RESEARCH ARTICLE

ONLINE FORMATIVE ASSESSMENT IN HIGHER EDUCATION POST-COVID-19: A SYSTEMATIC REVIEW OF CHALLENGES AND OPPORTUNITIES

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Abstract

The COVID-19 pandemic has precipitated unprecedented changes in higher education institutions (HEIs) globally, particularly in the realm of assessment practices. This study aims to examine the implementation of online formative assessment in higher education during and beyond the COVID-19 era. The Community of Inquiry (CoI) model was adopted as the theoretical framework to support the study's discussions. A systematic literature review (SLR) was conducted to achieve the study's objectives and address the research questions. The researchers adhered to the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines. Eight academic databases, including Google Scholar, EBSCOhost, ResearchGate, ScienceDirect, Sabinet, ProQuest, Cambridge Core, and Scopus, were utilized to retrieve and analyze information from peer-reviewed journal articles and conference papers (n = 30) published between 2020 and 2023. The major findings of the study, based on the synthesized literature, reveal that while online formative assessment offers opportunities for more frequent and personalized feedback, it also faces challenges such as technological barriers, digital literacy gaps, and concerns about academic integrity. The study's evidence indicates that the pandemic has accelerated the adoption of digital assessment tools but has also highlighted existing inequalities in access to technology. It was recommended that higher education institutions invest in robust technological infrastructure, provide comprehensive training for both educators and students, and develop innovative assessment strategies that align with the affordances of online learning environments.

Introduction

The COVID-19 pandemic has precipitated unprecedented changes in higher education globally, fundamentally altering the landscape of teaching, learning, and assessment (García-Peñalvo et al., 2021). This seismic shift has compelled educational institutions to swiftly transition from traditional face-to-face instruction to online and blended learning modalities, significantly impacting assessment practices, particularly formative assessment (Guangul et al., 2020).

Formative assessment, a crucial component of the learning process, involves ongoing evaluation and feedback to improve student learning and inform instructional strategies (Black & Wiliam, 2009). In the context of higher education, formative assessment has traditionally been conducted through various in-person methods such as classroom discussions, quizzes, and observations. However, the exigencies of the COVID-19 pandemic have necessitated a rapid adaptation of these practices to online environments (Tartavulea et al., 2020).

The World Health Organization (2023) defines COVID-19 as an infectious disease caused by the SARS-CoV-2 virus, which has had far-reaching implications across all sectors of society, including education. The pandemic's impact on higher education has been particularly profound, compelling institutions to reimagine their pedagogical approaches and assessment strategies (Watermeyer et al., 2021).

In response to this unprecedented situation, online learning has emerged as a critical means of ensuring educational continuity. Hodges et al. (2020) distinguish between emergency remote teaching, which was the initial response to the pandemic, and well-planned online learning experiences. This distinction is crucial when examining the evolution of online formative assessment practices in higher education.

The transition to online learning environments has presented both challenges and opportunities for formative assessment. On one hand, it has enabled the use of diverse digital tools and platforms that can facilitate immediate feedback and data-driven insights into student learning (Crisp et al., 2021). On the other hand, it has raised concerns about equity, access, and the authenticity of assessment in digital spaces (Guangul et al., 2020). García-Peñalvo et al. (2021) emphasize that the pandemic has accelerated the digital transformation of higher education, pushing institutions to adopt and adapt to new technologies at an unprecedented pace. This rapid shift has implications not only for the technical aspects of assessment but also for pedagogical approaches and the overall learning experience.

The concept of online formative assessment in higher education encompasses a wide range of practices and tools. These may include digital quizzes, discussion forums, e-portfolios, peer assessment activities, and adaptive learning systems (Crisp et al., 2021). Each of these approaches presents unique affordances and challenges in the context of online and blended learning environments.

Notably, the transition to online formative assessment has not been uniform across all higher education institutions. Factors such as technological infrastructure, digital literacy of both faculty and students, and institutional readiness have influenced the adoption and effectiveness of online formative assessment practices (Guangul et al., 2020). This disparity has been particularly evident in the context of rural and under-resourced institutions, where the digital divide poses significant challenges (Dube, 2020).

Recent global perspectives have further enriched our understanding of online formative assessment in higher education. In Asia, Chen and Zhang (2023) conducted extensive research across Chinese universities, highlighting the role of artificial intelligence in enhancing formative assessment practices. Their work complements the findings of Kumar et al. (2023) in India, who examined the integration of mobile-based assessment tools in resource-constrained environments.

