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Analysis of HOTS in Informatics Textbook Assessment Questions Based on Revised Bloom's Taxonomy

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Abstrak

Permasalahan utama dalam pembelajaran Informatika di tingkat SMA adalah rendahnya penerapan aspek Higher Order Thinking Skills (HOTS) dalam soal evaluasi, yang berdampak pada pengembangan kemampuan berpikir komputasional, analitis, dan kreatif siswa. Studi ini dilatarbelakangi oleh kebutuhan untuk meningkatkan kualitas pembelajaran melalui evaluasi yang menuntut keterampilan berpikir tingkat tinggi. Penelitian ini bertujuan untuk menganalisis dan mengevaluasi representasi aspek HOTS pada soal evaluasi dalam buku teks Informatika untuk SMA Kelas X serta menilai implikasinya terhadap kualitas pembelajaran. Subjek penelitian adalah soal evaluasi dalam buku teks Informatika untuk SMA Kelas X, dengan total 75 soal yang dianalisis. Pengumpulan data dilakukan melalui metode analisis isi, dengan instrumen berupa lembar kategorisasi berdasarkan taksonomi Bloom revisi (C1–C6). Teknik analisis data meliputi identifikasi, klasifikasi, dan interpretasi tingkat kognitif soal-soal evaluasi. Hasil penelitian menunjukkan bahwa proporsi soal yang mengakomodasi aspek HOTS masih rendah (28%), dengan mayoritas soal berada pada kategori berpikir tingkat rendah (C1 dan C2). Pada ranah HOTS, dimensi menganalisis (C4) mendominasi, sedangkan mengevaluasi (C5) dan mencipta (C6) masih terbatas. Temuan ini mengindikasikan perlunya pengembangan soal evaluasi berbasis HOTS agar pembelajaran Informatika dapat lebih efektif dalam menumbuhkan kemampuan berpikir tingkat tinggi dan berpikir komputasional. Implikasi penelitian ini menegaskan pentingnya keterlibatan penulis buku teks, guru, dan pemangku kebijakan pendidikan dalam merancang soal evaluasi yang menekankan aspek HOTS untuk mempersiapkan siswa menghadapi tantangan abad 21.

Kata Kunci: HOTS; Soal Evaluasi; Buku Teks Informatika; Taksonomi Bloom Revisi

Abstract

The main problem in Informatics learning at the high school level is the low application of Higher Order Thinking Skills (HOTS) aspects in assessment questions, which impacts the development of students' computational, analytical, and creative thinking abilities. This study is motivated by the need to improve the quality of learning through assessments that demand higher-order thinking skills. This study aims to analyze and evaluate the representation of HOTS aspects in the assessment questions within an Informatics textbook for SMA Class X, and to assess its implications for the quality of learning. The research subject is the assessment questions in an Informatics textbook for high school students in Class X, with a total of 75 questions analyzed. Data collection was carried out using the content analysis method, with the instrument being a categorization sheet based on the revised Bloom's taxonomy (C1–C6). Data analysis techniques included identifying, classifying, and interpreting the cognitive levels of the assessment questions. The results indicate that the proportion of questions accommodating HOTS aspects is still low (28%), with the majority of questions falling into the lower order thinking category (C1 and C2). Within the HOTS domain, the analyzing dimension (C4) is dominant, while evaluating (C5) and creating (C6) remain limited. This finding indicates the need for developing HOTS based assessment questions so that Informatics learning can be more effective in fostering higher order and computational thinking skills. The implications of this research underscore the importance

of involving textbook authors, teachers, and education policymakers in designing assessment questions that emphasize HOTS aspects to prepare students for the challenges of the 21st century.

