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The Understanding Of Higher-Order Thinking Skills (Hots) Among Middle School Science Teachers in Lhokseumawe, Indonesia

R Andriani*, S Safriana, I W Winata, I Ameliah
Physics Education Departmen, Malikussaleh University, Aceh, Indonesia
*rizaandriani@unimal.ac.id

Abstract. This study aims to evaluate the understanding of Higher-Order Thinking Skills (HOTS) among middle school science teachers in public schools in Lhokseumawe. Employing a quantitative descriptive design, data were collected from 15 teachers selected through purposive sampling. A 15-item multiple-choice test was administered, with each question targeting specific HOTS indicators, such as Bloom's Taxonomy, project-based assessment, and analytical skills. The results revealed that while teachers demonstrated strong foundational knowledge of HOTS, with 93% showing proficiency in basic concepts and 87% understanding Bloom's Taxonomy, significant gaps were observed in the practical application of HOTS. Only 60% of teachers showed proficiency in project-based assessment, and just 53% demonstrated strong analytical skills. Furthermore, while 73% of teachers recognized the importance of HOTS in education, only 60% understood its long-term benefits for student growth. These findings highlight the need for targeted professional development, resource provision, and mentorship programs to enhance teachers' ability to implement HOTS effectively in their teaching practices. Addressing these gaps will better equip educators to foster critical thinking and problem-solving skills among students.

Keyword: HOTS, Science Teachers, Bloom's Taxonomy, Project-Based Assessment, Teacher Development, Education

1. Introduction

Higher-Order Thinking Skills (HOTS) are indispensable in contemporary education, as they foster students' ability to analyze, evaluate, and create knowledge rather than simply memorize or recall information. Rooted in Bloom's Taxonomy, HOTS encompass the upper levels of cognitive processes, including application, analysis, synthesis, and evaluation (Anderson & Krathwohl, 2001). These skills are critical in equipping students with the intellectual tools necessary to navigate an increasingly complex and dynamic global environment (Amali et al., 2022; Ms Sanchana Srivastava, 2023). In the context of science education, HOTS enable students to move beyond rote learning and engage in deeper, inquiry-based learning experiences that mirror the practices of real-world scientific exploration (Aryal, 2023; Suyidno et al., 2017)). The incorporation of HOTS into the learning process has been widely recognized as essential for preparing students to address challenges in academic, professional, and societal contexts (Brookhart, 2010).

A basic understanding of HOTS serves as the foundation for teachers to integrate these skills effectively into their teaching (Safirah et al., 2024). Teachers who grasp the core concepts of HOTS can design instructional strategies that challenge students to think critically, solve problems creatively, and apply knowledge in novel contexts (Ertmer & Newby, 2013; Kim et al., 2019). Bloom's Taxonomy, which categorizes cognitive learning objectives, is central to understanding HOTS. It helps educators differentiate between lower-order skills, such as remembering and understanding, and higher-order skills, such as analyzing and creating (Chinedu et al., 2015; Seman et al., 2017). This framework provides a structured approach for teachers to design learning activities that progressively build students' cognitive abilities (Krathwohl, 2002). Research suggests that teachers' mastery of Bloom's Taxonomy significantly impacts their ability to implement HOTS in classroom practices effectively (Presseisen, 2001)

HOTS-based learning, particularly in science education, emphasizes active student engagement through methods such as problem-based learning, inquiry-based experiments, and real-world application of scientific principles (Harlen, 2010; Jailani et al., 2017). For example, HOTS-based science learning encourages students to formulate hypotheses, analyze data, synthesize findings, and draw evidence-based conclusions (Alanazi et al., 2024; Usman et al., 2024). These activities cultivate deeper understanding and critical thinking, preparing students for advanced studies and professional challenges (Andriani, 2018). However, the success of HOTS-based learning hinges on teachers' ability to synthesize information effectively (Deshpande & Metkewar, 2020; Moyo et al., 2022; Ulgari et al., 2024). Synthesis, a core component of HOTS, involves combining disparate pieces of information into cohesive and innovative ideas, a skill essential for fostering creativity and innovation in students (Binkley et al., 2012).

