



The Role of Digital Assessment in Developing Higher Order Thinking Skills (HOTS) in Students: A Systematic Literature Review

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Abstract: The aim of this study is to synthesise the strategic role of digital assessment in facilitating the development of Higher Order Thinking Skills (HOTS) in students through a Systematic Literature Review (SLR) approach. The main focus of this review encompasses the identification of characteristics of digital tools capable of stimulating the aspects of analysis, evaluation and creation. Key findings indicate that the effectiveness of HOTS development is highly dependent on the interface design and interactivity of the digital platform used, with real-time feedback and simulations of complex problem-solving emerging as key factors. The study's conclusions affirm that systematically designed digital assessment can overcome the limitations of conventional evaluation in mapping students' cognitive profiles in depth. The innovation offered by this study is a taxonomy of digital assessment relevant to the needs of the modern post-pandemic education curriculum. The results of this study are expected to serve as a reference for educational technology developers and practitioners in designing a more authentic, adaptive, and future-competency- oriented assessment ecosystem across various levels of education.

Keywords: Critical thinking; Digital assessment; Educational transformation; HOTS; SLR

Introduction

The development of digital technology in the world of education has brought significant changes to the learning and evaluation processes. One rapidly developing innovation is digital assessment, namely the use of technology to measure student learning outcomes in a more flexible, adaptive, and efficient manner (Nafi'ah, 2025). In line with this, the demands of 21st-century education emphasise the importance of mastering Higher Order Thinking Skills (HOTS), which encompass critical, analytical, evaluative, and creative thinking. The integration of digital assessment into learning is highly relevant as it has the potential to support the development of HOTS through the presentation of questions that are more contextual, interactive, and challenging.

However, the implementation of digital assessment in educational practice still faces various challenges (Abosalem, 2016; Darling-Hammond et al., 2020). Many of the digital assessment tools currently in use still focus on measuring Lower Order Thinking Skills (LOTS), such as recall and comprehension, and thus do not fully support the development of Higher Order Thinking Skills (HOTS) (Sulistifa et al., 2025). This situation highlights a gap between learning objectives that emphasise higher-order thinking skills and the assessment practices carried out in the field. Therefore, it is necessary amore in depth and systematic study to understand how digital assessment can play an optimal role in developing HOTS in students.

Various previous studies have shown that digital assessment has great potential in improving the quality of learning. Features such as instant feedback, adaptability, and the use of interactive media enable

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students to engage more actively in the evaluation process (Nafi'ah, 2025; Ramadhanti et al., 2022). Furthermore, the use of online assessment tools based on case studies and simulations has been shown to encourage students to think more critically and analytically (Ashari et al., 2023). Nevertheless, the effectiveness of digital assessment is heavily influenced by the design of the instruments as well as educators' competence in integrating them with Higher Order Thinking Skills (HOTS) based learning objectives (Fatonah et al., 2026). This indicates that the use of technology alone is insufficient; it must be supported by appropriate pedagogical strategies.

In light of these issues, this study employs a Systematic Literature Review (SLR) approach to comprehensively examine various studies on the role of digital assessment in developing Higher Order Thinking Skills (HOTS). Through this approach, the study aims to identify trends, analyse effectiveness, and explore the factors influencing the successful implementation of digital assessment in an educational context. This approach is expected to provide a systematic, objective, and evidence-based overview grounded in the latest scientific research (Damaianti et al., 2023).

The novelty of this study lies in its effort to integrate the study of digital assessment and the development of HOTS into a single comprehensive systematic analysis. This study not only summarises previous findings but also offers a synthesis and practical recommendations for educators and interdisciplinary researchers in optimising the use of digital assessment (Musyaffa & Atno Atno, 2025). Thus, this study is expected to make a significant contribution to the development of more innovative learning evaluation practices oriented towards strengthening higher order thinking skills.

Method

Research Design

This study employs a Systematic Literature Review (SLR) approach to comprehensively examine the role of digital assessment in developing Higher Order Thinking Skills (HOTS) in students. This method was chosen as it

enables the systematic, transparent, and evidence-based integration of various research findings (Tyas et al., 2025; Gable et al., 2018). Through this approach, researchers can obtain a comprehensive overview of trends, findings, and research gaps related to the topic under investigation.

