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Transformation of Digital Learning Evaluation to Support Assessment in The 21st Century

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Abstrak: *Perkembangan teknologi digital telah mendorong transformasi sistem evaluasi pembelajaran menuju pendekatan yang lebih relevan dengan tuntutan pendidikan abad ke-21. Evaluasi konvensional berbasis kertas dinilai kurang mampu mengukur keterampilan berpikir kritis, komunikasi, kolaborasi, dan kreativitas (4C) yang menjadi kompetensi utama peserta didik masa kini. Penelitian ini bertujuan untuk menganalisis tren, efektivitas, serta model evaluasi digital yang mendukung penilaian berbasis keterampilan abad ke-21, khususnya pada konteks pendidikan dasar. Penelitian menggunakan metode Systematic Literature Review (SLR) dengan menganalisis 30 artikel ilmiah yang diperoleh dari database Scopus, Web of Science, ERIC, dan Google Scholar yang diterbitkan pada tahun 2020–2025. Hasil penelitian menunjukkan bahwa Learning Analytics dan penilaian autentik berbasis digital, seperti portofolio elektronik, proyek digital, dan platform peer assessment, efektif dalam meningkatkan motivasi belajar, memberikan umpan balik secara real time, serta mengukur keterampilan berpikir kritis dan kolaboratif siswa. Namun demikian, implementasi evaluasi digital masih menghadapi berbagai tantangan, seperti keterbatasan infrastruktur teknologi, rendahnya literasi digital guru, dan kesulitan dalam mengukur aspek kreativitas secara otomatis. Oleh karena itu, diperlukan pengembangan kerangka evaluasi digital yang terpadu, kontekstual, dan berkelanjutan untuk mendukung kualitas pembelajaran abad ke-21.*

Kata Kunci*: *Evaluasi digital, Learning analytics, Penilaian abad ke-21, Keterampilan 4C, Kajian literatur

Abstract: The development of digital technology has encouraged the transformation of learning evaluation systems toward approaches that are more relevant to the demands of 21st-century education. Conventional paper-based assessments are considered less capable of measuring critical thinking, communication, collaboration, and creativity (4C) skills, which have become essential competencies for modern learners. This study aims to analyze trends, effectiveness, and digital evaluation models that support 21st-century skills-based assessment, particularly in the context of elementary education. The study employed a Systematic Literature Review (SLR) method by analyzing 30 scientific articles obtained from the Scopus, Web of Science, ERIC, and Google Scholar databases published between 2020 and 2025. The findings reveal that Learning Analytics and digital-based authentic assessments, such as electronic portfolios, digital projects, and peer-assessment platforms, are effective in enhancing students' learning motivation, providing real-time feedback, and measuring students' critical thinking and collaborative skills. However, the implementation of digital evaluation still faces several challenges, including limited technological infrastructure, low levels of teachers' digital literacy, and difficulties in automatically

assessing creativity. Therefore, the development of an integrated, contextual, and sustainable digital evaluation framework is necessary to support the quality of 21st-century learning.

Keywords: Digital evaluation, Learning analytics, 21st-Century assessment, 4C skills, Literature review

INTRODUCTION

Fundamental changes in the demands of the world of work and social life in the twenty-first century have driven global reforms in curriculum and pedagogy. Rapid technological advancement, globalization, and increasing social complexity require education systems to produce learners who not only possess strong disciplinary knowledge but are also capable of critical thinking, effective communication, collaboration, and creative problem solving (Munawir & Muhidin, 2025; Varghese & Mohamedunni Alias Musthafa, 2021). Consequently, today's generation of learners must be equipped with core twenty-first-century competencies (Yang et al., 2025) in order to succeed and actively participate in a knowledge-based society (Butterworth, 2024).

In line with these demands, the focus of learning has shifted globally from the mere transmission of knowledge toward the development of complex and contextual competencies. Learning is no longer oriented solely toward content mastery but emphasizes learners ability to apply knowledge in solving real-world problems, making informed decisions, and engaging constructively in social and professional environments (Setiawan Agung, Wigati Sri, 2019). Competency-oriented learning requires a comprehensive transformation, not only in instructional strategies but also in evaluation systems used to assess students learning outcomes (Azzahro & Subekti, 2022).

However, despite the shift in learning toward competency development, evaluation practices in many educational institutions particularly at the primary education level are still dominated by conventional paper-based assessments that tend to measure lower-order cognitive skills (Disa Sahra et al., 2025). This approach has not been able to comprehensively capture the complexity of 21st-century skills, especially the 4C skills (critical thinking, communication, collaboration, and creativity). In addition, previous studies on digital evaluation have generally focused on the use of specific tools or platforms, without thoroughly examining their effectiveness in assessing 4C skills (Varghese & Mohamedunni Alias Musthafa, 2021). This indicates a research gap regarding how digital-based evaluation models can systematically support the assessment of 21st-century skills, particularly within the context of primary education.