Assessment also plays a vital role in promoting HOTS. Project-based assessment is a powerful tool for evaluating students' higher-order skills, as it requires them to apply their knowledge to solve real-world problems. By engaging in projects, students demonstrate their ability to synthesize information, analyze complex issues, and create viable solutions. However, the effectiveness of project-based assessment depends on teachers' understanding of how to design and implement such evaluations to align with HOTS principles (Thomas, 2000). Research by Widiati et al (2020) highlights the importance of integrating project-based learning with HOTS to enhance students' cognitive and problem-solving abilities, particularly in science education.

The importance of HOTS in education extends beyond academic achievement. HOTS empowers students to approach challenges with confidence, think independently, and adapt to diverse contexts. In an era of rapid technological advancement and information overload, these skills are essential for lifelong learning and active participation in society (Voogt & Roblin, 2012). Teachers' ability to evaluate students' application of HOTS is crucial, as effective evaluation ensures that instructional strategies meet learning objectives. Evaluation in HOTS requires teachers to assess students' analytical and critical thinking processes, providing feedback that encourages further cognitive development (Brookhart, 2010).

Developing strategies for HOTS implementation is an integral aspect of teacher preparation. Educators must be equipped with practical tools and methodologies to foster HOTS effectively in their classrooms. For instance, integrating Bloom's Taxonomy with innovative teaching approaches, such as project-based learning or technology-enhanced instruction, can make HOTS more accessible and impactful (Mellyzar et al., 2024). Teachers also need to understand the characteristics of HOTS, such as problem-solving, critical thinking, and creativity, to tailor their instruction to meet these objectives (Riza Andriani et al., 2023; Trilling & Fadel, 2009)

Moreover, understanding the benefits of implementing HOTS highlights its transformative potential. Beyond academic success, students who develop HOTS are better prepared for the workforce and life challenges, as they can think critically, collaborate effectively, and innovate solutions to complex problems. Teachers must recognize these benefits to remain motivated in incorporating HOTS into their instruction, even when faced with challenges such as limited resources or time constraints (OECD, 2018). Research further suggests that teacher training and continuous professional development are key to equipping educators with the skills and confidence to foster HOTS in their students (Darling-Hammond et al., 2017).

The understanding and application of HOTS among middle school science teachers are crucial for fostering a learning environment that prepares students for future challenges. From mastering basic concepts to implementing advanced strategies like project-based assessment, teachers' proficiency in HOTS directly influences students' ability to develop critical and creative thinking skills. This study seeks to evaluate the current level of HOTS understanding among teachers in Lhokseumawe, focusing on key aspects such as Bloom's Taxonomy, synthesis, evaluation, and the benefits of HOTS-based learning. By identifying strengths and gaps, this research aims to provide actionable recommendations for enhancing teachers' instructional practices, ultimately benefiting students and contributing to the broader goals of educational excellence.

2. Methodology

The methodology for this study employed a quantitative descriptive design to assess the understanding of Higher-Order Thinking Skills (HOTS) among middle school science teachers in public schools in Lhokseumawe. The population for this study consisted of 15 science teachers selected using a purposive sampling technique, targeting individuals actively teaching science in middle schools who are relevant to the study's objectives. Data were collected through a structured multiple-choice test containing 15 questions, each designed to measure a specific aspect of HOTS, such as Bloom's Taxonomy, project-based assessment, and analytical skills. Each question corresponded to an individual indicator, with teachers' responses providing quantitative data on their level of proficiency in each aspect.

The data collection process involved administering the test under controlled conditions to ensure accuracy and consistency in responses. For data analysis, the percentage of correct answers for each question was calculated to evaluate the overall performance and understanding level of HOTS indicators among the participants. Descriptive statistics, such as frequency distributions and percentages, were used to summarize and interpret the results, allowing for a clear representation of the strengths and weaknesses in teachers' understanding of HOTS. The findings were then analyzed to identify specific areas where teachers demonstrated high proficiency as well as areas requiring further professional development. This methodological approach ensured a structured, objective evaluation of HOTS understanding among the sample group, providing insights into their instructional capabilities and areas for improvement.

