Review Article

Limitations of Electronic Assessment: A Systematic Review

Zahra Akbari Pordanjani [1], Keyvan Salehi [2]

[1] Faculty of Engineering Sciences, University of Tehran, Tehran, Iran

[2] Faculty of Psychology and Education, University of Tehran, Tehran, Iran

*keyvansalehi@ut.ac.ir

Abstract

Electronic assessment—also referred to as online, digital, or automated assessment—has become an integral component of modern education, particularly in the context of e-learning and blended learning environments. It facilitates the evaluation of students' knowledge, skills, and attitudes while offering notable advantages such as flexibility, cost-effectiveness, and enhanced access to educational data. Despite its growing prominence, electronic assessment is not without its limitations, which can hinder its effectiveness and broader adoption in educational settings. This study aims to systematically identify and analyze the key limitations associated with electronic assessment, with the goal of informing improved practices and aligning assessment strategies with future educational demands. Employing the PRISMA framework, a systematic review was conducted using articles published between 2000 and 2024. Relevant studies were sourced from databases such as Scopus, Google Scholar, and ScienceDirect, using a comprehensive set of search terms related to electronic assessment and its constraints across various educational contexts. The review identified ten major categories of limitations: technical issues, academic integrity concerns, accessibility and equity challenges, difficulties in measuring learning outcomes, data privacy risks, student inexperience, inadequate technical infrastructure, inaccuracies in scoring and grading, challenges in assessing group work, and limited teacher familiarity with assessment technologies. These challenges underscore the need for strategic improvements to maximize the reliability, equity, and pedagogical value of electronic assessments. Furthermore, the findings reveal a predominant focus in the literature on assessing individual content knowledge, with relatively limited exploration of broader educational outcomes or diverse theoretical frameworks. Addressing these gaps—both methodological and practical—will be critical to enhancing the future role of electronic assessment in education.

Keywords: Electronic Assessment, Online-assessment, Digital Assessment, E-Assessment, Virtual Assessment, Limitations of Assessment.

INTRODUCTION

While electronic assessment (e-assessment) has become increasingly prevalent in educational settings, it is not without its limitations and challenges. By understanding these limitations, educators and policymakers can make informed decisions about the implementation and integration of e-assessment tools and strategies.

One of the primary limitations of e-assessment is the potential impact on the reliability and validity of assessment outcomes. Traditional assessment methods often rely on human judgment and interpretation, which can introduce subjectivity and

variability in grading. In contrast, e-assessment systems use automated algorithms and pre-defined criteria to evaluate student responses, raising concerns about the accuracy and consistency of grading [1]. Moreover, e-assessment platforms may not always capture the full range of student knowledge and skills, leading to incomplete or biased assessment results [2, 3, 4]. As a result, educators must critically evaluate the reliability and validity of e-assessment tools and ensure that they align with established standards and best practices in assessment.

The adoption of electronic assessment (e-assessment) in education promises significant benefits such as efficiency, cost savings, and immediate feedback. However, it is essential to understand the limitations of e-assessment to maximize its potential. Technical challenges, including inadequate infrastructure and unequal access to technology, hinder its effectiveness and equity [5]. Educational limitations, such as difficulties in assessing practical skills and interpersonal competencies, raise concerns about the comprehensiveness of e-assessments [6]. Additionally, security issues like cheating and data privacy breaches pose significant risks to the integrity of assessments [7]. Furthermore, the psychological impact on students, including increased anxiety and stress, cannot be overlooked [8]. Recognizing these limitations is crucial for developing effective strategies to address them, thereby enhancing the reliability, fairness, and overall quality of e-assessment in educational systems.

Another limitation of e-assessment is its dependence on technology and infrastructure, which can pose barriers to access and equity. Students from disadvantaged backgrounds or regions with limited internet connectivity may face challenges in accessing e-assessment platforms and completing assessments online [9, 10] Moreover, technical issues such as server outages, software glitches, and compatibility issues can disrupt the-assessment process and compromise the integrity of assessment results [11]. As educational institutions increasingly rely on e-assessment for high stakes exams and standardized testing, it is essential to address these technological dependencies and ensure equitable access to assessment opportunities for all students.

Security and integrity issues represent significant challenges in e-assessment, particularly with regards to preventing cheating and academic dishonesty. Unlike traditional paper-based assessments, e-assessment platforms may be vulnerable to various forms of cheating, including plagiarism, collusion, and unauthorized access to assessment materials [12]. While some e-assessment tools offer features such as secure browser settings and plagiarism detection software, these measures may not always be foolproof and can create additional burdens for educators and students [13, 14, 15]. Balancing the need for security with the principles of fairness and accessibility is a complex challenge in e-assessment, requiring careful consideration of assessment design, proctoring methods, and ethical guidelines.

E-assessment tools may be limited in their ability to assess complex cognitive skills and higher order thinking abilities effectively. While multiple choice and short answer questions are well suited for assessing factual knowledge and basic concepts, they may

not adequately measure skills such as critical thinking, problem solving, and creativity [16]. Moreover, e-assessment platforms may struggle to accommodate diverse-assessment formats, such as performance-based tasks, portfolio assessments, and peer evaluations, which are essential for evaluating complex learning outcomes [17]. As a result, educators must carefully consider the appropriateness of e-assessment tools for different types of assessment tasks and learning objectives.

Statement of the problem

The increasing adoption of e-assessment in educational institutions promises numerous benefits such as enhanced efficiency, cost effectiveness, and immediate feedback. However, this shift from traditional assessment methods to digital formats is not without its challenges. The limitations of e-assessment pose significant barriers to its effective implementation and can impact on the overall quality of education. These limitations encompass technical issues such as inadequate infrastructure and access to necessary technology, educational challenges including the inability to assess practical and interpersonal skills comprehensively, security concerns related to cheating and data privacy, and psychological effects such as increased anxiety and stress among students.

Despite the growing reliance on e-assessment, there is a lack of comprehensive studies that address these multifaceted limitations and propose effective solutions. This gap in research highlights the need for a detailed investigation into the constraints associated with e-assessment. The primary problem is how to identify, analyze, and mitigate these limitations to ensure that e-assessment can be reliably and effectively integrated into educational systems, thereby enhancing the overall learning experience.

The adoption of electronic assessment (e-assessment) in educational systems worldwide offers substantial advantages, including enhanced efficiency, cost savings, and the provision of immediate feedback. However, these benefits are accompanied by a series of limitations that hinder the full potential of e-assessment. These limitations span across technical, educational, security, and psychological domains. Technical issues such as insufficient infrastructure and unequal access to necessary technology can prevent equitable participation [18]. Educationally, e-assessment often struggles to evaluate practical skills and interpersonal competencies effectively [6]. Security concerns, including the potential for cheating and data privacy breaches, pose significant risks [7]. Additionally, the psychological impact on students, such as increased anxiety and stress, cannot be overlooked [19].

Despite its growing implementation, comprehensive research addressing these multifaceted limitations and proposing viable solutions is limited. The primary challenge is to identify, analyze, and mitigate these limitations to ensure the effective and equitable integration of e-assessment into educational frameworks.