The limitations of traditional assessment become increasingly apparent when applied to the measurement of 4C skills, which are inherently dynamic, contextual, and

developmental (Omer et al., 2020). Skills such as critical thinking, collaboration, communication, and creativity cannot be adequately assessed through conventional written tests, such as multiple-choice or short-answer formats. This mismatch highlights a significant gap between competency-based learning goals and assessment practices that remain focused on cognitive achievement alone. Consequently, a pressing research gap emerges: how can assessment systems be effectively transformed to align with the demands of twenty-first-century skills evaluation?

Transforming learning assessment toward more authentic and comprehensive approaches is nearly impossible without the support of digital technology. Digital technology enables the development of flexible, continuous, and learner-centered assessment systems (Lin & Pryor, 2020). Digital platforms do not merely transfer traditional tests into online formats; rather, they facilitate a reconfiguration of assessment philosophy (Judi, 2022; Susyla & Jaya, 2023) by emphasizing learning processes and the measurement of higher-order competencies (Yusro et al., 2025).

The digitalization of educational assessment enables the real-time collection and analysis of learning data through Learning Analytics (Omer et al., 2020; Topali et al., 2023). Such data include patterns of learner engagement, learning progress, and areas of difficulty encountered throughout the instructional process. The digitalization of educational assessmenthe utilization of Learning Analytics is particularly crucial in supporting the concept of assessment for learning, wherein assessment functions as a tool to continuously enhance learning quality rather than merely determining final outcomes (Omer et al., 2020). Through real-time feedback and data-driven insights, educators are better positioned to adjust instructional strategies and provide personalized support aligned with learners' needs.

In this context, digital assessment holds significant potential to bridge the gap between the goals of twenty-first-century education and existing evaluation practices, particularly at the elementary education level. Digital tools offer opportunities to implement authentic assessment methods such as e-portfolios, project-based tasks, collaborative online activities, and reflective learning artifacts that more accurately represent students' competencies and learning trajectories.

Therefore, this systematic literature review aims to provide a comprehensive understanding of the transformation of digital-based learning evaluation within the context of twenty-first-century education. Specifically, the objectives of this study are threefold. First, it seeks to identify major trends in the use of digital technology for learning evaluation over the past five years. Second, it aims to analyze how digital tools and platforms specifically support the assessment of twenty-first-century skills (4C). Third, this study intends to propose a conceptual framework that integrates digital evaluation transformation within the context

of elementary education. Through this review, it is expected that both theoretical and practical insights will be generated to support the development of more relevant, authentic, and future-oriented assessment systems aligned with the demands of twenty-first-century education.

METHOD

This study employs a Systematic Literature Review (SLR) approach to obtain a comprehensive and structured overview of the transformation of digital-based learning evaluation within the context of 21st-century educational assessment. The SLR approach was selected because it enables researchers to systematically, transparently, and reproducibly identify, evaluate, and synthesize findings from previous studies. Through this approach, the study not only summarizes prior research results but also analyzes trends, patterns, research gaps, and the relevance of the findings to the development of learning evaluation in the digital era.

Systematic literature review is highly relevant for technology-based educational research, given the rapid development of digital innovations and the diversity of evaluation approaches applied across different levels of education. Accordingly, SLR provides a strong scientific foundation for drawing valid conclusions regarding the effectiveness of digital evaluation models in measuring 21st-century skills, particularly critical thinking, communication, collaboration, and creativity (4C).

Data Collection and Selection Techniques

The data collection and selection process was conducted in stages by following a rigorous and systematic SLR procedure. Article selection adhered to four main stages: identification, screening, eligibility, and final inclusion

At the identification stage, the researcher conducted a search for scientific articles through reputable national and international journal databases. The keywords used in the search process included digital assessment, educational evaluation, learning analytics, authentic assessment, and 21st century skills. The search was conducted by considering the relevance of article topics to the research focus, namely the transformation of digital-based learning evaluation.

The second stage was screening, which involved selecting articles based on their titles and abstracts. At this stage, articles that were not relevant to learning evaluation, did not address educational contexts, or did not incorporate digital technology aspects were excluded. Screening was also conducted to avoid duplication of articles found across multiple databases.