Keywords: *HOTS; Assessment Questions; Informatics Textbook; Revised Bloom's Taxonomy*

INTRODUCTION

Learning Informatics at the high school level plays a strategic role, not only in mastering technological and programming content but also as a means of developing computational, critical, analytical, and creative thinking skills. These competencies are essential for addressing the challenges of the twenty-first century, in which digital literacy and problem solving have become core capabilities (Huda et al., 2021; Listiani & Rachmawati, 2022). The national curriculum explicitly mandates the development of Higher Order Thinking Skills (HOTS) to equip students with analytical, evaluative, and creative abilities, as reflected in the higher level cognitive dimensions of Bloom's revised taxonomy (Anderson & Krathwohl, 2001; Kamaludin & Ismiatun, 2023). In practice, however, textbooks remain the primary reference in the classroom, and the assessment instruments within them function as benchmarks for students' competency achievement (Li & Wang, 2024; Safi'i et al., 2020). Consequently, the quality and proportion of HOTS questions in Informatics textbooks become a decisive factor in achieving these curricular goals, particularly for a subject that is intrinsically oriented toward computational and algorithmic reasoning.

Empirical findings indicate a clear discrepancy between expectations and reality, as the distribution of HOTS questions in textbooks is still uneven and tends to be suboptimal. Analyses of subject textbooks reveal that although HOTS questions (C4-C6) are present, their distribution lacks variation and balance (Dakoranis & Wahyuni, 2025; Santi et al., 2024). Similarly, research at the secondary level shows that HOTS content is frequently dominated by the analyzing dimension (C4), while evaluating (C5) and creating (C6) remain limited (Rudiansah, 2023; Setyorini, 2025), indicating a partial and less comprehensive development of higher order thinking skills. This condition suggests that textbooks have not fully functioned as effective instruments for fostering the full spectrum of HOTS as mandated by the curriculum, a concern that is especially pertinent in Informatics, where higher order tasks such as algorithm design, debugging, and system evaluation are central to the discipline.

The persistence of this gap becomes more critical in the context of Informatics textbooks for tenth grade students, where the mapping of HOTS aspects in assessment questions has not been systematically conducted. The absence of such mapping raises questions about the extent to which these textbooks contribute to students' computational and critical thinking development and overall learning quality (Hasnah et al., 2024; Utami, 2020). Theoretically, HOTS refer to high-level cognitive abilities that go beyond memorization and require the application of knowledge to solve problems and generate new ideas (Tindowen et al., 2017). These skills are increasingly essential in the twenty-first century (Johnson, 2009; Solihati & Hikmat, 2018) and include analyzing (C4), evaluating (C5), and creating (C6) based on Bloom's revised taxonomy (Anderson & Krathwohl, 2001). Thus, mapping HOTS aspects in textbook assessment questions is a crucial indicator for assessing the extent to which Informatics textbooks support higher-order thinking development.

Several studies have highlighted the importance of integrating HOTS into assessment instruments; however, their analytical focus remains limited and fragmented. Research on subject textbooks shows that HOTS distribution is still dominated by C4, while C5 and C6 are relatively underrepresented (Rahim et al., 2025; Rudiansah, 2023). Similar findings are reported in analyses of grade X textbooks, which reveal that although variations of HOTS questions exist, they remain limited in scope and depth (Geshere et al., 2026; Santi et al., 2024). At the international level, studies confirm that the integration of HOTS in assessment significantly contributes to students' cognitive development and readiness to face global challenges (King et al., 2020; Tan & Halili, 2019), and that HOTS-based instruments can enhance analytical and creative abilities while

supporting meaningful learning (Ballakrishnan & Mohamad, 2020; Heong et al., 2021). Nevertheless, many studies tend to focus only on the proportion of cognitive levels without examining qualitative dimensions such as computational thinking, problem solving, and decision making (Chandra et al., 2021; Yan & Cheng, 2021). Moreover, textbook-based studies in the field of Informatics remain very limited, despite evidence that textbook quality strongly influences the effectiveness of HOTS implementation due to teachers' reliance on instructional materials (O'Keeffe, 2022; Wijaya, 2024).

Accordingly, a clear research gap emerges. First, existing studies predominantly emphasize the quantitative proportion of cognitive levels (C1–C6) without systematically mapping the distribution, variation, and qualitative characteristics of HOTS (C4–C6) in an integrated manner. Second, there is a lack of in-depth analysis that connects cognitive levels with broader HOTS dimensions such as computational thinking, critical thinking, problem solving, and decision making, which are particularly relevant to Informatics. Third, studies specifically examining assessment questions in Informatics textbooks for grade X remain very limited. As a result, the current literature has not yet provided a comprehensive and context-specific understanding of how HOTS is represented, distributed, and operationalized in Informatics textbook based assessment.