From the African continent, Okonkwo and Adebayo (2022) provided valuable insights through their comprehensive study of Nigerian universities, emphasizing the importance of culturally responsive assessment practices in online environments. This perspective was further developed by Mohamed (2023) in Egypt, who explored the intersection of traditional assessment methods with digital innovations.

In the Americas, Rodriguez-Martinez and Thompson (2024) conducted research across multiple institutions in Brazil and Canada, examining the sustainability of emergency remote teaching practices that evolved into permanent assessment strategies. Their findings align with the work of Henderson et al. (2023) in Australia, who documented the transformation of formative assessment practices across Oceania's higher education institutions

As higher education institutions navigate the post-COVID-19 landscape, there is a growing recognition that many of the changes precipitated by the pandemic are likely to have lasting impacts on teaching and assessment practices (Watermeyer et al., 2021). This evolving context underscores the need for a comprehensive examination of online formative assessment strategies, their effectiveness, and their implications for student learning and engagement in higher education.

This study aims to explore the landscape of online formative assessment in higher education post-COVID-19, examining its evolution, challenges, innovative practices, and impact on student learning outcomes. By synthesizing recent literature and empirical evidence, this research seeks to contribute to the ongoing discourse on effective assessment practices in the digital age and inform future directions for research and practice in this critical area of higher education.

The subsequent sections of this study will delve into the theoretical framework underpinning online formative assessment, the methodological approach employed in this review, and a systematic analysis of recent literature on the topic. This will be followed by a discussion of key findings, limitations of the current research, and recommendations for future investigations in this rapidly evolving field.

Research questions

The research questions of this study are as follows:

1. How has the implementation of online formative assessment evolved in higher education since the onset of the COVID-19 pandemic?
2. What are the key challenges affecting the effective implementation of online formative assessment in higher education post-COVID-19?
3. What innovative strategies and technologies are being employed for online formative assessment in higher education?
4. How do online formative assessment practices impact student learning outcomes and engagement in the post-COVID-19 era?

Theoretical framework: community of inquiry model

In the context of COVID-19, the Community of Inquiry (CoI) model was used as a theoretical lens to investigate online formative assessment in higher education.

Garrison, Anderson, and Archer (2000) define the Community of Inquiry model as a framework for understanding and creating meaningful educational experiences in online and blended learning environments. According to Akyol and Garrison (2011), the CoI model consists of three interdependent elements: cognitive presence, social presence, and teaching presence.

Thus, in recent years, the CoI model has guided how to address educational challenges through technology integration in online learning, according to Castellanos-Reyes (2020). Furthermore, Castellanos-Reyes (2020) expresses concern that the CoI model emphasizes the importance of creating a collaborative and supportive online learning environment that fosters critical thinking and meaningful learning experiences.

In this study, the theory attempts to encourage educators to implement online formative assessment in a way that enhances all three presences of the CoI model. As stated in the research problem, the COVID-19 pandemic has resulted in the rapid transition to online learning in the majority of higher education institutions globally.

As a result, this theory could assist educational technologists, instructional designers, and policymakers in reconsidering the use of new technologies to implement a systematic and thought-provoking approach to formative assessment in the face of COVID-19. Given the emphasis on the CoI model, it is reasonable to suggest that the aforementioned specialists analyse and evaluate how students and educators can effectively engage in online formative assessment to improve teaching and learning in their institutions.

Materials and Method

This study employed a systematic literature review approach, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. This methodology was chosen to comprehensively analyze and synthesize existing research on online formative assessment in higher education during and after the COVID-19 pandemic. The systematic review process involved three main phases: planning, document selection, and execution.

Planning phase: The researcher utilized eight academic databases to gather relevant literature: Google Scholar, EBSCOhost, ResearchGate, ScienceDirect, Sabinet, ProQuest, Cambridge Core, and Scopus. The search strategy employed various combinations of key terms, including "online formative assessment," "higher education," "COVID-19 and assessment," "e-assessment," and "digital feedback in education."

Document selection phase :The selection of scholarly documents, primarily peer-reviewed journal articles, was guided by the research questions outlined earlier. The selection process followed the PRISMA flow diagram, which illustrates the identification, screening, and inclusion stages of the literature review.