Next, the eligibility stage was carried out by reviewing the full texts of articles that passed the screening stage. At this stage, the researcher assessed the suitability of each article based on predetermined inclusion and exclusion criteria. The inclusion criteria were: (1) articles published in reputable journals seperti Scopus, Web of Science, ERIC, Google Scholar (2) articles published between 2020 and 2025; (3) articles discussing digital-based learning evaluation or assessment; and (4) articles related to the measurement of 21st-century skills. Meanwhile, opinion-based articles, non-empirical reports, or articles that did not present research findings were excluded.

At the final inclusion stage, a total of 30 selected journal articles were designated as the primary data sources and served as the research subjects for in-depth analysis. The research subjects of this study were 30 selected journal articles related to digital assessment and 21st-century skills published between 2020 and 2025. These articles represented various educational contexts, ranging from primary education to higher education, thus providing broad perspectives on the implementation of digital evaluation.

Data Analysis Techniques

Data obtained from the 30 selected articles were analyzed using two main techniques: Content Analysis and Synthetical Analysis. The research instrument used in this study was a literature review matrix employed to categorize article characteristics, research findings, digital assessment models, and measured 4C skills. The combination of these techniques aimed to generate an in-depth and holistic understanding of the phenomenon under investigation. Content Analysis was used to extract and code important information from each article, such as the types of digital evaluation instruments used, evaluation objectives, measured skills, identified benefits, and implementation challenges. This process was carried out systematically by categorizing findings into major themes, including the use of Learning Analytics, gamification-based media, digital authentic assessment, infrastructure readiness, and teachers' digital literacy competencies.

Subsequently, Synthetical Analysis was applied to compare, contrast, and collectively interpret the findings across articles. This technique allowed the researcher to identify dominant patterns, similarities and differences among research results, as well as major trends in the transformation of digital evaluation. Through synthesizing the research findings, the researcher was able to draw conclusions regarding the most effective digital evaluation models for supporting the measurement of 21st-century skills, while also identifying research gaps that require further investigation.

The results of the analysis are presented in a descriptive-analytical manner to provide a clear and systematic overview of developments in digital-based learning evaluation. Therefore, this research method is expected to generate findings that are valid, reliable, and

relevant as a basis for policy development and the practice of learning evaluation in the context of 21st-century education. Figure 1 below is the diagram prisma to illustrate the data collection and selection techniques used in our study:

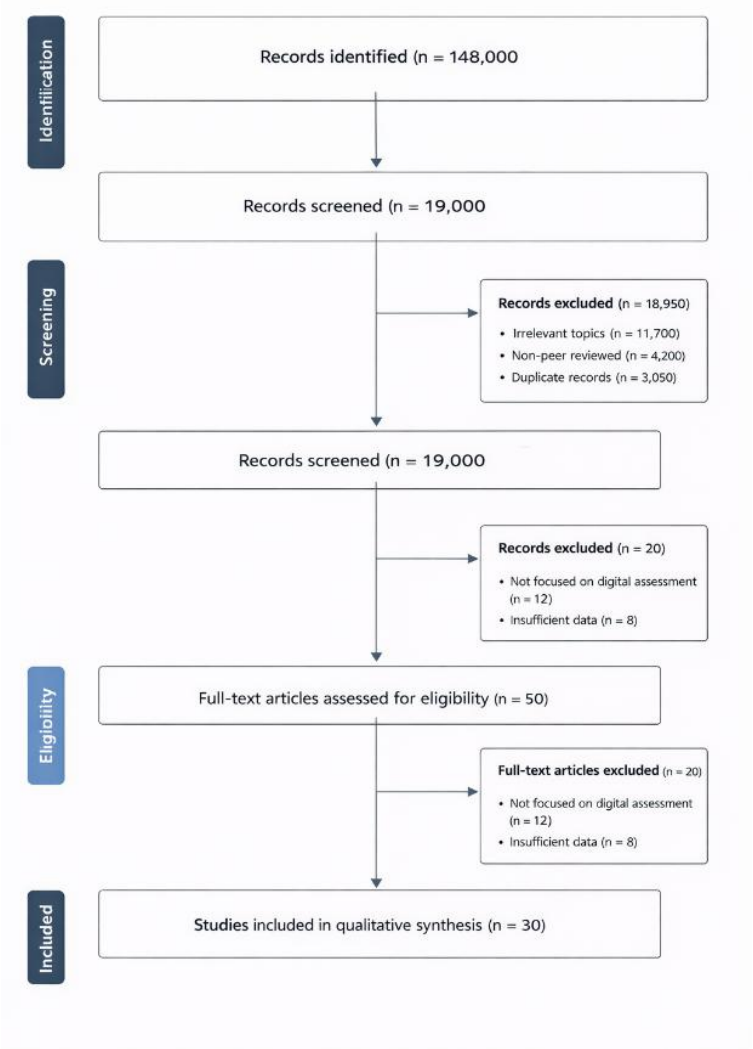

Figure 1. Diagram Prisma

RESULTS AND DISCUSSION

Results

Based on the synthesis of 30 national and international scientific articles published over the past ten years, this study identifies four major trends in the transformation of learning evaluation in the digital era. These trends indicate a significant paradigm shift from traditional evaluation toward evaluation systems that are more adaptive, sustainable, and oriented toward the development of 21st-century competencies.

