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Assessing Faculty Investments in Emerging Education Technologies and Artificial Intelligence in Selected African Universities

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ABSTRACT

Educational technology and Artificial Intelligence (AI) have revolutionised various industries including education. New education technologies, sometimes, find the education sector ill-prepared, not only in their applications but also in the technical know-how of faculty. This is especially so for higher education institutions (HEIs) in developing countries. The socio-economic and digital divide between developed and low-income countries continues to factor in education disparities between the two worlds. Anchored on the technology acceptance model (TAM), the aim of this study was to assess faculty awareness, personal investments, and perspectives on the potential of AIs as an emerging educational technology in higher education. A descriptive survey was conducted on faculty (n=65) drawn from selected universities in Africa using purposive snowball sampling. Quantitative and qualitative methods of data collection were integrated into a structured online questionnaire and administered through emails and social media.

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Assessing Faculty Investments in Emerging Education Technologies and Artificial Intelligence in Selected African Universities

Dr. Tabitha Rangara - Omol[α], Ms. Mary M. Musyoki[σ] & Dr.Pamela A. Juma[ρ]

ABSTRACT

Educational technology and Artificial Intelligence (AI) have revolutionised various industries including education. New education technologies, sometimes, find the education sector ill-prepared, not only in their applications but also in the technical know-how of faculty. This is especially so for higher education institutions (HEIs) in developing countries. The socio-economic and digital divide between developed and low-income countries continues to factor in education disparities between the two worlds. Anchored on the technology acceptance model (TAM), the aim of this study was to assess faculty awareness, personal investments, and perspectives on the potential of AIs as an emerging educational technology in higher education. A descriptive survey was conducted on faculty (n=65) drawn from selected universities in Africa using purposive snowball sampling. Quantitative and qualitative methods of data collection were integrated into a structured online questionnaire and administered through emails and social media. Participants represented thirty-four (34) universities in eight (8) African countries. Four (4) themes emerged from the findings; i) A remarkable level of awareness, use, and investment of educational technology mainly from self-learning with a score of 74% (n=65) on a three-point Likert scale, ii) Perceived benefits of ed-tech included AI as useful study, writing and research companion for both faculty and students iii) Faculty's belief on institutional support and investments indicated only 43% (n=65) affirmation and iv) Cost, speed and policies were the main challenges in adopting new ed-tech. These results should inform decision -making, policy formulation, administrative and budgetary priorities, faculty capacity needs, and adoption of ed-tech including generative AIs.

Keywords: educational technology, generative ais, developing countries, higher education.

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I. INTRODUCTION

Digital transformation is capital-intensive (Gkrimpizi et al., 2023). The acquisition, installation, adoption, and maintenance of education technologies including AI (Lee & Han, 2021) remain difficult for higher educational institutions (HEIs) in low-income countries that are already resource-constrained. The choice and use of educational technology (ed-tech) for many Universities in Africa is mostly driven by cost which sometimes attracts affordable but redundant models (Gkrimpizi et al., 2023). This, in the long run, proves to be expensive due to maintenance costs of hardware, recurrent costs of upgrade and licensing software, and the need for replacement. Consequently, university administrations in low-income countries are reluctant to invest in educational technology and Artificial intelligence (AI) (Gkrimpizi et al., 2023; Maguatcher & Ru, 2023).

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As an emerging ed-tech, artificial intelligence (AI) is promising efficiency and effectiveness not only in education but for all sectors (Altmäe et al., 2023; Crawford, Cowling, Ashton-Hay, et al., 2023). As HEIs adopt AI, they should be informed through constructive discussions and research to inform its careful adoption. AI is already associated with positive societal changes including improved quality of life and strengthened education systems (Nasri et al., 2022). Generative AIs like numerous open education resources (OERs) are widely free but associated costs of technology including the cost of purchasing digital hardware and software, internet bandwidths, and access hinder their adoption and use (Gkrimpizi et al., 2023; Maguatcher & Ru, 2023). Thus, for many reasons; factors surrounding the socio-economic and digital divide between low-income and the first world countries must continue to be articulated on discussion tables (Matthess & Kunkel, 2020). Despite cost issues, low-income countries cannot afford to be left behind. It is important to assess how faculty are adopting emerging ed-tech including AI in teaching, learning, and administrative processes as an indicator for HEIs adoption trends and to develop comprehensive policies (Lubinga et al., 2023; Shwedeh, 2024).

Despite the techno-stress or phobia, history has shown that previous disruptive technologies like mobile phones, digital search engines, video-conferencing classrooms, and general multimedia generated valuable discussions among academia of the time (Granić, 2023) but ended up being adopted. Even with notable challenges of costs and accessibility, past education technologies have yielded benefits including efficiency and effectiveness for both teacher-centred and learner-centred modes of learning (Alvi, 2023). In addition, digital learning is also a strong component of the successful adoption of education technologies (Alenezi et al., 2023). The most recent technologies that have impacted higher education are the group of generative AIs with disproportionate disruption to assessments (Crawford, Cowling, & Allen, 2023; Naidu & Sevnarayan, 2023). An example is the ChatGPT (chat generative pre-trained transformer), considered as an emerging educational technology that was launched to an immediate reception and wide range of users in late 2022 (Baber et al., 2023; Rudolph et al., 2023b).

García-Peñalvo (2023), cautions that whether faculty uses this AI technology or not, whether its disruption succeeds or not, it already has an impact and that it will not be the last one. and that many more AI-based technologies will disrupt education in the future. In any case, students are already using it in their learning processes (Altmäe et al., 2023). Universities have had varied reactions to generative AI; some reacted with unsustainable solutions including banning its use (Firat, 2023). 'Bans' have been recognized as a short-lived shock reaction (Hassoulas et al., 2023). Other solutions need to be explored. At the launch of ChatGPT, university policies, especially examination and assessment policies were ill-prepared because they could not have provided policies for something they had not envisaged (Crawford, Cowling, Ashton-Hay, et al., 2023). Nonetheless, the use of generative AIs in education has contributed to digital learning with unmatched speed to content creation; providing speedy solutions to previously complex questions (Eke, 2023; Sallam, 2023).

Even as HEI realises that digital learning is required in the responsible use of generative AIs, it must advance with the assurance that generative AIs do not provide all the answers, especially to skills and psychomotor domains of learning. ChatGPT for example, has in some situations generated incorrect information because of the limited access to new data which it has not been trained to use (Eke, 2023; Rudolph et al., 2023a). Research should focus on both student and faculty awareness, access and adoption of emerging educational technologies including AI. This study targets university faculty including those in administration and management. Findings should inform awareness and adoption strategies, policies, investment priorities, and ownership of the benefits (or lack) of emerging ed-tech including generative AIs.

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II. RESEARCH QUESTIONS

- What is the awareness, adoption, and investment levels of faculty in the use of emerging educational technologies and generative AIs?
- What are the barriers to the adoption and utilisation of emerging educational technologies and generative AIs among faculty in African Universities?