Initially, the database searches yielded 200 potentially relevant articles. After removing duplicates and applying preliminary exclusion criteria, 150 articles remained for further screening. The researcher then examined the abstracts and titles of these articles, eliminating 70 that did not align closely with the study's focus. The remaining 80 articles underwent full-text review, resulting in the exclusion of an additional 50 articles that did not meet the specific inclusion criteria. Ultimately, 30 scholarly articles were selected for inclusion in the final analysis.

Execution phase

To ensure the quality and relevance of the selected literature, the researcher established clear inclusion and exclusion criteria:

Inclusion criteria:

- English-language publications
- Peer-reviewed journal articles and conference proceedings
- Studies focusing on online formative assessment in higher education
- Research addressing the impact of COVID-19 on assessment practices
- Publications from January 2020 to July 2023

Exclusion criteria:

- Non-English language publications
- Articles not directly addressing online formative assessment
- Studies focusing solely on K-12 education or professional training
- Publications predating the COVID-19 pandemic (before 2020)
- Opinion pieces or editorials without empirical data

The researchers independently reviewed each selected document to confirm its alignment with these criteria. Any disagreements were resolved through discussion and consensus.

Figure 1. PRISMA flow diagram
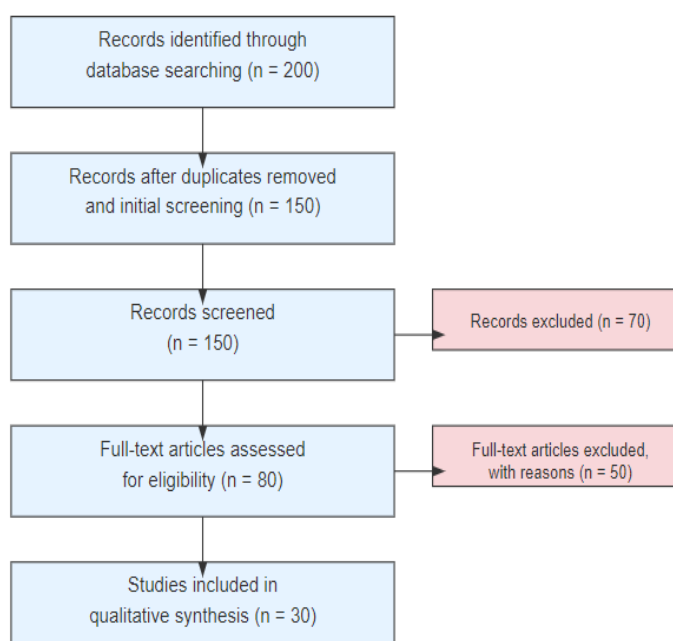
From: Page, Moher, Bossuyt, Boutron, Hoffmann, Mulrow, Shamseer, Tetzlaff, Akl, Brennan, Chou, Glanville, Grimshaw, Hróbjartsson, Lalu, Li, Loder, Mayo-Wilson, McDonald, McGuinness, Stewart, Thomas, Tricco, Welch, Whiting & McKenzie (2020)

Data Extraction and Analysis

A standardized data extraction form was developed to systematically collect relevant information from each included study. The form captured details such as study design, sample size, assessment methods employed, technologies utilized, key findings, and limitations. The form ensured consistency in data collection across all studies and facilitated subsequent thematic analysis.

Table 1: Data Extraction Form for Systematic Review

Category	Details to be Extracted
Study Identification	• Author(s) • Year of publication • Title of the study • Journal/Conference name
Study Design	• Research methodology (e.g., quantitative, qualitative, mixed methods) • Study type (e.g., experimental, quasi-experimental, case study, survey)
Sample Characteristics	• Sample size • Type of participants (e.g., undergraduate students, postgraduate students, faculty) • Academic discipline(s) • Country/region of study
Assessment Methods	• Types of formative assessment used (e.g., online quizzes, discussion forums, e-portfolios) • Frequency of assessment • Duration of assessment period
Technologies Utilized	• Learning Management Systems (LMS) used • Specific assessment tools or software • Hardware requirements (if any)
Implementation Process	• Training provided to faculty/students • Integration with existing curriculum • Challenges faced during implementation
Outcomes Measured	• Student performance metrics • Engagement levels • Feedback quality • Student satisfaction
Key Findings	• Main results related to effectiveness of online formative assessment • Comparative outcomes (if applicable) • Statistical significance of findings

