Digital Competencies Among University Teachers in Ghana: Enhancing Innovative Approaches for Effective Teaching and Learning

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ABSTRACT

This study investigated the digital competencies of university teachers in Ghana, focusing on their ability to integrate and utilize digital technologies in their teaching practices. The research assesses various aspects of digital competencies, including the teachers' self-assessment of their skills, the digital infrastructure available in their institutions, and the degree to which digital technologies are integrated into the teaching and learning process. A questionnaire survey was conducted with 100 randomly selected university teachers, with data analysed using frequency analysis. The study found that most teachers reported a moderate to high level of competence in areas such as online course management and digital assessment techniques. The research also highlights the growing role of digital technologies in higher education, noting their potential to improve teaching effectiveness, student engagement, and research productivity. Challenges hindering effective implementation of these digital skills included inadequate digital infrastructure, insufficient training opportunities, absence of advanced research tools, digital collaboration, and the use of multimedia content creation. The research therefore recommended policy interventions, such as improving access to digital tools, providing regular continuous professional development programs and integrating digital competencies into faculty recruitment and promotion criteria to ensure that university teachers are adequately prepared for the evolving educational landscape.

Keywords: Digital Infrastructure, competencies, Integration, tools, Innovative Approaches.

INTRODUCTION

In recent years, the importance of digital competencies in modern education delivery has become increasingly evident, particularly with the rapid advancement of technology and the quest for its integration into teaching and learning environments [3; 2; 11]. As education systems worldwide continue to embrace digital transformation, there is the need for Ghanaian educators to develop and refine their digital skills. Digital competencies encompass a broad range of abilities, including the use of digital tools for teaching, communication, content creation, and the ability to adapt to new technologies that enhance learning experiences [10]. In the context of higher education, these competencies are critical for effectively engaging students, improving instructional quality, and fostering an environment of innovation and

collaboration. The role of technology in modern education is no longer a luxury but a necessity, as digital tools and platforms are reshaping the way knowledge is delivered, accessed, and consumed [11; [13].

In Ghana, the landscape of higher education has witnessed significant changes, particularly in recent years. The growing availability of digital tools and the push for online learning have prompted universities to rethink traditional teaching methodologies [8]. As universities in Ghana continue to expand their use of technology, the role of university teachers becomes even more central in ensuring the successful integration of these tools.

Despite the growing recognition of the importance of digital competencies, there are existing gaps among university teachers in Ghana [14] . These gaps, particularly in the use of advanced digital tools and pedagogical strategies, can have a detrimental impact on teaching effectiveness and learning outcomes. Teachers who are not well-versed in digital tools may struggle to engage students effectively, limiting the impact of their teaching. Furthermore, the lack of digital competencies may also affect the development of innovative teaching approaches, such as online learning and digital assessment techniques, which are increasingly crucial in today's educational environment [1].

This study aims to assess the level of digital competencies among university teachers in Ghana, with a particular focus on understanding the gaps and challenges they face in integrating digital tools into their teaching practices. The study will explore how university teachers are currently utilizing digital technologies and the innovative approaches they have adopted to enhance teaching and learning. It will also seek to identify the strategies that can be employed to address the existing gaps in digital competencies and improve the overall effectiveness of teaching in higher education institutions in Ghana. By examining these aspects, the study aims to provide valuable insights into how digital competencies can be better fostered and integrated into the higher education system, ultimately contributing to improved teaching and learning outcomes.

The research questions guiding this study include: What is the current state of digital infrastructure and access in Ghanaian universities? What is the current level of digital competency among university teachers in Ghana? What innovative approaches are being utilized by university teachers, and how effective are they in improving teaching and learning? These questions are designed to address key areas of concern regarding digital competencies in higher education and to identify the gaps that need to be addressed for more effective integration of technology into teaching and learning processes.

