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From emergency remote teaching to innovative online pedagogy: Post-COVID insights from a Ghanaian University

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ABSTRACT

The COVID-19 pandemic triggered a swift transition to online learning, reshaping tertiary education in Ghana. This study explores how students at a Ghanaian technical university perceive online teaching effectiveness in the post-COVID era. Using a qualitative design and semi-structured interviews, it investigates students' experiences, attitudes, and challenges before, during, and after the pandemic. Findings reveal that while online learning enhanced flexibility, digital literacy, and resource access, unstable internet, limited interaction, and unsuitability for practical courses impeded effectiveness. Guided by Social Learning and Expectation Confirmation Theories, results show that students value online education but hesitate to fully embrace it due to technological and pedagogical gaps. The study advocates for blended learning models, stronger digital infrastructure, and faculty training, emphasising equitable access, engagement strategies, and institutional support to sustain online education in Ghana's tertiary sector.

KEYWORDS

Online learning; student perceptions; technical university; blended learning; learning engagement

Introduction

The COVID-19 pandemic dramatically altered the landscape of higher education, forcing a rapid and often unplanned transition to online learning (Meng et al., 2024). While online education had been steadily growing in popularity prior to 2020, the pandemic served as an unprecedented catalyst, accelerating its adoption and highlighting its potential to transform the traditional educational paradigm (Wang et al., 2024). This abrupt shift, while essential for maintaining educational continuity, presented a unique set of challenges and opportunities for both educators and students (Sarpong et al., 2021). Institutions rapidly adapted their curricula and teaching methodologies to the online environment (Zhu et al., 2022),

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employing a diverse range of strategies from synchronous video conferencing to asynchronous online modules (Koh & Daniel, 2022). This period of rapid adaptation and experimentation underscored the complexities of online learning, raising fundamental questions about its long-term efficacy and impact on student learning outcomes (Dos Santos, 2022). Furthermore, the sudden shift to online learning exacerbated existing inequalities in access to technology and reliable internet connectivity, disproportionately impacting students from underprivileged backgrounds (Meng et al., 2024). The transition to online learning was not without its challenges. Students reported difficulties with internet access, unstable technology, and a lack of social interaction (Nkrumah et al., 2024; Wang et al., 2024). The absence of face-to-face interaction raised concerns about student engagement, motivation, and the development of essential social skills (Koren & Zerahia, 2023). Moreover, the increased screen time and technological dependence contributed to technostress and feelings of isolation among students (Koren & Zerahia, 2023). The abrupt shift also raised concerns about academic integrity and the effective assessment of student learning (Koh & Daniel, 2022). These challenges underscore the need for a thorough examination of student perceptions and experiences with online learning to inform future pedagogical practices. Despite the proliferation of online learning, even before the pandemic (Dos Santos, 2022), the sudden and widespread shift to online teaching during COVID-19 exposed significant gaps in our understanding of its long-term effectiveness and its influence on student learning (Boakye-Yiadom et al., 2025; Meng et al., 2024). Existing research provides valuable insights into various facets of the online learning experience, such as faculty perceptions (Ahmed et al., 2023), student motivations (Dos Santos, 2022), and the challenges encountered during the transition (Koh & Daniel, 2022; Nkrumah et al., 2024; Sarpong et al., 2021). However, a comprehensive understanding of student perceptions regarding the effectiveness of online teaching in the post-COVID era, particularly within the context of technical disciplines, remains elusive. This research seeks to address this gap by exploring student perceptions of online learning effectiveness, their willingness to recommend online learning, and their lived experiences with online learning both before and after the pandemic at a selected technical university. Focusing on a technical university allows for an understanding of the challenges and opportunities unique to these disciplines, which often rely heavily on hands-on, practical training and laboratory experiences (Dos Santos, 2022). Several key factors influence the effectiveness of online learning. Technological infrastructure and access remain critical, as the digital divide and unequal availability of reliable internet connectivity and technology create significant barriers to successful online education (Koren & Zerahia, 2023; Meng et al., 2024). Additionally, pedagogical approaches and instructional design play a vital role, requiring educators to adapt their teaching methods and employ innovative strategies to engage students effectively in virtual environments (Ahmed et al., 2023; Wang et al., 2021). Student engagement and interaction are also crucial, as fostering meaningful participation enhances active learning and builds a sense of community among learners (Dos Santos, 2022). Furthermore, effective assessment and feedback mechanisms are essential for maintaining academic integrity and supporting student learning, ensuring that evaluations are both constructive and timely (Wang et al., 2021; Amponsah et al., 2025). Together, these factors shape the overall success and quality

