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Quality Beyond Connectivity: Generation Z Perspectives on Practical and Online Learning in Hybrid Engineering Education

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Abstract

The adoption of hybrid learning in higher education, stirred by the Education 5.0 agenda and the global digitalization trends, has transformed engineering education. However, the practicality of engineering programmes and the nature of the current cohort enrolled for undergraduate degrees- the generation raises concerns about the quality of learning in a hybrid set-up. This study examined Generation Z students' perceptions of the quality of hybrid learning in engineering programmes. It unraveled the extent to which existing quality assurance frameworks address their experiences and monitor online learning. A mixed-methods approach was used, combining quantitative data from questionnaires completed by 100 undergraduate engineering students with qualitative insights from unstructured interviews and document analysis. Results indicate that despite the high access to digital materials, perceived quality of online learning remains low due to limited interactivity, delayed feedback and passive teaching methods. Media multitasking also contributes to disengagement, while practical learning is mostly hindered by lack of hands-on experience, limited access to licensed simulation software and inadequate instructional guidance. The existing QA frameworks tend to be predominantly input-oriented, failing to capture key aspects such as student engagement, interaction quality and digital pedagogy. Guided by Lev Vygotsky's social constructivist theory, the study stresses the significance of interaction, scaffolding and feedback for effective learning. It proposes a process-oriented QA framework and recommends policy and pedagogical reforms to boost engagement, develop practical skills and align with Generation Z' S learning needs in hybrid engineering education.

Keywords: Generation Z, Hybrid Learning, Online Learning, Quality Assurance, Education 5.0.

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Introduction to the study

Globally, the rapid shift towards hybrid learning has fundamentally reshaped higher education, particularly following the disruption caused by the COVID-19 pandemic. Hybrid learning, which strategically blends face-to-face instruction with online components, has been widely adopted as a flexible and resilient model for delivering tertiary education (Mhlanga and Mooloi, 2020). This model promises enhanced access, personalised learning pathways, and increased student engagement. However, the transition has also sparked critical debates regarding the quality and effectiveness of teaching and learning, especially within skills-intensive and practice-oriented disciplines such as engineering. Scholars across North America, Europe, and Asia have documented persistent challenges in assessing practical competencies, maintaining academic integrity, and ensuring equitable access to digital resources in hybrid environments (Garwe, 2023; Seemiller and Grace (2019)). Research indicates that effective blended learning necessitates a careful balancing act between digital and in-person components, with increased accessibility and flexibility cited as major advantages, while digital equity and student motivation remain concerns (Bozkurt, 2023). Consequently, quality assurance (QA) frameworks originally designed for traditional,

campus-based education are being interrogated for their adequacy in evaluating virtual learning spaces, digital pedagogies, and the complex interplay between online and in-person learning components (Coates and Mahat, 2014).

Within the African context, the adoption of hybrid learning has followed a varied and uneven trajectory. While universities in South Africa, Kenya, and Nigeria have made significant strides in deploying digital learning platforms, many institutions across the continent continue to grapple with infrastructural deficits, including unreliable electricity, limited broadband connectivity, and a shortage of digitally proficient faculty (Chisita, 2021). A study in a Sub-Saharan African university found that while students positively perceived blended learning courses citing exposure to diverse digital resources, improved motivation, and enhanced flexibility significant constraints persisted, including internet instability, computer proficiency gaps, power supply concerns, and limited computer access (Zakariya, Danlami, and Shogbesan (2024). In South Africa, research has shown that the pandemic exposed and worsened long-standing structural disparities, and addressing deficiencies in training, infrastructure, and institutional support is necessary for successful blended learning implementation (Mukhithi, A., Phahlane, M. M., & Malungana, L. (2025). Regional bodies such as the African Union and the Southern African Development Community (SADC) have called for the modernisation of QA systems to accommodate blended and online modes of delivery (Shava et.al., 2021). However, empirical research on how these systems should be adapted for engineering education remains sparse. Existing QA frameworks in Africa remain predominantly input-oriented, focusing on physical infrastructure, library holdings, and contact hours, rather than on learning outcomes, student experiences, or the unique demands of virtual laboratories and simulation-based learning (Makuku, as cited in Umar, 2025).

Turning to Zimbabwe, hybrid learning has become the new normal mode of delivery in higher education since the advent of COVID-19. Zimbabwean universities have adopted hybrid learning with varying levels of preparedness. While this transformation has created opportunities for pedagogical innovation, it has exposed major gaps in quality assurance systems, especially in engineering disciplines, which require practical and experiential learning (Garwe, 2023). Existing quality assurance frameworks in the country have been primarily designed around input-oriented metrics that evaluate institutions based on tangible assets such as physical infrastructure, library resources, and classroom contact hours. Consequently, motivated by the need to modernise and broaden educational access, Zimbabwean universities have progressively embraced these hybrid models with varying preparedness (Chisita, 2021). This rapid transition has shifted hybrid learning from a peripheral to a central position in teaching practices. The shift of learning from a single physical location disrupts the traditional evaluation criteria. Thus, there is a dire need to rethink quality assurance frameworks worldwide, and particularly in Zimbabwe, to establish structures capable of effectively assessing the quality of virtual learning environments, digital pedagogy, and the intricate interplay between online and face-to-face learning components.

This study's particular focus is on Generation Z (Gen Z) students, born from 1995 onward. These students are often called digital natives and have distinct learning expectations, including a preference for on-demand content, interactive digital tools, and immediate feedback (Seemiller and Grace, 2019). This study therefore seeks to gain an in-depth understanding of their perceptions and experiences with hybrid learning in order to recommend QA mechanisms that ensure the development of highly competent engineering graduates within Zimbabwe.

Zimbabwean universities are currently being driven by the Heritage-Based Education 5.0 philosophy, which mandates universities as engines of national development, producing graduates equipped to drive economic growth and modernisation. This policy, however, faces a stark and challenging reality on the ground. Designed as a cornerstone of transformation, it seeks to integrate technology into teaching and learning, making the shift toward digital education not merely a response to global trends but a fundamental element of the national development strategy. The transition to effective hybrid learning is contingent upon robust technological infrastructure, widespread digital literacy, and adequate institutional resources conditions that are not uniformly present across Zimbabwe's higher education landscape. Unfortunately, the policy is being implemented in a context characterised by significant systemic challenges, creating a palpable tension between national aspirations and operational capacity. This study is situated at this complex and consequential intersection of policy, pedagogy, and practicality

Statement of the Problem

Zimbabwean universities are gradually implementing hybrid learning to address the demands of Education 5.0 and global digitalisation trends. However, hybrid learning in engineering programmes is inhibited by infrastructural challenges, insufficient digital support and limited capacity to deliver practical components online. Current QA frameworks mainly focus on physical inputs and do not adequately assess the digital and interactive dimension of hybrid learning. Generation Z students, as the primary beneficiaries of these programs, have expectations regarding digital engagement, interactivity and technological reliability. Yet their perception of quality remains largely undocumented in Zimbabwe. This research, therefore, attempts to address the question of how Generation Z engineering students perceive the quality of hybrid learning in Zimbabwean universities and how suitable the current QA frameworks are in addressing their learning experiences both online and in practical settings.