Understanding the limitations of e-assessment is crucial for several reasons. Firstly, it ensures that educational institutions can effectively address the technical, educational,

security, and psychological challenges associated with this form of assessment, thereby enhancing its reliability and fairness. Recognizing these limitations helps in developing robust strategies to mitigate potential issues and improve the overall quality of e-assessment [20]. Technical Challenges: Technical issues such as inadequate infrastructure, unreliable internet connectivity, and lack of access to necessary devices can significantly hinder the effectiveness of e-assessment. Identifying these problems allows institutions to invest in appropriate technologies and support systems, ensuring that all students have equal access to e-assessment tools [6]. Educational Impact: E-assessment often struggles to evaluate practical skills and interpersonal competencies comprehensively. By understanding these educational limitations, educators can design assessments that better measure a wider range of skills and competencies, thereby providing a more holistic evaluation of student performance [21]. Security Concerns: E-assessment systems are vulnerable to security breaches, including cheating and data privacy issues. Awareness of these limitations enables the development of more secure systems and the implementation of measures such as proctoring software and secure browsers, which help maintain the integrity of the assessment process [7]. Psychological Effects: The shift to e-assessment can increase anxiety and stress among students. Understanding these psychological impacts is essential for creating supportive environments and providing resources that help students manage their stress, thereby improving their performance and overall well-being [8]. By comprehensively understanding these limitations, participants in the education sector can enhance the design and implementation of e-assessment systems. This, in turn, can lead to more accurate and fair evaluations, better student engagement, and ultimately, improved educational outcomes.

Materials and Methods

In this study, articles related to the subject in international journals written in Latin were systematically selected and studied. Examining theoretical foundations is an important step before conducting any research study [20]. This creates the context for knowledge accumulation, which in turn enables the development of theories, closes gaps in research, and reveals areas missed by previous research [22]. A theoretically grounded review can be considered a systematic background review only when the review is explicit about the research questions, identifies and analyzes relevant research studies, and assesses their quality against specific criteria [23]. In this review, the guidelines of [24, 25, 26]. for conducting a systematic review were followed, in addition to the procedures of other systematic reviews conducted in which the review was conducted in four stages Separately performed: identification of inclusion and exclusion criteria, data sources and search strategy, quality assessment, and data coding and analysis Details of these steps are shown in the following subsections. A systematic review of e-assessment is essential for the field of e-learning, as it sets us the limits of e-assessment. Therefore, the purpose of this study is to provide a comprehensive review of research conducted in the field of electronic assessment through a systematic literature review of articles in this field. To be able to answer the research questions and help the researchers and

practitioners in better understanding and knowledge of the issues related to this field. And give us the limitations of the electronic evaluation.

Eligibility Criteria

This review includes research papers describing the use of Artificial Intelligence (AI) for student assessment, published in peer-reviewed journals, and published between 2000and 2024. The year 2010 has been used as the starting year for the search, due to the great development of this technology. The languages used for the search were English. Once the search had been carried out, the inclusion and exclusion criteria used were those set out in the following Table 1. It is important to clarify that the review is based primarily on the use of AI for student assessment in online and face-to-face subjects.

Table 1. Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Published 2000–2024	Published before 2000
English language	Not in English
Empirical research	Not empirical (e.g., review)
Peer review journal	Not peer review journal
Use of artificial intelligence to assess and learners or electronic assessment	Not artificial intelligence or electronic assessment Not learning setting Not for assessment
We must include access to the entire text of the article	Only their abstracts are available

Data sources and search strategy

Based on PRISMA guidelines [27], articles indexed in Scopus, Google Scholar and Science Direct databases in the period from 2000 to 2022, using the combination of keywords ((" Electronic assessment" or "Assessment with Artificial Intelligence") and ("limitation") and ("Education ") and ("Limitations" or "Assessment or evaluation and with artificial intelligence or Electronic assessment") were investigated.

Keyword selection is an essential step in any systematic review; because it determines which articles should be physically retrieved [25]. The initial search results identified 654 articles Finally, by applying restrictions and using exclusion criteria, this number was reduced to 80 articles with entry and exit conditions, and after deeper investigations, 20 articles that were of high quality were included in the analysis process. The search and refinement steps in this review were based on the Preferred Reporting Items for Meta-Analytical Systematic Reviews (PRISMA) [28]. Figure 1 shows the flow chart of PRISMA. This study included a systematic review and synthesis of peer-reviewed research articles published between 2000 and 2024, which were first identified through a search of the databases Google Scholar, Scopus, Science Direct, then based on a Defined criterion were selected for inclusion [29]. Our approach was to use elements of the protocol presented by [23]. According to our research questions, it included identifying relevant work,

assessing the quality of studies, summarizing evidence, and interpreting findings. The articles must meet the four conditions, including 1. related to the research topic; 2. Be published between 2000 and 2024; 3. The articles have reached the final publication; 4. Articles should include keywords ((Artificial Intelligence assessment or Electronic Assessment) and (Assessment or Evaluation) and (Limitation) and (Education)). Type of document: articles. Time period: 2000–2024. Languages: English.
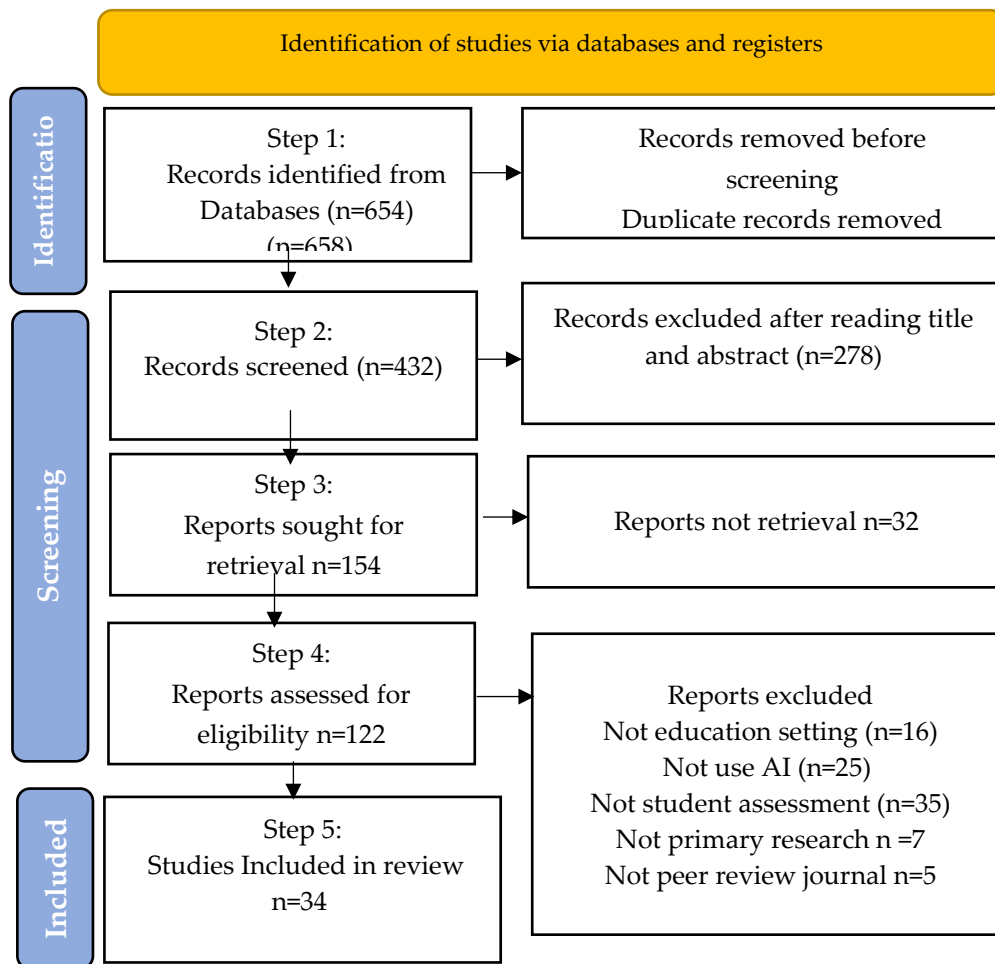