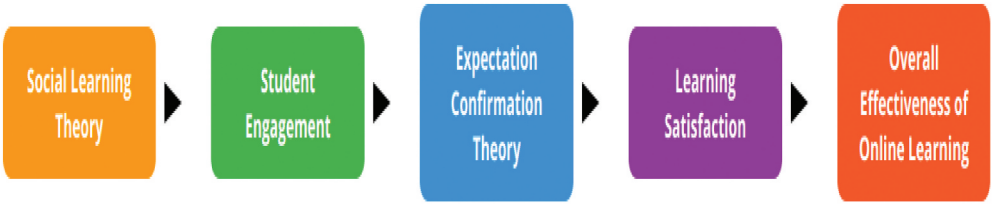

Figure 1. Conceptual framework establishing the factors influencing the effectiveness of online learning post-COVID. Source: Authors' construct (2025).

of online learning experiences. Figure 1 demonstrates the conceptual framework establishing the factors influencing the effectiveness of online learning post-COVID.

Research questions:

(1) How do students describe and interpret the effectiveness of online learning in the post-COVID era?
(2) What are students' lived experiences of online learning pre-COVID and post-COVID?

By addressing these research questions and considering the multifaceted factors influencing online learning effectiveness, this study aims to contribute to a clearer understanding of the evolving landscape of tertiary education and offer valuable insights for shaping the future of teaching and learning in the post-pandemic world.

Empirical review

The resurgence of online teaching post-COVID in Ghanaian universities

The COVID-19 pandemic drastically altered global education, compelling tertiary institutions to shift rapidly to online learning. This transformation created unique challenges and opportunities, particularly in developing contexts such as Ghana. This review examines the resurgence of online teaching in Ghanaian universities, highlighting its complexities, potentials, and implications for higher education. The transition, largely driven by government restrictions and school closures (Mensah et al., 2024; Sualihu et al., 2024), ensured educational continuity but exposed systemic gaps. For many institutions, online delivery was not a planned pedagogical innovation but an emergency response. Existing studies based on gradual, well-prepared transitions did not fully capture the realities of this abrupt shift.

While some universities had experimented with blended learning, the pandemic required a more comprehensive embrace of digital platforms (Alhassan et al., 2021). Learning Management Systems such as Moodle became essential for content delivery and student engagement (Alhassan et al., 2021; Buabeng-Andoh, 2022). Adoption, however, depended on factors such as system quality and social influence (Buabeng-Andoh, 2022; Nii Akai Nettey et al., 2024). The shift revealed inequities in access to devices, internet connectivity, and digital resources, deepening the digital divide (Anane & Adusei, 2024). Universities introduced partial remedies, including device rental

programmes and efforts to reduce internet costs, but socio-demographic disparities persisted.

The quality of online instruction and its impact on learning outcomes also emerged as pressing concerns. Effective online education required faculty training, pedagogical redesign, and institutional support (Anane & Adusei, 2024). Student experiences varied widely, with many reporting challenges in engagement, confidence, and performance (Sualihu et al., 2024). Faculty preferences for recorded lectures, shorter sessions, and tutorial support highlight the ongoing adaptation required (Nyarko et al., 2023). The post-COVID resurgence of online teaching in Ghana signals both opportunities and challenges for higher education. Long-term success depends on addressing the digital divide, investing in faculty development, and designing inclusive, student-centred pedagogies (Mensah et al., 2025). Future research should investigate differential impacts across demographics, sustainable technology adoption, and the role of online education in widening participation. Insights from such work will be crucial for shaping policies that ensure equitable and effective higher education in Ghana.