3. Result and Discussion

This study aimed to assess teachers' performance in applying *Higher-Order Thinking Skills* (HOTS) in science teaching at the secondary school level. Data collected from 15 science teachers in Lhokseumawe revealed that most teachers had a strong basic understanding of HOTS concepts, but there was significant variation in how they applied HOTS in their teaching practices. Figure 1 presents the teachers' performance on each HOTS indicator, with further discussion on strengths and areas needing further development.

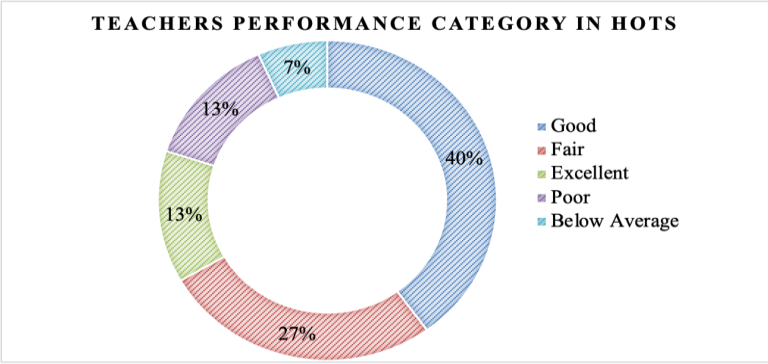

Figure 1. Science Teachers' Performance Category in HOTS

Figure 1 provides a breakdown of the performance categories of middle school science teachers in Lhokseumawe in their understanding of Higher-Order Thinking Skills (HOTS). According to the data, 40% of the teachers fall under the "Good" category, indicating that a significant portion of the educators has a relatively strong grasp of HOTS. The "Fair" category follows with 27%, suggesting that many teachers are competent but may still have room for improvement. Notably, only 13% of teachers are rated as "Excellent," while an equal percentage (13%) falls into the "Poor" category. The "Below Average" category accounts for the remaining 7%.

This distribution reveals several critical insights into the professional development needs and instructional capabilities of science teachers in Lhokseumawe. While a combined 67% of teachers fall within "Good" and "Fair" categories, the low percentage of teachers in the "Excellent" category highlights a gap in exceptional proficiency. This could suggest that while the majority of teachers have a functional understanding of HOTS, only a few demonstrate advanced or exemplary skills necessary for deepening student engagement and fostering critical thinking skills effectively in the classroom.

The presence of teachers in the "Poor" (13%) and "Below Average" (7%) categories raises concerns about the quality of science education provided to students who may be exposed to inadequate instructional methods. HOTS are critical for preparing students for complex problem-solving and analytical tasks; thus, these findings indicate an area that may require urgent intervention. Teachers with limited understanding of HOTS may struggle to implement teaching strategies that challenge students to apply, analyze, evaluate, and create new ideas—skills central to scientific literacy.

The moderate percentage of teachers in the "Good" category implies a foundation that can be built upon through targeted professional development initiatives. However, the scarcity of "Excellent" teachers could also point to systemic issues, such as limited access to resources or training opportunities focused on HOTS. To address these disparities, Lhokseumawe's educational authorities might consider implementing specific workshops, mentorship programs, or continuing education courses tailored to developing HOTS competencies. While the data indicate a fair level of understanding of HOTS among the majority of science teachers, the lack of excellence and presence of lower-performing teachers underscore a need for structured and sustainable professional development. By elevating teachers' proficiency in HOTS, Lhokseumawe's educational system can better equip students with the critical thinking and problem-solving skills essential in today's knowledge-driven world (Kimani, 2024; Mansell, 2002; Rati et al., 2023).