Integration of Learning Analytics in Formative Assessment

The first dominant trend is the increasing integration of Learning Analytics (LA) in the learning evaluation process, particularly in formative assessment. Learning Analytics refers to the process of collecting, analyzing, and interpreting students' learning data obtained through digital platforms, such as Learning Management Systems (LMS), online quiz applications, and other e-learning systems.

The results of the review indicate that the use of Learning Analytics enables educators to monitor students' learning progress in real time, ranging from levels of participation and understanding of learning materials to frequently occurring error patterns. These data provide an empirical basis for teachers to deliver faster, more targeted, and more personalized feedback. The integration of LA also supports data-driven decision making in education, in which pedagogical decisions are no longer based solely on teachers' intuition but are strengthened by objective data.

In the context of measuring 21st-century skills, Learning Analytics demonstrates a high contribution to assessing critical thinking and communication skills, as students' activities are systematically documented through online discussions, reflective tasks, and digital interactions.

Use of Gamification Media as Digital Evaluation Instruments

The second identified trend is the use of gamification media, such as Wordwall, Quizizz, and Kahoot, as learning evaluation tools. These media are widely used, especially at the primary and secondary education levels, although they are also beginning to be adopted in higher education.

The literature analysis shows that gamification media generally have moderate to low effectiveness in measuring critical thinking and creativity skills; however, they are quite effective in increasing learning motivation, student engagement, and reducing anxiety during evaluation. Gamification is more commonly used as a formative assessment tool to measure basic conceptual understanding and mastery of factual material.

Nevertheless, some studies indicate that when well designed, gamification can be combined with context-based questions and simple problem-solving tasks, thereby having the potential to support the development of higher-order thinking skills. However, the main limitation of gamification media lies in their predominant focus on recall and recognition, making them less optimal for measuring collaboration and creativity skills in depth.

Shift Toward Technology-Based Authentic Assessment Models

The third major trend identified is the shift in evaluation models toward technology-based authentic assessment. Authentic assessment emphasizes evaluating students' abilities to complete real-world tasks that are relevant to life contexts, rather than merely answering multiple-choice questions or written tests.

The literature indicates that instruments such as digital portfolios, technology-based projects, online simulations, and peer-review platforms are increasingly used as alternatives to conventional evaluation methods. These instruments are considered to have high effectiveness in measuring critical thinking, collaboration, and creativity skills. Digital portfolios, in particular, allow educators to assess the learning process longitudinally, not merely final outcomes.

The following is a summary of the relationship between digital platforms and 4C skills based on the synthesis of the literature:

a. Learning Analytics: Shows a high contribution to measuring critical thinking and communication, with a moderate level for collaboration and creativity.
b. Gamification Media: Moderate effectiveness for critical thinking, and low effectiveness for collaboration and creativity skills.
c. Digital Portfolios: Moderate to high effectiveness across all aspects of 4C skills.
d. Peer-Review Platforms: High contribution to critical thinking, communication, and collaboration skills, but relatively low for creativity.

The analysis table indicates that no single digital instrument is fully capable of optimally accommodating the measurement of all four 4C skills; therefore, a combination of various evaluation methods is required.

Dominant Shift from Summative to Formative Evaluation

The findings also reveal a dominant shift from paper-based summative evaluation toward continuous formative evaluation supported by digital platforms. Digital evaluation enables automated correction processes and instant feedback, allowing students to immediately recognize their strengths and weaknesses.

The use of digital evaluation applications such as Quizizz, Google Forms, and LMS platforms has been shown to accelerate the assessment process, reduce teachers' administrative workload, and enhance learning effectiveness. This rapid and continuous feedback contributes to improving the quality of both the learning process and students' learning outcomes.

Furthermore, the variety of assessment instruments facilitated by digital technology allows for the measurement of higher-order thinking skills such as analysis, evaluation, and creation which are difficult to achieve through traditional evaluation approaches. Instruments such as e-portfolios, digital projects, and online simulations are becoming increasingly relevant alternatives in this context.