At the policy and empirical level, strengthening HOTS remains a national priority through the curriculum, the Minimum Competency Assessment (AKM), and literacy based learning initiatives, which align with international assessments such as PISA and TIMSS that show relatively low performance of Indonesian students in literacy, numeracy, and problem solving compared to the OECD average (Mullis et al., 2020; OECD, 2020). One contributing factor is the limited exposure of students to learning activities that demand higher order thinking (Arum & Meier, 2021; Zubaidah et al., 2022). International evidence also shows that countries with high PISA performance systematically integrate HOTS into curricula, textbooks, and assessments (Breakspear, 2019; Darling et al., 2020). The legal basis for strengthening HOTS in Indonesia is reinforced through policies emphasizing twenty first century competencies, including the 4Cs (critical thinking, creativity, collaboration, and communication), in line with global standards (OECD, 2019; UNESCO, 2019).

The novelty of this study lies in its focused and systematic mapping of HOTS aspects (C4-C6) in the assessment questions of an Informatics textbook for grade X using a content analysis approach based on Bloom's revised taxonomy. Unlike previous studies that primarily emphasize the proportion of cognitive levels or focus on language and social science subjects, this study integrates the analysis of proportion, variation, and qualitative dimensions of HOTS questions within the specific context of Informatics, connecting them to computational thinking. This approach provides a more comprehensive and critical understanding of how HOTS is represented and operationalized in Informatics textbook based assessment. This study aims to analyze, map, evaluate, and interpret HOTS aspects (C1-C6, with emphasis on C4-C6) in the assessment questions of an Informatics textbook for grade X. Specifically, it seeks to examine the distribution of cognitive levels, identify the variation of HOTS dimensions, evaluate the quality of HOTS questions, and interpret their implications for the development of students' higher order and computational thinking skills. The findings are expected to provide both conceptual contributions to the study of HOTS and practical recommendations for improving the quality of textbook based assessment in Informatics education.

RESEARCH METHODS

This study employed a qualitative content analysis approach to systematically examine higher-order thinking skills (HOTS) in the assessment questions presented in an Informatics textbook for senior high school. Content analysis was chosen because it allows for an in depth and systematic exploration of textual data, particularly in identifying cognitive patterns embedded in assessment items. The research procedure was carried out through several sequential stages, beginning with the identification of all questions contained in the textbook, followed by the

classification of questions based on the revised Bloom's taxonomy (C1-C6) with particular attention to HOTS indicators, namely analyzing, evaluating, and creating. Furthermore, the study analyzed the distribution of these questions across chapters and examined the alignment between learning objectives, HOTS indicators, and the constructed assessment items to ensure instructional coherence.

The subject of this study was an Informatics textbook used at the senior high school level for grade X. The textbook was selected using a purposive sampling technique based on its relevance to the current curriculum and its widespread use in educational practice. A total of 75 assessment questions across all chapters were analyzed. This sampling approach was employed to ensure that the selected data source was representative and aligned with the objectives of the study, particularly in capturing the implementation of HOTS-oriented questions in authentic instructional materials. Data collection was conducted through document analysis by systematically reviewing and extracting all questions from the selected textbook.

The primary instrument used in this study was an analysis sheet specifically developed to identify and categorize questions based on the revised Bloom's taxonomy. The instrument encompassed several key aspects, including the six cognitive levels (C1–C6), the HOTS indicators (analyzing, evaluating, and creating), the distribution of questions based on cognitive levels, and the alignment between learning objectives and assessment items. These aspects were operationalized into measurable indicators to ensure that each question could be accurately classified and evaluated according to its cognitive demand. To ensure the validity of the instrument, content validation was conducted through expert judgment involving specialists in Informatics education and educational evaluation, who evaluated the relevance, clarity, and representativeness of each indicator in capturing HOTS components. Empirical evidence from previous studies supports this approach, indicating that HOTS question analysis instruments can achieve high validity levels (Arifin & Retnawati, 2024; Koza et al., 2024). The reliability of the instrument was tested through a pilot study and internal consistency analysis using Cronbach's Alpha, with instruments in comparable studies achieving an Aiken's V value ≥ 0.3 and a Cronbach's Alpha value ≥ 0.658, indicating that the instrument is both valid and reliable for analyzing HOTS-based questions (Arifin & Retnawati, 2024; Kurniawan & Karpudewan, 2021).