The significance of this study lies in its potential to inform policy-making, curriculum development, and professional development programs aimed at improving digital competencies among university teachers in Ghana. As digital technologies continue to play an increasingly important role in education, the findings of this study will contribute to the development of strategies and frameworks that can guide universities in fostering the necessary skills among their faculty members. This research will provide insights that can help universities design targeted professional development programs, enhance digital infrastructure, and create supportive environments for teachers to embrace and effectively use digital technologies in their teaching practices. Furthermore, the study will contribute to the ongoing discourse on the role of technology in education, providing evidence-based

recommendations that can inform educational policy at both the institutional and national levels. Ultimately, this study aims to contribute to the overall improvement of teaching and learning in Ghanaian universities, ensuring that university teachers are equipped with the digital competencies required to meet the demands of the modern educational landscape.

LITERATURE REVIEW

Contextualising Theoretical Underpinning of Digital Competencies and Innovation

Theoretically, the Technological Pedagogical Content Knowledge (TPACK) model serves as a cornerstone for understanding digital competencies in education. Developed by [9] and Koehler (2006) to address the complexities of integrating technology into teaching, TPACK emphasizes the interplay of three primary domains: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). Effective teaching with digital tools requires educators to seamlessly integrate these domains, ensuring that the technology not only supports the content being taught but also aligns with sound pedagogical strategies. For university teachers in Ghana, the TPACK framework is particularly relevant in assessing their preparedness to balance these interconnected domains. It provides a structured lens to evaluate whether educators possess the necessary skills to effectively incorporate digital tools into their teaching practices, thereby fostering engaging and meaningful learning experiences.

Rogers' Diffusion of Innovations Theory also plays a significant role in this study by offering insights into how digital tools and competencies are adopted in the academic environment. The theory outlines five key factors influencing adoption: relative advantage, compatibility, complexity, trialability, and observability [12]. These factors help to explain the pace and extent of technology adoption among university teachers. For instance, the perceived advantages of digital tools in enhancing teaching outcomes, their compatibility with traditional teaching methods, and the availability of training to reduce complexity significantly influence adoption. In the Ghanaian higher education context, where challenges such as inadequate infrastructure and limited professional development opportunities may persist, this theory provides a valuable framework for understanding and addressing barriers to the adoption of innovative digital practices. Together, TPACK and Diffusion of Innovations Theory offer complementary perspectives, bridging the gap between individual competencies and systemic adoption of digital technologies in education.

Empirical Studies

Prior studies have recognised that digital competencies are critical in contemporary education, particularly as technology increasingly shapes teaching and learning environments. For instance, [6] introduces the Teacher Digital Competency (TDC) Framework, emphasizing a broader, interdisciplinary approach to digital skills development that goes beyond technical knowledge to include ethical, safe, and productive use of digital tools in diverse settings. The framework highlights the necessity of preparing educators for the complex demands of modern classrooms. Similarly, [15] explore the transformative impact of digital technologies on education, noting how the COVID-19 pandemic exposed significant gaps in schools' digital capacity, widening inequalities and learning losses. Their findings stress the need for enhanced digital preparedness and targeted interventions for successful educational transformation. [3] focus on higher education, revealing a persistent gap in university teachers' digital competencies. Their systematic review shows that many educators rate their skills as low or medium-low, particularly in evaluating educational practices, thus highlighting the need for

practical and personalized training programs tailored to teachers' digital needs. Meanwhile, [7] investigated the relationship between teachers' data literacy, digital teaching competence, and their ability to empower students in classrooms. Their study identifies data literacy as a significant predictor of digital teaching competence and demonstrates its direct impact on empowering students through ethical technology use, communication, and collaboration. Collectively, these studies underscore the critical role of teacher digital competencies in addressing challenges and fostering innovation within educational systems, while calling for strategic interventions to ensure effective integration of digital tools in education.

METHODOLOGY

Study Design
This study employed a descriptive survey research design [4;5] to explore the state of digital technology adoption and integration among university teachers. The design was chosen to provide a comprehensive overview of the current infrastructure, competencies, and practices of educators, as well as their perceptions of the impact of digital technologies. The approach allowed for a systematic collection of data and a detailed analysis of patterns and trends within the study population.