Figure 1. PRISMA diagram

One of the basic steps that must be followed in addition to the entry and exit criteria is qualitative assessment [26]. In the current research, after the initial reviews and identification of the main articles, a qualitative evaluation was carried out, in which it was checked that 1- Are the objectives of the research clearly defined? 2- Are the data collection methods accurate enough? 3- Does the study explain the reliability and validity of the criteria? 4- Are the results clearly defined? 5- Does reading add to your knowledge and understanding? Each question was scored on a three-point scale, where "yes" is 1 point, "no" is 0 points, and "somewhat" is 0.5 points. Therefore, each study can have

between 0 and 5 points, and the higher the total score of a study, the higher the response rate of this study to the research questions.

Data coding and analysis

After coding the articles and categorizing the subject of education and the application of assessment in education and its achievements, analysis was done by the researcher and the results were presented.

Results

First, Table 2 provides an overview of the papers considered for this evaluation. We extracted the sources, materials, and methods utilized in those articles, as well as a summary of their results.

Table 2: Overview of the articles used for the review

study	Summary of Results	Title	Materials and Methods	Author	Journal
[30]	Reliance on tools like ChatGPT can impede critical thinking and problem-solving skills while also raising concerns about academic integrity due to potential misuse for dishonesty.	Rethinking Homework in the Age of Artificial Intelligence	Experimental research method	(Ibrahim et al., 2023)	IEEE
[31]	Innovative-assessment methods may raise costs, introduce validity concerns due to language variations, limit precision with small item pools, underrepresent diverse populations, and require contextual manipulation alongside improved construction to enhance learning outcomes.	Sophisticated tasks in e-assessment: what are they and what are their benefits?	Experimental research method	(Boyle & Hutchison 2009)	Assessment & Evaluation in Higher Education
[32]	Many self-assessment tools for distance education lack validation and psychometric properties, assumptions about their predictive validity are unfounded, and their use may discourage student enrollment in online courses, highlighting the need for caution and better alternatives for identifying at-risk students.	Review on e-readiness assessment tools	Review study	(Đurek& Reðep, 2016)	IEEE.
[33]	E Learning presents challenges such as limited hands-on learning opportunities, reduced feedback quality, dependence on sometimes unreliable technology, a digital divide restricting access, lack of standardization complicating result comparison, security vulnerabilities risking assessment integrity, and limited accessibility for students with disabilities.	Hacettepe Üniversitesi Eğitim Fakültesi Dergisi Hacettepe University	Editorial Paper	(KAYIŞ ,et al 2023)	Journal of Education
[34]	System limitations affect assessment transfer between campuses and create time constraints for students, while concerns about unfair advantages from immediate feedback, along with privacy and security issues, are prevalent among students.	Electronic assessment in higher education.		(Brink & Lautenbach, 2011)	Educational Studies,
[35]	identifies limitations in electronic assessment related to the construction and evaluation of a web-based learning portfolio system, including the technical challenges of implementing the system and ensuring consistent user engagement. Additionally, there are concerns about the reliability and validity of assessments due to varying levels of user familiarity with the technology.	Construction and evaluation of a web-based learning portfolio system: An electronic assessment tool.	Experimental research method	(Chang, 2001).	Computers & Education
[36]	highlights limitations in electronic assessment, including challenges in the technical implementation of a web-based learning portfolio system and potential issues with user engagement and familiarity with the technology. Additionally, the reliability and validity of the-assessments may be compromised due to variations in	AMEE Guide 32: e-Learning in medical education Part 1: Learning, teaching and	Experimental research method	(Ellaway & Masters, 2008)	Medical Teacher

	user experience and access to resources.	assessment.		
[37]	The effectiveness of online exams and cheating prevention methods is limited by reliance on technology, adaptability challenges for students and educators, potential for false positives in cheating detection systems, reduced personal interaction, biases introduced by automated systems, and scalability issues in large-assessments.	Physical and virtual laboratories in science and engineering education	review	(De Jong et al, 2013)	Computers & Education
[38]	The study revealed limitations in understanding the long-term impact of e-assessment on student perceptions and highlighted that the positive attitudes observed may not be generalizable across different educational contexts or student populations.	Students' Perceptions of E-Assessment at Saudi Electronic University.	Qualitative research method	(Alsadoon, 2017)	Turkish Online Journal of Educational Technology-TOJET,
[39]	The limitations of online learning readiness assessments include a lack of standardization, time and resource constraints in developing valid assessments, reliance on potentially inaccurate self-reported data, challenges in evaluating essential soft skills, and the difficulty of continuously monitoring and improving assessment validity.	Student online readiness assessment tools: A systematic review approach.	A systematic review approach	(Alem et al .,2014)	Electronic Journal of e-Learning,
[40]	The limitations of using portfolios in student assessment include minimal impact on motivation and transferable skills, inconsistent student perceptions of portfolios and rubrics, the necessity of understanding contextual factors that affect implementation, personal factors influencing student opinions, the need for guidance and training for effective use, and challenges for teachers in adapting their practices to align with portfolio-based assessments.	University students' perceptions of e-portfolios and rubrics as combined assessment tools in education courses.	Quantitative research method	(Contreras-Higuera et al.,2016).	Journal of Educational Computing Research,
[41]	The reliance on automatic assessment methods, with no use of manual assessment, limits the diversity of evaluation approaches; this technology dependency can create vulnerabilities during technical failures or limited access to resources. Additionally, the shift to automated assessments necessitates further training for educators and careful planning to support the transition from traditional practices.	A systematic review of formative-assessment tools in the blended learning environment.	systematic review	(Febriani & Abdullah, 2018).	International Journal of Engineering & Technology,
[42]	Overreliance on electronic tools like email and discussion boards may limit instructional diversity and overlook traditional teaching benefits; this reliance can also create equity and access issues for those lacking technology or skills. Additionally, these tools may impose pedagogical limitations that restrict assessment types and interactions with course materials, reducing the depth of learning experiences.	Integrating electronic instructional and assessment tools into teacher education programs.	mixed method	(Petriashvili, 2012)	International Journal of Arts & Sciences,
[43]	The study's focus on student perceptions at the University of Bradford limits the generalizability of its findings to other institutions, and while it explored various perceptions, it lacked a comprehensive analysis of all potential benefits and drawbacks of e-assessment. Additionally, although age and gender did not significantly impact responses, other demographic factors that may influence perceptions were not considered.	e-Assessment and the student learning experience: A survey of student perceptions of e-assessment.	Quantitative research method	(Dermo, 2009).	British Journal of Educational Technology,
[44]	The study revealed that e-portfolio tests have moderate washback effects, which may limit their influence on learning outcomes and teaching practices, while teachers' below-average perceptions could hinder assessment effectiveness. Although students generally viewed e-portfolio tests positively, potential limitations in motivation and engagement exist if they do not recognize the-assessments' value. Additionally, technical challenges related to system reliability and user-friendliness may further restrict the effectiveness of e-portfolio assessments for both students and teachers.	Corporate governance in the 2007–2008 financial crisis: Evidence from financial institutions worldwide.	Quantitative research method	(Erkens et al,.2012)	Journal of corporate finance,
[45]	The study indicated that teachers have below-average	E-assessment: Wash-back effects	mixed	(Binnahed	Theory and