III. THEORETICAL FRAMEWORK

The technology acceptance model (TAM) by Fred Davis (Granić, 2023) posits that the adoption of any new technology is based on the user's motivation driven by three factors; usability, usefulness, and general attitude towards technology (Granić, 2023). For lecturers and teachers (faculty), new technologies usually arrive with an element of fear because it finds them ill-prepared for adoption (Khlaif et al., 2023). Faculty who are often dismayed by the entry and speed of ed-tech are constantly in fear of losing their jobs and have expressed such fears through reactions described by Khlaif et al., (2023) as 'techno-stress'. Faculty is often stressed by the frequent changes in education technologies. Sometimes, these changes happen even before the one in use is adopted (Chugh et al., 2023). Such fear is not unfounded because faculty are rarely trained before the arrival of new technologies. Yet, there is the expectation by the administration that faculty will transfer skills from the previous technology applications (Granić, 2023).

IV. LITERATURE

Technology and higher education in the 21st Century, have developed an interdependent relationship that is unlikely to change (Castillo et al., 2023; Granić, 2023). Equally, AI as an emerging educational technology (ed-tech), has demonstrated its potential to disrupt higher education. It has also illustrated its benefits through improved work outputs, within previously unimagined paradigm shifts (Firat, 2023; Habib et al., 2024). Though the technology-education relationship cannot be broken, education sometimes seems to be the weaker sibling; always playing catch up with new technologies, even before the recently adopted one is fully implemented (Chugh et al., 2023; Scott & Guan, 2023). This is particularly problematic for universities in Africa (Matthess & Kunkel, 2020). In a systematic review of papers published on ChatGPT and AI education tools through four leading databases, within a very wide search criterion, Baber et al., (2023), found 300 articles and almost 2000 citations of which none of the articles originated from Africa. This exemplifies issues of divide on; adoption, access, affordability, innovation, participation, usage, and research studies (Chugh et al., 2023). Countries in Africa (by extension, universities and faculty) vary on the level, scale and sectorial use of technology (Matthess & Kunkel, 2020). But, 'being left behind' is not an option because it contributes to the widening divides between the first world and themselves (Matthess & Kunkel, 2020). Even though, faculty acknowledge that education technologies must accompany their work (García-Peñalvo, 2023; Nasri et al., 2022), within the already existing divides (technology, information, and skills), they are unable to afford and/or cope with the new and everchanging education technologies (Shwedeh, 2024).

Ed-tech most often seems to arrive in HEIs with an 'uncertainty' for faculty (Lund et al., 2023) borne of pertinent questions; Will faculty find it useful and user-friendly (worth the cost, training, usability, and adoptability)? Will the new technologies take up the roles of the teacher (redundancy and adaptability)? How different is the new technology from the ones already in use (disruption)? Is the new technology affordable to both faculty and students (cost and access)? What problems can the new technology solve (what is broken)? Thus, the general reaction to the new generative AIs is no different from previous education technologies when they first came into the market (García-Peñalvo, 2023). It is not plausible for faculty to invest in technologies that is new or are yet to arrive. Most often new education technologies arrive as a disruptor to the 'normal' teaching and learning processes and then adoption processes including training and acceptance begin (Shwedeh, 2024). Faculty are

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expected to find self-directed ways of accommodating technology as the solution to disruptions or risk being left behind. This limits the frequency and depth of the much-needed continuous professional development.

Technology has influenced many administrative processes in education. It has brought solutions that have contributed to speed and efficiency (Chugh et al., 2023). Each successive educational technology attempts to contribute solutions to the challenges that bedevil teaching and learning processes including high attrition, (especially from distance learning formats), differences in learning styles, unmotivated or low achieving learners, an ever-growing socio-economic, information, and digital divide, and faculty development (Naidu & Sevnarayan, 2023). Technology through blended and online formats anticipates improved access and participation for learners who would otherwise not register for higher education including persons with disabilities and people in low socio-economic strata. Therefore, many university administrations already understand the benefits of digital transformation and the need for ed-tech (Alenezi et al., 2023).

Steered by lessons learned following the effects of physical lockdowns of HEIs during the COVID-19 pandemic (Mpofu & Mpofu, 2023), one of the pillars for disaster preparedness in education is investment in ed-tech. This is especially important for technology-driven departments like open, distance education and e-learning (ODEL) which, following the COVID-19 pandemic, has extended its delivery spectra to include the much utilized blended and hybrid formats of learning (Alvi, 2023; Gupta et al., 2024; Islam et al., 2022). Through ed-tech, distance learning formats provide education to diverse student populations in diverse global locations. Technology has bridged distances created by travel, relocation, culture, and transactions. This in turn has increased student numbers (Gupta et al., 2024) and more revenue for institutions (Scott & Guan, 2023). Faculty have also reported increased efficiency in resource utilization including a reduction of time spent in course administration and other duties; recording lectures, automated attendance reports, simulations, co-creation with global peers and cross-border knowledge sharing (Lubinga et al., 2023; Shwedeh, 2024).

It is expected that the experiences of the COVID-19 lockdown positively changed universities towards digital transformation (Mpofu & Mpofu, 2023). However, it is not easy to evaluate the aftermath of COVID-19 lessons regarding HEI, whether there was a work revolution or not (Mpofu & Mpofu, 2023). Even at the time of lockdowns, there was marked discomfort and resistance by faculty to the adoption of ed-tech (Firat, 2023; Granić, 2023). The lessons learned from the COVID-19 pandemic shutdown should have changed the education landscape forever. Through institutional lockdowns occasioned by the COVID-19 pandemic, ed-tech in HEIs gained larger budgetary allocations (Shwedeh, 2024). The pandemic compelled many universities to transition into online/remote learning with quick adoption of ed-tech including learning management systems (LMS) and enterprise resource projects (ERP) solutions (Alismaiel et al., 2022; Naidu & Sevnarayan, 2023). While these changes are incorporated, AI has entered the education space with many more disruptions than previously experienced (Castillo et al., 2023; Eke, 2023).

ChatGPT, a generative AI, is an example of emerging and aggressive global ed-tech (Baber et al., 2023; Cotton et al., 2024). Since its launch in 2022 (Eke, 2023; Lund et al., 2023), various scholars have assessed its penetration, adoption, benefits, and challenges (Cotton et al., 2024; Sallam, 2023). Some of its benefits include i) A new paradigm shift in remodelling approaches to processes of teaching and learning, especially assessments, in higher education that will acknowledge the ethical use of AI (Nguyen et al., 2023) ii) A balanced and well-thought-out blended approach of AI and human creativity that can foster students higher order critiquing skills that require students to use questioning, evaluation, and synthesis before incorporating outputs from generative AI into their work (Habib et al., 2024). Faculty is relieved from teaching lower-level concepts to facilitate higher-order

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skills training (Firat, 2023). iii) It has introduced efficiency and speed as a teaching and learning companion/aid. Generative AI can create and develop answers for the widest range and combination of questions. This shortens the time for research and evaluation (Sallam, 2023). AI can process and store large amounts of information and brings precision to the search and preparation of learning materials (Stacey, 2022). iv) Adopting AI in education has taught both faculty and administration more about the three facets of teaching and learning; intuition, intelligence, and creativity (Habib et al., 2024). v) Traditional and new assessments have adversely been impacted by generative AI including ChatGPT, Monica, and quizziz among many others. Cheating in assessments has to be redefined within new policies that will propel HEI to skill-based outcomes (Cotton et al., 2024; Stacey, 2022).