Data analysis was conducted using a combination of qualitative and descriptive quantitative techniques. The identified questions were categorized based on the cognitive levels of the revised Bloom's taxonomy and subsequently quantified to determine their distribution. The analysis aimed to identify patterns, proportions, and potential imbalances in the representation of HOTS questions throughout the textbook. To strengthen the interpretation of the findings, semi-structured interviews were also conducted with three Informatics teachers who use the textbook, exploring their experiences and perceptions regarding the quality and cognitive demand of the assessment questions. The alignment between learning objectives and assessment items was examined to evaluate the extent to which the textbook supports the development of higher-order thinking skills. The findings were then interpreted systematically to provide a comprehensive and methodologically robust understanding of HOTS integration in the Informatics textbook.

RESULTS AND DISCUSSION

Results

Based on the content analysis of the 75 assessment questions in the Informatics textbook for grade X, the distribution across the six cognitive levels of the revised Bloom's taxonomy revealed a clear dominance of lower-order thinking skills (LOTS). Questions at the remembering (C1) and understanding (C2) levels together accounted for more than half of all items, while questions accommodating HOTS aspects (C4–C6) constituted only 28% of the total. The distribution of questions by cognitive level is presented in Table 1.

Table 1. Distribution of Assessment Questions by Cognitive Level

Cognitive Level	Category	Number of Questions	Percentage
C1	Remembering (LOTS)	22	29.3%
C2	Understanding (LOTS)	19	25.3%
C3	Applying (LOTS)	13	17.3%
C4	Analyzing (HOTS)	10	13.3%
C5	Evaluating (HOTS)	6	8.0%
C6	Creating (HOTS)	5	6.7%
Total		**75**	**100%**

As shown in Table 1, lower-order thinking questions (C1–C3) dominated the assessment items, accounting for 71.9% of the total, while higher-order thinking questions (C4–C6) accounted for only 28.1%. The imbalance is visualized in Figure 1, which contrasts the LOTS and HOTS regions of the cognitive spectrum.

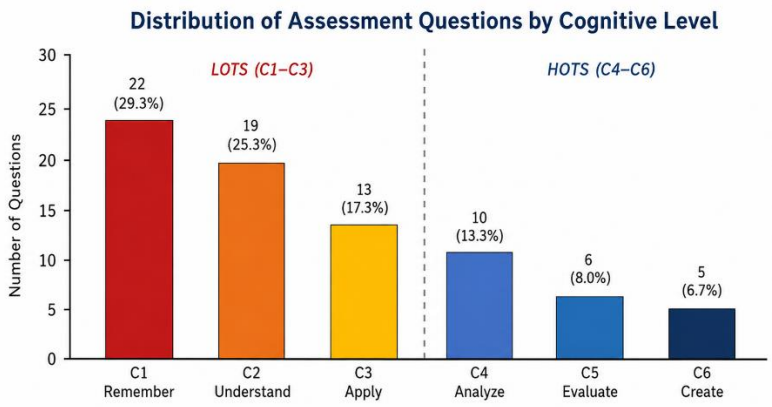

Figure 1. Distribution of Assessment Questions by Cognitive Level

Within the HOTS domain, the distribution across the three higher dimensions was itself uneven. The analyzing dimension (C4) was the most dominant, accounting for 47.6% of all HOTS questions, followed by evaluating (C5) at 28.6% and creating (C6) at 23.8%, as illustrated in Figure 2. This pattern indicates that even where higher order thinking is addressed, the textbook emphasizes analytical tasks more than evaluative and creative ones.