Population and Sample
The target population for the study comprised all university teachers in Ghana, reflecting diverse faculties and academic disciplines. Due to resource and logistical constraints, a sample of 100 university teachers was randomly selected to represent this population. Random sampling was employed to ensure an unbiased and representative selection, providing a diverse cross-section of educators. This sampling approach increased the generalizability of the findings while maintaining the feasibility of data collection and analysis.

Data Collection Instrument
The primary data collection instrument for this study was a structured questionnaire designed to comprehensively assess digital technology usage and its impact among university teachers. The questionnaire consisted of five main sections. The first section gathered demographic information such as age, gender, and years of teaching experience. The second section focused on Digital Infrastructure and Access, examining the availability of digital tools among others. The third section addressed Digital Competencies Self-Assessment, where respondents rated their proficiency with digital tools, experimentation with new technologies, and feedback-seeking behaviours. The fourth section explored Teaching Technology Integration and innovative approaches implemented. This comprehensive structure ensured the collection of diverse and relevant data for the study's objectives.

Data Analysis
The study utilized frequency analysis as the primary method to examine the responses of the respondents. This approach involved counting and categorizing the responses to provide a detailed understanding of the extent to which university teachers are engaged with digital technologies in their teaching and professional activities. Frequency analysis was particularly effective in identifying patterns and trends in key areas such as access to digital infrastructure, self-assessment of digital competencies, and the integration of technology into university teaching.

The analysis highlighted the proportion of teachers using specific digital tools and methods, such as online lecture recordings, virtual labs, and e-assessments, and the frequency of their participation in activities like training on digital pedagogy and collaboration on digital projects among others. This methodological focus on frequency analysis provided clear and straightforward insights into the current state of digital technology usage among university teachers.

Ethical Considerations

Ethical considerations were integral into the study to ensure the rights, dignity, and privacy of participants were upheld throughout the research process. Prior to data collection, participants were informed about the purpose and scope of the study, their role as respondents, and the voluntary nature of their participation. Consent was obtained from all participants, and they were assured that their responses would be treated with the utmost confidentiality. Anonymity was maintained by ensuring that no identifying information was collected or linked to individual responses. Data were aggregated to prevent the identification of specific participants in the analysis or reporting stages. This approach fostered a safe environment for respondents to provide honest and unbiased feedback on sensitive issues such as institutional support, digital competencies, and access to digital infrastructure.

The findings were reported transparently and objectively, avoiding any manipulation of data to misrepresent the results. These ethical measures ensured that the study upheld integrity and accountability while respecting the rights and welfare of all participants involved.

RESULTS

Demographic Information

The demographic distribution of the participants' highlights key insights into the profile of university teachers in Ghana. In terms of age, Figure 1 shows that the largest age group among respondents falls within the 46-55 age bracket, accounting for 44 participants (44%), followed closely by the 36-45 age group with 40 participants (40%). The 25-35 age group constitutes 10% of respondents, with 10 individuals, while the smallest group is those aged 56-60, comprising only 6% of respondents (6 individuals). Figure 2 shows that the gender composition of respondents indicates a significant male dominance, with 90 participants (90%) identifying as male. Female respondents account for 8 participants (8%), while 2 respondent (2%) preferred not to disclose their gender.
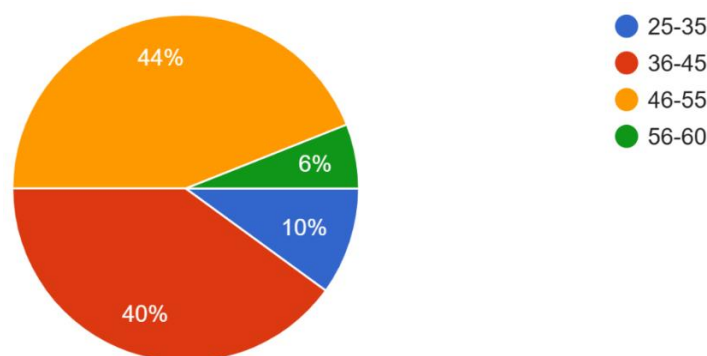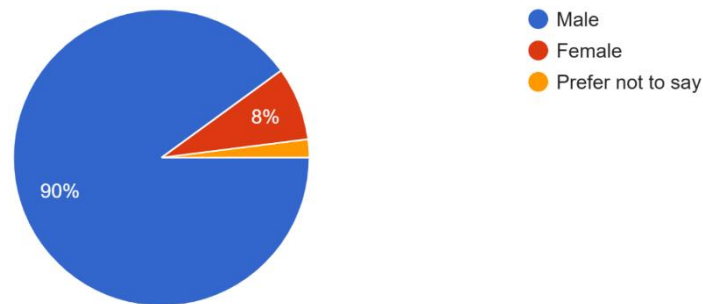