There are equally numerous challenges associated with generative AIs. Academic cheating and plagiarism need deeper discussions (Stacey, 2022). Previous examination policies will need to be reviewed (Crawford, Cowling, Ashton-Hay, et al., 2023). It poses an even greater challenge to assessments including online assessments that were just being adopted by universities (Jarrah et al., 2023; Naidu & Sevnarayan, 2023). Outputs from generative AIs like ChatGPT though well-researched, sometimes need verification (Rudolph et al., 2023a). In many cases, generative AIs almost lose their function when students are required to apply knowledge through process reasoning, critical judgment, and decision-making (Rudolph et al., 2023a). The jury is still out on the emotional and physical presence that human faculty brings to learning in contrast to AI. There is consensus that AI has positioned itself in teaching and learning and is unlikely to leave (Jarrah et al., 2023). Therefore, its adoption is inevitable (Granić, 2023). It threatens to automate cognitive teacher functions required for teaching and learning in traditional classrooms (Nasri et al., 2022). Faculty should make the necessary changes to remodel the higher education space. Generative AI has aggressivel positioned itself in teaching and learning (Eke, 2023).

Higher education institutions (HEIs) are concerned with the impact emerging generative AIs are having in the traditional classroom processes (Shwedeh, 2024). Pertinent questions include; Will AI contribute solutions, or will it add to the challenges (Alvi, 2023)? Should higher education remodel itself, change its approach to teaching, learning, and research, or sit back and wait for AI to consume it (Rudolph et al., 2023b)? Because ed-tech is here and generative AIs are aggressively impacting teaching and learning processes, we should find ways to work with it (Hassoulas et al., 2023; Naidu & Sevnarayan, 2023). It, has, however, raised questions of integrity and ethics in issues of academia and research (Lund et al., 2023). Eke (2023), identifies ethical issues including honesty, trust, and responsibility among many fundamental values of integrity. How can these values be entrusted to students and faculty when both use generative AI to create academic content either for assignments, writing, or research? It seems that HEIs will need to turn a greater focus on value-based education (Nguyen et al., 2023). Banning the use of AI and trying to police its use is already proving futile (Hassoulas et al., 2023). Available policies are mostly outdated or unsupportive to capacity building the knowledge and skills required by faculty for the adoption of new and emerging educational technologies (Crawford, Cowling, Ashton-Hay, et al., 2023). Discussions should open to all possible solutions to uphold academic integrity and ethics (Jarrah et al., 2023). This paper seeks to examine such issues through the lens of Faculty in awareness, investment, and adoption of recent educational technologies including generative AI as a representation of other AIs.

V. METHODS

A descriptive mixed methods survey design using an online questionnaire for data collection was employed. The questionnaire was designed to include both closed-ended and open-ended questions. Most quantitative questions used 3-point Likert scales (3-Agree, 2-Neutral, 1-Disagree) in testing the awareness, investment, and use of education technologies including generative AIs while closed-ended questions were

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used to examine both research questions with more depth. The Central Limit Theorem (CLT), allows for a sample size of thirty (30) or more as sufficient to assume a normal distribution (Ganti, 2022). One hundred (100) participants were selected with a target of thirty (30) responses through purposive and snowballing sampling techniques in diverse universities in Africa mainly through social media including WhatsApp and LinkedIn. Inclusion for participation was teaching faculty including those with additional roles apart from teaching. Data was collected over four (4) weeks with weekly reminders posted on direct messaging in social media. Both descriptive quantitative and qualitative content analysis were used for data analysis and presentation of results. Ethical approval was requested from the host university of the lead researcher. Participants were requested and required to sign/initialize the consent letter attached to the face page of each questionnaire as a condition for participation.

VI. DATA ANALYSIS AND RESULTS

Participants were drawn from thirty-four (34) Universities in eight (8) African countries; Ethiopia, Kenya, Malawi, Nigeria, Rwanda, South Africa, Uganda, and Zambia. Participants ranged between the ages of 20 years old to 55 and over years with only 3% (n=65) falling into the category below 25 years. 49% (n=65), were in the category of 20 - 39 years while 51% (n=65) were in the 40 - 55 and over category.

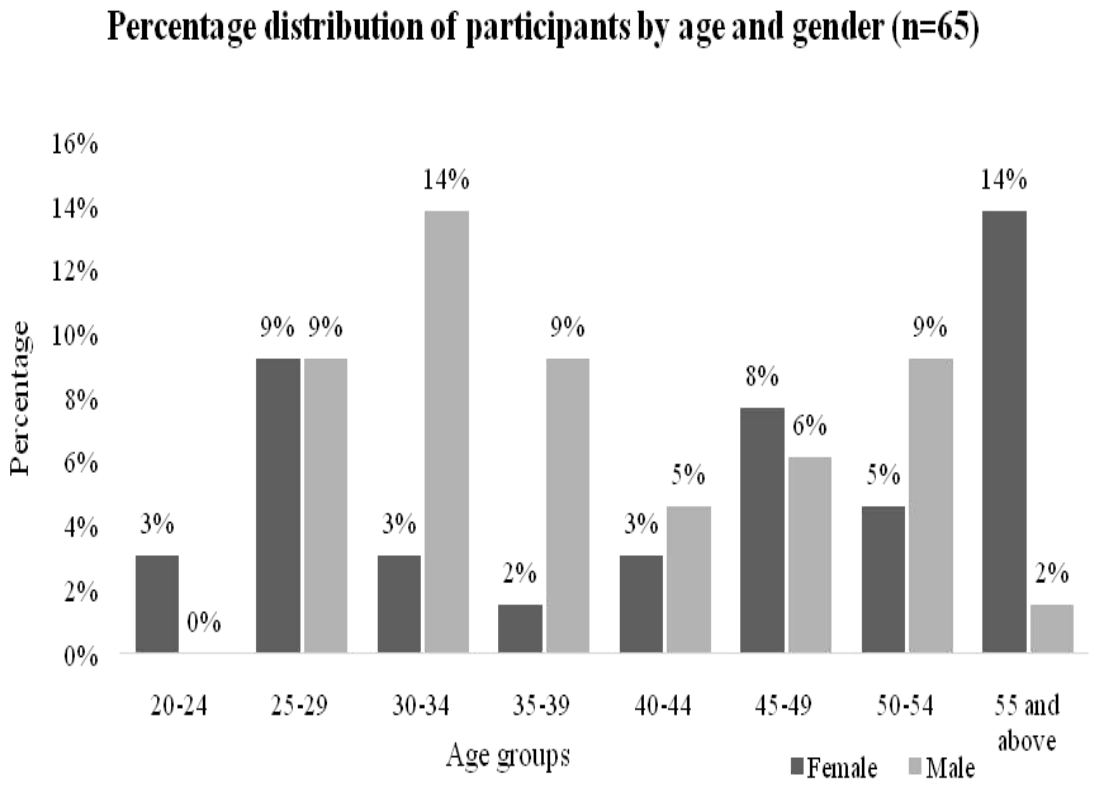

Figure 1

The gender composition of participants comprised 46% (n=65) and 54%(n=65) accounting for females and males respectively (Fig 1). Most university staff in the 30 – 44-year category were male 28% (n=65) compared to females at 8% (n=65) in the same age group. Females were the majority in the 45 - 55 years and over categories accounting for 27% (n=65) compared to males at 17% (n=65) in the same.