Theoretical review

Social Learning Theory

Social Learning Theory, developed by Bandura, explains how individuals acquire behaviours within social contexts through observation, modelling and cognitive processes. Unlike behaviourist approaches, it emphasises attention, retention, reproduction and motivation as key mediational processes, alongside reciprocal determinism, which highlights the interaction between personal factors, environment and behaviour (Kytle & Bandura, 1978). Central concepts include observational learning, vicarious reinforcement and self-efficacy, all of which influence motivation, persistence and learning outcomes.

The theory is relevant to this study as the shift to online learning created new social environments requiring adaptation to digital tools and virtual interaction. Students observed and modelled the behaviours of lecturers and peers, while experiences of success or difficulty shaped motivation through vicarious reinforcement. Self-efficacy in using online platforms influenced engagement and satisfaction. The concept of social presence further reflects the importance of interaction and belonging in digital classrooms. Social Learning Theory therefore provides a useful lens for understanding student engagement and perceptions of online teaching effectiveness after COVID.

Expectation Confirmation Theory

Expectation Confirmation Theory explains satisfaction as the outcome of a comparison between prior expectations and perceived performance (Shukla et al., 2025). The theory comprises four key constructs: expectations, perceived performance, disconfirmation and satisfaction. Users evaluate whether actual performance confirms, exceeds or falls short of expectations, and this evaluation shapes satisfaction and continuance intentions.

In the context of post-COVID online learning, students' expectations were influenced by their pandemic experiences and institutional preparedness. Perceived performance relates to factors such as platform usability, instructional quality and peer interaction.

Where performance meets or exceeds expectations, satisfaction increases; where it falls short, dissatisfaction occurs.

This study applies Expectation Confirmation Theory to assess students' expectations of post-pandemic online teaching, evaluate perceived performance and determine how confirmation or disconfirmation influences satisfaction. The framework also acknowledges contextual influences, including digital access and socioeconomic factors, in shaping both expectations and perceptions. Together, these insights support efforts to enhance the quality and sustainability of online education in tertiary institutions.

The conceptual framework illustrates the interconnected factors influencing the effectiveness of online learning post-COVID. Social Learning Theory serves as the foundation, emphasising how students adapt to online learning through observation, interaction, and modelling of behaviours. This directly influences Student Engagement, as active participation in virtual environments enhances learning experiences and fosters a sense of community. Next, Expectation Confirmation Theory comes into play, shaping students' perceptions based on whether their online learning experiences meet or exceed their expectations. If engagement and instructional delivery align with expectations, it leads to Learning Satisfaction, where students feel motivated and confident in the online learning environment. Finally, a high level of satisfaction translates into the Overall Effectiveness of Online Learning, determining whether online education is a viable and sustainable mode of instruction. This flow highlights the sequential impact of theoretical constructs on students' engagement, expectations, satisfaction, and the broader validation of online learning in tertiary education.

Methodology

Research design

The research design chosen for this study was case study, which focuses on understanding and interpreting social phenomena through the perspectives and experiences of the individuals involved (Creswell et al., 2018). This qualitative approach thoroughly explores students' perceptions, attitudes, and experiences in Ghana regarding post-covid validation of the effectiveness of online learning. Using a qualitative research design is particularly appropriate for this study because it allows researchers to delve deeply into the complexities and multiple dimensions of the research topic. Using qualitative methods, the study aims to capture the richness and depth of individual experiences, providing profound insights into the effectiveness of online learning post-covid. Qualitative research provides a flexible framework for an iterative and dynamic research process. It also allows for adapting the research design based on emerging findings and exploring unexpected aspects of the topic. This design enables an in-depth exploration of participants' perspectives, allowing them to express their thoughts, beliefs, and experiences in their own words. Considering the research questions and the necessity for a comprehensive understanding of student's perceptions and experiences, a qualitative research design is relevant to this study. It allows for data collection and analysis flexibility, enabling the

researchers to capture the intricate and nuanced aspects of virtual classes within the Ghanaian context.