A Systematic Literature Review (SLR) enables researchers to avoid subjective bias through structured procedures, from problem formulation to the synthesis of research findings. This approach also offers the advantage of identifying common patterns as well as differences in research outcomes across various contexts and methodologies employed. Consequently, the results obtained possess a higher level of validity and reliability compared to standard literature reviews (Retify & Hidajat, 2025).

This study began with the formulation of a research question focusing on how digital assessment contributes to the development of HOTS and the factors influencing its effectiveness in learning. This research question served as the basis for determining the literature search strategy and the data analysis process carried out.

By employing a Systematic Literature Review (SLR) design, this study serves not only to summarise the findings of previous research but also to provide an in-depth synthesis and recommendations that can be utilised in the development of technology-based learning practices.

Literature Search Strategy

The literature search was conducted systematically through several reputable scientific databases, such as Google Scholar, Scopus, and ScienceDirect. These databases were selected based on their extensive coverage of publications and the quality of articles that have undergone a peer-review process. This was done to ensure that the data sources used were of high credibility.

The literature search was conducted across three main databases: Scopus, the Education Resources Information Centre (ERIC), and Google Scholar. The keywords used included the following combinations of terms in English and Indonesian:

Table 1. Literature Search Keywords

Main Keywords	Related Terms
Digital Assessment	E-assessment, computer-based assessment, online assessment, technology-enhanced assessment
Higher Order Thinking Skills (HOTS)	Critical thinking, creative thinking, analytical thinking, Bloom's Taxonomy level 4-6
Online Assessment	Web-based assessment, internet-based testing, remote assessment, virtual assessment, online testing, digital testing
Effectiveness	Impact, influence, role, contribution, outcomes

This combination of keywords was used to identify articles relevant to the research focus, thereby enabling

a more specific, systematic, and targeted literature screening process (Barnett & Ceci, 2014).

The search process was conducted by taking into account publication time constraints, namely articles published within the last five years (2020–2025). This aims to ensure that the data used represents the latest findings relevant to current developments in technology and education. Furthermore, only articles available in full text were considered in this study.

Through a systematic and targeted search strategy, this study successfully gathered a number of relevant articles for further analysis. This stage serves as a crucial initial step in ensuring the quality and completeness of the data used in the research.

Inclusion and Exclusion Criteria

In this study, inclusion and exclusion criteria were used to screen articles relevant to the research objectives.

The inclusion criteria comprised: (1) research articles published between 2020 and 2025, (2) articles that directly addressed the relationship between digital assessment and HOTS, (3) articles written in Indonesian or English, and (4) articles available in full text.

Meanwhile, the exclusion criteria included articles irrelevant to the research topic, duplicate articles, and non- scientific publications such as opinion pieces, blogs, or reports that had not undergone a peer-review process. These criteria were applied to ensure that only high-quality articles were used in the analysis process.

These criteria were applied progressively during the literature selection process. Articles failing to meet the criteria were eliminated at an early stage to avoid bias in the analysis. By Thus, only articles that are truly relevant to the research focus will be analysed further.

Table 2. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Examines digital assessment and/or HOTS	Not relevant to the main topic
Available in English or Indonesian	Languages other than English and Indonesian
Full text available	Abstract only available
Context education formal K-12	Context Higher education or non-formal

The use of clear and systematic inclusion and exclusion criteria helps to enhance transparency and accountability in the research process. This also ensures that the research findings are based on valid and relevant sources.

Literature Selection Process

The article selection process in this study followed the Preferred Reporting Items for Systematic Reviews and Meta- Analyses (PRISMA) guidelines, comprising four stages: identification, screening, eligibility, and inclusion (Agarwal et al., 2021; Cavanaugh et al., 2016; Chen & Yang, 2019).

In the identification stage, all articles obtained from the search results were collected and recorded. This stage yielded an initial number of articles which were then screened further. In this stage, a total of 287 articles were obtained from all the databases used. After removing duplicates, the number of articles was reduced to 241, which then proceeded to the screening stage.