Research Objectives

1. To examine Gen Z students' perceptions of online learning quality in hybrid models.
2. To identify challenges in delivering practical learning during online learning.
3. To evaluate the adequacy of current QA frameworks in addressing Generation Z students' learning experiences.
4. To identify mediating tools that enable or hinder students' progression in hybrid learning.

Review of related literature

This study is grounded in the Social Constructivism Theory developed by Lev Vygotsky, which posits that learning is fundamentally a social process whereby knowledge is constructed through interaction, collaboration, and engagement with others (Vygotsky, 1978). The theory provides a relevant lens for examining Generation Z students' perceptions of quality assurance in hybrid engineering education because it emphasises active participation, social engagement, and contextualised learning experiences. Social Constructivism suggests that meaningful learning occurs through dialogue with peers, instructors, and other knowledgeable individuals. Within hybrid learning environments, these interactions take place through both face-to-face and digital platforms, making the quality of communication, collaboration, and support central indicators of educational effectiveness. For Generation Z learners, who are characterised by high levels of digital engagement and preference for interactive learning, perceptions of online learning quality, lecturer support, and digital tool effectiveness reflect the extent to which knowledge construction is facilitated.

The theory further highlights the concepts of the More Knowledgeable Other (MKO) and the Zone of Proximal Development (ZPD). MKOs- including lecturers, peers, industry mentors, and technical staff- provide the scaffolding necessary for learners to progress beyond their current level of competence. In hybrid engineering education, quality assurance should therefore assess the availability and effectiveness of such support structures. Similarly, the ZPD underscores the importance of adaptive learning experiences that provide timely guidance through online resources, practical activities, and collaborative learning opportunities. Another key principle of Social Constructivism is the mediation of learning through tools. In engineering education, these tools include digital technologies such as learning management systems, simulation software, and internet-based communication platforms, as well as physical resources such as laboratory equipment and workshop machinery. The accessibility and effective integration of these tools significantly influence students' learning experiences and outcomes.

Finally, the theory emphasises situated learning, which holds that knowledge is best acquired within authentic contexts and real-world activities. Engineering education therefore requires learning experiences that connect theoretical knowledge with practical application through laboratories, projects, industrial attachments, and problem-solving activities. This perspective is particularly relevant in evaluating whether hybrid learning environments adequately support the development of practical engineering competencies. Accordingly, Social Constructivism provides a robust theoretical foundation for understanding how Generation Z students experience and evaluate hybrid engineering education. It supports the study's focus on student perceptions as a valid measure of educational quality and offers a framework for examining the social, technological, and practical dimensions of quality assurance in Zimbabwean universities.

Global Perspectives on Generation Z and Hybrid Learning

This section unravels a global overview of Generation Z's interaction with hybrid learning models, concentrating more on how technological exposure, cultural contexts and educational systems influence learning behaviours and outcomes.

Positive Perceptions and Identified Benefits

Research from global contexts reveals that Generation Z students generally perceive hybrid learning models favourably, appreciating the flexibility and autonomy these approaches offer. Studies conducted in the United States, Europe, and parts of Asia indicate that Gen Z learners value the ability to control their learning pace and access materials asynchronously while still maintaining some face-to-face interaction (Adnan and Anwar, 2020). In the same vein, Fesol et al. (2024) study of 227 undergraduate business students in the US posits that while Gen Z students are proficient with e-learning and technology adoption, they also showed a strong preference for face-to-face interaction and group work. These students appreciated being able to control the pace of their learning through hybrid formats. Similarly, Fesol et al. (2024) observed that Gen Z learners favour visual learning modes, video-based content, and hands-on, project-based tasks over traditional lecture-based instruction. Their study reported that many Gen Z students prefer to observe tasks being performed, for instance, through video, before trying them themselves, reflecting a strong affinity for visual and practical learning (Fesol et al., 2024). The alignment of Gen Z with their self-directed learning preferences emerges as a significant factor in their positive reception of hybrid models. The integration of multimedia resources and digital tools in hybrid courses particularly resonates with Gen Z's preference for visual and interactive content over traditional lecture-based formats

The value Generation Z places on personalised learning experiences finds substantial support in well-designed hybrid environments. Chardonnens (2025) concurs, postulating that Generation Z, preferences lie more in dynamic and immersive learning experiences, which seek personalised, real-time, interactive online tools beyond traditional methods. Consequently, Chan and Lee (2023) confirm in their survey that Gen Z learners expect active, engaging delivery, desire prompt feedback and regular communication like weekly check-ins and video updates to feel connected in online courses. Studies, therefore, deduce that Gen Z values self-paced flexibility and blended learning formats that combine hands-on activities with online content (Bozkurt, 2023). Thus, students view instructors as facilitators of practical skills and teamwork, while also needing guidance in critical thinking and digital literacy.

Conversely, Gen Z's digital nativity shapes expectations of seamless Learning Management Sy stem (LMS) platforms, rich media, and mobile access. Research indicates they appreciate the ability to review recorded lectures, engage with diverse digital resources, and utilise self-paced learning modules that allow them to take greater ownership of their learning process (Chisita, 2021). Similarly, Bozkurt (2023) note that hybrid models successfully support the development of 21st-century skills highly valued by Gen Z, including digital literacy, collaboration across platforms, and self-directed learning. International research has found that Generation Z students particularly value how thoughtfully designed hybrid learning can create balanced learning experiences that combine the structure of face-to-face classes with the flexibility of online components (Kaspar and Utsumi, 2021).

Similarly, a qualitative study on blended learning at the University of Zimbabwe found that students generally perceive blended learning positively, as it provides the flexibility of self-study along with the benefits of face-to-face interaction (Chitanana, 2024). Participants considered face-to-face classes effective for immediate clarification, while the online component offers flexibility for study due to its leniency on time and location. Benson et al. (2024) also note that Generation Z, however, struggles to manage inconsistencies in their schedules, often completing last-minute work and requiring ongoing instructor presence and clear communication to remain engaged. Reports from the region highlight the need for dynamic and immersive learning experiences that motivate young learners, suggesting that Zimbabwean institutions should adapt hybrid models to meet these expectations of Generation Z.

Global Challenges faced with hybrid learning

Despite widespread enthusiasm for hybrid learning, global research highlights several significant concerns among Gen Z students. Adnan and Anwar (2020) assert that self-regulation challenges pose a notable obstacle, with some students struggling to maintain motivation and discipline in the less structured online elements of hybrid courses. Furthermore, Garwe (2023) observes that without

the regular accountability of face-to-face classes, some Gen Z students experience procrastination and decreased engagement, indicating they may require additional support to develop effective self-regulated learning strategies for hybrid environments.