Figure 1: Age Group
Source: Field Survey, 2024

Figure 2: Gender
Source: Field Survey, 2024

Regarding University Teaching Experience, Figure 3 shows that the respondents demonstrate diverse teaching experience. Those with 0-5 years of teaching experience make up the largest group at 40% (40 participants), followed by those with 11-15 years (24%, 24 participants). Respondents with 6-10 years of experience account for 20% (20 participants), while 16-20 years and 21+ years are equally represented at 8% each (8 participants each).
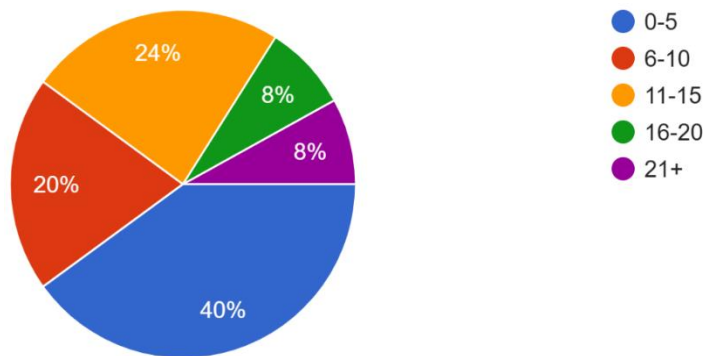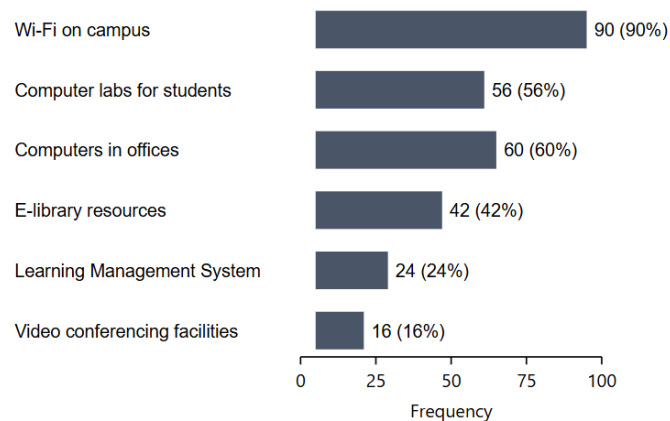

Figure 3: University Teaching Experience
Source: Field Survey, 2024

Digital Infrastructure and Access
Digital Resources:
The survey results highlight the state of digital infrastructure and access within universities.

Figure 4: Digital Resources
Source: Field Survey, 2024

Among digital resources provided by institutions in Figure 4 reveals that campus Wi-Fi is the most accessible, available to 90 respondents (90%), followed by computers in offices (60 respondents, 60%) and computer labs for students (56 respondents, 56%). E-library resources are available to 42% of respondents (42), while Learning Management Systems (24%, 24 respondents) and video conferencing facilities (16%, 16 respondents) are less common.