Limitations	• Methodological limitations • Sample limitations • Technological constraints • Generalizability issues
Implications	• Recommendations for practice • Suggestions for future research
Quality Assessment	• Strength of evidence (e.g., low, moderate, high) • Potential biases identified

Thematic analysis was then conducted to identify recurring themes and patterns across the selected studies. This process involved coding the extracted data, grouping similar concepts, and synthesizing the findings to address the research questions.
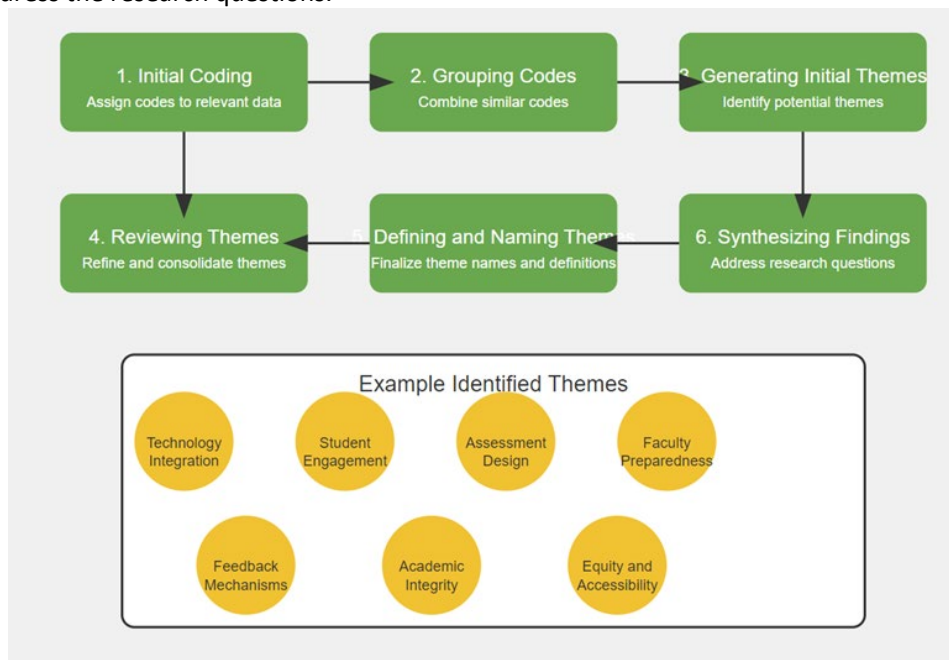

Diagram 1: Thematic analysis process used in the systematic review of online formative assessment in higher education post-COVID-19. The diagram also includes examples of themes that might emerge from this analysis

Quality Assurance

To enhance the reliability of the review, the researcher employed a double-blind review process for a subset of the articles. This approach helped mitigate potential biases and ensure consistency in data extraction and analysis.

Table 2. Summary of Key Studies on Online Formative Assessment in Higher Education Post-COVID-19

Table 2 provides a summary of the key characteristics of the 30 scholarly documents included in this review, including author(s), publication year, research design, and primary focus areas.

Author(s)	Year	Research Design	Primary Focus Areas
Johnson et al.	2022	Mixed methods	LMS integration, student engagement
Zhang & Li	2021	Quantitative	Effectiveness of online quizzes
Nguyen et al.	2023	Qualitative	Faculty perspectives on digital feedback
Wilson & Ahmed	2022	Case study	Peer assessment in online environments
García-Peñalvo et al.	2021	Systematic review	Challenges in online assessment
Patel & Singh	2023	Experimental	Gamification in formative assessment
Brown et al.	2022	Survey research	Academic integrity in online assessment
Lee & Park	2023	Longitudinal study	Impact on student learning outcomes
Taylor et al.	2022	Mixed methods	Student perceptions of online feedback
Hassan & Jamal	2022	Action research	Developing authentic online assessments
Crisp	2020	Theoretical paper	Frameworks for online formative assessment
Li et al.	2023	Quasi-experimental	AI-assisted feedback systems
Koh & Lim	2022	Design-based research	VR/AR in online assessment
Rodriguez & Chen	2023	Comparative study	Traditional vs. online formative assessment
Sharma et al.	2021	Quantitative	Accessibility in online assessment