Research approach

The research approach delineates the methodical strategy for carrying out the investigation and accomplishing its goals. The present study utilised a qualitative research approach to investigate students' perspectives and encounters with online learning post-covid within the Ghanaian environment. Semi-structured interviews were used in the study's single technique design to collect participants' rich and varied viewpoints.

Population

The target population for this study comprised 240 first-year (Level 100) students within the Department of Civil Engineering at Takoradi Technical University (TTU) who were enrolled in the African Studies course. This cohort was specifically selected because they utilised online classroom learning platforms for a non-technical course within a technical faculty, providing a unique vantage point on pedagogical transition.

The choice of this population was strategically driven by the study's focus on the technical education sector in Ghana. While online learning was implemented across various faculties, the Department of Civil Engineering represents a critical case for exploring the 'theory-versus-practice' tension inherent in technical disciplines. Furthermore, focusing on a single department ensured the feasibility of the qualitative inquiry, allowing for a deeper, more nuanced exploration of student perceptions within a shared academic culture. The population included individuals of diverse ages, genders, and socio-economic backgrounds, reflecting the broader demographic distribution of students in Ghana's technical universities.

Sample and sampling technique

This study employed a purposive sampling technique, a non-probability sampling method where participants are selected based on specific characteristics relevant to the research objectives. The final sample consisted of 240 students, including 221 males and 19 females, all of whom had direct, lived experience with online teaching and learning platforms during and after the COVID-19 pandemic.

In alignment with qualitative research standards, the final sample size was determined by data saturation. Rather than seeking statistical generalisability, the we continued the interview process until informational redundancy was reached. Saturation was confirmed when three consecutive interviews yielded no new themes, codes, or insights regarding student perceptions of online effectiveness or engagement. This rigorous approach ensured that the data collected was sufficiently rich and varied to capture the complexities of the student experience at this Ghanaian technical institution.

Instrumentation

The instrumentation for this study involved designing and developing a semi-structured interview guide (DiCicco-Bloom & Crabtree, 2006). This approach allowed participants to share their experiences, perceptions, and insights in their own words while ensuring that specific research questions were addressed. The interview guide was carefully constructed to cover critical themes related to participants' experiences with online classroom learning, as well as designed using constructs from Social Learning Theory (e.g. questions on peer interaction/modelling) and Expectation Confirmation Theory (e.g. questions comparing pre-COVID expectations to post-COVID realities). The research questions and study objectives were the foundation for developing the interview guide. It consisted of open-ended questions and prompts meant to delve into participants' opinions, difficulties, preferences, and suggestions on online learning. The discussion flow was allowed to occur naturally while simultaneously eliciting thoughtful and nuanced answers from participants.

Data collection

Qualitative interviews served as the primary data collection method, as they are well suited to exploring participants' experiences and perspectives in depth (DiCicco-Bloom & Crabtree, 2006). One to one interviews enabled detailed examination of students' experiences of online learning, generating rich and nuanced responses. Open ended questions, aligned with the research objectives, focused on perceptions of ease of use, effectiveness of online teaching after COVID, and experiences before and after the pandemic.

Interviews were conducted in a conversational and supportive manner, with follow up questions used to clarify and deepen responses. Ethical principles were strictly observed: verbal informed consent was obtained, participation was voluntary, confidentiality and anonymity were assured, and participants could withdraw at any stage without consequence.

Data were collected between February and April 2025. Interviews were conducted either in person or online, according to participants' preferences. In person sessions took place in private university spaces, while online interviews were conducted via Zoom or WhatsApp. With permission, interviews were audio recorded to ensure accurate transcription and supplemented with field notes capturing non verbal cues and contextual observations. Each interview lasted approximately 20 to 30 minutes, allowing for comprehensive exploration of participants' experiences within a safe and trusting environment.

