=50). The intervention group participated in HOTS-focused teaching strategies, while the control group continued with traditional instructional methods.

Settings

The research was conducted at Sebelas Maret University, specifically within the Department of Education Technology. This setting provided a relevant context for evaluating HOTS-focused teaching strategies, allowing for an examination of their effectiveness in enhancing critical thinking skills among first-year university students.

Data Collection Techniques

Data were collected through multiple methods

- **Standardized Assessments:** A critical thinking assessment was administered before and after the intervention to measure changes in student performance.
- **Surveys:** Student surveys evaluated engagement levels, interest in the subject matter, and overall satisfaction with the learning experience.
- **Interviews:** Qualitative data were gathered from teachers to understand the challenges and benefits experienced during the implementation of HOTS strategies

Validity of the research

To ensure the validity of the data:

- **Triangulation:** Multiple data sources (assessments, surveys, and interviews) were employed to provide a comprehensive view of the impact of HOTS instruction.
- **Pilot Testing:** The assessment tools and surveys were pilot-tested with a small group of students to refine questions and ensure clarity.

Data analysis techniques

Quantitative data from the standardized assessments were analyzed using statistical methods to determine the significance of differences between groups. Descriptive statistics were calculated for survey responses, and thematic analysis was applied to qualitative interview data to identify common themes and challenges related to HOTS instruction.

Ethical consideration

The study was conducted with a strong emphasis on ethical research principles:

- **Informed Consent:** All participants received a clear information sheet detailing the study's purpose, procedures, risks, and benefits, ensuring informed consent was obtained prior to data collection.
- **Anonymization:** All data collected were anonymized to protect participant identities.
- **Confidentiality:** Data were securely stored, with access restricted to the research team. Data will be destroyed after the study's completion.
- **Ethical Review:** The study received approval from the Muhammadiyah Surakarta University's ethics committee, ensuring compliance with ethical research standards.

Limitation of the study

This study had a relatively small sample size and was conducted in a specific context, which may limit the generalizability of the findings. Future research could:

- Explore the longitudinal impacts of HOTS instruction on academic achievement and long-term critical thinking skills.
- Investigate additional strategies for supporting teachers in successfully integrating HOTS into their classrooms.
- Examine the influence of student characteristics, such as learning styles and motivation, on the effectiveness of HOTS instruction.
- Evaluate the impact of HOTS-focused instruction across different subject areas and grade levels.

RESULT AND DISCUSSION

Subheadings

This section presents a comprehensive analysis of the data collected during the study, illuminating the key findings related to the effects of various teaching strategies on the development of higher-order thinking skills (HOTS) among students. The findings are derived from both quantitative and qualitative data sources, providing a robust understanding of how different instructional approaches influence students' cognitive abilities. By systematically examining the results, we aim to uncover the effectiveness of specific pedagogical methods in fostering critical and analytical thinking, problem-solving, and creativity within educational contexts. This analysis not only highlights the significance of these teaching strategies but also sets the stage for a deeper exploration of their implications for educational practice and student engagement.

Quantitative findings

Table 1: HOTS Pre- and Post-Test Scores by Group

Group	Pre- test mean	Post- test mean	Effect size
Intervention	65.20 (8.75)	78.50 (7.20)	1.65
Comparison	64.80 (9.10)	69.30 (8.50)	0.52

As illustrated in Table 1, the quantitative analysis reveals that students in the intervention group, who were exposed to HOTS-focused teaching strategies, demonstrated a significant improvement in their HOTS performance. The intervention group's post-test mean score of 78.50 represents a noteworthy increase from their pre-test mean of 65.20. In contrast, the comparison group showed only a modest increase from a pre-test mean of 64.80 to a post-test mean of 69.30. The calculated effect size of 1.65 indicates a large and meaningful impact of the instructional intervention on students' HOTS development.

Discussion

The findings of this study provide compelling insights into the effectiveness of teaching strategies aimed at promoting higher-order thinking skills (HOTS) among students. The analysis of both quantitative and qualitative data reveals the significant impact of HOTS-focused instruction on student learning, supporting the importance of transitioning from traditional, passive learning environments to more engaging and student-centered approaches.

Interpretation of Findings

The substantial improvement in post-test scores for the intervention group, which increased from a pre-test mean of 65.20 to a post-test mean of 78.50, demonstrates the effectiveness of targeted HOTS-focused teaching strategies. This result aligns with constructivist theories, which suggest that active engagement in learning, particularly through inquiry-based approaches, fosters deeper understanding and critical thinking (Brusilovsky & Millán, 2007). This finding also supports the principles of cognitive load theory, which suggests that meaningful and engaging activities reduce cognitive load, allowing students to focus on higher-order thinking processes (Sweller, 1988). The effect size of 1.65 indicates a large and meaningful impact of these instructional strategies on students' HOTS development.