The screening stage involved reviewing the titles and abstracts of the articles to determine their relevance to the research topic. Articles that did not align with the research focus were eliminated at this stage. During the screening stage, the titles and abstracts of the articles were reviewed to assess their suitability for the research topic. A total of 168 articles were eliminated at this stage due to irrelevance.

Next, during the eligibility stage, articles that passed the initial selection were analysed in full (full-text review) to ensure their compliance with the inclusion

criteria. During the eligibility stage, 73 articles that passed the initial selection were analysed thoroughly via full-text review. At this stage, 31 articles were eliminated as they did not meet the established inclusion criteria.

The final stage was inclusion, namely the selection of articles that met all criteria and were ready for further analysis. The selected articles were then used as the primary data sources in this study. A total of 42 articles were found to meet all criteria and were used as the primary data sources in this study. This process was carried out systematically to ensure that the data used were truly relevant and of high quality.

By following a structured selection process, this study was able to minimise bias and enhance the validity of the findings. This process also ensured that every article analysed made a clear contribution to the research objectives.

Data Analysis Techniques

Data analysis in this study employed a thematic analysis approach, conducted systematically through four main stages (Sari & Asmendri, 2020). The first stage was in-depth reading (familiarisation), wherein the researcher read all articles repeatedly to understand the context, objectives, methods, and key findings of each study. This process aims to gain a comprehensive understanding of the data and to identify initial patterns relevant to the research focus (Fadli, 2021).

The second stage is open coding, in which the researcher identifies and labels key sections of the data relating to the study’s key concepts. Relevant

information such as the type of digital assessment, learning strategies, and HOTS indicators is systematically coded to facilitate the grouping of data.

The third is grouping codes into categories and themes (theme development), which is the process of organizing codes that share similar meanings into broader categories, which are then developed into main themes (Zulkarnain, 2025). These themes represent patterns of findings across studies that explain the role of digital assessment in developing HOTS.

The fourth stage is cross study narrative synthesis, which involves integrating all themes into a systematic and comprehensive narrative. At this stage, the methodological quality of the articles is also considered to ensure the validity and credibility of the data used in the research (Sofiana et al., 2025).

Thus, through systematic and structured stages of analysis, the resulting synthesis not only presents a description of the research findings but also provides a deeper, more analytical and reflective understanding of the role of digital assessment in developing Higher Order Thinking Skills (HOTS).

This process enables researchers to identify patterns, relationships, as well as gaps in research in a comprehensive manner, thereby yielding stronger conclusions that can serve as a basis for the development of technology-based learning practices in the future.

Result and Discussion

Results of the Literature Review

Based on the results of a systematic literature review of 42 articles that met the inclusion criteria, an overview of the characteristics of the analysed studies was obtained. Geographically, the majority of studies originated from the Asian region, accounting for 52.4%, followed by Europe (23.8%), the Americas (16.7%), and other regions (7.1%). This dominance of the Asian context indicates a high level of attention to the integration of technology in education, particularly in the development of digital assessment to support higher-order thinking skills. This aligns with global trends showing that Asian countries are actively

adopting educational technology innovations to improve the quality of learning (Bintang et al., 2023).

When examined by educational level, the majority of research was conducted at the secondary education level (junior and senior secondary schools) with a percentage of 64.3%, whilst the primary school level accounted for 35.7%. These findings suggest that the implementation of digital assessment is more focused on students with more complex cognitive levels, where the development of Higher Order Thinking Skills (HOTS) such as analysis, evaluation, and creation becomes more relevant. This is consistent with the view of Anderson and Krathwohl (2020), who state that HOTS abilities develop more optimally at the upper secondary education level and above (Nurdianti & Kurino, 2023).

From a temporal perspective, the distribution of publication years indicates a significant increase from 2019 to 2024. This increase is strongly suspected to be influenced by the accelerated adoption of educational technology due to the COVID-19 pandemic, which drove the massive use of digital platforms in learning and assessment. This situation reinforces the role of digital assessment as an alternative solution in ensuring the continuity of the learning process whilst also serving as a means to develop higher-order thinking skills.