	perceptions of e-tests, which could negatively affect their effectiveness if teachers are not fully engaged. Additionally, the moderate washback effects noted from students' perspectives suggest potential limitations in the influence of e-tests on learning outcomes and teaching practices.	and challenges (examining students' and teachers' attitudes towards e-tests).	method	h, 2022)	Practice in Language Studies,
[46]	E-assessments exhibit moderate washback effects on learning outcomes and teaching practices, with teacher perceptions often being below average, which can hinder their effectiveness. Additionally, student motivation may be limited if they do not recognize the value of these-assessments, compounded by challenges related to digital literacy and restricted access to devices and internet connectivity, particularly for disadvantaged students.	E-classroom interactional competencies: Mediating and assisting language learning during synchronous online lessons.	mixed method	(Moorhouse et al ,. 2023).	Relc Journal,
[47]	Online-assessments face challenges such as potential technical issues and internet connectivity problems that can disrupt the-assessment process, as well as difficulties in monitoring students, which may compromise validity. Additionally, accessibility issues arise for students lacking digital devices or internet access, and the potential for invalid measurements exists when students fail to submit assignments or seek external assistance.	Electronic practical skills assessments in the health professions: a.	review	(Snodgrass et al, 2014)	Internet Journal of Allied Health Sciences and Practice,
[48]	Integrating educational content into a Content Management System (CMS) can be hampered by technical issues like system reliability and user-friendliness, which affect both students and teachers. Although the CMS provides improved monitoring of student progress and assignments, it may struggle with ensuring academic integrity during online-assessments, and while it allows for content reuse, limitations in creating personalized assessments based on stored metadata can restrict customization and adaptability.	EduComponents : Experiences in e-assessment in computer science education.	Experimental research method	(Amelung et al. 2006, June)	In Proceedings of the 11th annual SIGCSE conference on Innovation and technology in computer science education
[49]	The effectiveness of e-assessment and e-learning methods can be constrained by learner profiles and learning outcomes, necessitating a tailored approach based on institutional or workplace contexts. While plagiarism detection tools enhance the assessment of subjective assignments, they may face limitations in accuracy and reliability, and their incorporation into e-learning systems can be hindered by costs, implementation challenges, and user acceptance.	E-assessment for e-learning..	mixed method	(Prakash& Saini, 2012)	IEEE International Conference on Engineering Education
[50]	The systematic sharing of data collected from interRAI assessments across various care settings presents a significant challenge that requires further investigation. Additionally, developing effective strategies to address known health issues identified through these assessments is crucial for enhancing client outcomes. Finally, successfully integrating interRAI assessment tools into existing clinical workflows is essential to lessen the burden on clinicians and encourage their adoption.	User experience of interRAI assessment tools in New Zealand.	qualitative	(Smith et al ,2013)	In MEDINFO
[51]	The study highlights stress and inadequate ICT skills as significant barriers for students, restricting their engagement with e-assessment and negatively impacting their learning experiences. While implementing e-assessment in primary and secondary education could better prepare students for tertiary education, challenges such as insufficient infrastructure and IT skill gaps must be addressed to maximize its effectiveness and improve student perceptions in the Indian educational context.	Experiencing e-assessment during COVID-19: an analysis of Indian students' perception..	descriptive quantitative methodological	(Kundu & Bej, 2021)	Higher Education Evaluation and Development, 15(2), 114-134
[52]	The current research highlights a limited understanding of the effects of various Patient-Reported Outcome Measures (PROMs) on improving patients' quality of life, indicating a need for further investigation. Additionally, while the focus is on the implementation process and the	Can electronic assessment tools improve the process of shared decision-	systematic review	(Wickrama sekera,et al., 2023)	Health Information Management Journal

	use of multiple PROMs by physicians, important aspects of electronic assessment tools may be overlooked, and the findings may lack generalizability across diverse healthcare settings.	making? A systematic review.		
[53]	The adoption of e-assessment methods is hindered by varying levels of IT competence among students, significant time commitments required from educators to develop effective evaluation strategies, and challenges in transitioning from traditional assessment methods to more authentic e-assessment tasks. Additionally, the lack of user-centered approaches in existing e-assessment experiments and limited research on the adoption and acceptance of these methods indicate gaps in understanding their effectiveness and associated challenges.	. E-assessment in higher education: A review. International	Review	(Appiah & Van Tonder, 2018)	Journal of Business Management & Economic Research
[54]	The adaptation of traditional classroom assessment methods to online education is often inadequate, leading to a limited range of teaching and assessment methods constrained by financial models and scheduling issues, while the potential of the Internet and social media for enhancing education and assessment remains underutilized.	E-Assessment of students performance during the E-Teaching and learning.	Quantitative method	(Al-Hattami, 2020)	International Journal of Advanced Science and Technology,
[55]	Superficial implementation of Assessment for Learning (AfL) practices can undermine their intended positive impact on student achievement, making meaningful application crucial; additionally, assessing long-term recall of knowledge poses challenges that require careful planning, and transitioning from traditional summative-assessment methods necessitates gradual change and support for successful adoption.	e-Assessment for learning and performativity in higher education: A case for existential learning.	Case Study	(Charteris et al , 2016)	Australasian Journal of Educational Technology
[56]	Portfolios are not standardized, feasible for large-scale-assessment, or unbiased . Structured EHR data are a poor source of information on functional limitations, with most categories likely to be under-captured or missing completely.EHR documentation of function is not standardized across vendors and health systems, limiting interoperability and information sharing..	Effectiveness of Using E-Module and E-Assessment.	(true experimental research) (posttest-only control group design)	(Kurniawan et al.,2019)	International Journal of Interactive Mobile Technologies
[57]	The assessment life cycle framework emphasizes the importance of a hybrid system for assessment, combining electronic and paper modes, indicating a limitation in fully transitioning to electronic assessments. Institutions should prioritize electronic submissions, marking, and feedback on coursework, with medium and lower priority given to computer-based assessments and online exams, suggesting a limitation in fully embracing electronic assessment methods	E-assessment: Institutional development strategies and the-assessment life cycle	qualitative approach	(Tomas et al .,2015)	. British Journal of Educational Technology
[58]	Formative-assessment is designed to monitor student learning and provide ongoing feedback, while summative-assessment evaluates student learning at the end of an instructional unit. Formative-assessments are typically low-stakes and do not carry a grade, but feedback from summative-assessments can be used formatively	Online formative-assessment in higher education: Its pros and cons..	Quantitative method	(Baleni, 2015)	Electronic Journal of e-Learning
[59]	The study highlights the need for further research to explore integrating assessment tools into LMSs and establishing a software product line for tailored programming assignment assessment tools, indicating a current lack of comprehensive solutions in these areas.	A systematic literature review of assessment tools for programming assignments.). IEEE	meta-analysis	(Souza et al.,2016)	In 2016 IEEE 29th International Conference on Software Engineering Education and Training (CSEET)
[60]	The study only provides initial statistical results, indicating the need for further research on the system's long-term impact on learning outcomes. The system may	Advancing electronic assessment. 65.	an experiment	Doukas & Andreatos, 2007	International Journal of Computers

	face challenges in scaling to larger universities or across different disciplines without significant customization.			Communications & Control,
[61]	Subjectivity in Evaluation: The evaluation process relies on individual specialists' judgments, which may introduce subjectivity and variability in assessments. Resource Intensive: Conducting evaluations for a large number of product quality aspects can be resource-intensive and may require significant time and expertise from evaluators	The comprehensive evaluation of electronic learning tools and educational software (CEELTES).	Quantitative method	(Karolcík et al.,2015)	Informatics in Education

What are the limitations of electronic assessment?