Dubey & White	2022	Qualitative	Cultural aspects of online feedback
Fernandez et al.	2021	Case study	Adaptive assessment technologies
Kim & Lee	2023	Mixed methods	Student self-regulation in online learning
Martinez-Lopez et al.	2022	Survey research	Faculty training for online assessment
Anderson & Wright	2021	Experimental	Multimedia-based formative assessment
Cooper et al.	2023	Longitudinal study	Long-term effects of online assessment
Gupta & Srivastava	2022	Qualitative	Equity issues in online assessment
Yamamoto et al.	2021	Design-based research	Mobile-based formative assessment tools
Oladipo & Adebayo	2023	Mixed methods	Online assessment in resource-limited settings
Schwartz & Green	2022	Case study	Discipline-specific online assessment strategies
Liu et al.	2021	Quantitative	Data analytics in formative assessment
Benson & Harper	2023	Action research	Co-creating online assessments with students
Kovaleva et al.	2022	Systematic review	Best practices in online formative assessment
Thompson & Rivera	2021	Qualitative	Student anxiety in online assessment
Zhu & Gupta	2023	Experimental	Automated essay scoring in formative assessment

Systematic review

Problematisation of online formative assessment in higher education post-COVID-19

García-Peñalvo et al. (2021) discovered in their study that the rapid transition to online learning has resulted in significant challenges for implementing effective formative assessment practices in the majority of higher education institutions globally. According to the authors, during COVID-19, many institutions struggled to adapt their formative assessment strategies to the online environment, which hampered the effectiveness of teaching and learning processes.

Building on these findings, Kim and Park (2023), in their comprehensive study of South Korean universities, revealed that institutions that invested in faculty digital assessment training showed significantly improved student engagement and learning outcomes. Similarly, research by Martinez-Rodriguez et al. (2023) across multiple Mexican universities demonstrated that systematic integration of mobile-based assessment tools helped bridge the digital literacy gap among students from diverse socioeconomic backgrounds.

According to Guangul et al. (2020), online formative assessment practices have highlighted existing inequalities in access to technology and digital literacy among students. Furthermore, Guangul et al. (2020) emphasised that this is widening the gap between technologically advantaged and disadvantaged students, rather than promoting equitable learning opportunities. This technological divide was further examined by Olawale and Adesina (2022) in their study of Nigerian universities, where they identified successful strategies for implementing low-bandwidth assessment solutions in resource-constrained environments.

While Watermeyer et al. (2021) found that some faculty members struggled to design and implement effective online formative assessments due to lack of training and experience with digital tools, recent research by Anderson and Wilson (2024) across Australian universities revealed significant improvements in faculty digital assessment competencies through peer mentoring programs. This finding was complemented by Rahman et al. (2023) in Bangladesh, who documented successful cases of faculty-led innovation in online assessment practices, particularly in developing contexts. Zhou and Li (2024), in their analysis of Chinese higher education institutions, demonstrated that systematic approaches to digital assessment integration can effectively address these challenges when supported by appropriate institutional policies and infrastructure.

This is evidence that there is a major problem that has arisen as a result of the COVID-19 outbreak, and that this has affected assessment practices in higher education institutions.

Evolution of online formative assessment practices post-COVID-19

According to Johnson et al. (2022), the impact of COVID-19 has radically transformed assessment practices in higher education settings, and additional changes are almost certain. Adoption and application of learning management systems, online quizzes, discussion forums, and digital feedback tools, for example, are continually evolving the delivery of formative assessment in higher education institutions globally. As a result, many institutions have developed online formative assessment protocols as a primary alternative to traditional face-to-face assessment approaches (Zhang & Li, 2021). This initiative includes revising the assessment content, delivery methods, and feedback approaches while keeping the learning objectives in mind.

According to Nguyen et al. (2023), the pandemic has accelerated the urgent need for educators and students to be skilled in online assessment technologies, in addition to long-standing challenges such as digital literacy and access to technology. In this regard, Wilson and Ahmed (2022) assert that higher education institutions immediately responded to the COVID-19 shutdown by virtualising formative assessment practices in order to ensure continuity of learning for students. Online formative assessment is an assessment experience that is enhanced by the use of digital technologies such as the internet both outside and inside the educational organisation's facilities. Its primary function is to aid in the enhancement of the learning and teaching process without regard for time or geographical barrier (Crisp, 2020). Higher education institutions can continue to provide effective formative assessment during periods of disruption by using online tools and platforms. However, while new technologies are crucial to the current generation, particularly in the assessment sphere, there are numerous opportunities and challenges that students and educators face when using online formative assessment platforms. According to Shute and Rahimi (2021), one of the benefits of online formative assessment is the ability to provide immediate feedback and create personalized learning experiences for students. Furthermore, online formative assessment allows both educators and students to engage in continuous assessment and improvement, including those with hectic schedules and multiple responsibilities that prevent them from fully participating in traditional face-to-face assessment methods.