Furthermore, an analysis of the types of digital assessment used in the study reveals considerable variation, with a dominance of e-portfolios (28.6%), followed by Computerised Adaptive Tests (CAT) (21.4%), digital simulations (19.0%), online problembased projects (16.7%), and game-based assessment (9.5%).

Each type of assessment makes a different contribution to the HOTS dimensions, with e-portfolios and problem-based projects are more effective in developing creative and evaluative skills, whereas Computer Adaptive Testing (CAT) and digital simulations contribute more to analytical and evaluative skills. These findings indicate that the design of digital assessments has a significant influence on the types of higher order thinking skills developed (Fatonah et al., 2026).

The following presents the distribution of digital assessment types and the dominant HOTS dimensions:

Table 3. Distribution of Digital Assessment Types and HOTS Dimensions

Type Digital Assesmen	Number Studies	HOTS Dimensions Dominant
E-Portofolio	12 (28.6%)	Creating, Evaluating
Adaptive Quiz (CAT)	9 (21.4%)	Analysing, Evaluating
Digital Simulation	8 (19.0%)	Analysing, Creating
Problem Based Online Problem Based	7 (16.7%)	Creating, Evaluating

Overall, these findings indicate that the use of digital assessment in various forms holds great potential for developing HOTS, yet its effectiveness is highly

dependent on the type and design of the assessment employed. Therefore, the selection of digital assessment types must be aligned with learning objectives to

optimise the development of higher-order thinking skills in students.

Effective Types of Digital Assessment

The results of the review indicate that the effectiveness of digital assessment in developing HOTS is highly dependent on the type and design of the assessment used. Case based assessments and interactive simulations are among the most effective forms as they present real life situations that require analytical and problem solving skills (Fitriana & Subali, 2025; DeHaan, 2009). Consequently, students are not merely answering questions but are also required to understand the context and make decisions.

Based on an analysis of the 42 included articles, it was found that 88.1% of studies (37 out of 42) demonstrated a positive effect of the use of digital assessment on the development of Higher Order Thinking Skills (HOTS). These findings indicate that digital assessment not only serves as a tool for evaluating learning outcomes but also acts as a medium capable of fostering higher-order thinking processes students in a more active and I -depth manner. The integration of technology into assessment provides opportunities for students to engage in more complex cognitive activities through the presentation of contextual, interactive and problem solving based questions.

When examined according to the HOTS dimensions, the highest effectiveness is observed in the 'creating' aspect, reported by 30 studies, followed by the 'evaluating' skill in 26 studies, and the 'analysing' skill in 24 studies. The dominance of the 'creating' aspect indicates that digital assessment provides ample scope for students to generate new ideas, solutions, and products through various forms of project-based tasks and portfolios. This suggests that digital assessment is capable of encouraging students not only to understand information but also to process and develop knowledge creatively (Bond et al., 2021; Golding, 2011).

The type of digital assessment that most consistently demonstrates effectiveness is the e-portfolio, particularly in developing the skills of creating and evaluating. E-portfolios allow students to document their learning process continuously, reflect on their work, and evaluate the development of their understanding. These characteristics make the e-portfolio an instrument that not only assesses final outcomes but also comprehensively evaluates students' thought processes.

Furthermore, computer-based adaptive quizzes, or Computer Adaptive Testing (CAT), demonstrate strong effectiveness in developing analytical skills (Garrison et al., 1999). Adaptive systems that dynamically adjust the difficulty level of questions encourage students to

continue thinking at higher cognitive levels. Through such adjustments, students are presented with challenges commensurate with their abilities, thereby making the analytical process more optimal and sustainable (Baker, 2019).

Digital simulations and online problem-based projects also demonstrate high effectiveness, particularly in learning contexts that require the practical application of concepts, such as in STEM subjects. Both types of assessment present complex and realistic scenarios, requiring students to integrate various knowledge and skills to solve problems. This process directly involves analytical, evaluative, and creative skills simultaneously.

Overall, the effectiveness of digital assessment in developing HOTS is significantly influenced by the design and type of assessment used. Assessments that are interactive, adaptive, and based on real world contexts have proven to be more effective in fostering skills higher order thinking skills compared to assessments that are static and rote-learning oriented. Therefore, the selection and design of digital assessments are key factors in optimising the development of HOTS in students (Ariani et al., 2025).