Despite having many advantages, e-assessment is not completely free from disadvantages that curb its wide application and acceptance [62]. Several past studies pointed out disadvantages [63]. Talked about the lack of institutional commitment that most institutions have; [64] pointed out the lack of confidence among students and teachers mainly due to their lack of computer efficacy; in [62] found the lack of students' motivation as a disadvantage, and [6] found teachers' doubt on its effectivity and unbiasedness as a disadvantage. [65] made a very significant point when he said computer distraction.

Is a disadvantage for e-assessment affecting the students' achievement as whole? [64] found the lack of feedback as a potential disadvantage. [66] found certain challenges pertaining to students' verification, authorship and authentication participating in e-assessment, and [67] found cheating and plagiarism as a grave concern associated with e-assessment compared to traditional paper-based assessment. Several other studies also advocated that cheating and plagiarism are easier and more frequent in e-assessment [68, [69, 70, 71,72,66] categorize cheating and plagiarism in e-assessment like impersonation, taking materials into exams, looking at others' answers and ghostwriting. [69,43] unequivocally said such forms of malpractice undoubtedly affect the validity and reliability of e-assessments. In this paper, we have identified ten categories of challenges, which are illustrated in Figure 2.
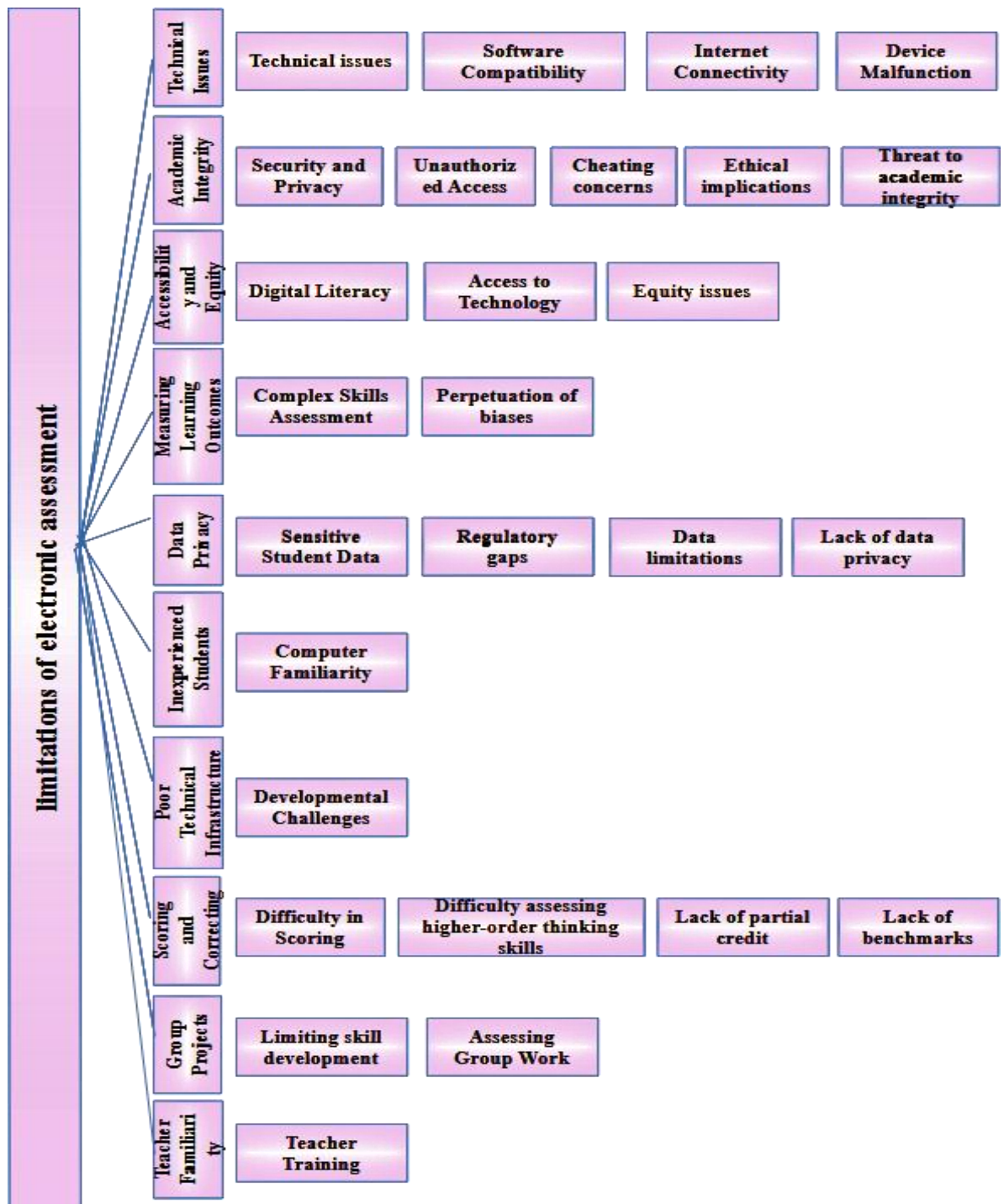
Figure 2. Limitations of electronic assessment

The limitations of electronic assessment (e-assessment)

a) Technical Issues:

Technical issues: Online assessments are susceptible to technical glitches, system failures, or internet connectivity problems, which can disrupt the assessment process.

Internet Connectivity: Students may face difficulties due to poor internet connectivity, which can hinder the smooth conduct of online assessments.

Software Compatibility: Compatibility issues between different devices and software can cause technical problems.

Device Malfunction: Device malfunctions or hardware issues can disrupt the assessment process.

Socio-technical limitations: AI systems are impermanent and can change rapidly, making it challenging to ensure the validity and reliability of AI assessment methods over time. Additionally, AI lacks human critical thinking abilities essential for comprehensive assessment.

b) Academic Integrity:

Security and Privacy: Ensuring the security and integrity of online assessments is crucial to prevent cheating and plagiarism. This includes measures such as proctoring software, secure browser settings, and plagiarism detection tools.

Unauthorized Access: The ease of accessing unauthorized materials or collaborating with others online can increase the risk of cheating and plagiarism.

Cheating concerns: Online-assessments face risks of cheating through screen sharing, online searches, or accessing external resources, compromising assessment integrity.

Ethical implications: AI assessment raises ethical concerns regarding bias, discrimination, privacy, and accountability of AI systems.