Quality of Digital Infrastructure:
In figure 5, respondents were asked to rate the quality of digital infrastructure, 40% (40 respondents) rated it as adequate, while 36% (36 respondents) described it as poor, and only a small percentage rated it as good (18%, 18 respondents) and excellent (2%, 2 respondent). These percentages are shown in figure 5 below.
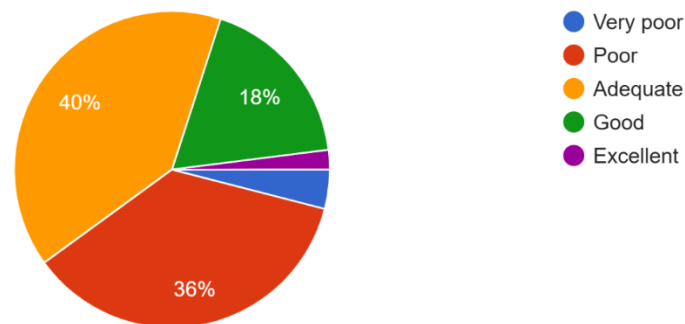
Figure 5: Quality of Digital Infrastructure
Source: Field Survey, 2024

Personal Access to Digital Devices:
Regarding personal access to digital devices, figure 6 shows that laptops are the most owned, with 72% (72 respondents) reporting access, followed by smartphones (62%, 62 respondents) and desktop computers (42%, 42 respondents). Tablets are the least commonly owned, with only 22% (22 respondents) having access.
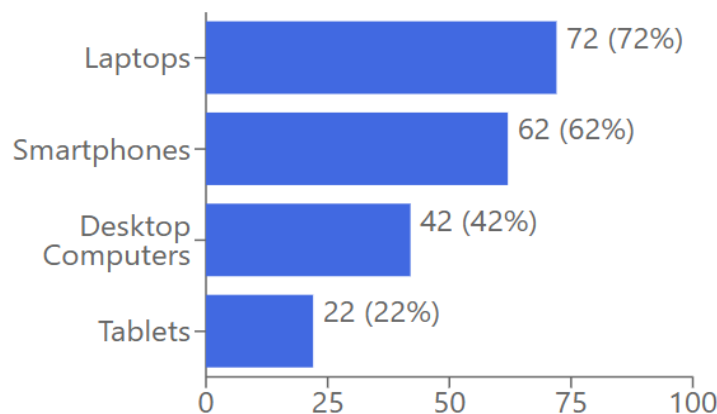

Figure 6: Personal Access to Digital Devices
Source: Field Survey, 2024

These findings as presented above suggest a moderate level of digital resource availability and highlight areas for improvement in infrastructure quality and accessibility.

Digital Competencies Self-Assessment
The self-assessment of digital competencies reveals varying levels of proficiency across different areas among respondents. Respondents were asked to rate their proficiency in specific areas, with the scale defined as follows: 1 - No proficiency, 2 - Basic, 3 - Intermediate, 4 - Advanced, and 5 - Expert.

Data Analysis Software:
Figure 7 illustrates the use of advanced data analysis software, such as SPSS, R, and STATA. Most respondents reported intermediate proficiency 30%, advanced proficiency 38%, and only 8% indicated expert-level skills. Regarding the navigation of academic databases.
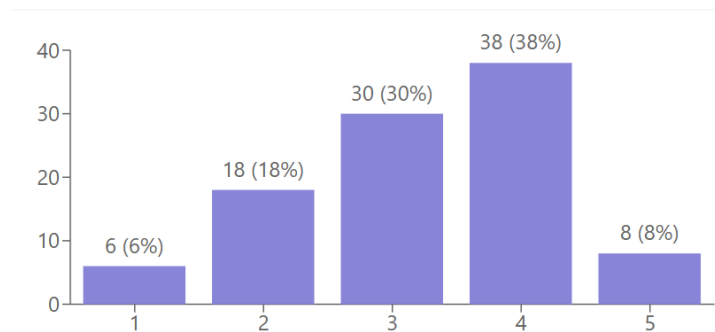
Figure 7: Data Analysis Software
Source: Field Survey, 2024