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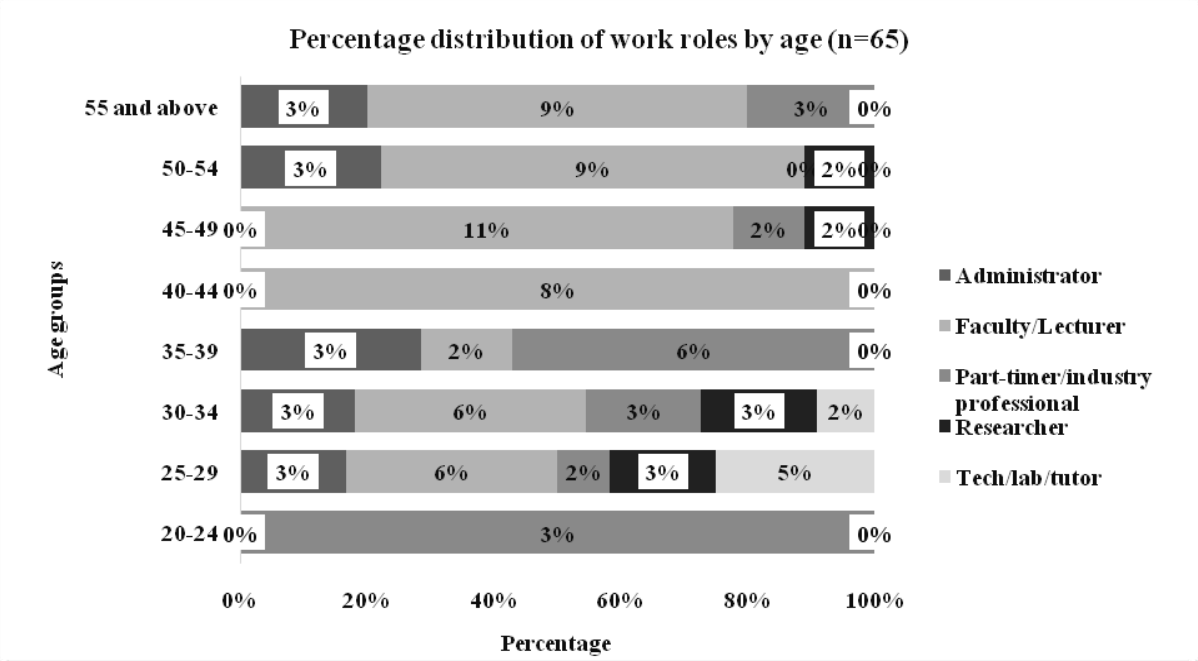

Figure 2

University staff combine teaching with other work roles. The administration needed to be involved in this study as they are the key decision-makers of capital investments in acquiring ed-tech. In addition to other duties, the work roles indicated 51% (n=65) were pure faculty, while 15% (n=65) were also in administration, 27% (n=65) industry professionals but part-time faculty, and 6% (n=65) lab techs and tutors (Fig 2). The majority of faculty, 37%(n=65) were in the 40-55 years and above category compared to 14%(n=65) in the 20-39 years category.

Further findings were grouped under four (4) themes based on the research questions:

6.1 Awareness, Investment, and use of Educational Technologies Including Generative AIs

Findings indicated that gender is not a factor in the adoption of ed-tech by faculty. The majority of faculty, though in the 40 years and above categories indicated 98% (n=65) awareness and use of prevailing ed-tech, having used different versions of video-conferencing software, learning management systems, online assessments, virtual reality, and undisclosed 'others'.

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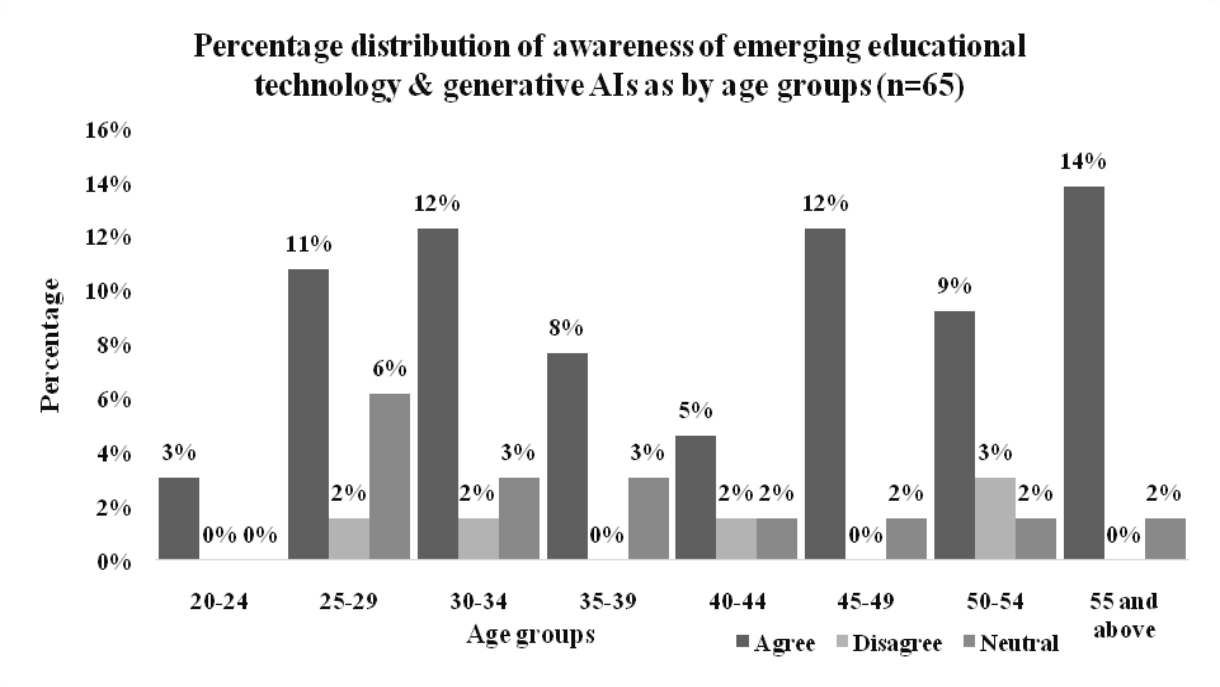

Figure 3

In the combined question of awareness and use of generative AIs as an emerging educational technology, 74%(n=65) indicated 'agree' while 9%(n=65) and 17%(n=65) indicated 'disagree' and 'neutral' respectively (fig 3). In addition, there was minimal difference in percentages between the age groups for those who agreed to awareness and use of emerging educational technologies, with the 20-39 years category accounting for 34% (n=65) and the 40-55 years and above category at 40% (n=65) (fig 3).