Threat to academic integrity: Students can use AI text generators to produce answers, raising concerns about plagiarism and the reliability of content.

c) Accessibility and Equity:

Digital Literacy: Students and teachers who lack digital literacy may struggle with navigating the features and tools of online assessments, which can hinder their ability to participate effectively.

Access to Technology: Not all individuals or regions have equal access to reliable internet connections, appropriate devices, and digital literacy skills, leading to potential disparities and limited opportunities.

Equity issues: Students with limited access to technology, reliable internet, or digital literacy skills may be disadvantaged in online assessments, creating an uneven playing field.

d) Measuring Learning Outcomes:

Complex Skills Assessment: Online assessments can struggle to measure complex skills that require human judgment, such as open-ended questions or group projects.

Perpetuation of biases: If the training data for AI contains biases, the AI-generated content will also be biased, perpetuating biases in assessments.

e) Data Privacy:

Sensitive Student Data: Online assessments involve collecting and storing sensitive student data, including personal information, academic performance, and assessment results. Insufficient security measures can make these platforms vulnerable to cyberattacks.

Regulatory gaps: There is a lack of clear regulations and standards governing the development, deployment, and assessment of AI systems across industries.

Data limitations: AI tools may produce inaccurate or biased outputs if the training data is outdated, limited in scope, or perpetuates biases and stereotypes.

Lack of data privacy: AI systems may store and process sensitive student data, raising privacy concerns if the systems are compromised.

f) Inexperienced Students:

Computer Familiarity: Students who are not familiar with computers or the online assessment process may need training to be comfortable with the system.

g) Poor Technical Infrastructure:

Developmental Challenges: Implementing e-assessment systems in areas with limited technical infrastructure, such as some developing countries, can be challenging.

h) Scoring and Correcting:

Difficulty in Scoring: Scoring and correcting questions with open-ended responses can be difficult, especially when comparing computer and human judges.

Difficulty assessing higher-order thinking skills: Online assessments often rely on objective-type questions like multiple-choice or true/false, which primarily test knowledge recall and comprehension. Assessing higher-order cognitive abilities like analysis, evaluation, and creation is challenging through online assessments**.**

Lack of partial credit: Online assessments typically mark answers as either right or wrong, with no provision for partial credit or insight into the student's thought process and reasoning.

Lack of benchmarks: There is an absence of established benchmarks or frameworks for assessing the performance, safety, and trustworthiness of AI systems across different domains**.**

i) Group Projects:

Assessing Group Work: Assessing group projects can be challenging due to the need to evaluate communication skills, group work, and individual contributions

Limiting skill development: Over-reliance on AI for assessments may hinder the development of essential skills like critical thinking and problem-solving in students.

j) Teacher Familiarity:

Teacher Training: Teachers who are unfamiliar with technology or using e-assessment for the first time may require training to be confident in using the system. limitations of Electronic Assessment.

Desiccation

Electronic assessment has limitations that can be overcome by iodine. Concerns about reliability, validity, technological dependence, accessibility, security, and assessment complexity highlight the need for careful planning, implementation, and evaluation of e-assessment practices. By acknowledging these limitations and adopting evidence-based strategies for mitigating their impact, educators can harness the potential of e-assessment to improve-assessment practices and enhance student learning outcomes effectively.

Technical issues like internet connectivity problems, software incompatibility, and device malfunctions can disrupt the assessment process and negatively impact the test-taker experience. Ensuring the security and integrity of online assessments is crucial, as the ease of accessing unauthorized materials or collaborating with others can increase the risk of cheating and plagiarism. Online-assessments require access to reliable internet connections, appropriate devices, and digital literacy skills. However, not all individuals or regions have equal access to these resources, leading to potential disparities and limited opportunities. Students and teachers who lack digital literacy may struggle with navigating the features and tools of online assessment platforms, which can result in frustration and hinder their ability to participate effectively. Measuring learning outcomes in online assessments can be more challenging than traditional face-to-face assessments. Assessing group projects is also difficult in an online setting, as it requires monitoring communication skills, evaluating group work, assessing each member individually, and providing feedback. Some teachers may be unfamiliar with the technology or using e-assessment for the first time. Therefore, they need training to be confident in using the assessment system. Scoring and correcting open-ended questions with student responses can be challenging, although solutions like comparing the correlation between computer and human judges or using well-defined answers for short answer questions can help. In summary, while online assessments offer numerous advantages, such as flexibility, data-driven instruction, interactive formats, and immediate feedback, addressing the limitations related to technical issues, academic integrity, accessibility, digital literacy, and measuring learning outcomes is crucial for the successful implementation of e-assessment in higher education.

Rather than trying to retrofit AI into existing assessment systems, a fundamental rethinking of assessment practices is needed. The purpose of education and assessment should align with developing critical thinking, problem-solving, and real-world application skills that AI currently lacks. Incorporating AI into the learning process, rather than just assessment, could be beneficial. AI tools can support idea generation, writing assistance, and understanding complex concepts. However, transparency about AI usage and ensuring work remains the student's own is crucial. A balanced approach is essential, leveraging AI's strengths while recognizing its limitations. AI should be viewed as a tool to enhance learning, not replace human cognition and evaluation. Assessments should have a mix of AI-enabled components (Lane 2) and secure, human-graded components (Lane 1) to ensure attainment of learning outcomes. Ultimately, addressing the limitations of AI in assessment requires a fundamental re-evaluation of assessment practices and the purpose of education itself. Embracing AI while prioritizing the

development of human skills like critical thinking, creativity, and real-world problem-solving is key for meaningful assessment in the AI era.

Conclusion

This systematic review has shed light on the multifaceted limitations of electronic assessment in contemporary education. While electronic assessments offer significant advantages—such as flexibility, cost-efficiency, and real-time feedback—they are also constrained by critical challenges that impede their full integration and effectiveness. The study identified ten key categories of limitations, including technical reliability, concerns over academic integrity, inequitable access, issues with accurately measuring learning outcomes, and privacy risks, among others. These findings underscore the urgent need for a more holistic and inclusive approach to the design and implementation of electronic assessments. In particular, the lack of theoretical and methodological diversity in current research suggests that the field remains in a formative stage. Future research should explore broader educational impacts, such as student engagement, critical thinking development, and collaborative learning, while also incorporating interdisciplinary frameworks that draw from educational psychology, data science, and digital ethics. To realize the full potential of electronic assessments, participants—including educators, system designers, and policymakers, must address these limitations through better infrastructure, comprehensive training, equitable access initiatives, and rigorous privacy safeguards.