A more detailed analysis of the teachers' achievements across the 15 aspects of HOTS can be found in Table 1. This table provides a comprehensive breakdown of the teachers' understanding and application of each specific HOTS indicator, offering valuable insights into areas of strength as well as those that may require further development and improvement.

Table 1. Evaluation of HOTS Knowledge Among Middle School Science Teachers in Lhokseumawe

Question Number	Indicator	Percentage Correct	Comments
1	Basic Understanding of HOTS (Q1)	93%	Strong understanding of HOTS basics
2	Higher-Order Thinking Skills (Q2)	67%	Moderate understanding; needs improvement
3	Bloom's Taxonomy Levels (Q3)	87%	Good understanding of Bloom's Taxonomy
4	HOTS-Based Learning (Q4)	87%	Good understanding of HOTS-based learning
5	HOTS-Based Science Learning (Q5)	73%	Fair understanding of HOTS-based science
6	Synthesis of Information in HOTS (Q6)	67%	Needs improvement in synthesis skills
7	Project-Based Assessment (Q7)	60%	Requires further clarity on project-based assessment
8	Importance of HOTS in Education (Q8)	73%	Awareness of HOTS importance is adequate
9	Evaluation in HOTS (Q9)	67%	Evaluation process needs better comprehension
10	Bloom's Taxonomy - New Ideas (Q10)	80%	Understanding of idea generation is fair
11	Characteristics of HOTS (Q11)	53%	Requires clarity on HOTS characteristics
12	Analysis in HOTS (Q12)	53%	Limited understanding of analysis in HOTS
13	Strategies for Developing HOTS (Q13)	80%	Fair knowledge of HOTS development strategies

14	Project-Based Assessment for HOTS (Q14)	80%	Fair comprehension of project-based assessment
15	Benefits of Implementing HOTS (Q15)	60%	Requires improvement in understanding benefits

The data on middle school science teachers' understanding of Higher-Order Thinking Skills (HOTS) in Lhokseumawe provides a detailed insight into the strengths and challenges faced by educators in incorporating these essential skills into their teaching practices. HOTS, which encompasses skills such as critical thinking, analysis, synthesis, and evaluation, is crucial for developing students' ability to tackle complex problems and adapt to various academic and real-life situations. The overall results indicate that while a foundational understanding of HOTS is prevalent (with 93% scoring well in basic HOTS understanding), there are clear discrepancies in more specialized and practical applications. For instance, a good grasp of Bloom's Taxonomy (87%) and HOTS-based learning (87%) suggests that teachers understand the theoretical structure of HOTS and its general application. However, the lower scores in HOTS-based science learning (73%) and synthesis (67%) point to difficulties in contextualizing these skills within specific subject areas like science, which requires a specialized approach to foster critical thinking and problem-solving.

One relevant aspect for further analysis is the teachers' ability to apply HOTS through various pedagogical strategies. The moderate scores in project-based assessment (60%) and strategies for developing HOTS (80%) reveal that while teachers may be aware of these strategies, they might lack the practical tools or confidence to integrate them effectively into their teaching routines. Project-based learning (PBL) and other experiential methods are proven to foster deeper learning and engagement, especially in science subjects (Almulla, 2020; Lavado-Anguera et al., 2024; Yu, 2024). However, the low score in general project-based assessment indicates a need for more intensive training on how to design, implement, and assess projects that require students to apply HOTS. This gap suggests that while teachers might conceptually understand PBL, they may not feel equipped to apply it in their classrooms effectively, thus limiting students' opportunities to engage in hands-on, real-world problem-solving activities.

Additionally, the relatively low scores in understanding the *Characteristics of HOTS* (53%) and *Analysis in HOTS*(53%) point to a fundamental gap in recognizing the unique elements that define HOTS. This could affect how teachers interpret and implement HOTS-based approaches, potentially leading to surface-level rather than deep applications. If teachers lack clarity on what distinguishes HOTS from basic learning skills, they may inadvertently deliver lessons that do not fully challenge students' cognitive capacities. Therefore, training should include a focus on defining and recognizing HOTS elements across different scenarios, which could be supported by case studies and real-world examples to deepen teachers' understanding (King & Ritchie, 2012; Lloyd, 2017; Sølvik & Glenna, 2022).