6.2 Perceived Benefits of using New Educational Technologies and Generative AIs

A combined score of 98% (n=65) in the age categories of 20-39 years and 40-55 years believed that investing in technology was a priority for the institution and individual faculty. This has demonstrated faculty acknowledgment that education technologies are part of academic work (Castillo et al., 2023; Firat, 2023; Granić, 2023) and that the paradigm shift to ed-tech is unlikely to change (Castillo et al., 2023).

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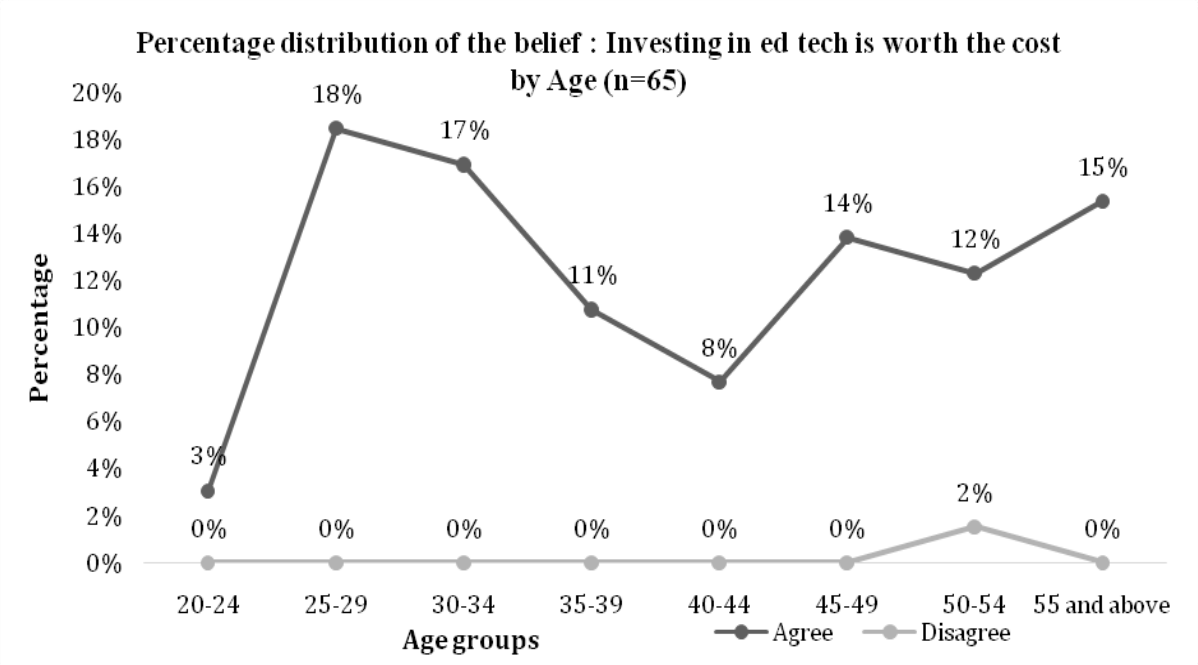

Figure 4

Fig 4 indicates participants' opinions on the question of investing in ed-tech both for themselves and their institutions. There was equivocal agreement that investing in ed-tech is worth the cost with the age categories of 20-39 years and 40-55 years and above both scoring 'agree' at 49% (n=65) and 49% (n=65) respectively in the Likert scale.

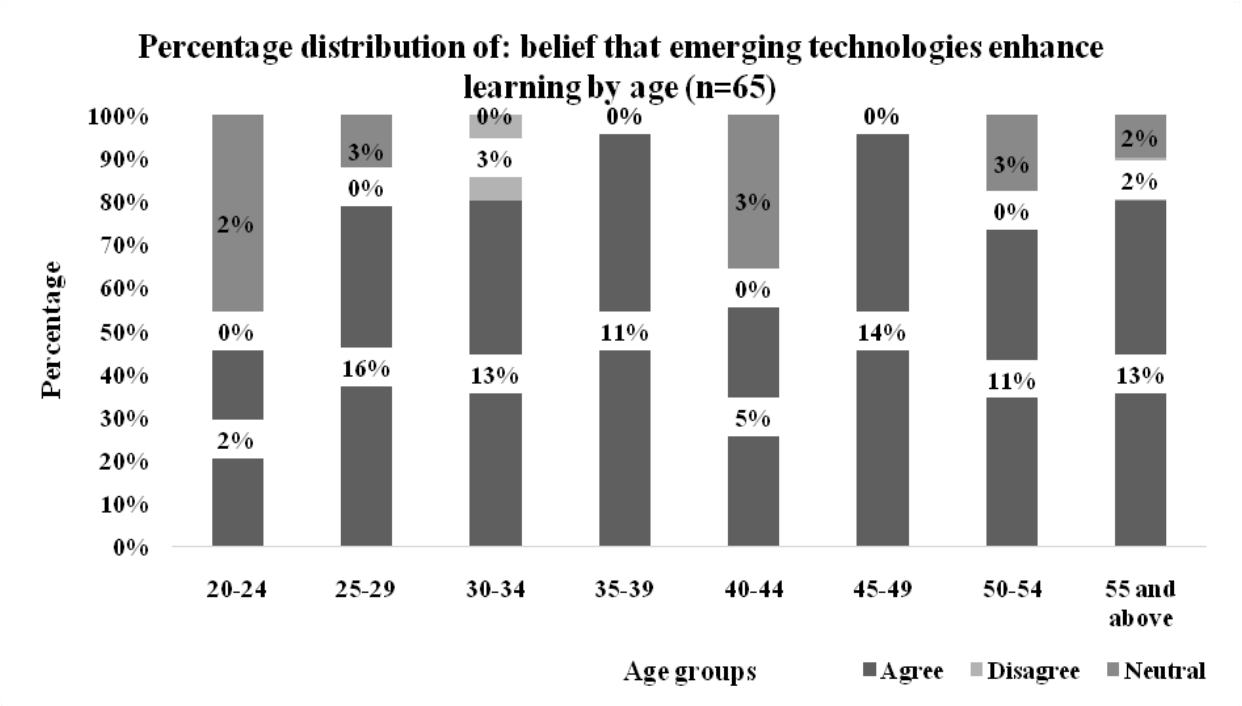

Figure 5

On the role of technologies in teaching and learning, participants were asked about their belief in technologies' capabilities in enhancing learning (Fig 5). All age categories indicated that technology could enhance learning with the age categories of 20-39 years and 40-55 years and

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above scoring 42% (n=65) and 43% (n=65) respectively in the agree Likert scale. This totals 85% (n=65) compared to 15% (n=65) in the disagree and neutral scales combined (fig 5).