The review also indicates that gamification elements in digital evaluation tend to increase learning motivation and reduce students' anxiety levels during assessment. Data from LMS systems show that educators can identify individual learning gaps more quickly,

thereby enabling more effective adjustments to learning strategies. In table 1 below there is a list of several articles that are relevant to this study:

Table 1. Lists of articles that are relevant

Number	Author	Year	Methoded	Finding
1.	Anisah et al.	2025	Quantitative	Digital media is effective in elementary learning evaluation
2.	Azzahro & Subekti	2022	Systematic Literature Review	Digital evaluation improves mathematics understanding
3.	Beerepoot M. T.	2023	Literature Review	Automated feedback supports formative assessment
4.	Pillay P.	2024	Conceptual	CoI framework supports digital assessment
5.	Butterworth C.	2024	Qualitative	Digital project-based assessment is effective as authentic assessment
6.	Henderson & Phillips	2023	Systematic Literature Review	Digital technology enhances feedback quality
7.	Howard & Gasevic	2022	Literature Review	AI introduces opportunities and ethical challenges in assessment
8.	Hui et.al	2025	Systematic Literature Review	Technology supports authentic assessment practices
9.	Susyla D.Jaya S.	2023	Thematic Review	Digital assessment evolves in modern education
10.	Min Yang, Zi Yan, Lan Yang, Ying Zhan	2025	Literature Review	Assessment literacy is crucial in the digital era
11.	Aliyu H.Ebikabowei M.Kola A. J.	2023	Experimental	VR effectively measures complex skills
12.	Xiangze Z.Abdullah Z.	2023	Empirical study	Gamification increases student engagement
13.	Ma & Ismail	2025	Systematic Literature Review	Digital competence is essential in education
14.	Paraskevi Topali, Irene-Angelica et al	2023	Literature Review	Learning analytics supports data-driven evaluation
15.	Tazkia H.Safitri D.Sujarwo	2024	Qualitative	Digital assessmet impacts assessment integrity

Number	Author	Year	Methoded	Finding
16.	Wolf M. K.Oh S.	2024	Experimental	Automated writing evaluation is rapidly developing
17.	Zorrilla Abascal M. L.Castillo Díaz M.	2023	Literature Review	Digital assessment supports transversal competencies
18.	Hellystia D.Hermawati S.	2024	Empirical Study	Peer assessment enhances collaboration
19.	Arbine S.Abd Hamid M. S.	2024	Conceptual	Validity is essential in digital performance assessment
20.	Muhidin	2025	Literature Review	Integration of learning analytics and authentic assessment is important
21.	Salsabila et al.	2020	Descriptive	Quizizz improves student motivation
22.	Disa Sahra, et al	2025	Descriptive Qualitative	Challenges exist in digital assessment implementation
23.	Setiani & Firmansyah	2021	Experimental	Kahoot is effective as an evaluation tool
24.	Muji A. P.Ambiyar A	2021	Descriptive	Quizizz supports online learning
25.	Setiawan et al	2020	Experimental	Educational games improve learning outcomes
26.	Mutiara Mutiara	2024	Case study	Digital portfolios are effective assessment tools
27.	Taufiq et al	2025	Literature Review	Technology integration in curriculum is essential
28.	Levine M.Philpot R.	2024	Literature Review	Ethical challenges exist in digital assessment
29.	Afriadi B.KomarudinSutisna A.	2024	Qualitative	Authentic assessment is effective in curriculum implementation
30.	Zhang et al.	2023	Systematic Literature Review	Learning analytics supports formative assessment

Discussion

Interpretation of Digital Evaluation Results in the Context of 21st-Century Education

The paradigm shift in learning evaluation identified in this study is in line with the demands of 21st-century education, which emphasizes the development of 4C skills: critical thinking, communication, collaboration, and creativity (Ma & Ismail, 2025; Munawir & Muhidin, 2025; Xiangze & Abdullah, 2023). Learning evaluation is no longer viewed merely as a tool to measure cognitive achievement, but rather as an integral part of the learning process itself.

Digital evaluation plays an important role in facilitating the assessment of competencies that are complex, dynamic, and contextual. Through digital systems, educators can assess students' thinking processes, the ways in which they collaborate, and their ability to communicate ideas effectively. This indicates that the function of evaluation has shifted from merely measuring learning outcomes toward fostering the development of students' learning capacities (Aliyu et al., 2023; Yang et al., 2025; Zorrilla Abascal & Castillo Díaz, 2023).

Furthermore, the integration of digital technologies in assessment practices has shifted the role of teachers from knowledge transmitters toward facilitators of learning and competency development (Nur Hasanah, 2023). This transformation also requires educators to strengthen their digital literacy competencies to effectively support students in developing essential 21st-century skills.