Methods for data analysis

The data were analysed using Braun and Clarke's (2006) six-phase thematic analysis framework to ensure a systematic and rigorous interpretation of the lived experiences of the 240 participants. The researchers began by transcribing interviews verbatim and immersing themselves in the data through repeated readings and review of field notes. Systematic coding was then conducted across the dataset, with significant features

identified and grouped into broader themes through an iterative process of comparison and refinement. The final analysis produced key themes, including Digital Literacy and Adaptability, Technological and Infrastructural Barriers, Social Isolation and Reduced Engagement, and Pedagogical Gaps in Practical Courses. These themes were subsequently defined, refined, and integrated into a theoretically grounded discussion informed by Social Learning Theory and Expectation Confirmation Theory.

To ensure rigour and credibility, the research team engaged in regular discussions and peer debriefing, while memos were kept to document analytical decisions, reflections, and emerging insights. Two strategies were employed to enhance validity and reliability. First, participants were invited to verify the preliminary findings through member checking, allowing them to confirm the accuracy of interpretations or offer corrections. Second, triangulation was applied by cross-referencing interviews, field notes, and relevant literature to substantiate the developing themes.

The analysis was conducted with methodological precision and transparency, aligning with established qualitative research standards. The process aimed to generate meaningful insights, uncover significant themes, and provide a comprehensive understanding of the research problem.

Ethical approval statement

Ethical approval was waived by the Research Ethics Committee of Takoradi Technical University because no sensitive data was collected in this study. Participants received detailed explanations of the study's purpose and provided verbal informed consent prior to participation. Anonymity was maintained through the use of pseudonyms, and participants were reminded of their right to withdraw at any stage without penalty. The methodology ensured that findings were grounded in students' lived realities, while adhering to rigorous ethical and analytical standards.

Findings

Theme 1: Digital literacy and adaptive proficiency

A dominant and widely shared pattern in the dataset was the recognition of improved digital competence following the pandemic-induced transition to online learning. This theme addresses both RQ1 and RQ2. While many participants described initial difficulties pre-COVID, most acknowledged significant post-COVID adaptation and increased technological confidence.

Several participants described limited prior exposure:

> Pre-COVID, I had little to no knowledge on how to navigate varied online teaching platforms . . . This has made my post-COVID learning experience easier.

Similarly:

> Pre-COVID, students were adjusting to new tools . . . Now, post-COVID, we have become more equipped with online learning skills.

Others framed online learning as broadening pedagogical exposure:

> It has revamped and broadened our knowledge. Now both traditional method and online are blended into mainstream teaching.

Across interviews, online learning was described as enhancing digital literacy, improving navigation of learning management systems, and strengthening adaptability. This theme indicates a shift in technological self-efficacy and reflects a broader normalisation of blended pedagogies in the post-pandemic period.

However, improved competence did not automatically translate into universal satisfaction or perceived effectiveness, as other structural and relational barriers remained salient.

Theme 2: Infrastructural constraints and technological inequity

A second and consistently recurring theme concerned unstable internet connectivity and broader technological limitations. This theme appeared across the majority of interviews and was frequently described as the primary barrier to effective online learning. It answers all research questions

Participants emphasised national network challenges:

> Our current situation as a country with regard to network connectivity made the delivery of the online mode ineffective.

Network instability disrupted continuity and comprehension:

> When the network is not good, it is hard to hear or see what you are being taught.

Beyond inconvenience, infrastructure problems were linked to perceived inefficiency:

> It does not aid the effectiveness of its purpose due to our inability to have effective network connectivity.

Students framed these barriers as structural rather than individual failures, suggesting that technological inequity directly undermined perceived ease of use and satisfaction. Even participants who valued online learning's potential expressed conditional support dependent on improved infrastructure.

Theme 3: Diminished social presence and participatory engagement

Distinct from infrastructural concerns, many participants articulated dissatisfaction rooted in reduced interpersonal interaction and weakened classroom community. This theme reflects relational and pedagogical dynamics rather than technological failure alone, as RQ1 seeks to answer.

Participants contrasted online learning with face-to-face engagement:

> During the pre-COVID era, there was intimacy, togetherness, and class experience … online learning lacked all the above.

Others emphasised passivity:

> Students join the online teaching and do not really participate, leading to meaningless lessons.

The phrase 'meaningless lessons' emerged in relation to limited discussion, muted cameras, low participation, and lack of communal presence. Students described diminished motivation and weaker peer interaction even when sessions technically functioned.