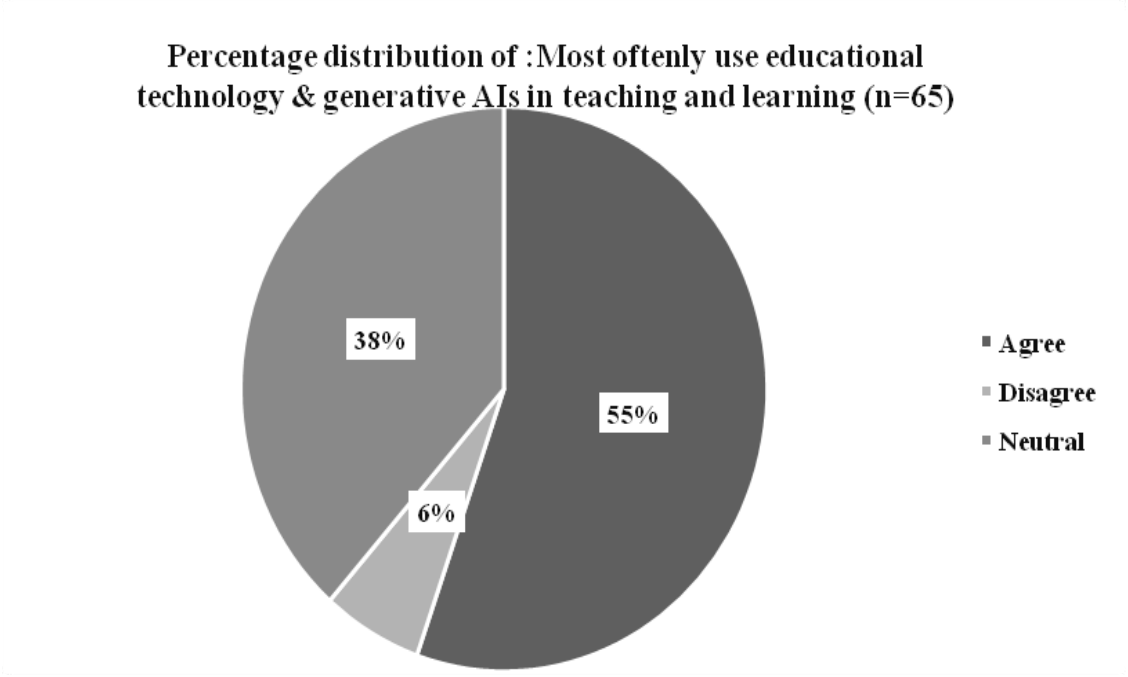

Figure 6

In the standalone question of 'often use of new technologies and generative AIs in teaching and learning', 55% (n=65) of participants indicated 'agree' leaving 45% (n=65) in the category of those who were unsure or did not use (fig 6). To further to this, participants were also asked about their beliefs regarding the impact of generative AIs on learning.

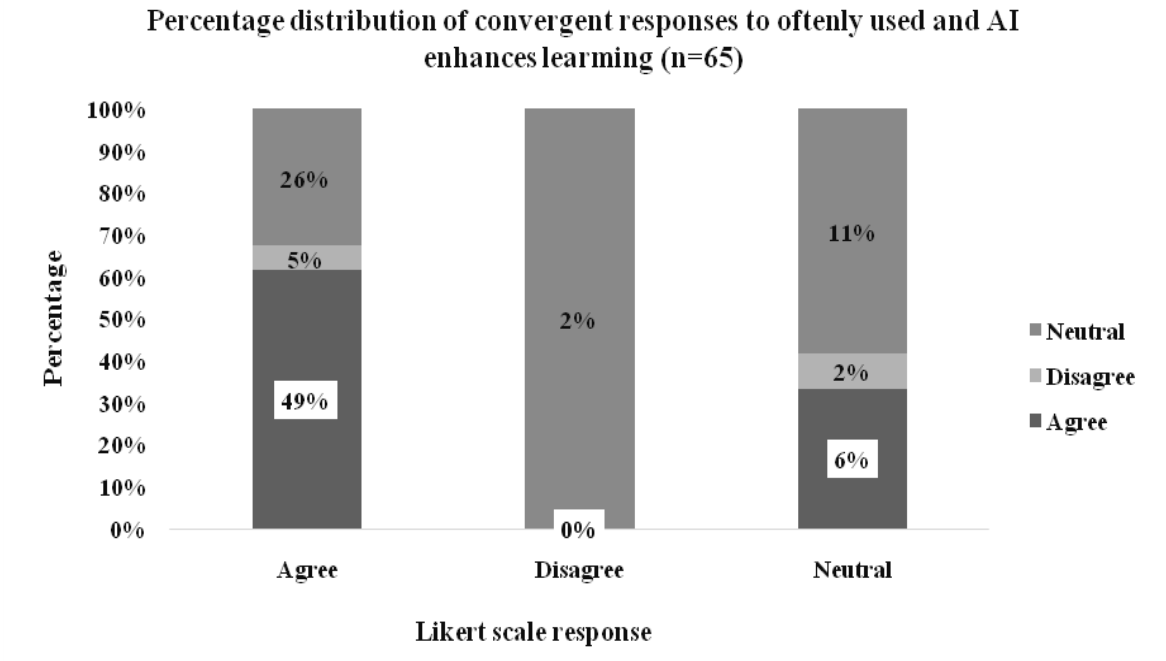

Figure 7

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Fig 7 illustrates the convergent responses in the combined statements that i) emerging educational technologies can enhance learning and ii) the often use of new educational technologies including generative AIs in teaching and learning. Here, 'agree' for both scored 49% (n=65) while 26% (n=65) and 5% (n=65) indicated 'disagree' and 'neutral' respectively.