Academic Database Navigation and Research:
Figure 8 below it shows that 40% rated their proficiency as advanced, 28% considered themselves intermediate and 20% as expert.
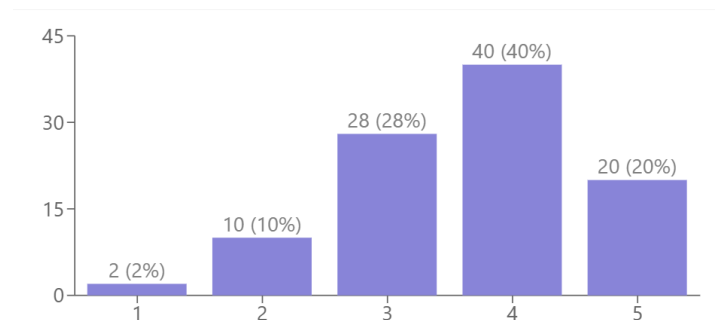

Figure 8: Academic Database Navigation and Research
Source: Field Survey, 2024

Usage of Plagiarism Detection Software:
In Figure 9, the use of plagiarism detection software revealed a significant proportion with advanced (28%) and expert (30%) skills.
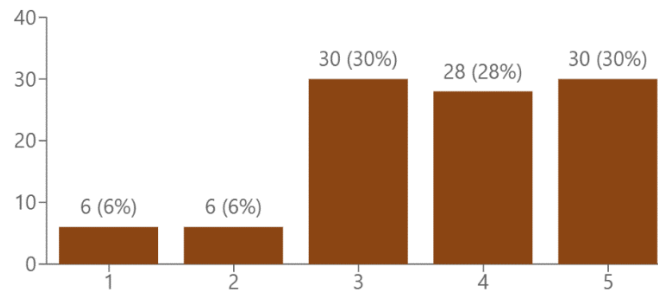
Figure 9: Usage of Plagiarism Detection Software
Source: Field Survey, 2024

Creating and Managing Online Courses:

Figure 10 illustrates the creation and management of online courses, showing a similar trend, with 30% reporting advanced proficiency and 20% expert, although 10% reported no proficiency.
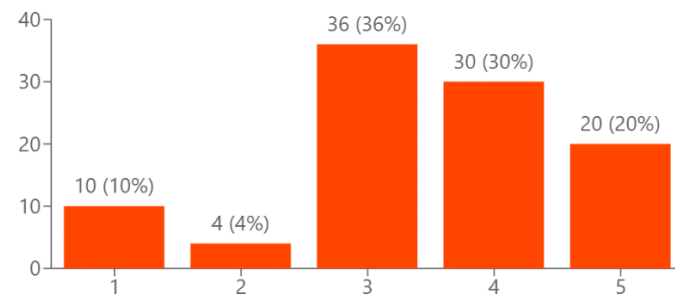

Figure 10: Creating and Managing Online Courses
Source: Field Survey, 2024

Digital Assessment and Grading Tools:

For digital assessment and grading tools, figure 11 shows that 36% rated themselves as advanced and 12% as expert.
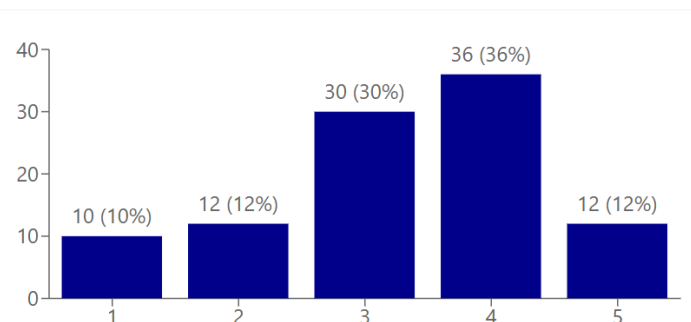

Figure 11: Digital Assessment and Grading Tools
Source: Field Survey, 2024

Usage of Citation Management Software:

Proficiency in citation management software, as seen in figure 12, demonstrates a varied trend, with 24% identifying as advanced and 18% as expert users, while 14% reported no proficiency.
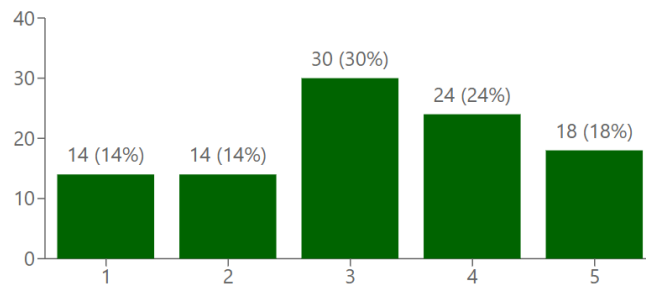
Figure 12: Usage of Citation Management Software
Source: Field Survey, 2024