The digital divide is also emerging as a major concern in the global context and in developed nations as well. Adnan and Anwar (2020) propound that while Gen Z is often characterised by their universal connection, significant disparities exist in their access to reliable internet connectivity, appropriate hardware and conducive learning environments. The COVID-19 pandemic exposed such weaknesses. The abrupt shift to hybrid learning continues to affect the effectiveness of this model for students from varying socioeconomic backgrounds. Digital interactions have, however, proven their inability to fully replace the spontaneous connections and social learning that occur in physical classrooms, as confirmed by Garcia et al.'s (2023) study, which echoes sentiments from Gen Z students who report feelings of isolation in hybrid environments. This highlights the continued importance of designing opportunities for genuine community-building within hybrid models.

African Context and Challenges

Adaptation of hybrid learning in the African higher education context happens within a distinct set of structural challenges that significantly influence Gen Z students' experiences and perceptions. Munamati et al. (2024)'s study of five Zimbabwean state universities avers poor connectivity, limited access to personal computers and less technical skills among lecturers as major hindrances to hybrid learning. In the same vein, Garwe's (2023) study at Great Zimbabwe University suggests that only half of the students confirmed the effectiveness of platforms like Google Classroom and Zoom, while 83% cited unreliable internet, and many lacked adequate devices. Chitanana (2024) concurs, postulating that hybrid learning in Zimbabwean universities provided enhanced accessibility and personalised flexibility, but was often undermined by poor infrastructure and inadequate lecturer training. Results from this study indicate that there is limited internet. Massive power cuts deterred the ability to engage online. Similarly, Dangaiso, & Makudza (2022) asserts that students charge devices at neighbours' solar panels and tether to friends' Wi-Fi to cope. These findings indicate how infrastructure inequality has undermined the quality of hybrid learning; however, none have a particular focus on engineering disciplines and the prevailing conditions that affect them. Research from various African contexts highlights how infrastructure limitations represent a fundamental barrier to effective hybrid learning (Dimock 2019; Kaspar and Utsumi, 2021). Additionally, to further enhance the contention studies from Nigeria, South Africa, and Kenya also contend with unreliable internet connectivity, erratic power supply and limited access to digital devices among students (Dimock,2019). These constraints have a direct impact on the feasibility and effectiveness of hybrid models, which in turn creates frustration among Gen Z students who expect seamless digital experiences.

The historical educational disparities in most African countries further complicate hybrid implementation. Adnan and Anwar's (2020) study on South African universities avers that the shift to hybrid learning occurred against a backdrop of existing structural inequalities, with historically disadvantaged institutions facing massive resource constraints. This compounds the digital access gaps between urban and rural students and between those of diverse socio-economic backgrounds. Furthermore, literature shows that diverse digital proficiency among both students and lecturers denotes that not all Gen Z students in African contexts arrive with the expected level of digital literacy, despite their generational cohort (Kaspar and Utsumi, 2021). This contrasts with assumptions about universal tech- savviness among Gen Z and necessitates additional support structures in African hybrid implementations.

This contrasts with assumptions about universal tech-savviness among Gen Z and necessitates additional support structures in African hybrid implementations.

Quality and Perceptions in Online/Hybrid Learning

Intense debates on the quality of online and hybrid learning have increased globally since the advent of COVID 19. Literature reveals that transformation to online learning is not a guarantee for quality; rather, rigorous standards and evaluation are needed (Benson et al.,2024). Effective quality in online/hybrid learning is said to be multidimensional and includes facets like learning outcomes, student satisfaction and equitable access. Bozkurt (2023) highlights that although students' e-learning skills and self-regulation are essential to quality, these do not really guarantee full benefits to learners.

Additionally, Gen Z perceptions of quality include interaction and support, content relevance

and technological reliability (Yalan and Marcial, 2025). These tend to weigh quality based on how engaging and useful the experience feels. A study in the US gathered that the majority of Gen Z undergraduates expect lecturers to be interactive and engaging and to communicate multiple times per week in online courses (Yalan and Marcial,2025). They anticipate high production standards because quality expectations are high since their lives have been marked by online streaming since birth (Mugweni and Masuku, 2022). Conversely, frequent technical glitches, outdated materials, or perceived lack of instructor presence diminish their sense of quality.

Globally, quality in education has been generally assessed through learning outcomes, student support and teaching effectiveness (Yalan and Marcial,2025). APEC (2017), however, brings in a new dimension, outlining nine domains for hybrid learning: leadership, staffing, review/ improvement, resources, student support, curriculum, assessment and learning outcomes, covering both operational and pedagogical aspects. These bring in a broader aspect in the measurement of educational quality. Benson et al. (2024) add on clarifying that QA in hybrid learning must measure impact on student performance and include evidence-based frameworks for benchmarking. Ultimately, if hybrid programs fail to deliver their learning outcomes or leave students dissatisfied, students will perceive them as low quality. Quality in this case is therefore based on the recipient's satisfaction.

In the broader Southern African region, QA bodies are also grappling with hybrid learning. South Africa's Council on Higher Education has issued guidelines for distance and online learning QA, and universities have set up units to monitor e-learning quality. However, scholars note a gap: many QA frameworks were designed for traditional campus programs and are only beginning to adapt to hybrid models. In practice, most institutions still rely on measures like course completion rates and student surveys, which may not fully capture Gen Z's online learning expectations, such as interactivity and the speed of feedback. Southern African educators thus advocate for updated QA processes that include Gen Z-friendly metrics, such as mobile accessibility, social learning, and real-world skill application, alongside institutional standards.

Regulatory and Institutional Approaches

Although Quality assurance (QA) in higher education has traditionally focused on curriculum standards, faculty qualifications, and learning outcomes, frameworks for digital higher education are also evolving globally. A survey in Europe, by Ubachs and Henderikx (2022), highlights that multi-level QA systems integrate national regulations, institutional self-assessments, and student perspectives. They emphasise that digital education QA must be multifaceted, accounting for inputs like technology, staff, processes, and outputs such as student success, satisfaction (Ubachs and Henderikx, 2022).

UNESCO (2021) adds that QA is not a one-time audit but a continuous process of aligning programs with clear standards and improving them over time. UNESCO note that standards and regular evaluation are essential for benchmarks like the ICT Competency Framework for Teachers and the Quality Matters rubric outline clear criteria for online course design and delivery (Li et al., 2017). In practice, international reviews recommend multiple QA strategies for blended learning. Benson et al. (2024) identify four main interventions in the literature: professional development for staff, communities of practice/mentoring, audit frameworks, and learning design support, each helping institutions to maintain and enhance blended course quality (Li et al., 2017).