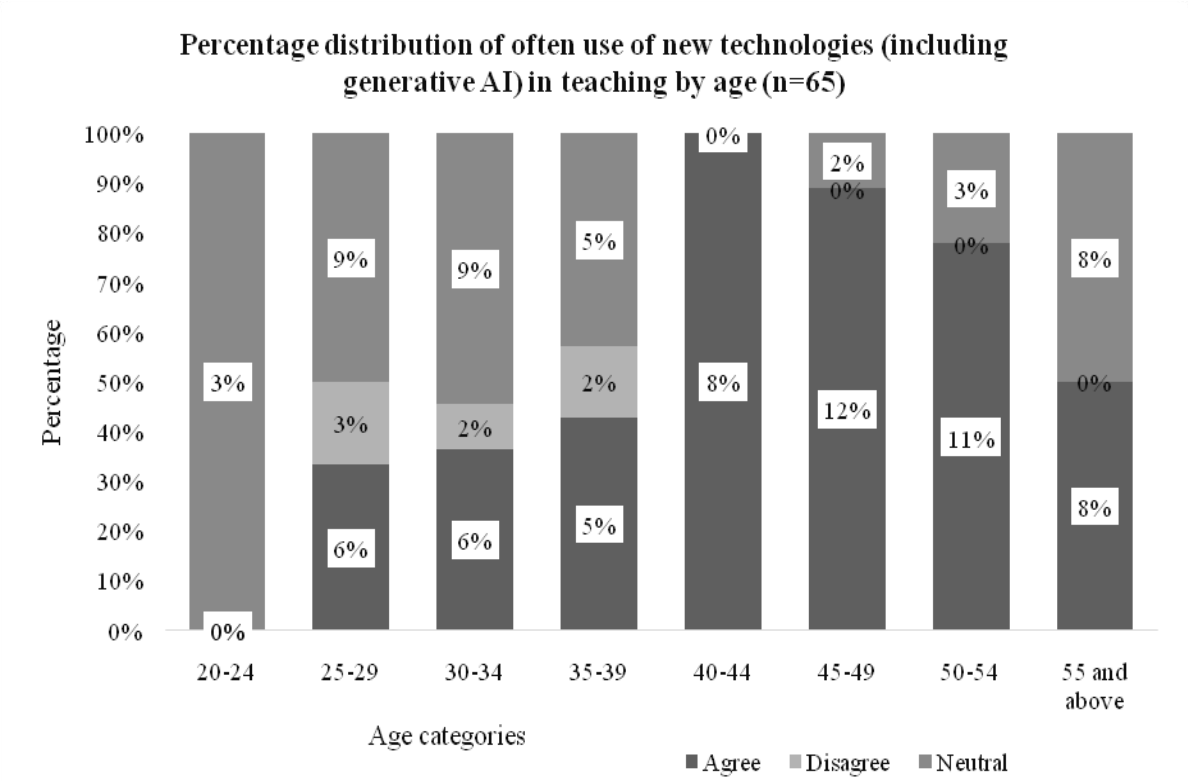

Figure 8

The use of new technologies and generative AIs was plotted by age (Fig 8). There was marked variation between the age groups; the age categories of 20- 39 years and 40- 55 years and above scored 17% (n=65) and 39% (n=65) respectively on 'agree' in the Likert scale. 26% (n=65) and 7% (n=65) in the 20-39 years category indicated 'neutral' and 'disagree' respectively for the use of emerging technologies in teaching.

Table 1

	Generative AI can Personalize Learning for Students				
Concern on possible ethical issues of using generative AI in education		Agree	Disagree	Neutral	Grand Total
	Agree	74%	6%	12%	92%
	Disagree	2%	0%	0%	2%
	Neutral	3%	2%	2%	6%
	Grand Total	78%	8%	14%	100%

Table 1 illustrates the convergent responses in the combined statements that i) Generative AI can personalize learning for students and ii) Concern on possible ethical issues of using generative AI in education. Here, 'agree' for both statements scored 74% (n=65) while 2% (n=65) and 3% (n=65) indicated 'disagree' and 'neutral' respectively. HEIs practitioners, including faculty

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and administration, will need to accommodate AI and future technologies in competency and skills-based assessments rather than basic knowledge and application assessments.

6.3 Support and Investments in Emerging Educational Technologies and Generative AIs

The influence of technology solutions in education has brought efficiency to many processes including administration, class management, student records management, and examinations (Firat, 2023). However, due to dwindling fiscal support from the government, universities also face financial challenges leading to insufficient budgetary allocation to departments and faculty. This has resulted in a reluctance to invest in educational technology and Artificial intelligence (AI) in university administrations in low-income countries (Gkrimpizi et al., 2023; Maguatcher & Ru, 2023; Nasri et al., 2022). Participants discussed institutional support for digital transformation and capital investment in new educational technologies.

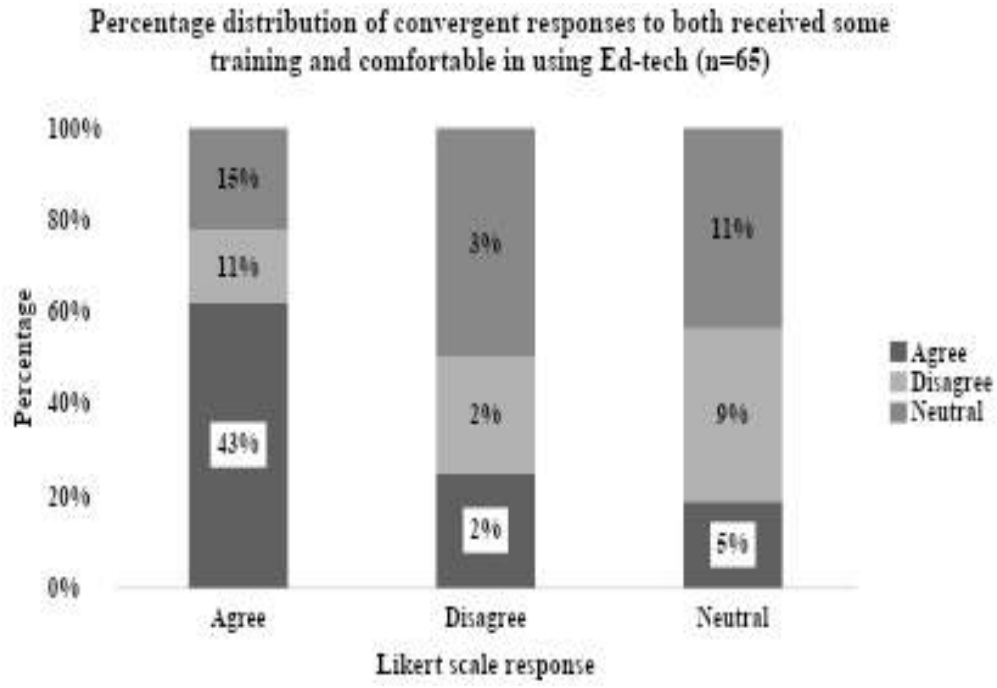

Figure 9

Fig 9 illustrates the convergent responses in the combined statements that i) they had received training and ii) were comfortable with using emerging educational technologies and generative AIs due to institutional-supported training. 'Agree' to both statements scored 43% (n=65) while 12% (n=65) and 15% (n=65) indicated 'disagree' and 'neutral' respectively. Some institutions have invested in digital transformation and continue to support faculty. One participant indicated:

> *My institution was continuously investing in and implementing new educational technologies ... these investments need joint efforts from both faculty and administration. (P28)*

Another participant indicated the opposite:

> *There were no provisions for technologies, and I didn't know which technology applies in my educational class. (P46)*

One participant expressed dissatisfaction with the university's provision of reliable internet and meeting the costs of training and capacity building:

> *We don't have reliable internet access and compatible devices, to effectively utilize technology, Teachers may also require*

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extensive training to effectively integrate technology into their teaching practices. (P2)

6.4 Challenges in Adopting New Educational Technologies and Generative AIs

University administrations should prioritize technology-driven formats of education through investments in capacity building, policies, accreditation, and establishment. Participants raised various challenges in using educational technologies including individual, institutional, and external challenges. The individual challenges included inadequate understanding and skills in using the new educational technologies. This has been described by Khlaif et al., (2023) as 'techno-stress'. Some faculty members lack confidence, are afraid of the unknown, and are resistant to change. Sometimes this is due to a lack of training in the use of various technologies or simply due to fixed mindsets and negative attitudes. The rapid change in new technology is also a major issue as many faculty members cannot keep up with the new changes (Alenezi et al., 2023; Chugh et al., 2023).