Previous studies have also shown that students' engagement and analytical abilities can be improved through technology-assisted assessments that provide adaptive and immediate feedback during learning activities (Wattanapanit, 2025; Yusro et al., 2025).

The Importance of Contextuality in Digital Assessment

The success of implementing digital evaluation is highly dependent on the level of contextuality of the instruments used. Effective digital assessment must be able to present authentic problems and real-world scenarios that require complex problem-solving (Butterworth, 2024; Mutiara Mutiara, 2024). In this context, constructivist theory and authentic assessment serve as relevant theoretical foundations for interpreting the research findings.

Project-based assessments and online simulations provide opportunities for students to integrate knowledge, skills, and attitudes in situations closely resembling real-life contexts (Aliyu et al., 2023; Lin & Pryor, 2020). Furthermore, technology-supported project learning has also been shown to strengthen students' engagement and digital literacy competencies (Arbine & Abd Hamid, 2024; Posumah et al., 2024). The findings of this study are consistent with previous research emphasizing the efficiency and objectivity of digital evaluation. The automation of digital assessment is able to reduce teachers' workload, thereby allowing teachers more time to implement meaningful pedagogical interventions.

In addition, other studies highlight that digital evaluation supports the principle of assessment for learning, in which assessment is used as a tool to improve the quality of learning rather than merely to classify students. Therefore, the findings of this study reinforce the argument that the transformation of digital evaluation is a necessity that cannot be separated from broader educational reform.

Comparison with Previous Studies

The findings of this study are consistent with previous research emphasizing the efficiency and objectivity of digital evaluation. The automation of digital assessment has been found to reduce teachers' workload and improve the efficiency of feedback processes (Beerepoot, 2023; Wolf & Oh, 2024). Digital evaluation also enables the use of automated systems that support formative assessment practices.

In addition, previous studies suggest that digital evaluation supports the principle of assessment for learning, where assessment functions as a means to improve learning quality rather than merely classify students (Pillay, 2024; Topali et al., 2023). Learning Analytics has also demonstrated significant potential in providing data-driven feedback and identifying students' learning patterns (Hasanah & Pramesti, 2021; Omer et al., 2020). Previous studies also indicate that gamification and online evaluation platforms positively influence students' motivation and participation during learning processes (Muji et al., 2021; Setiani & Firmansyah, 2021; Setiari, 2021). Therefore, the findings of this study reinforce the argument that the transformation of digital evaluation is closely connected with broader educational reform efforts.

Implementation Challenges and Ethical Implications

Despite its advantages, digital evaluation still faces several challenges. Major concerns include unequal access to technology, limited digital literacy among teachers and students, and issues related to data privacy and security (Ma & Ismail, 2025; Wattanapanit, 2025).

The utilization of Learning Analytics raises ethical implications regarding data collection, management, and use in educational settings (Levine et al., 2024). Similarly, the integration of artificial intelligence into educational assessment introduces issues related to transparency, fairness, and explainability in automated decision-making systems (Khosravi et al., 2022). Beyond technical barriers, the implementation of digital assessment also raises concerns regarding fairness, accessibility, and the responsible use of learner data in educational settings. Ethical issues become increasingly important as educational institutions adopt data-driven systems and artificial intelligence-based assessment tools. The effectiveness of digital evaluation is also strongly influenced by institutional readiness, including technological infrastructure, policy support, and teachers' capacity to integrate digital tools into assessment practices (Afriadi et al., 2024; Disa Sahra et al., 2025).

CONCLUSIONS

The transformation of digital-based learning evaluation has become an important component of 21st-century education in supporting the development of students' critical thinking, communication, collaboration, and creativity (4C) skills. The findings of this study indicate that digital evaluation has shifted the assessment paradigm from merely measuring

final learning outcomes toward becoming an integral part of the learning process through real-time monitoring, personalized feedback, and adaptive instructional support.

The implementation of digital technologies, such as Learning Analytics, digital portfolios, project-based assessments, and online simulations, provides more authentic and contextual approaches for measuring students' competencies. These approaches are considered more effective in assessing higher-order thinking skills and supporting meaningful learning experiences.

However, the implementation of digital evaluation still faces challenges, including technological infrastructure limitations, unequal access to digital resources, and insufficient digital literacy among educators. Therefore, future research is recommended to focus on developing integrated digital assessment frameworks and strengthening teacher competencies to support sustainable, effective, and pedagogically meaningful assessment practices in 21st-century education.