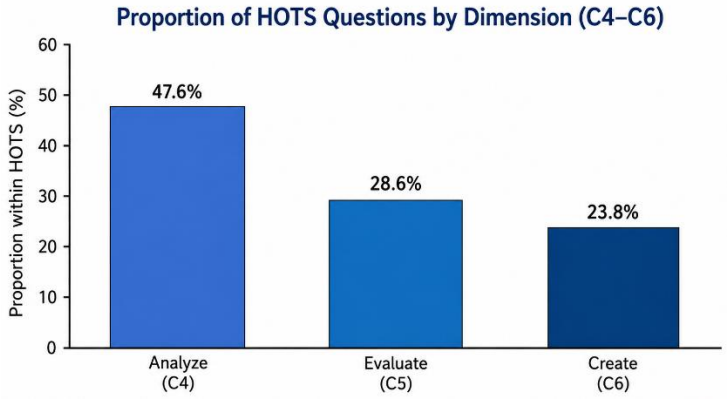

Figure 2. Proportion of HOTS Questions by Dimension (C4–C6)

A closer examination of the characteristics of each HOTS dimension provides insight into how higher-order thinking is operationalized in the Informatics context. In the analyzing dimension (C4), questions asked students to trace the flow of an algorithm, identify errors in a program fragment, compare two data structures, or examine the relationship between inputs and outputs in a system. In the evaluating dimension (C5), questions required students to assess the efficiency of an algorithm, judge the appropriateness of a data representation, or critique the validity of a proposed solution. In the creating dimension (C6), questions invited students to design a simple algorithm, construct a flowchart for a given problem, or develop a small program to meet specified requirements. The characteristics of the HOTS dimensions are summarized in Table 2.

Table 2. Characteristics of HOTS Dimensions in the Informatics Textbook

HOTS Dimension	Characteristics of the Questions
Analyzing (C4)	Tracing algorithm flow, identifying program errors, comparing data structures, and examining input–output relationships in a system.
Evaluating (C5)	Assessing the efficiency of an algorithm, judging the appropriateness of a data representation, and critiquing the validity of a proposed solution.
Creating (C6)	Designing a simple algorithm, constructing a flowchart for a given problem, and developing a small program to meet specified requirements.

To enrich the document-based findings, interviews were conducted with three Informatics teachers who use the textbook in their schools, referred to here by the initials AS, RD, and MN to preserve confidentiality. All three teachers stated that they used the assessment questions from the textbook for daily assessments, quizzes, and class discussions, although their experiences and appraisals differed. Teacher AS stated that the questions help students understand basic concepts but that many remain at the recall level; he often adds his own HOTS-based questions, particularly those involving contextual programming problems, to train students' computational reasoning. Teacher RD observed that most questions measure remembering and understanding, and that although some creating questions (C6) exist, analyzing (C4) and evaluating (C5) questions are still too few to challenge students adequately. Teacher MN noted that students frequently struggle with questions requiring higher-order thinking, especially those involving algorithm evaluation and problem solving, and expressed the hope that publishers would add more contextual, real-world programming tasks. The three teachers agreed that the assessment questions needed improvement in both the variety of HOTS aspects and their relevance to contemporary, contextual problems, and hoped that publishers could balance the proportion of LOTS and HOTS questions to provide a more challenging learning experience.

DISCUSSION

The findings of this study reveal that the analyzed Informatics textbook has incorporated higher-order thinking skills (HOTS), yet the distribution across cognitive levels remains imbalanced and dominated by lower-order thinking. The predominance of remembering and understanding questions indicates that the textbook prioritizes cognitive tasks that are structured, measurable, and aligned with conventional assessment practices, while higher-order tasks that are central to Informatics, such as algorithm design and system evaluation, are underrepresented. This imbalance mirrors broader concerns raised in the literature regarding the insufficient integration of higher cognitive levels in instructional materials (Rahmawati, 2018; Susanti et al., 2022), and it is particularly significant for a discipline whose core competence, computational thinking, depends on analyzing, evaluating, and creating.