In contrast, the comparison group showed a more modest increase in their post-test scores, rising from a pre-test mean of 64.80 to a post-test mean of 69.30. The effect size of 0.52 reflects a moderate impact, suggesting that traditional instructional methods may not be as effective in promoting HOTS. This finding supports previous literature indicating that passive learning environments often fail to cultivate the analytical and evaluative skills necessary for higher-order thinking (Freeman et al., 2014).

Insights on Student Engagement

Qualitative data from interviews revealed that students in the intervention group reported higher levels of engagement and enjoyment in their learning experiences. Many students expressed that activities designed to promote HOTS were not only more interesting but also relevant to their lives. This observation aligns with the theory of experiential learning, which posits that students learn best when they can connect their educational experiences to real-world contexts (Kolb, 1984). Additionally, the findings might suggest that the HOTS activities provided students with a greater sense of autonomy and control over their learning, consistent with self-determination theory (Deci & Ryan, 2000). By engaging with content that resonates with their experiences, students are more likely to remain motivated and invested in their learning.

Teacher Perspectives and Challenges

Teachers emphasized the importance of adapting their instructional practices to foster a more inquiry-based and student-centered learning environment. However, they also identified several challenges, including time constraints and a lack of resources, which hinder their ability to implement effective HOTS instruction. This finding echoes existing research that highlights systemic barriers faced by educators when attempting to shift from traditional teaching methods to more innovative practices (Darling-Hammond et al., 2017). This resistance to change can be understood through the lens of social cognitive theory, which suggests that teachers' beliefs about their capabilities and the potential outcomes of implementing new teaching strategies can influence their willingness to adopt these changes (Bandura, 1986).

Implications for Educational Practice

The results of this study underscore the necessity for educational institutions to prioritize the development of HOTS through curriculum design and professional development for teachers. To maximize the effectiveness of HOTS-focused teaching strategies, schools should provide educators with the training and resources needed to implement these methods successfully. This involves providing teachers with the necessary knowledge, skills, and support to effectively design and deliver HOTS-focused instruction. Furthermore, creating a collaborative environment where teachers can share best practices and strategies for integrating HOTS into their instruction is essential, aligning with principles of distributed leadership (Spillane, 2005).

Framework for developing HOTS

This framework outlines key areas for developing higher-order thinking skills (HOTS) in students, emphasizing three main skill sets essential for fostering these abilities. The first skill set, Critical Thinking, Evaluation, Analysis, Problem-Solving, and Decision-Making, encompasses vital cognitive skills that enable students to critically assess information, evaluate different viewpoints, analyze complex issues, and devise effective solutions to problems. The development of these skills is crucial for students to navigate academic challenges and real-world dilemmas successfully. The second skill set, Creativity, Idea Generation, Flexibility, and Fluency, promotes innovative thinking and adaptability among students. Creativity encourages learners to explore new ideas and approaches, while idea generation involves producing multiple possibilities for solutions. Flexibility and fluency further enhance students' ability to adjust their thinking and generate diverse responses to varying challenges. The third skill set, Metacognition, Self-Regulation, and Self-Mentoring, focuses on students' ability to reflect on their own learning processes and take control of their educational journeys. Metacognition involves awareness of one's own thought processes, enabling students to evaluate their understanding and strategies. Self-regulation and self-mentoring foster independence, encouraging students to set goals, monitor their progress, and

adjust their learning strategies accordingly.

CONCLUSION

This study has provided valuable insights into the impact of higher-order thinking skills (HOTS)-focuses teaching strategies on student learning outcomes. The findings indicate that students who participated in HOTS instruction exhibited significant improvements in their analytical and creative thinking abilities, as evidenced by their post-test scores. Additionally, both students and teachers reported heightened levels of engagement and enjoyment, emphasizing the effectiveness of an inquiry-based learning environment.

The Implications of these findings are profound. Educational institutions must prioritize the development of HOTS through intentional curriculum design and robust teacher professional development programs. Addressing the challenges identified, such as time constraints and resource limitations, is essential to fully realize the benefits of HOTS in the classroom. Future research should explore the long-term impacts of HOTS instruction on various student outcomes and examine additional strategies to support educators in this transition. By focusing on enhancing HOTS, we can better equip students to navigate the complexities of the information age and improve their problem-solving skills in real-world contexts.

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