REFERENCES

1. R. E. Bennett, "Formative-assessment: A critical review," *Assessment in Education: Principles, Policy & Practice*, vol. 18, no. 1, pp. 5–25, 2011.
2. T. Mitchell, N. Aldridge, W. M. Williamson, and P. Broomhead, "Computer-based testing of medical knowledge," 2003.
3. M. A. Maar et al., "Unpacking the black box: A formative research approach to the development of theory-driven, evidence-based, and culturally safe text messages in mobile health interventions," *JMIR mHealth and uHealth*, vol. 4, no. 1, 2016.
4. M. K. Wolf, Ed., *Assessing English language proficiency in US K-12 Schools*. Routledge, 2020.
5. K. Ghouali, S. Benmoussat, and R. Ruiz Cecilia, "E-assessment on the spotlight: Present and future prospects," 2020.
6. C. Redecker, Y. Punie, and A. Ferrari, "eAssessment for 21st century learning and skills," in *21st Century Learning for 21st Century Skills*, A. Ravenscroft, S. Lindstaedt, C. D. Kloos, and D. Hernandez-Leo, Eds. Springer, Germany, 2012, pp. 292–305.
7. N. C. Rowe, "Cheating in online student assessment: Beyond plagiarism," *Online Journal of Distance Learning Administration*, vol. 7, no. 2, pp. 1–10, 2004.
8. J. R. Stowell and D. Bennett, "Effects of online testing on student exam performance and test anxiety," Journal of Educational Computing Research, vol. 42, no. 2, pp. 161–171, 2010.
9. G. T. Brown and L. R. Harris, Eds., *Handbook of Human and Social Conditions in Assessment*. New York, NY: Routledge, 2016, p. 323.
10. J. Thornton, "We will fix the deficit: Deficit theories in the literature of educational technology adoption," in *Proceedings of Rhetoric and Reality: Critical Perspectives on Educational Technology, ascilite Dunedin*, 2014, pp. 320–334.

11. S. Hatzipanagos, A. Tait, and L. Amrane-Cooper, "Towards a post COVID-19 digital authentic assessment practice: When radical changes enhance the student experience," in *EDEN Conference Proceedings*, vol. 1, pp. 59–65, 2020.

12. M. Ripley, *E-assessment: An update on research, policy and practice*. Bristol: FutureLab, 2007.

13. A. M. Nortvig, A. K. Petersen, and S. H. Balle, "A literature review of the factors influencing e-learning and blended learning in relation to learning outcome, student satisfaction and engagement," *Electronic Journal of E-learning*, vol. 16, no. 1, pp. 46–55, 2018.

14. N. Dahalan, H. Hassan, and H. Atan, "Student engagement in online learning: Learners' attitude toward e-mentoring," *Procedia - Social and Behavioral Sciences*, vol. 67, pp. 464–475, 2012.

15. H. Al-Samarraie, B. K. Teng, A. I. Alzahrani, and N. Alalwan, "E-learning continuance satisfaction in higher education: A unified perspective from instructors and students," *Studies in Higher Education*, vol. 43, no. 11, pp. 2003–2019, 2018.

16. C. Garrison and M. Ehringhaus, *Formative and Summative-assessments in the Classroom*, 2007.

17. R. E. Bennett, "The changing nature of educational assessment," *Review of Research in Education*, vol. 39, no. 1, pp. 370–407, 2015.

18. P. I. Wuisan, B. Wibawa, and A. Suparman, "Development of electronic assessment system of teachers' professional competence at Faculty of Education, Pelita Harapan University," *Journal of Positive School Psychology*, vol. 6, no. 3, pp. 2014–2020, 2022.

19. J. R. Stowell, "Use of clickers vs. mobile devices for classroom polling," *Computers & Education*, vol. 82, pp. 329–334, 2015.

20. JISC, *Effective Practice with e-Assessment: An Overview of Technologies, Policies and Practice in Further and Higher Education*, 2007.

21. J. W. Gikandi, D. Morrow, and N. E. Davis, "Online formative-assessment in higher education: A review of the literature," *Computers & Education*, vol. 57, no. 4, pp. 2333–2351, 2011.

22. M. Al-Emran, V. Mezhuyev, and A. Kamaludin, "PLS-SEM in information systems research: A comprehensive methodological reference," in *Proceedings of the 4th International Conference on Advanced Intelligent Systems and Informatics (AISI 2018)*, Springer, 2018.

23. K. S. Khan, R. Kunz, J. Kleijnen, and G. Antes, "Five steps to conducting a systematic review," *Journal of the Royal Society of Medicine*, vol. 96, no. 3, pp. 118–121, 2003.

24. B. Kitchenham and S. Charters, *Guidelines for performing systematic literature reviews in software engineering*, Software Engineering Group, School of Computer Science and Mathematics, Keele University, 2007, pp. 1–57. doi:10.1145/1134285.1134500.

25. V. Costa and S. Monteiro, "Key knowledge management processes for innovation: A systematic literature review," *VINE Journal of Information and Knowledge Management Systems*, vol. 46, no. 4, pp. 444–464, 2016. doi:10.1108/VJIKMS-02-2015-0017.

26. A. Baniasadi, K. Salehi, E. Khodaie, K. Bagheri Noaparast, and B. Izanloo, (2023). Fairness in classroom assessment: a systematic review. *The Asia-Pacific Education Researcher*, vol. 32, pp. 91–109, 2023. https://doi.org/10.1007/s40299-021-00636-z

27. M. J. Page et al., "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews," *International Journal of Surgery*, vol. 88, p. 105906, 2021.

28. D. Moher, A. Liberati, J. Tetzlaff, D. G. Altman, and The PRISMA Group, "Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement," *PLoS Med*, vol. 6, no. 7, 2009.

29. I. Roberts et al., "The role of systematic reviews in research," *International Journal of Epidemiology*, vol. 35, no. 4, pp. 877–881, 2006. doi:10.1093/ije/dyl187.

30. H. Ibrahim, R. Asim, F. Zaffar, T. Rahwan, and Y. Zaki, "Rethinking homework in the age of artificial intelligence," *IEEE Intelligent Systems*, vol. 38, no. 2, pp. 24–27, 2023.

31. A. Boyle and D. Hutchison, "Sophisticated tasks in e-assessment: What are they and what are their benefits?" *Assessment & Evaluation in Higher Education*, vol. 34, no. 3, pp. 305–319, 2009.

32. V. Đurek and N. B. Reðep, "Review on e-readiness assessment tools," in *Proceedings of the Central European Conference on Information and Intelligent Systems*, Faculty of Organization and Informatics Varazdin, 2016, p. 161.

33. Ö. KAYIŞ, E. G. YILDIRIM, and A. N. ÖNDER, *Hacettepe University Journal of Education*, e-ISSN: 2536-4758, 2023.

34. R. Brink and G. Lautenbach, "Electronic assessment in higher education," *Educational Studies*, vol. 37, no. 5, pp. 503–512, 2011.

35. C. C. Chang, "Construction and evaluation of a web-based learning portfolio system: An electronic assessment tool," *Innovations in Education and Teaching International*, vol. 38, no. 2, pp. 144–155, 2001.

36. R. Ellaway and K. Masters, "AMEE Guide 32: E-Learning in medical education Part 1: Learning, teaching and assessment," *Medical Teacher*, vol. 30, no. 5, pp. 455–473, 2008. doi:10.1080/01421590802108331.

37. T. De Jong, M. C. Linn, and Z. C. Zacharia, "Physical and virtual laboratories in science and engineering education," *Science*, vol. 340, no. 6130, pp. 305–308, 2013.

38. H. Alsadoon, "Students' perceptions of e-assessment at Saudi Electronic University," *Turkish Online Journal of Educational Technology (TOJET)*, vol. 16, no. 1, pp. 147–153, 2017.

39. F. Alem, M. Plaisent, P. Bernard, and O. Chitu, "Student online readiness assessment tools: A systematic review approach," *Electronic Journal of e-Learning*, vol. 12, no. 4, pp. 376–384, 2014.