Similarly, institutional-level QA frameworks are emerging. A conceptual QA framework for virtual, real-time (synchronous) courses was proposed by researchers who integrate outcome-based education with active learning practices (Ahmad & Alammary, 2022). This framework highlights the need for technical support, professional development, and continuous course review (Ahmad & Alammary, 2022)

Methodology

This study adopted a pragmatic research paradigm and employed a mixed-methods. An exploratory case study design was used to examine hybrid learning within its natural institutional context. The study was conducted at three state universities offering accredited engineering programmes: The National University of Science and Technology (NUST), Harare Institute of Technology (HIT), and Chinhoyi University of Technology (CUT). The target population comprised Generation Z undergraduate engineering students, engineering lecturers, and quality assurance officers directly involved in teaching, learning, and quality monitoring processes. A quantitative sample

of 100 students was selected through stratified random sampling to ensure representation across engineering disciplines, while a purposive sample of 20 participants, including students, lecturers, and quality assurance officers, was selected for qualitative inquiry.

Data were collected using structured online questionnaires, semi-structured interviews, and document analysis. The questionnaire generated quantitative data on students' access to digital resources, experiences with online and practical learning, and perceptions of educational quality. Semi-structured interviews provided in-depth insights into stakeholder experiences and institutional practices related to hybrid learning and quality assurance. Document analysis was conducted on institutional quality assurance policies, Zimbabwe Council for Higher Education (ZIMCHE) standards and audit manuals, and the African Standards and Guidelines for Quality Assurance to examine the alignment between policy frameworks and lived educational experiences. The integration of quantitative and qualitative data enabled a comprehensive understanding of the effectiveness of hybrid learning and its implications for quality assurance in engineering education.

The methodology described is appropriate for exploring Generation Z students' perceptions of quality assurance in hybrid engineering education. However, several methodological limitations should be acknowledged:

Limitations

1. Case study scope: Restricted to three state universities in Zimbabwe, limiting generalizability to other institutions and regions.
2. Sample representativeness: Quantitative sample of 100 students and qualitative sample of 20 participants may not fully capture the diversity of perspectives.
3. Self-reported data: Reliance on questionnaires and interviews introduces recall bias and social desirability bias.
4. Institutional bias: Document analysis focused on official policies and standards, potentially overlooking informal practices and unrecorded challenges.
5. Technological constraints: Online data collection assumed consistent internet access and digital literacy, possibly excluding disadvantaged students.
6. Cross-sectional design: Captured perceptions at a single point in time, limiting insights into changes over time.
7. Focus on Generation Z: Exclusion of postgraduate and mature learners narrows applicability of findings to broader higher education populations.
8. Practical learning assessment: Did not directly measure student performance outcomes in laboratory or industrial settings, leaving conclusions about practical competencies tentative.

Although the study employed a rigorous mixed-methods case study design, several limitations should be acknowledged. The research was confined to three state universities in Zimbabwe, which restricts the generalizability of findings to other institutions such as private universities, polytechnics, or those in different regions with varying infrastructural and policy contexts. The quantitative sample of 100 students, though stratified, represents only a fraction of the broader student population, while the purposive qualitative sample of 20 participants may not fully capture the diversity of perspectives among lecturers and quality assurance officers. Reliance on self-reported data through questionnaires and interviews introduces the possibility of recall bias and social desirability bias, potentially affecting the accuracy of reported experiences. Document analysis was limited to institutional policies and official quality assurance frameworks, which may reflect formal positions but overlook informal practices and unrecorded challenges. Furthermore, the use of online questionnaires assumed consistent internet access and digital literacy, potentially excluding disadvantaged students and skewing the findings toward those with better connectivity. The cross-sectional design captured perceptions at a single point in time, limiting the ability to observe changes as hybrid learning evolves. By focusing exclusively on Generation Z undergraduate students, the study excluded older cohorts such as postgraduate or mature learners, thereby narrowing the applicability of findings. Finally, while the study highlighted challenges in practical and simulation-based learning, it did not directly measure student performance outcomes in laboratory or industrial settings, leaving conclusions about the effectiveness of hybrid learning in developing practical competencies tentative.

Besides the limitations highlighted above, the study remains credible and worthwhile despite its

limitations because it fills a critical research gap by exploring Generation Z students' perceptions of quality assurance in hybrid engineering education in Zimbabwe. Although restricted to three state universities and modest sample sizes, the mixedmethods design provided triangulated insights from questionnaires, interviews, and document analysis, strengthening reliability. The focus on digitalnative learners offered timely relevance, while situating findings within ZIMCHE and African QA frameworks ensured policy significance. By transparently acknowledging these constraints, the researchers demonstrated methodological integrity, making the study a credible foundation for future work that can broaden scope, include diverse cohorts, adopt longitudinal designs, and incorporate performancebased measures to deepen understanding of hybrid learning and quality assurance.

Results and discussion

The section presents, analyses and interprets the results from the study on quality assurance in hybrid learning within engineering programmes in Zimbabwean universities. The findings are organised according to research objectives to ensure alignment between the data and the purpose of the study.

(1) Perceptions towards online learning quality in hybrid models

The focus was on key factors influencing students' learning experiences in digital environments. Four major sub-themes emerged from the data: accessibility of learning materials, interactivity of online lectures, timelines of lecturer feedback and platform use experience. These were analyzed through quantitative results from the questionnaire and triangulated with interview responses and supporting literature to provide a comprehensive interpretation of the findings. Table 1 presents respondents' perceptions of key quality indicators of online learning within the hybrid model.

Table 1: Perception of online learning

Quality Indicator	Mean Score	Interpretation	Sample Student Responses
Accessibility of Learning Materials	4.2	High (Efficient LMS repositories)	I can easily download lecture notes and past papers. / The LMS makes it simple to access resources anytime."
Interactivity of Online Lectures	2.4	Low (Passive learning)	Most lectures feel like one-way communication. / There is little chance to ask questions or engage.
Timeliness of Lecturer Feedback	1.8	Very Low (Major quality gap)	Assignments take weeks to be marked. / We rarely get feedback before the next topic begins.
Platform User Experience (UI/ UX)	3.1	Moderate	The system works but is not user-friendly. / Navigation is confusing, especially during assessments.

Accessibility of learning materials

The high mean score (4.2) shows that the respondents generally have access to online learning materials through institutional Learning Management System (LMS) and digital repositories. Frequency distribution further confirmed that most respondents own or have access to laptops, computers or smartphones. Interviews with students further confirmed accessibility to digital tools; one respondent indicated that digital tools were part of life, and owning one was a prerequisite. The state substantiates the nature of Generation Z digital natives whose lives revolve around digital gadgets. Lecturers confirmed that the institutions had a bring your own gadget policy (BYOG). These results show that at the basic infrastructural level, hybrid learning systems are operational. Institutions seem to have successfully implemented digital content distribution mechanisms. Global literature confirms the findings, echoing that hybrid learning environments typically succeed in expanding access to materials (Bozkurt, 2023; Benson et al., 2024). International studies consistently show that LMS platforms improve flexibility and enable asynchronous access, particularly for Generation Z learners who value self-paced learning.