This theme demonstrates that perceived effectiveness was shaped not only by access but by social presence, engagement quality, and the ability to model and observe peers and instructors within the learning environment.

Theme 4: Socio-economic utility and flexibility

Despite infrastructural and relational challenges, a substantial proportion of participants highlighted economic and logistical advantages of online learning. Flexibility, cost savings, and convenience were recurrent subthemes.

Participants emphasised reduced travel expenses:

> Online teaching is cost-effective … The cost of traveling is reduced.

Safety and convenience were also noted:

> It allows students to have lessons in the comfort of their homes and eliminates the danger of vehicular traffic.

Flexibility strongly influenced recommendation intentions:

> Online learning is flexible; it allows students learn at their own pace.

Another participant stated:

> I would recommend online learning emphatically because the world is evolving.

However, endorsement was often conditional rather than absolute, suggesting that socio-economic utility coexisted with structural reservations. Students appeared to weigh flexibility benefits against infrastructural and pedagogical limitations when forming overall judgements.

Theme 5: Practical–Pedagogical misalignment in technical education

A final theme that emerged strongly within this technical university context was the perceived incompatibility between online delivery and practical or skill-based courses. This concern was analytically distinct from infrastructure.

Participants explicitly referenced discipline-specific limitations:

> Most courses are practical … online learning limits practical and hands-on work.

Even where connectivity was manageable, students felt that laboratory work, demonstrations, and applied components were insufficiently replicated online. As one participant noted:

> I don't think online learning is effective because most courses are practical.

This theme reflects modality – discipline misalignment: the belief that certain technical competencies require embodied, in-person interaction. Students therefore perceived

online learning as more appropriate for theoretical instruction than for skill-intensive courses.

Discussion of findings

This study explored students' perceptions of the effectiveness of online learning in the post-COVID era within a Ghanaian technical university. The findings reveal a multi-layered evaluation shaped by five interrelated dimensions: digital adaptation, infrastructural limitations, social presence, socio-economic utility, and disciplinary compatibility. Together, these findings reflect a complex post-pandemic reality in which technological competence has improved, but systemic and pedagogical challenges persist.

The first theme highlights a clear transformation in students' digital competencies. Participants widely acknowledged that the forced migration to online learning during COVID-19 accelerated their familiarity with digital platforms, increasing confidence and navigational ability. This aligns with Ahmed et al. (2023), who observed increased post-pandemic proficiency in learning management systems.

From an SLT perspective, students acquired digital behaviours through observation, repetition, and environmental exposure (Kytle & Bandura, 1978). The pandemic functioned as an intensive modelling environment in which peers and instructors collectively adapted to new technologies. This repeated exposure likely enhanced self-efficacy, a central SLT construct. However, improved digital literacy alone did not guarantee satisfaction. This finding refines overly optimistic narratives of 'digital transformation' by showing that competence and perceived effectiveness are analytically distinct constructs.

Despite improved competence, infrastructural instability remained a dominant barrier. Persistent network challenges undermined continuity, comprehension, and overall class effectiveness. This supports prior Ghanaian studies (Nkrumah et al., 2024) highlighting digital inequity as a structural impediment to online learning.

Applying ECT to this understanding, dissatisfaction emerges when perceived performance fails to meet expectations (Shukla et al., 2025). Post-COVID, students' expectations appear recalibrated upward they now expect smoother technological delivery. When network instability persists, negative disconfirmation occurs, leading to reduced satisfaction and hesitation to recommend online learning. Importantly, this dissatisfaction is systemic rather than behavioural. Students did not primarily attribute challenges to lecturer incompetence but to infrastructural limitations beyond institutional control.

A particularly significant contribution of this study lies in its identification of diminished social presence as a relational rather than purely technological issue. Even in cases where connectivity was functional, students described reduced intimacy, engagement, and communal existence. This supports Liu and Mo (2022) and Zhang et al. (2024), who emphasise the role of social presence in satisfaction and persistence in online learning environments.