Limitations of Digital Assessment Implementation

Despite its great potential, the implementation of digital assessment still faces various limitations. One of the main findings is the continued dominance of assessments based on Lower Order Thinking Skills (LOTS), such as simple multiple-choice questions that merely measure recall and comprehension (Hendriani et al., 2022). This indicates that digital transformation has not yet been fully accompanied by changes in pedagogical approaches (Akbar et al., 2026).

Around 30% of the studies analysed indicated that the use of technology in assessment has not yet had a significant impact on Higher Order Thinking Skills (HOTS). This is due to a lack of understanding in designing HOTS based instruments, meaning that technology is merely used as a tool without regard for the quality of the assessment content.

Furthermore, technical constraints such as limited internet access, devices, and platforms also pose barriers to the implementation of digital assessment. This situation is particularly prevalent in areas with inadequate technological infrastructure, thereby hindering the optimal use of digital assessment in learning.

On the other hand, human resource factors also present a significant challenge. Some educators still show resistance to the use of technology in learning and assessment, caused by a lack of digital literacy, insufficient training, and limited experience in

integrating technology with HOTS based learning strategies (Musyaffa & Atno Atno, 2025).

This results in the utilisation of digital assessment not being optimal and tending to be administrative in nature, rather than serving as a tool to improve the quality of learning. Overall, the limitations of digital assessment implementation indicate that the success of technology use in education is determined not only by the availability of devices, but also by pedagogical readiness, educators' competencies, and the quality of the assessment design itself.

Therefore, a more comprehensive approach is required, encompassing the strengthening of teachers' capacity, the development of valid and HOTS based instruments, and the improvement of technological infrastructure, so that digital assessment can be implemented optimally and sustainably.

In addition to these factors, limitations have also been identified in the design and validity of digital assessments. Not all instruments used have undergone adequate validity and reliability testing, resulting in less accurate measurement of HOTS. Furthermore, the lack of standard guidelines for the development of HOTS based digital assessments leads to significant variations in the quality of instruments across research studies and in practice.

Overall, the limitations of digital assessment implementation indicate that the success of technology use in education is determined not only by the availability of devices, but also by pedagogical readiness, educators' competencies, and the quality of the assessment design it self. Therefore, a more comprehensive approach is required, encompassing the strengthening of teachers' capacity, the development of valid and HOTS based instruments, and the improvement of technological infrastructure, so that digital assessment can be implemented optimally and sustainably.

Factors Influencing Effectiveness

Thematic analysis indicates that the effectiveness of digital assessment in developing Higher Order Thinking Skills (HOTS) is influenced by several key factors acting as moderators, namely the alignment of assessment design with HOTS indicators, the quality of feedback, and the digital readiness of teachers and students. These three factors do not stand alone but are interrelated and determine the extent to which digital assessment can optimally foster higher-order thinking processes.

The first factor is the alignment of the assessment design with HOTS indicators. Effective assessments are generally designed explicitly based on the revised Bloom's taxonomy, particularly at the cognitive levels of analysing, evaluating, and creating. Good assessment design does not merely convert the format from

conventional to digital, but also reconstructs learning tasks to demand more complex thinking processes. For example, case-based questions, open-ended problem-solving, or digital projects that require students to integrate various concepts (Li et al., 2024). Conversely, assessments that merely transfer multiple choice questions to a digital platform without altering the cognitive structure tend not to have a significant impact on HOTS, as they remain focused on lower order skills.

The second factor is the quality of the feedback provided in digital assessment. Effective feedback is immediate, specific and formative, thereby helping students to understand their mistakes and improve their thinking (Nurdianti & Kurino, 2023). Digital assessment has the advantage of providing automatic, real-time feedback, which allows students to reflect on their answers immediately. Elaborative feedback does not merely state whether an answer is correct or incorrect, but also explains the reasoning behind the answer and provides guidance for further has been shown to be highly effective in improving analytical and evaluative skills (Sulistifa et al., 2025).