While global research often associates accessibility with improved satisfaction, the current

study complicates this assumption. Although students can access materials, this does not necessarily translate into high engagement or instructional satisfaction. Interview data shows that in this context, accessibility meant passive document upload rather than structured instructional delivery. One student noted that:

Lecturers simply download PDFs and post them on the platforms without any further explanation (S2)0p

Another one acknowledged the presence of learning material but was distressed with the lack of explanations or guidance to the level that they ended up ignoring the material uploaded. Document analysis of institutional QA policies and standards from the Zimbabwe Council for Higher Education confirms this structural emphasis. Their structure mainly assesses the availability of LMS, the existence of course outlines and the provision of digital material. There are, however, no explicit indicators evaluating instructional interaction quality or guided engagement within online environments. This implies that while digital materials are available, pedagogical mediation is limited. Social Constructivists, on the other hand, further substantiate the view, arguing that access to content represents only the first stage of learning (Benson et al., 2024). Knowledge is constructed through mediated interaction, not passive consumption, ibid. Thus, while the technological infrastructure exists, the social dimension of learning appears underdeveloped. Therefore, from a quality assurance perspective, the status quo is a clear reflection of a technologically compliant system which lacks pedagogical depth. This finding, therefore, extends existing literature by demonstrating that access alone is insufficient in technical disciplines such as engineering, where applied interaction is critical.

(2) Interactivity for online lectures

Mean 2.4 indicates that despite high material accessibility, interactivity scored significantly lower. Additionally, 72% of the respondents described online sessions as one-way. Structured interviews with students further confirmed the assessment, revealing that most lecturers just posted PDFs with no further explanations. Quality Assurance Officers stated that their surveys for online learning indicated

Online learning was more of a tick-boxing exercise where lecturers just post something on the LMS just to be recorded as active, even though it does not benefit the recipients.

Another student highlighted that:

Online lectures, you just listen, that's all you, worse still, with simulations, you just struggle on your own.

This highlights that online learning is largely lecturer-driven and transmission-based rather than dialogic and collaborative.

Therefore, as depicted by the results, hybrid learning has been implemented technologically but not pedagogically transformed. This finding contradicts some global studies that suggest Generation Z students generally respond positively to hybrid environments when they include active learning strategies (Fesol et al., 2024; Chan and Lee, 2023). In well-designed hybrid models, students report high engagement due to multimedia integration and collaborative tools.

However, the current findings align more closely with research conducted in resource-constrained contexts (Adnan and Anwar, 2020; Munamati et al., 2024), which highlights that technological implementation without pedagogical redesign results in passive, lecture-dominated online environments. The results reflect hybrid adoption at a structural level rather than a pedagogical transformation. Thus, online learning in this case appears to be more of a traditional lecture format replica transferred into digital space without any meaningful engagement mechanisms whatsoever. Social Constructivists resonate with these findings. Vygosky (1978) stresses that learning occurs first on a social plane (interpsychological) before internalisation. Thus, low interactivity suggests that the essential dialogic processes necessary for cognitive development are weakened in the online component. In essence, hybrid learning in this context appears technologically enabled but socially impoverished.

Media multi-tasking

The limited interactivity during online learning heightened another challenge amongst the respondents who by their nature of being digital native have divided attention on virtual space. One respondent said:

Imagine I will be working online and a TikTok notification pops up, I can't resist the temptation of just attending to the notification. (S7)

Another one said:

You know data is expensive, so I would rather save my data for my content creation rather than download PDFs. (S9)

These responses demonstrate that student engagement in online learning is influenced by both digital habits and contextual constraints, such as data affordability. The tendency to multitask in media has significant implications and consequences for the students.

The findings indicate that media multi-tasking among Generation Z learners is not solely an inherent generational characteristic but is significantly influenced by the quality of online learning environments. When online lectures are perceived as passive, one-directional, and lacking interaction, students are more likely to disengage and shift their attention to alternative digital platforms. These results are consistent with global literature highlighting Generation Z's susceptibility to digital distractions due to constant exposure to multiple information streams (Seemiller & Grace, 2019; Turner, 2022). However, the current study extends existing knowledge by demonstrating that instructional design can either mitigate or intensify media multitasking, with limited interactivity and delayed feedback increasing divided attention. The findings also align with Social Constructivist Theory, which emphasises the role of interaction, guidance, and social engagement in learning (Vygotsky, 1978). In the absence of meaningful interaction and scaffolding within the Zone of Proximal Development, cognitive engagement is weakened, making students more vulnerable to distraction and reducing the depth and effectiveness of knowledge acquisition.

Timelines of lecturer feedback

Timelines of Lecturer feedback scored the lowest with a mean of 1.8, representing a major perceived quality gap. Interview data reinforces this view. One student commented that submitted assignments usually have feedback during a face-to-face session, or may never receive any. Another student highlighted that they only get to know about failed coursework as they approach exams. Lecturers confirmed that they had workload challenges and could not keep up with the pressure. Lecturers also alluded to the overwhelming pressure to cover the content during the six weeks of face-to-face learning. More so, the results from analysis of QA frameworks also indicate how these stress on assessment integrity, yet are limited on operational guidelines on the feedback turnaround time in online environments. The findings thus reveal a systemic feedback breakdown rather than isolated lecturer negligence. Theoretically, feedback functions as scaffolding within the Zone of Proximal Development (Vygotsky,1978). Weak scaffolding reduces academic confidence, resulting in declining practical competence for Generation Z learners.

While the hybrid model successfully integrates technology and provides personalised access to learning materials, the lack of immediate feedback and meaningful interaction significantly undermines Generation Z learning in engineering education (Hodges et al., 2024).

As a cohort accustomed to real-time digital responsiveness and participatory environments, Generation Z students rely on continuous feedback to refine understanding, build confidence, and sustain engagement (Geng, 2023). In engineering disciplines, where learning is inherently iterative and problem-based, delayed feedback disrupts error-correction cycles and allows misconceptions to persist. From Lev Vygotsky's Social Constructivist perspective, learning occurs through guided social interaction within the Zone of Proximal Development (ZPD), where a More Knowledgeable Other provides scaffolding to advance cognitive growth (Vygotsky,1978). The absence of timely feedback and interactive mediation weakens this scaffolding process, limiting students' ability to internalise complex engineering concepts. Consequently, insufficient interaction in hybrid environments does not merely affect student satisfaction; it constrains deep conceptual understanding, collaborative problem-solving, and the development of professional engineering competence. This finding directly challenges global QA frameworks (APEC toolkit, 2025), which emphasise continuous instructor presence as a core quality dimension.