Within SLT, observational learning and vicarious reinforcement rely on visible behavioural modelling. When cameras are off, participation is low, and discussions are minimal, opportunities for modelling decrease. Consequently, motivation and engagement may decline even in technically functional environments. This theme suggests that effectiveness is not simply a matter of access but of pedagogical design capable of cultivating interaction and participatory engagement.

Students consistently acknowledged the economic and logistical benefits of online learning, reduced transportation costs, increased convenience, improved time management, and safer commuting alternatives. These findings align with those of Meng et al. (2024), who highlight accessibility and flexibility as core advantages of online delivery.

Under ECT, when online learning satisfies expectations related to convenience and efficiency, positive confirmation occurs. This explains why many participants expressed conditional endorsement despite infrastructural concerns. However, socio-economic utility did not fully offset relational and disciplinary shortcomings. Students appear to conduct a cost-benefit evaluation, balancing flexibility against engagement quality and instructional adequacy.

The most contextually specific finding concerns perceived incompatibility between online delivery and practical technical disciplines. Engineering students particularly emphasised the inadequacy of virtual instruction for laboratory and hands-on components. This extends existing Ghanaian research (Anane & Adusei, 2024; Nyarko et al., 2023) by demonstrating that dissatisfaction is not solely infrastructural but curricular. Even with optimal connectivity, certain competencies require embodied engagement and physical manipulation. Practical learning depends heavily on modelling, guided imitation, and real-time feedback in embodied environments. When these observational processes are weakened, skill acquisition may be perceived as incomplete. Thus, the data strongly support hybrid or blended learning approaches rather than full online replacement in technical institutions.

Conclusions and recommendations

This study highlights the dual perceptions of online learning in the post COVID period within Ghanaian tertiary institutions. Students appreciated the flexibility, accessibility and improvement in digital competencies associated with online education. However, persistent challenges such as unstable internet connectivity, limited social interaction, reduced engagement and concerns about academic integrity constrained its overall effectiveness. The success of online learning was found to depend largely on adequate digital infrastructure, appropriate pedagogical strategies and the nature of the academic discipline. Practical and technical programmes particularly require blended approaches that combine online theoretical instruction with face to face practical engagement. Students' willingness to recommend online learning remained mixed, reflecting both its advantages and its limitations.

The findings align with Social Learning Theory, which suggests that reduced peer interaction and limited opportunities for observational learning contributed to lower engagement levels. Expectation Confirmation Theory further explains that dissatisfaction emerged where students' expectations regarding technological reliability and instructional quality were not met.

In light of these conclusions, a structured and sustainable framework for online learning in Ghanaian tertiary education is essential. Policymakers should collaborate with internet service providers to expand broadband infrastructure, regulate data costs and improve connectivity, especially for students from low income backgrounds. Universities should establish digital learning hubs and device loan schemes to promote equitable access.

Blended learning models should be institutionalised, particularly in disciplines requiring practical application. The National Council for Tertiary Education should provide policy guidance mandating hybrid approaches that integrate online theory with supervised in person practical sessions. Departments should incorporate interactive digital tools such as virtual simulations and case based learning to enhance engagement while maintaining academic rigour.

Continuous professional development for lecturers is necessary to strengthen digital pedagogical competence. Training in online instructional design, student engagement strategies and effective use of learning management systems should be prioritised. Certification in online teaching and performance based incentives may further enhance instructional quality.

Institutions must also strengthen student engagement and wellbeing by fostering peer learning communities, encouraging interactive teaching methods and providing accessible psychological support services. To safeguard academic standards, universities should adopt robust assessment strategies, including plagiarism detection systems, secure proctoring technologies and alternative assessments such as project based tasks and reflective assignments.

Finally, national and institutional policies should prioritise digital equity through subsidised internet access, public private partnerships and targeted support schemes. By investing in infrastructure, blended learning frameworks, faculty development, student engagement mechanisms, academic integrity measures and equitable access initiatives, Ghanaian universities can establish a resilient, inclusive and high quality online learning system that supports sustainable higher education development.

Disclosure statement

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Data availability statement

The data that support the findings of this study are available from the corresponding author, [ROM], upon reasonable request.

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