40. W. E. Contreras-Higuera, F. Martínez-Olmo, M. J. Rubio-Hurtado, and R. Vilà-Baños, "University students' perceptions of e-portfolios and rubrics as combined assessment tools in education courses," *Journal of Educational Computing Research*, vol. 54, no. 1, pp. 85–107, 2016.

41. I. Febriani and M. I. Abdullah, "A systematic review of formative-assessment tools in the blended learning environment," *International Journal of Engineering & Technology*, vol. 4, no. 11, pp. 33–39, 2018.

42. I. Petriashvili, "Integrating electronic instructional and assessment tools into teacher education programs," *International Journal of Arts & Sciences*, vol. 5, no. 5, p. 323, 2012.

43. J. Dermo, "E-assessment and the student learning experience: A survey of student perceptions of e-assessment," *British Journal of Educational Technology*, vol. 40, no. 2, pp. 203–214, 2009. doi:10.1111/j.1467-8535.2008.00915.x.

44. D. H. Erkens, M. Hung, and P. Matos, "Corporate governance in the 2007–2008 financial crisis: Evidence from financial institutions worldwide," *Journal of Corporate Finance*, vol. 18, no. 2, pp. 389–411, 2012.

45. B. I. A. Binnahedh, "E-assessment: Wash-back effects and challenges (examining students' and teachers' attitudes towards e-tests)," *Theory and Practice in Language Studies*, vol. 12, no. 1, pp. 203–211, 2022.

46. B. L. Moorhouse, Y. Li, and S. Walsh, "E-classroom interactional competencies: Mediating and assisting language learning during synchronous online lessons," *Relc Journal*, vol. 54, no. 1, pp. 114–128, 2023.

47. S. J. Snodgrass, S. E. Ashby, L. Onyango, T. Russell, and D. A. Rivett, "Electronic practical skills assessments in the health professions: A review," *Internet Journal of Allied Health Sciences and Practice*, vol. 12, no. 1, p. 8, 2014.

48. M. Amelung, M. Piotrowski, and D. Rösner, "EduComponents: Experiences in e-assessment in computer science education," in *Proceedings of the 11th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education*, 2006, pp. 88–92.

49. L. S. Prakash and D. K. Saini, "E-assessment for e-learning," in *2012 IEEE International Conference on Engineering Education: Innovative Practices and Future Trends (AICERA)*, July 2012, pp. 1–6. IEEE.

50. J. Smith, D. Whiddett, and I. Hunter, "User experience of interRAI assessment tools in New Zealand," in *MEDINFO 2013*, pp. 744–748. IOS Press.

51. A. Kundu and T. Bej, "Experiencing e-assessment during COVID-19: An analysis of Indian students' perception," *Higher Education Evaluation and Development*, vol. 15, no. 2, pp. 114–134, 2021.

52. N. Wickramasekera, S. K. Taylor, E. Lumley, T. Gray, E. Wilson, and S. Radley, "Can electronic assessment tools improve the process of shared decision-making? A systematic review," *Health Information Management Journal*, vol. 52, no. 2, pp. 72–86, 2023.

53. M. Appiah and F. Van Tonder, "E-assessment in higher education: A review," *International Journal of Business Management & Economic Research*, vol. 9, no. 6, 2018.

54. A. A. Al-Hattami, "E-assessment of students' performance during the E-teaching and learning," *International Journal of Advanced Science and Technology*, vol. 29, no. 8, pp. 1537–1547, 2020.

55. J. Charteris, F. Quinn, M. Parkes, P. Fletcher, and V. Reyes, "E-assessment for learning and performativity in higher education: A case for existential learning," *Australasian Journal of Educational Technology*, vol. 32, no. 3, 2016.

56. W. Kurniawan, K. Anwar, and D. A. Kurniawan, "Effectiveness of using e-module and e-assessment," *International Journal of Interactive Mobile Technologies*, vol. 13, no. 9, 2019.

57. C. Tomas, M. Borg, and J. McNeil, "E-assessment: Institutional development strategies and the-assessment life cycle," *British Journal of Educational Technology*, vol. 46, no. 3, pp. 588–596, 2015.

58. Z. G. Baleni, "Online formative-assessment in higher education: Its pros and cons," *Electronic Journal of e-Learning*, vol. 13, no. 4, pp. 228–236, 2015.

59. D. M. Souza, K. R. Felizardo, and E. F. Barbosa, "A systematic literature review of assessment tools for programming assignments," in *2016 IEEE 29th International Conference on Software Engineering Education and Training (CSEET)*, April 2016, pp. 147–156. IEEE.

60. N. Doukas and A. Andreatos, "Advancing electronic assessment," *International Journal of Computers Communications & Control*, vol. 2, no. 1, pp. 56–65, 2007.

61. Š. Karolcík, E. Cipková, R. Hrušecký, and M. Veselský, "The comprehensive evaluation of electronic learning tools and educational software (CEELTES)," *Informatics in Education*, vol. 14, no. 2, pp. 243–264, 2015.

62. D. A. Bacigalupo, W. I. Warburton, E. A. Draffan, P. Zhang, L. Gilbert, and G. B. Wills, "A formative eAssessment co-design case study," in *2010 IEEE 10th International Conference on Advanced Learning Technologies (ICALT)*, 2010, pp. 35–37.

63. P. Isaías and T. Issa, "E-learning and sustainability in higher education: An international case study," *The International Journal of Learning in Higher Education*, vol. 20, no. 4, pp. 77–90, 2013.

64. D. M. Whitelock and A. Brasher, "Developing a roadmap for e-assessment: which way now?," in *Proceedings of the 10th CAA International Computer Assisted Assessment Conference, Professional Development*, M. Danson, Ed., Loughborough University, 2006, pp. 487–501.

65. S. Mason and D. Seng, *Electronic evidence*, p. 422, University of London Press, 2017.

66. H. Mellar, R. Peytcheva-Forsyth, S. Kocdar, A. Karadeniz, and B. Yovkova, "Addressing cheating in e-assessment using student authentication and authorship checking systems: Teachers' perspectives," *International Journal for Educational Integrity*, vol. 14, no. 2, 2018. doi:10.1007/s40979-018-0025-x.

67. H. Xu and S. Mahenthiran, "Factors that influence online learning assessment and satisfaction: Using Moodle as a learning management system," *International Business Research*, vol. 9, no. 2, 2016. doi:10.5539/ibr.v9n2p1.

68. C. Pedersen, R. White, and D. Smith, "Usefulness and reliability of online-assessments: A Business Faculty's experience," *International Journal of Organisational Behaviour*, vol. 17, no. 3, pp. 33–45, 2012.

69. N. Alruwais, G. Wills, and M. Wald, "Advantages and challenges of using e-assessment," *International Journal of Information and Education Technology*, vol. 8, no. 1, pp. 34–37, 2018.

70. J. M. Bartley, "Assessment is as assessment does: A conceptual framework for understanding online-assessment and measurement," in *Online-assessment and Measurement: Foundations and Challenges*, IGI Global, 2005, pp. 1–45.

71. J. Alves, J. Herman, and N. C. Rowe, "Robust recognition of ship types from an infrared silhouette," in *Proceedings of the Command and Control Research and Technology Symposium*, 2004.

72. M. Hillier, "The very idea of e-exams: Student (pre) conceptions," in *Proceedings of the Australasian Society for Computers in Learning in Tertiary Education Conference*, 2014, pp. 77–88.