Platform user experience

The platform user experience (UI/UX) received a moderate score (3.1). This indicates that although systems are functional, they may not be optimally designed or consistently used. Interview data further revealed the simultaneous use of multiple platforms. One student said that:

The lecturers use whatever they feel can be Zoom, WhatsApp, Telegram, or Google Classroom; it's so confusing.

Additionally, the interviews confirmed the inconsistent communication channels and confusion regarding content location. Such fragmentation reduces cognitive efficiency and increases student

frustration. Generation Z learners typically expect seamless digital experiences. Therefore, inconsistent platform usage may significantly reduce perceived quality, even when materials are available.

Overall, the findings indicate that engineering Generation Z students perceive hybrid online learning environments as accessible, but they remain insufficiently interactive. While digital platforms effectively provide learning resources, the lack of timely feedback and meaningful engagement reduces perceived learning quality, particularly in disciplines such as engineering, where collaborative discussion and immediate clarification are essential for conceptual understanding.

Challenges in delivering practical sessions through online formats

Practical learning is a fundamental component of engineering education because it enables students to apply theoretical knowledge in real-world problem-solving contexts. In hybrid learning environments, however, the delivery of practical components becomes increasingly complex due to limitations in technological infrastructure, laboratory accessibility, and simulation-based learning tools. This section, therefore, examines the key challenges associated with delivering practical engineering learning through online and hybrid modalities. Below is a representation of possible major barriers to practical engineering mastery.

Table 2: Challenges in delivering practical learning

Challenge Factor	Number of Students	% of Students Affected
Total number of students	100	100%
Lack of Tactile/Hands-on Experience	88	88%
Connectivity/Data Costs	82	82%
Hardware Limitations	65	65%
Limited Software Access Licenses	44	44%

These findings reveal that the challenges affecting practical learning in hybrid environments are multidimensional in nature. The barriers identified by students can broadly be categorized into technological constraints, institutional limitations, and pedagogical challenges. Technological constraints include connectivity problems and hardware limitations that restrict students' ability to participate effectively in online practical activities. Institutional limitations are reflected in restricted access to licensed simulation software and laboratory resources. Pedagogical challenges arise from the absence of structured guidance during simulation exercises, which may limit students' ability to meaningfully engage with virtual laboratory activities.

Lack of Tactile/Hands-on Experience

88% of the respondents alluded to limited physical laboratory exposure as a major barrier to practical mastery. The absence of hands-on laboratory engagement may significantly affect the development of applied engineering competencies. Engineering education relies heavily on experiential learning processes where students test theoretical concepts through experimentation, observation, and iterative problem solving. Without opportunities to physically interact with equipment and materials, students may find it difficult to translate conceptual understanding into practical engineering skills.

Interview data also strongly corroborated this finding. One student stressed that:

What you experience during simulations seems to be different from the lab experience. There is need for us to have face to face experiments and practical lessons.

Another individual noted that engineering requires time spent in the lab. Lecturer interviews further confirmed that students have little time for practice; when they report for face-to-face sessions, it becomes overwhelming to cover all the content within six weeks. This suggests that the semester has effectively been shortened from the normal thirteen weeks to six weeks. The time allocated for sufficient practice is limited, labs will be crowded, and some lecturers will be demanding students' presence for theoretical lectures.

The findings support existing literature that identifies experiential learning as fundamental to engineering competence development (Al-Khatib et al., 2024). Consistent with post-pandemic studies,

the results suggest that while theoretical content can be effectively delivered online, laboratory-intensive disciplines often face challenges in practical skill acquisition (Fesol et al., 2024). Although virtual laboratories and simulations can complement physical laboratories when adequately resourced (Garcia, Yousef, & Alhussain, 2023), their effectiveness is highly context-dependent. In Zimbabwe, limitations in technological infrastructure, hardware, and software constrain the effectiveness of simulation-based learning. Furthermore, the findings align with Social Constructivist theory, which emphasises learning through guided interaction, mediation, and scaffolding (Vygotsky, 1978; Schunk, 2020). Reduced laboratory time and limited access to lecturers and technicians weaken these processes, thereby restricting practical skill development and the translation of conceptual knowledge into engineering competence. This challenge is particularly significant for Generation Z learners, who prefer experiential, hands-on learning environments (Seemiller, & Grace, 2016), making compressed laboratory sessions less conducive to meaningful participation and engagement.

The reduction of the practical learning period is contrary to Seemiller and Grace (2016)'s assertion that Generation Z learners prefer experiential, hands-on learning; thus, pressure in the labs declines their morale to learn. More so, these learners are known for a short concentration span; thus, compressed learning in such a short space of time may reduce meaningful participation and compromise the quality of work.

Hardware limitations and software access

65% of respondents indicated inadequate hardware, while 44% alluded to limited access to licensed engineering software as another barrier to hybrid learning. One student said that:

Some of the engineering software does not run on basic laptops (S6)

Lecturers concurred with the students view pointing out that:

Effective simulation software is not licensed; therefore, conducting practical online sessions is quite difficult, and pressure therefore mounts on the face-to-face session (L3)

The current study challenges the global research, which claims that engineering hybrid learning mainly depends on simulation tools and modelling software (Chan and Lee, 2023). Therefore, virtual labs and cloud-based software help address the lack of physical labs. However, the present study shows that such solutions are not scalable in resource-limited settings like Zimbabwe. Consequently, the study disputes universal claims that digital substitutes can fully replace hands-on laboratory experience. Hybrid learning in contemporary engineering contexts, therefore, largely influences the practical aspect of learning.

(3) Adequacy of Current Quality Assurance Frameworks in Addressing Hybrid Learning Needs.

The findings suggest that existing quality assurance (QA) frameworks, while effective in monitoring institutional processes, curriculum standards, infrastructure, and assessment procedures, may be insufficient for evaluating the complexities of hybrid learning environments. Document analysis revealed that QA systems largely focus on the availability of digital platforms and learning resources, yet pay limited attention to the quality of interaction, engagement, and feedback within online learning spaces. These results support literature arguing that traditional QA frameworks emphasise structural indicators and technological provision while inadequately assessing learner engagement and pedagogical effectiveness in digitally mediated environments (Graham, 2019; Garrison & Kanuka, 2004). The study further challenges assumptions that the introduction of digital platforms automatically enhances learning quality, demonstrating that accessibility and flexibility alone do not guarantee positive learning experiences when interactive teaching strategies and timely feedback are lacking. Consistent with concerns raised by Makransky and Petersen (2019), the findings also reveal significant gaps in evaluating practical learning within engineering programmes, where limited laboratory access and restricted simulation software undermine the development of applied competencies. Interpreted through Lev Vygotsky's Social Constructivist framework, the findings highlight that effective learning depends on interaction with mediating tools and knowledgeable others within the Zone of Proximal Development.