REFERENCES

Afriadi, B., Komarudin, & Sutisna, A. (2024). Evaluation of the Effectiveness of the Civic Education Curriculum in Indonesia: A Case Study of the KTSP Curriculum, the 2013 Curriculum, and the Independent Curriculum. *Journal of Curriculum and Teaching*, *13*(5). https://doi.org/10.5430/jct.v13n5p331

Aliyu, H., Ebikabowei, M., & Kola, A. J. (2023). Problem-Based Learning in Remote Learning Scenario Utilizing Climate Change Virtual Reality Video in Mobile Application to Train Critical Thinking. *International Journal of Essential Competencies in Education*, *2*(2). https://doi.org/10.36312/ijece.v2i2.1612

Arbine, S., & Abd Hamid, M. S. (2024). Developing and Validating a Digital Literacy Assessment: Bridging the Digital Divide among Adolescents in Sabah, Malaysia. *E-Bangi Journal of Social Science and Humanities*, *20*(4). https://doi.org/10.17576/ebangi.2024.2104.16

Azzahro, T. A., & Subekti, F. E. (2022). Systematic Literature Review : Efektivitas Penggunaan Media Evaluasi Digital dalam Pembelajaran Matematika. *Biormatika : Jurnal Ilmiah Fakultas Keguruan Dan Ilmu Pendidikan*, *8*(2), 207–213. https://doi.org/10.35569/biormatika.v8i2.1331

Beerepoot, M. T. P. (2023). Formative and Summative Automated Assessment with Multiple-Choice Question Banks. *Journal of Chemical Education*, *100*(8). https://doi.org/10.1021/acs.jchemed.3c00120

Butterworth, C. (2024). A Reflection of Authentic Assessment Design in Two Remote Sensing Case Studies. *Surveying & Land Information Science*, *83*(1).

Disa Sahra, Thalita Fitra Amaliya, Firana Fiwa, Athifanaila Fioni, Muhammad Farid Mustopa, Ranti Meizatri, & Muhammadi Muhammadi. (2025). Analisis Implementasi Evaluasi Pembelajaran Berbasis Digital di SD Binekas Bandung. *Journal Innovation In Education*, *3*(4). https://doi.org/10.59841/inoved.v3i4.3522

Hasanah, F. N., & Pramesti, S. L. (2021). Implementasi Metode Problem Solving dalam Pembelajaran Matematika Siswa Kelas Va di SD Muhammadiyah Kajen Kabupaten

Pekalongan. *Prosiding Seminar Nasional PGMI*.

Judi, H. M. (2022). Integrity and Security of Digital Assessment: Experiences in Online Learning. *Global Business and Management Research: An International Journal*, *14*(1).

Khosravi, H., Shum, S. B., Chen, G., Conati, C., Tsai, Y. S., Kay, J., Knight, S., Martinez-Maldonado, R., Sadiq, S., & Gašević, D. (2022). Explainable Artificial Intelligence in education. *Computers and Education: Artificial Intelligence*, *3*. https://doi.org/10.1016/j.caeai.2022.100074

Levine, M., Philpot, R., Nightingale, S. J., & Kordoni, A. (2024). Visual Digital Data, Ethical Challenges, and Psychological Science. *American Psychologist*, *79*(1). https://doi.org/10.1037/amp0001192

Lin, H., & Pryor, M. (2020). A Motivational 3D EdTech in Online Education: Digital Exhibition Space. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *12218 LNCS*. https://doi.org/10.1007/978-3-030-51968-1_15

Ma, H., & Ismail, L. (2025). Bibliometric analysis and systematic review of digital competence in education. In *Humanities and Social Sciences Communications* (Vol. 12, Issue 1). https://doi.org/10.1057/s41599-025-04401-1

Muji, A. P., Ambiyar, A., Aziz, I., & Hidayat, H. (2021). The implementation of Quizizz-based online evaluation in higher education: An exciting alternative for evaluation. *International Journal of Research in Counseling and Education*, *5*(2). https://doi.org/10.24036/00478za0002

Munawir, & Muhidin, N. M. (2025). Menjadi Guru Profesional di Abad 21: Keterampilan Dalam Literasi Digital. *Jurnal Pendidikan*, *34*(2). https://doi.org/10.32585/jp.v34i2.6696

Mutiara Mutiara. (2024). Instrumen Inovatif untuk Mengembangkan Asesmen Praktik dan Produk dalam Pembelajaran Bahasa Indonesia di Era Digital. *Dharma Acariya Nusantara: Jurnal Pendidikan, Bahasa Dan Budaya*, *2*(2). https://doi.org/10.47861/jdan.v2i2.1163