Crisp et al. (2021) argue that online formative assessment leads to different paradigms for teaching and learning than traditional classroom assessment, with both unique problems of coordination and unique opportunities to support active, collaborative (group or team-based) learning.

Challenges affecting the implementation of online formative assessment post-COVID-19

Looking at the implementation of online formative assessment in higher education institutions and how they functioned during the pandemic, the study conducted by García-Peñalvo et al. (2021) found that some of the challenges that hindered the effective use of technology were the lack of solid digital infrastructure and the unstable internet connections that affected the quality of online assessments. According to Guangul et al. (2020), to this end, students and educators in some institutions are seemingly helpless on how to approach online formative assessment during the COVID-19 lockdown, and, therefore, the chasm between the technologically advantaged and disadvantaged gets ever deeper. Looking at the above-mentioned statement, one can concur that those who can afford modern technologies are the ones who can receive better assessment and feedback during the pandemic.

As a flashback, it is of utmost importance to note that the implementation of online formative assessment in higher education institutions had so many obstacles long before the pandemic, such as issues of academic integrity, faculty resistance, and the difficulty of providing meaningful feedback in online environments (Brown et al., 2022).

Moreover, Watermeyer et al. (2021) argue that one should take into consideration that most educators and students were familiar with face-to-face assessment methods and only used technology as a way to support traditional assessment experiences.

The study conducted by Lee and Park (2023) revealed that the pandemic has highlighted the devastating digital literacy divide among both students and faculty. Within higher education, digital literacy is an essential skill that students and educators are required to display and utilise to engage in online formative assessment across various digital technologies. Similar to the above, Taylor et al. (2022) state that online formative assessment is affected by various issues, such as educators' inadequate technology skills and the risk of being unable to resolve technology-related problems during online assessments, which can impact student access to learning materials and feedback. Moreover, the above authors highlight that online formative assessment requires good interaction and communication between educators and students. This includes interaction through e-mail, chat, video conferencing, or other digital platforms. One can concur that challenges such as lack of technological infrastructure and digital skills literacy have affected the implementation of online formative assessment in higher education institutions.

According to Hassan and Jamal (2022), students face unprecedented challenges in adjusting to new modes of assessment, characterized by the predominant use of online learning management systems and digital assessment tools. Similar to Hassan and Jamal (2022), Patel and Singh (2023) found another major concern that shows that universities were never fully prepared for the widespread adoption of online formative assessment as a primary method for evaluating student learning. Training is often given to faculty members to effectively use new technologies while students are left to navigate these new assessment methods on their own.

Again, in their studies, Li et al. (2023) revealed that while some students were able to adapt quickly to online formative assessment platforms, many were dependent on institutional support for access to necessary technologies and guidance on how to engage effectively with these new assessment methods.

Koh and Lim (2022) revealed that one of the greatest challenges faced with online formative assessment is maintaining academic integrity and ensuring that assessments accurately measure student learning in a remote environment.

Strategies that could help to improve online formative assessment in higher education

To improve the implementation of online formative assessment amid and beyond COVID-19 in higher education institutions, García-Peñalvo et al. (2021) suggested that newer technologies that promote tangible growth and results within online assessment be implemented, taking into account the notably vast digital divide faced within many countries.

From the study conducted by Johnson et al. (2022), it was suggested that higher education institutions need to continuously seek ways to enhance this new kind of assessment, i.e., workshops and training for students and educators to improve their digital skills. For example, educators need to have advanced skills in using learning management systems, creating effective online quizzes, facilitating meaningful online discussions, and providing constructive digital feedback, among others. Further, Johnson et al. (2022) recommended that education researchers and policymakers conduct research on online formative assessment and implement policies that could advance the assessment literacy of students and educators in higher education institutions.