Although digital technologies can serve as mediating tools, their effectiveness is reduced when accessibility, guidance, and interactive engagement are inadequate, limiting students' ability to translate theoretical knowledge into practical competence. Overall, the study suggests that QA frameworks should evolve to incorporate indicators that assess

digital pedagogical practices, student engagement, feedback quality, and the effectiveness of simulation-based learning in hybrid environments, while recognizing the growing role of additional digital and social learning tools that students use to support their learning experiences (Vygotsky, 1978).

Mediating Tools Influencing Learning Progression in Hybrid Learning

Following the identification of limitations within existing quality assurance frameworks, this section highlights the mediating tools that Generation Z engineering students identify as significant in supporting their learning progression within hybrid learning environments. Mediating tools allude to the technological and social resources that enable students to interact with knowledge, instructors and peers. Students responses were utilized to rank the perceived importance of these tools.

Table 4: Adequacy of tools

Tool Category	Number of students	% of students	Rank	Primary Role
WhatsApp Groups	94	94%	1	Peer Support/Instant Info
Simulation Software	81	81%	2	Practical Substitution
Learning Management System	72	72%	3	Formal Resource Hub
YouTube/External Video	68	68%	4	Supplementary Instruction

The ranking of mediating tools highlights an important shift in how students navigate hybrid learning environments. Interestingly, informal digital communication platforms such as WhatsApp groups were ranked as the most important learning support tool. This suggests that students frequently rely on peer-to-peer communication networks to clarify concepts, share resources, and compensate for limited interaction within formal institutional learning platforms. Such findings indicate that students actively construct alternative learning support systems outside officially recognised educational technologies.

Relative Importance of Learning Tools in Hybrid Engineering Education

Results indicate that WhatsApp groups ranked highest (94%), followed by simulation software (81%), Learning Management Systems (72%), and YouTube or external instructor videos (68%).

The high ranking of WhatsApp groups indicates a heavy reliance on peer-based communication networks for real-time clarification and academic coordination. Interviews corroborate the result. One respondent indicated that:

Explanations are mostly done in the WhatsApp group after class. (L37)

Another student added:

Online lectures are mostly done through WhatsApp calls. (L54)

Lecturers also acknowledged the role of these informal channels"

Students often organize themselves on WhatsApp more effectively than the official platforms. (L2)

The results confirm Bozkurt's (2023) assessment of Generation Z's preference for interactive digital communication environments that allow instant feedback and peer engagement. Furthermore, results confirm the growing role of social communication platforms in supporting collaborative learning within digital education environments (Hrastinski, 2019; Dhawan, 2020). In this context, WhatsApp groups function as mediating social tools that allow students to collectively negotiate meaning and solve academic problems within their Zone of Proximal Development. These messaging platforms continue to facilitate rapid information exchange and peer engagement among these digitally native learners. In so doing, these informal digital communication platforms serve as collaborative learning spaces where students co-construct knowledge and share academic resources. In line with the social constructivist view, students in this context are recreating the social scaffolding processes through peer discussion, instant messaging, and collaborative problem solving (Vygotsky, 1978). These constantly provide each other with academic support that compensates for delayed lecturer feedback in formal learning systems. Nevertheless, the heavy reliance on peer-driven support structures may also reflect gaps in institutional instructional

design, where students compensate for limited real-time guidance from lecturers.

Document analysis of institutional digital learning policies indicates that while formal platforms such as Learning Management Systems are officially recognised and monitored under QA systems, informal communication tools like WhatsApp remain largely outside institutional oversight. This suggests a gap between formal quality assurance mechanisms and the actual learning ecosystems used by students.

(4) Simulation Tools and Digital Substitutes for Practical Learning

Simulation software was ranked as the second most important mediating tool with 81%. In hybrid engineering education, simulations are often used to replicate laboratory experiences when access to physical facilities is limited. Simulation technologies enable students to visualize complex engineering processes, manipulate variables, and observe outcomes within controlled virtual environments.

The findings partially confirm literature suggesting that simulations can enhance conceptual understanding in engineering education (Makransky and Petersen, 2019). The current study, however unravel challenges associated with their implementation. Responses from interviews with students show that most respondents experienced difficulties in simulating due to the limited or absence of licensed software and inadequate instructional guidance when using these platforms. One respondent explained:

In most cases, we conduct simulations without guidance, and this is more confusing. (L9)

Another one said:

Sometimes the licensed simulation software is available, but without proper guidance, it becomes difficult to understand what exactly we are supposed to learn from them. (L11)

The results, therefore, partially refute assumptions within existing literature that simulation technologies automatically enhance practical learning. While simulations may support conceptual learning, their effectiveness depends heavily on instructional infrastructure, software licensing and lecturer facilitation. Without adequate guidance and structured learning tasks, students may struggle to connect simulation activities to real-world engineering applications.

In line with Vygotsky's views, simulations function as cognitive mediating artefacts that support interaction with complex technical concepts (Vygosky, 1978). Vygotsky's theory further stresses that if these digital tools lack interactive depth or guided feedback, they cannot independently facilitate learning, and may fail to provide the scaffolding necessary for knowledge internalization (Chan and Lee, 2023). In the absence of such scaffolding, simulations may fail to fully support the internalization of practical engineering skills. Quality assurance in hybrid environments should therefore evaluate not only technological provision but also the extent to which virtual learning spaces facilitate interaction, scaffolding, and experiential engagement. Students may understand engineering concepts conceptually yet lack confidence in performing practical tasks, a pattern that aligns with the negative correlation observed between online practical exposure and self-reported engineering confidence. Thus, the effectiveness of simulations is not determined solely by their availability but by how they are pedagogically integrated into the learning process.

Effects of dysfunctional virtual tools

The results indicate that the dysfunctionality of virtual practical learning decreased the confidence of the students in the system. The prevailing situation defies the learning preferences of the digital natives, Generation Z, whose nature typically prefers interactive, feedback-rich, and experiential learning environments (Fesol et al., 2024). The absence of these elements has resulted in disengagement and reduced confidence in professional competence. Although this cohort is technologically fluent, the findings of this study suggest that digital familiarity does not automatically translate into effective learning in highly practical disciplines such as engineering. This confirms Fesol et al. (2024)'s assertion that the absence of guidance may result in simulations failing to facilitate the transition from theoretical knowledge to applied competence. The absence of interaction and dysfunctional tools has even resulted in more damage than previously noted by existing studies. Generation Z respondents in this study highlighted a new dimension of their diverse interests in virtual space. Thus, failure of simulations invites diversion of attention to social media, deferring the learning process to face- to- face session where they can have the attention of lecturers for feedback. The pressure exerted on face- to -face session results in questionable quality of hybrid learning.

This study, therefore, contributes to the discourse on hybrid engineering education by demonstrating that technological integration alone is

insufficient for ensuring learning quality in practice-based disciplines. Instead, effective hybrid models must combine digital tools with socially mediated, scaffolded, and experiential learning processes. This highlights the need for quality assurance frameworks to move beyond infrastructure-focused evaluation toward assessing how hybrid learning environments support interactive engagement, practical skill formation, and professional competence development among Generation Z engineering students.