The scores also suggest that while teachers acknowledge the importance of HOTS (73%) and have a fair understanding of generating new ideas based on Bloom's Taxonomy (80%), there is a limited awareness of the broader benefits of implementing HOTS in the classroom (60%). This finding indicates a need for educational programs that emphasize the long-term advantages of HOTS, not only in academic success but also in preparing students for life skills such as adaptability, critical thinking, and resilience (Carvalho et al., 2008; De Souza et al., 2015; Folke et al., 2010). By understanding the transformative potential of HOTS, teachers might be more motivated to invest in these methods and seek creative ways to incorporate them into their teaching practices.

Another factor to consider is the role of institutional support in enhancing teachers' HOTS proficiency. The data shows that only a small percentage of teachers excel in applying HOTS effectively, suggesting that the educational system may lack adequate resources or support structures (Hamzah et al., 2022). Effective HOTS implementation requires not only individual effort from teachers but also institutional backing in the form of curriculum support, access to resources, and a collaborative environment that encourages innovation (Bakah et al., 2019; Osborne, 2016; Zitha et al., 2023). School administrations in Lhokseumawe could support teachers by offering structured professional development opportunities, encouraging collaboration among teachers to share best practices, and providing access to teaching aids designed to facilitate HOTS-oriented lessons (Rati et al., 2023; Suhadi et al., 2023).

In light of this analysis, a comprehensive approach to address these gaps is recommended. First, workshops focusing on practical applications of HOTS within specific subjects like science could help teachers translate theoretical knowledge into actionable strategies. Second, ongoing mentoring programs that pair less experienced teachers with those who demonstrate higher proficiency in HOTS can foster a culture of continuous improvement. Third, providing teachers with access to resources—such as digital tools, lesson plans, and assessment models tailored to HOTS—can ease the transition from theory to practice. Finally, enhancing teachers' understanding of the long-term benefits of HOTS through seminars or discussions on educational psychology may inspire them to prioritize HOTS in their classrooms.

The data analysis reveals a foundational understanding of HOTS among middle school science teachers in Lhokseumawe, yet highlights significant areas for improvement, particularly in practical applications, project-based assessment, and a deeper conceptual grasp of HOTS characteristics. By addressing these gaps through targeted professional development, resource provision, and institutional support, Lhokseumawe's educational system can enhance teachers' capacity to deliver high-quality, HOTS-focused instruction. This improvement will ultimately benefit students, equipping them with critical thinking, problem-solving, and adaptive skills necessary for success in an increasingly complex world.

4. Conclusion

This study demonstrates that middle school science teachers in Lhokseumawe possess a strong foundational understanding of Higher-Order Thinking Skills (HOTS), with 93% demonstrating basic HOTS knowledge and 87% understanding Bloom's Taxonomy. However, they face challenges in practical application, particularly in areas such as project-based assessment, where only 60% show proficiency, and analytical skills, where just 53% demonstrate a strong grasp. These gaps in specialized skills limit teachers' ability to fully implement HOTS in the classroom, potentially restricting students' development of critical thinking and problem-solving abilities. Although 73% of teachers recognize the importance of

HOTS, only 60% understand its long-term benefits for student growth, which may impact their motivation to consistently integrate HOTS into their teaching practices. To bridge these gaps, the study recommends targeted professional development focusing on practical application of HOTS in science, provision of resources specifically designed to support HOTS-oriented teaching, and mentorship programs that encourage skill-sharing among educators. In summary, while teachers' foundational knowledge of HOTS is solid, enhancing their practical skills through institutional support, access to resources, and comprehensive training can better equip them to foster a classroom environment that promotes critical thinking, preparing students to navigate complex challenges in the future.References

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