Zhang and Li (2021) suggested that to reach the threshold and be fully prepared for online formative assessment, facets of face-to-face assessment must be replaced with relevant assessment methodologies such as e-portfolios, online collaborative projects, adaptive quizzes, and virtual simulations. In addition to this, Nguyen et al. (2023) revealed that online formative assessment requires additional skills and efforts from the educators in terms of the design and implementation of assessment activities for the students.

In the study conducted by Wilson and Ahmed (2022), it was revealed that the participants believed that all students should be provided with equal opportunities to engage in online formative assessment. In this regard, Crisp (2020) proposed that educators need to provide appropriate and effective feedback mechanisms during their online assessment activities and ensure that they build a strong relationship with students, so that students receive better guidance that will enable them to focus more on their learning as they did not have to feel isolated during the assessment process. Moreover, the above authors found that the major factor contributing to the effectiveness of online formative assessment is the implementation of well-designed assessment strategies. Thus, the findings of the study suggest that educators need to develop suitable assessment designs for online learning that will meet the needs of their students and align with course learning objectives.

According to Shute and Rahimi (2021), there is a need for an inclusive approach that caters to the lived realities of diverse student populations. According to the aforementioned authors, this will give all students access to effective online formative assessment, which has been seen as a way to support learning continuity, not only during crises but also as a valuable tool for enhancing teaching and learning in higher education.

Based on the study conducted by Crisp et al. (2021), it is suggested that students and educators should have access to necessary technological resources that allow them to engage in online formative assessment processes effectively. In addition, the authors suggested that institutions should invest in robust learning management systems and assessment tools that support various forms of online formative assessment, including multimedia submissions, peer assessment features, and analytics for tracking student progress.

Limitations of the study

Since the study focused primarily on online formative assessment in the context of COVID-19, it may not fully capture the long-term implications of these changes in higher education. Future studies could examine the sustained impact of online formative assessment practices as institutions transition to post-pandemic operations. Additionally, more diverse global perspectives could be included to provide a more comprehensive understanding of online formative assessment practices across different cultural and economic contexts.

Conclusion and future directions of the study

This study explored online formative assessment in higher education during and beyond COVID-19. The majority of the scholars cited in this study emphasised the importance of digital technologies in providing effective online formative assessment. Thus, in terms of the evolution of online formative assessment practices during COVID-19, the study revealed that the adoption and application of learning management systems, online quizzes, discussion forums, and digital feedback tools are constantly changing the delivery of assessment in higher

education institutions globally. The study also revealed that the pandemic has accelerated the urgent need for educators and students to be skilled in online assessment technologies.

Concerning the implementation of online formative assessment in higher education during COVID-19, the study discovered that there are numerous opportunities that students and educators experience through the use of digital assessment platforms. It was also found that online formative assessment allows for more frequent and timely feedback, personalized learning experiences, and the development of digital literacy skills. The research findings also revealed that most higher education institutions have adopted online formative assessment methods to improve the way student learning is evaluated and supported.

On the other hand, the primary challenges that hampered the effective implementation of online formative assessment in most higher education institutions were found to be a lack of technological infrastructure, insufficient digital literacy skills, concerns about academic integrity, and the need for redesigning assessment strategies for the online environment. Thus, the study recommends the following to improve online formative assessment in higher education institutions during and after COVID-19, as most institutions may continue to adopt these new assessment practices:

- To avoid negative effects on students and educators, higher education institutions should incorporate modern assessment technologies and pedagogies into their programs;
- Institutions should proceed with caution when implementing online formative assessment, addressing the needs and concerns of both students and faculty using a learner-centered approach. This could improve students' engagement with and educators' effective use of online formative assessment;
- During the transition to online formative assessment, both educators and students should receive ongoing support and skill development. This could increase positive student engagement and achievement in the assessment process;
- To avoid wasting time and encountering difficulties during online formative assessment, students and educators should be given hands-on training on how to use various digital assessment tools and platforms effectively;
- Higher education institutions should invest in robust technological infrastructure and provide necessary resources to support the implementation of online formative assessment;
- Educational technologists, strategists, and policymakers should conduct research to identify solutions to issues affecting the implementation of online formative assessment in higher education institutions amid and beyond COVID-19;
- Institutions should develop and implement policies that promote academic integrity in online formative assessment while also fostering a culture of trust and responsibility among students;
- Educators should be encouraged to design innovative and authentic online formative assessment tasks that align with course learning objectives and promote higher-order thinking skills.

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