From a theoretical perspective, these tools function as mediating artefacts that support the learning process. According to Lev Vygotsky, learning occurs through interaction with cultural tools and social collaboration within the learner's Zone of Proximal Development. Digital platforms such as Learning Management Systems, simulation software, and peer communication networks therefore serve as mediating tools that facilitate knowledge construction in hybrid learning environments. However, the effectiveness of these tools depends on the extent to which they support guided interaction, collaboration, and timely feedback.

Learning Management Systems as Institutional Learning Platforms

The Learning Management System (LMS) ranked third with 72%, indicating that students recognize its importance as a formal institutional platform for accessing course materials and submitting assignments. The LMS provides a structured environment where students can access lecture recordings, instructional materials, and assessment guidelines.

The findings confirm previous studies suggesting that LMS platforms play an essential role in organizing learning resources within online and hybrid learning environments (Almaiah et al., 2020). However, the results also reveal concerns regarding the limited interactivity of online lectures delivered through these systems. Many respondents indicated that LMS-based sessions were primarily lecture-driven and offered limited opportunities for real-time discussion or engagement.

These findings therefore support arguments within the literature that digital learning platforms are most effective when combined with interactive pedagogical strategies (Garrison & Kanuka, 2004). Without such strategies, LMS platforms may function primarily as content repositories rather than dynamic learning environments.

From a theoretical perspective, LMS platforms act as institutional mediating tools within the learning environment. According to the social constructivist perspective of Lev Vygotsky, meaningful learning occurs when learners actively engage in dialogue, reflection, and collaborative problem-solving. Consequently, LMS platforms must be complemented by interactive teaching strategies that facilitate guided participation and feedback.

External Learning Resources and Self-Directed Learning

External learning platforms such as YouTube and other instructional videos were ranked fourth, with 68%. Despite being ranked lower than other tools, these resources play a meaningful role in supporting students' self-directed learning processes.

Students reported that when lecture explanations or simulations were unclear, they often turned to external video platforms to obtain alternative explanations of complex engineering concepts. These platforms frequently provide visual demonstrations and simplified explanations that help students grasp abstract technical principles.

These findings confirm previous research indicating that Generation Z students frequently rely on digital video platforms to supplement formal learning experiences (Seemiller and Grace, 2019). Such platforms provide flexible and accessible learning opportunities that align with the digital habits of contemporary learners. However, reliance on external learning resources may also indicate gaps within formal instructional delivery, as students seek additional explanations beyond institutional learning environments.

From a theoretical standpoint, these behaviors illustrate how students actively utilize multiple mediating tools to construct knowledge. Within the framework proposed by Lev Vygotsky, these tools extend the learning environment beyond institutional boundaries, enabling learners to access diverse sources of knowledge and support their independent learning processes.

Overall, the findings demonstrate that Generation Z students navigate hybrid learning environments through a complex network of digital mediating tools that extend beyond formal institutional platforms. While systems such as LMS platforms and simulations play an important role in supporting learning, students frequently supplement these tools with peer collaboration and external online resources. These findings both confirm and extend existing literature on digital learning behavior among Generation Z students, highlighting the

importance of interactive engagement, collaborative learning, and accessible technological tools. The results also suggest that quality assurance frameworks must evolve to recognize the role of both formal and informal mediating tools in shaping students' learning experiences and academic progression within hybrid engineering education.

Recommendations

Policy Recommendations for Zimbabwean Universities

Universities should shift from infrastructure-focused policies toward learning experience-centred approaches that prioritize student engagement, interaction, and timely feedback in hybrid learning environments. This requires targeted investment in licensed simulation software and digital laboratory infrastructure to strengthen practical learning in engineering programmes. Additionally, institutions should address contextual challenges by introducing data subsidies or zero-rated access to educational platforms to reduce the economic burden on students. At a broader level, national regulatory bodies must revise existing quality assurance guidelines to incorporate digital learning quality standards that reflect the realities of hybrid education, ensuring that evaluation frameworks move beyond compliance to focus on meaningful learning outcomes.

Pedagogical Recommendations for Engineering Programmes

Engineering programmes should adopt interactive and student-centred teaching strategies, including problem-based learning, live demonstrations, and collaborative tasks, to enhance engagement in hybrid learning environments. Practical learning should be strengthened through the integration of guided simulations, supported by clear instructions and active lecturer facilitation to ensure meaningful understanding. In addition, institutions should implement continuous feedback mechanisms that provide timely and constructive responses to student queries, thereby supporting ongoing learning. Online sessions should also be redesigned into shorter, engaging segments that align with Generation Z attention patterns, promoting sustained focus and improved learning outcomes.

Quality Assurance Framework Redesign

This study proposes a shift from traditional input-driven quality assurance models toward a Hybrid Learning Quality Assurance Framework that prioritizes learning processes and student engagement. The framework is anchored on four interrelated dimensions: engagement monitoring, which tracks student participation, interaction frequency, and attention levels during online sessions; feedback responsiveness, which evaluates the timeliness and effectiveness of lecturer feedback; digital pedagogy quality, which assesses instructional design, interactivity, and the integration of digital tools; and practical competency development, which examines the effectiveness of simulations and alternative strategies in supporting hands-on learning. Collectively, these dimensions provide a more holistic approach to quality assurance by aligning evaluation mechanisms with the learning needs and behavioral characteristics of Generation Z students, while also addressing the specific demands of hybrid engineering education.

Alignment with Generation Z Learning Preferences

To effectively respond to the identified challenges, hybrid learning environments must be intentionally designed to align with Generation Z learning preferences. This requires the incorporation of interactive and visually engaging content to sustain attention, as well as the use of short, activity-based learning segments in place of long passive lectures. Equally important is the provision of immediate and continuous feedback to maintain engagement and support learning progression. Furthermore, the integration of collaborative learning opportunities can enhance peer interaction, while gamified and simulation-based elements can be leveraged to improve motivation and focus. Collectively, these approaches not only reduce media multitasking but also transform digital platforms into active, student-centred learning environments that are consistent with Generation Z expectations and constructivist learning principles.

Recommendations for further studies

While the study provided valuable insights on Generation Z students' perceptions of hybrid learning within engineering programmes in Zimbabwean universities, several areas require further investigation to deepen understanding and strengthen the evidence base

Further research could focus on the effectiveness of simulation-based learning, with special focus on the comparison of guided and unguided simulations using experimental or quasi- experimental designs. This would provide empirical evidence on how simulations can best support practical competency development in hybrid environments.

The other avenue of research can venture into the impact of media multitasking on cognitive

engagement and learning outcomes, particularly in technically demanding disciplines such as engineering. Such studies could inform strategies for managing attention and improving the instructional design of Generation Z learners.

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