The third factor is the digital readiness of teachers and students. Teachers with good digital literacy are better able to design and implement digital assessments effectively, including utilising features such as adaptive testing, interactive tasks, and automated feedback. Furthermore, adequate training prior to implementation is also a key factor in boosting teachers' confidence and competence in using technology (Nakjah & Adawiah, 2025; Gillies & Boyle, 2010). On the other hand, students' readiness also influences the success of digital assessment. Students accustomed to using technology tend to adapt more easily and can focus on the thinking process rather than the technical aspects of using the platform.

However, low digital readiness can pose significant barriers. The phenomenon of 'technology anxiety' or anxiety regarding the use of technology is still observed among both teachers and students. This condition can reduce the effectiveness of digital assessment as attention becomes more focused on using the tools rather than on the expected thinking processes (Saputra et al., 2025). Furthermore, a lack of experience in using digital platforms can also lead to technical errors, reduced confidence, and decreased participation in the assessment process.

Overall, these three factors indicate that the effectiveness of digital assessment is determined not only by the availability of technology, but also by the quality of pedagogical design, the feedback mechanisms provided, and users' readiness to utilise the technology (Ariani et al., 2025). Therefore, an integrated approach combining technological and pedagogical aspects is required so that digital assessment can optimally

support the development of Higher Order Thinking Skills (HOTS) in students.

Discussion

Research findings indicate that digital assessment can help develop Higher Order Thinking Skills (HOTS) when used appropriately. The use of technology in assessment makes questions more engaging, interactive, and relevant to real-life situations. This helps students think more deeply rather than merely memorising material (Retify & Hidajat, 2025).

The effectiveness of digital assessment is heavily influenced by the design of the questions used. Questions designed to train the ability to analyse, evaluate, and create have proven to be more effective in enhancing HOTS. Therefore, the use of technology alone is not sufficient; it must be accompanied by question design that aligns with the learning objectives.

Furthermore, feedback is also crucial. Feedback that is provided directly and clearly can help students understand their mistakes and correct them (Komara et al., 2026). If assessments merely provide marks without explanation, students will find it difficult to learn from the results.

The readiness of teachers and students to use technology also influences the success of digital assessments. Teachers with good digital skills will find it easier to create and use digital assessments. The same applies to students; if they are already accustomed to using technology, they will be focused on (Sinring et al., 2025).

Overall, digital assessment will be effective if supported by well-designed questions, clear feedback, and the readiness of teachers and students. Therefore, a balance is needed between the use of technology and learning strategies to ensure the best possible outcomes.

Conclusion

Based on the results of the Systematic Literature Review (SLR) conducted, it can be concluded that digital assessment plays a significant role in supporting the development of Higher Order Thinking Skills (HOTS) in students. Most studies indicate that the use of digital assessment can enhance critical, analytical, evaluative, and creative thinking skills, particularly when designed using contextual approaches such as case studies, simulations, and project based assessment. However, the effectiveness of digital assessment is highly dependent on the quality of the assessment instruments used. Research findings indicate that there are still digital assessment practices oriented towards Lower Order Thinking Skills (LOTS), and thus are not yet optimal in developing HOTS. Therefore, adequate pedagogical skills are required to design assessments

that not only utilise technology but are also aligned with HOTS based learning objectives. Furthermore, other factors such as teacher competence, infrastructure readiness, and educational policy support also influence the success of digital assessment implementation. Teachers with good digital literacy and adequate facilities tend to be more successful in effectively integrating digital assessment into learning. This indicates that the success of implementation is determined not only by technology, but also by the readiness of human resources and the educational environment. Thus, it can be concluded that digital assessment is a potential and relevant strategy in supporting the development of HOTS in the era of digital education. However, to achieve optimal results, synergy is required between high-quality assessment design, educator competence, and the support of an adaptive education system. It is hoped that this research can serve as a foundation for the development of more innovative learning evaluation practices oriented towards enhancing higher order thinking skills.

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Eliamra: preparation of original manuscript, methodology results, and Discussion; Muhamad Aras: methodology, conclusions review and editing; Shely Ferawati Rurua: analysis and proofreading.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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