Within the HOTS domain, the dominance of the analyzing dimension (C4) over evaluating (C5) and creating (C6) is consistent with findings reported in other subject areas, where HOTS content tends to be concentrated at the analyzing level while the higher dimensions remain limited (Rudiansah, 2023; Setyorini, 2025). In the Informatics context, this pattern suggests that the textbook more readily supports tasks such as tracing and debugging code than tasks requiring students to judge the efficiency of solutions or to design original algorithms. This is a notable limitation, since evaluating and creating are precisely the dimensions most closely aligned with authentic computational practice, in which learners must weigh trade-offs between alternative solutions and construct new artifacts to solve problems (King et al., 2020; Ulger, 2019).

The interview findings reinforce the document analysis and illustrate a persistent gap between curriculum expectations and classroom realities. Teachers acknowledged the dominance of lower-order questions and reported compensating for textbook limitations by independently developing HOTS-oriented, contextual programming tasks, a pattern also observed in prior research where teachers must supplement instructional materials to meet HOTS demands (Ningsih, 2020; Putri & Handayani, 2022). This underscores the importance of teacher autonomy and creativity in bridging the gap between policy and practice, and it aligns with international evidence indicating that successful HOTS implementation depends strongly on teachers' ability to design appropriate assessment instruments and apply innovative teaching methods (Aulawi et al., 2021; Wilson & Narasuman, 2020). Nevertheless, reliance on individual teacher initiative is not a substitute for well-designed textbooks, since not all teachers have equal capacity or time to develop supplementary HOTS questions.

The implications of these findings are significant for both theory and practice. Theoretically, the study reinforces the conceptualization of HOTS as a multidimensional construct that requires balanced integration across its components to achieve holistic cognitive development; an overemphasis on lower-order tasks may lead to partial development and limit students' readiness to engage in complex computational reasoning (Darmawan & Hilmawan, 2021; Ngazizah et al., 2021). Practically, the findings underscore the crucial role of textbook authors and teachers in addressing these imbalances, for instance by increasing the proportion of evaluating and creating tasks and by embedding authentic, project-based programming problems. Within the framework of the current curriculum, teachers are expected to implement innovative approaches such as project-based learning and contextual instruction to ensure that students experience a comprehensive range of HOTS development (Nasrullah et al., 2022; Raini, 2021), and strengthening teacher capacity in HOTS-oriented assessment design is therefore an essential step toward optimizing implementation.

Despite its contributions, this study has several limitations that should be considered. The analysis was limited to a single Informatics textbook, which may not fully represent the diversity of Informatics learning materials used in different educational contexts. Additionally, the study relied primarily on document analysis and teacher interviews without incorporating direct measurement of student learning outcomes, limiting the ability to assess the practical effectiveness of HOTS questions. Based on these limitations, future research is recommended to expand the scope of analysis by including multiple Informatics textbooks from different publishers and educational levels, and to adopt mixed-method approaches that combine content analysis with experimental or quasi-experimental designs to examine the impact of HOTS-based questions on students' computational thinking and learning outcomes.

CONCLUSION

The content analysis of assessment questions in the Informatics textbook for Senior High School Class X indicates that while elements of higher-order thinking skills (HOTS) are present, their distribution remains uneven, with a predominance of questions targeting lower-order thinking skills (LOTS), particularly remembering and understanding. Within the HOTS domain itself, the analyzing dimension (C4) dominates, while evaluating (C5) and creating (C6), the dimensions most closely tied to authentic computational practice, remain limited. Teachers

generally acknowledge this imbalance and often rely on textbook questions, though some take the initiative to develop their own contextual, HOTS-oriented programming tasks to better foster students' analytical and computational reasoning. Consequently, although basic understanding is well supported, students' higher-order and computational thinking abilities are not fully optimized, leading to insufficient preparation for HOTS-based assessments such as the AKM. Therefore, enhancing the quality and balance of HOTS in textbook questions, alongside encouraging teacher innovation in questioning and instructional strategies, is essential to better prepare students as critical, creative, and adaptive learners in line with curriculum goals and the demands of twenty first century Informatics education.

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