Technology is ever-changing so I see a case where before one gets used to a certain type of technology, another has come and replaced it. (P7)

Cost, ignorance, poor prioritizing, rigid and ignorant administration, resistance to change, fear of the unknown, commission for university education policies, outdated examination policies.(P12)

VII. DISCUSSION

This study illustrates that; even though technology adoption has both successes and challenges (Alenezi et al., 2023) faculty are well aware of prevailing paradigms of education technologies. However, the levels of investment and use in the same will always vary (Shwedeh, 2024). The increased awareness and use of ed-tech can also be attributed to the forced physical lockdowns of higher educational institutions (HEIs) during the COVID-19 pandemic (Alismaiel et al., 2022; Shwedeh, 2024) during which ed-tech was the only redemption for continuity of teaching and learning. In the utilization and self-learning investments in the new AI-associated technologies, at least half of the participants indicated the use of generative AIs including OpenAI, ChatGPT-3 /4, Google's BERT, and Copilot while a substantial number indicated that they had heard about AI in education but were yet to use any including generative (Lund et al., 2023). Faculty also indicated that they had gained awareness of new education technologies mostly through self-learning, forced change by students, reading / journals, conferences and workshops, internet, colleagues, social media, AI platform updates, news and pop-up advertisements on mobile phones, research and collegial learning (Alismaiel et al., 2022). It is also encouraging that the current breed of faculty has less 'technostress' (Khlaif et al., 2023) and more self-drive. This is facilitated by knowledge-seeking and life-long learning propelled by various needs including, career growth, success stories from colleagues, the internet, improved institutional support, recognition for innovation, and incentives from partners/grants.

On the possible benefits of using emerging education technologies and generative AIs in teaching and learning, the majority of participants indicated that the use of education technologies would increase student engagement in learning activities with a commensurate improvement in expected course outcomes. In addition, participants also indicated that the use of AI in education would benefit both faculty and learners with personalized learning experiences and enhance collaboration with peers. This will enhance creativity if generative AI outputs are used as guides and students are encouraged to think of alternatives for problem-solving (Crawford, Cowling, Ashton-Hay, et al., 2023). Subsequently, this will also enhance student engagement and active learning. Generative AIs can be used in collaboration with other education technologies for demonstrations and simulations in developing audiovisual learning materials. In the immediate past, video content for instance was generated using real actors and manual scripts. Generative and other AIs have illustrated

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the endless possibilities of artificial actors and scenario-generated scripts (Nasri et al., 2022).

AI in education is an emerging ed-tech (Baber et al., 2023; Cotton et al., 2024). Components of classroom learning that are possibly impacted by new technologies and generative AIs include; set up and administration of assessments (Altmäe et al., 2023). Participants indicated that AI would help education systems like assessments and evaluations to run more efficiently with improved speed of outcomes and feedback even though there was mistrust in AI capacity borne of policy and ethical issues (Eke, 2023; Jarrah et al., 2023). The main concerns included issues of cheating and plagiarism would have to be mitigated in better ways that are yet to be defined (Cotton et al., 2024; Stacey, 2022). Notwithstanding, participants indicated that accepting generative AIs as learning companions would enhance personalized learning, even though faculty would need more skills in moderating their use in learning activities. Overall, AIs have the potential to contribute to impactful growth in digital learning skills (Alenezi et al., 2023; Mpofu & Mpofu, 2023). A definitive positive that is already configured in many LMSs is automated assessment grading systems (Hassoulas et al., 2023). This has introduced efficiency and effectiveness as learners can receive immediate feedback. Other components that participants were positive about included, the use of AIs as adaptive tutors in virtual classrooms. In addition to visual and space simulations, adaptive tutoring can deliver real-time information if AI can gauge the classroom understanding of prevailing concepts and re-adapt the information to fit the current required information.

The institutional challenges included a lack of; financing for the purchase of personal and institutional tech-ware, administrative support for staff training and growth (Gkrimpizi et al., 2023; Maguatcher & Ru, 2023), and supportive policies on the use of new technology (Crawford, Cowling, & Allen, 2023; Eke, 2023). Many HEIs in developing countries lack relevant infrastructure including classrooms fitted with modern technology equipment, new software, smart classrooms, and projectors (Alvi, 2023; Gupta et al., 2024). Where there is some equipment, there is inadequate expertise or technicians to manage the educational technologies. In addition, poor internet connection hinders access to some of the technology applications. Another challenge is financial resources (Scott & Guan, 2023). Universities have limited funds to budget and prioritize new technologies. Participants also discussed student-related factors; some students lack the required equipment, experience poor access to the Internet, and poor participation mostly due to associated costs. Thus, in many universities that have adopted blended and hybrid modes of learning (Alvi, 2023; Islam et al., 2022), faculty find it hard to deliver effectively due to student-related factors.

External factors include the perceived high cost of capital equipment, new technology software, and licenses, as well as the cost of the internet and related infrastructure (Lee & Han, 2021). Another challenge is the influence of manufacturers and donors ending up with unreliable and non-useful technologies. In addition, most often there is insufficient evidence of cost-effectiveness and cost-efficiency of changing from one technology to a new one (Nasri et al., 2022).

VIII. CONCLUSION AND IMPLICATIONS

This study was limited in scope. Nonetheless, the sample was representative but non-generalizable due to the sampling technique of snowball. It has, however, illustrated faculty trends in awareness, use, and adoption of emerging ed-tech including AI. Faculty will need to adopt emerging ed-tech as aggressively as their invasion (García-Peñalvo, 2023). This will probably impact teaching and learning methodology in ways that are still open to research. Generative AIs have proven to be worthy learning companions and so faculty may need to incorporate them in relevant pedagogies. Old models of teaching and learning may not work as they used to in the face of emerging ed-tech like generative AIs (García-Peñalvo, 2023). HEIs probably need to integrate other theories and models as they adopt emerging ed-tech. The present generation of learners, borne into a technology world, now aided by AI, trained to access information through social media in a

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permissive socio-cultural environment allows learners to interact with information in small chunks, keep only what's useful for purpose, and apply what school or work demands (Alismaiel et al., 2022). Multimedia learning materials hosted by various LMSs can now accommodate new technologies including generative AIs. In addition to instruction and facilitation, faculty will adopt the role of active moderator who should be keen to moderate the use of generative AIs in coursework. Policies may need to give learners the choice to integrate generative AIs as learning companions. Learners can also implement collaborative learning with faculty to develop course content using generative AIs and integrate instructional materials in social media including Instagram and TikTok. Discussion forums may need to integrate collaborative social media including WhatsApp, Telegram, and mobile phone-based applications into learning management systems (LMS) and classrooms. All these are open to more research.

Notes

Declarations

This study has not currently been submitted to another journal.

Availability of Data and Materials

- The datasets generated and/or analysed during the current study are available in https://docs.google.com/spreadsheets/d/1q6DlLTW5bGgbpPlm6lXPjg68GqgUmoVC/edit?usp=sharing&ouid=113816018990677993987&rtpof=true&sd=true
- The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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List of Abbreviations

AI	Artificial intelligence
BERT	Bidirectional Encoder Representations from Transformers
ChatGPT Chat	Generative Pre-Trained Transformer
CLT	Central Limit Theorem
COVID-19	Coronavirus Disease of 2019
Ed-tech	Educational Technology
HEIs	higher education institutions
LMS	Learning Management System
ODEL	Open Distance Electronic Learning
OERs	Open educational resources
TAM	Technology Acceptance Model

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