Nur Hasanah, F. (2023). Optimalisasi Kompetensi Pedagogik Calon Guru PAI Melalui Implementasi Flipped Classroom Berbasis Moodle pada Microteaching. *Munaddhomah: Jurnal Manajemen Pendidikan Islam*, *4*(2), 261–271. https://doi.org/10.31538/munaddhomah.v4i2.448

Omer, U., Farooq, M. S., & Abid, A. (2020). Cognitive learning analytics using assessment data and concept map: A framework-based approach for sustainability of programming courses. *Sustainability (Switzerland)*, *12*(17). https://doi.org/10.3390/su12176990

Pillay, P. (2024). Online Formative Assessment in Higher Education Post-Covid-19: A Systematic Review Of Challenges and Opportunities. *Social Sciences and Education Research Review*, *11*.

Posumah, I., Taunaumang, H., & Rengkuan, M. (2024). Pengembangan Model Pembelajaran Digital Literasi "Science" Melalui Pendekatan Saintifik Berbasis Proyek Pada Pembelajaran IPA di SMP. *European Journal of Higher Education and Academic Advancement*, *1*(6). https://doi.org/10.61796/ejheaa.v1i6.682

Setiani, R. N., & Firmansyah, D. (2021). Kahoot! Sebagai Alat Evaluasi Pembelajaran Dikombinasikan dengan Aplikasi Matharitgeo Saat Pandemi Covid-19. *PYTHAGORAS: Jurnal Program Studi Pendidikan Matematika*, *10*(April), 13–28.

Setiari, L. (2021). Aplikasi Quizizz Dalam Pembelajaran Daring Matematika Pada Siswa

SDN Simokerto VI/139 Surabaya. *Inteligensi : Jurnal Ilmu Pendidikan*, *4*(1), 73–76. https://doi.org/10.33366/ilg.v4i1.2473

Setiawan Agung, Wigati Sri, S. D. (2019). Implementasi Media Game Edukasi Quizizz Untuk Meningkatkan Hasil Belajar Matematika Materi Sistem Persamaan Linear Tiga Variabel Kelas X Ipa 7 Sma Negeri 15 Semarang Tahun Pelajaran 2019/2020. *Seminar Nasional Edusainstek FMIPA UNIMUS 2019*, *2685–5852*, 167–173.

Susyla, D., & Jaya, S. (2023). Digital Assessment in English Language Teaching (ELT): A Systematic Literature Review. *Edu-Ling: Journal of English Education and Linguistics*, *7*(1).

Topali, P., Chounta, I. A., Martínez-Monés, A., & Dimitriadis, Y. (2023). Delving into instructor-led feedback interventions informed by learning analytics in massive open online courses. In *Journal of Computer Assisted Learning* (Vol. 39, Issue 4). https://doi.org/10.1111/jcal.12799

Varghese, J., & Mohamedunni Alias Musthafa, M. N. (2021). Why the Optimism Misses? An Analysis on the Gaps and Lags of Teachers' Perceptions of 21st Century Skills. *Shanlax International Journal of Education*, *10*(1). https://doi.org/10.34293/education.v10i1.4322

Wattanapanit, N. (2025). Leveraging Digital Learning Technologies to Drive Educational Administration Policies and Enhance Learning Quality in the Digital Age. *International Journal of Sociologies and Anthropologies Science Reviews*, *5*(3). https://doi.org/10.60027/ijsasr.2025.7696

Wolf, M. K., & Oh, S. (2024). Investigating the types and use of feedback in middle-school English language learners' academic writing. *Language Learning and Technology*, *28*(1). https://doi.org/10.64152/10125/73583

Xiangze, Z., & Abdullah, Z. (2023). Station Rotation with Gamification Approach to Increase Students' Engagement in Learning English Online. *Arab World English Journal*, *2023-July* (Special Issue on CALL No.9). https://doi.org/10.24093/awej/call9.7

Yang, M., Yan, Z., Yang, L., & Zhan, Y. (2025). Understanding and Developing Student Assessment Literacy: Translating Research into Actionable Approaches. In *Springer Briefs in Education: Vol. Part F253*. https://doi.org/10.1007/978-981-97-9484-3

Yusro, A. C., Setyosari, P., Degeng, I. N. S., & Degeng, M. D. K. (2025). Assessing Pre-Service Teachers' Analytical Thinking in Science Fundamentals through a Moodle-Based Online Test. *Journal of Educational Technology and Learning Creativity*, *3*(2). https://doi.org/10.37251/jetlc.v3i2.2541

Zorrilla Abascal, M. L., & Castillo Díaz, M. (2023). Information and digital literacy competencies in a virtual degree. *Apertura*, *15*(1). https://doi.org/10.32870/ap.v15n1.2285