Creating and Editing Multimedia for Lectures:
In Figure 13, the creation and editing of multimedia content was assessed, with 44% identifying as intermediate and 24% as advanced.
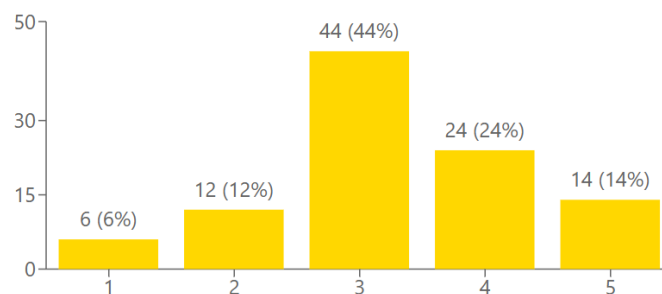

Figure 13: Creating and Editing Multimedia for Lectures
Source: Field Survey, 2024

Usage of social media For Academic Purposes:
Finally, the use of social media for academic purposes in Figure 14 revealed an even split, with 34% reporting both intermediate and advanced proficiency, while 18% claimed expert-level skills.
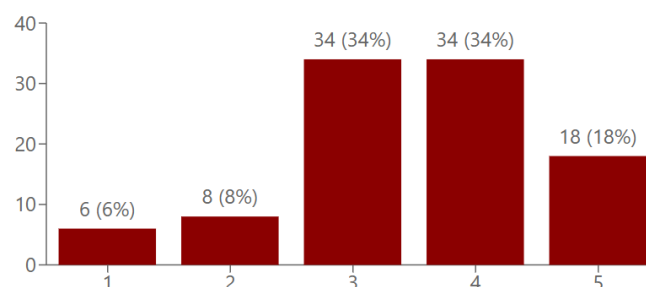

Figure 14: Usage of social media For Academic Purposes
Source: Field Survey, 2024

Overall, the findings indicate strong competencies in academic database navigation, plagiarism detection, and online course management, but highlight areas for growth in citation management and multimedia content creation.

Technology integration and Innovative Teaching Approaches in Higher Education
Innovative Teaching Approaches Using Digital Technologies:

Over the past two years in figure 15, nearly half of respondents (48%) reported implementing innovative teaching approaches using digital technologies, 36% had not, and 16% were unsure. Examples of these innovations include voice recordings over PowerPoint slides, conducting online lectures via Zoom, utilizing tools like Google Meet and Google Classroom, leveraging WhatsApp for communication, using projectors and smart boards, and integrating platforms such as Microsoft Teams.
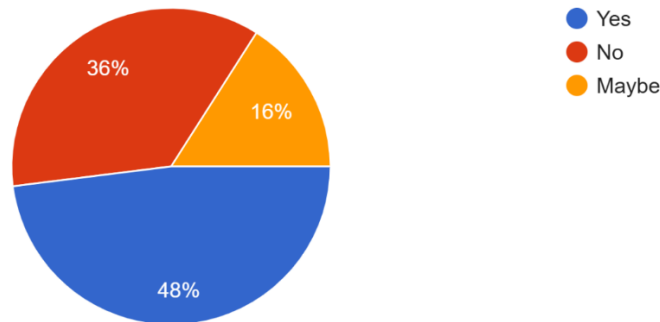

Figure 15: Innovative Teaching Approaches Using Digital Technologies
Source: Field Survey, 2024

Training on Digital Pedagogy:

Despite the efforts in figure 15, engagement with activities that promote digital pedagogy remains varied. In figure 16, while 38% sometimes attend workshops on digital pedagogy, only 14% attend them often or always.
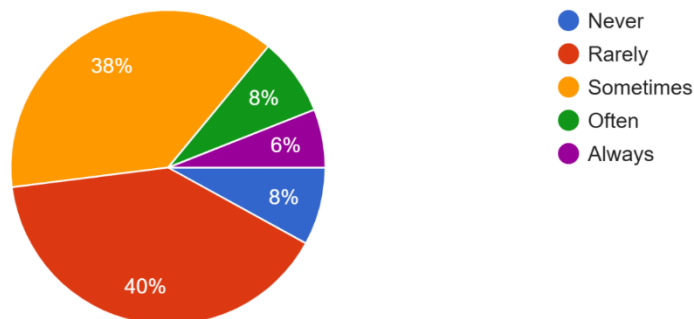

Figure 16: Trainings on Digital Pedagogy
Source: Field Survey, 2024

Participation in Online Teaching Communities:

Similarly in Figure 17, participation in online teaching communities is sometimes practiced by 38% and often by 18%.
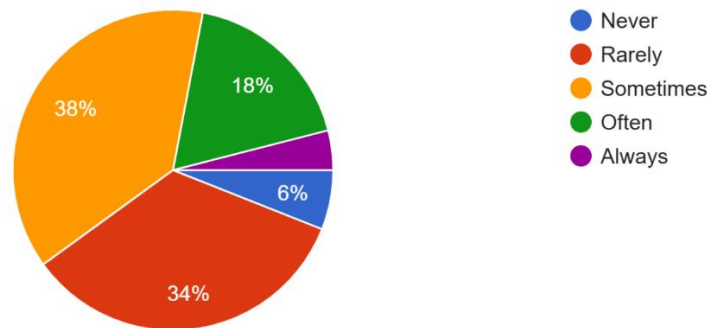
Figure 17: Participation in Online Teaching Communities
Source: Field Survey, 2024

Experimentation with New Educational Technologies:
Experimentation with new educational technologies in Figure 18 shows that it is more frequent, with 46% sometimes engaging and 24% often experimenting. Collaboration on digital projects and seeking student feedback are somewhat less common, with only small percentages doing so often or always. These findings indicate growing but uneven adoption of innovative teaching strategies in higher education.
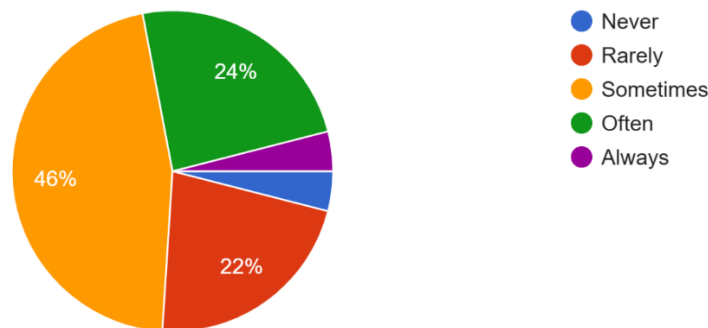

Figure 18: Experimentation with new Educational Technologies
Source: Field Survey, 2024

DISCUSSION OF FINDINGS
The discussions were organised under the following main headlines;

Digital Infrastructure and Access
The findings reveal that while digital infrastructure in Ghanaian universities is gradually improving, significant gaps still remain in ensuring accessibility and inclusivity for all educators.

Digital Competencies
The self-assessment results underscore the variability in digital competencies among university teachers. While many educators are experimenting with new technologies—46% of respondents reported doing so sometimes, and 24% often—there is a noticeable gap in collaborative and community-oriented digital activities. For instance, 40% rarely attend workshops on digital pedagogy, and 34% rarely participate in online teaching communities, limiting opportunities for shared learning and innovation. Additionally, seeking student feedback on digital teaching methods is infrequent, with only 18% of respondents doing so often or always. These patterns suggest that while individual exploration of digital tools is

moderately common, systemic efforts to foster collaboration, feedback, and professional growth remain underdeveloped.

Technology Integration and Innovative Approaches

The examples of innovative teaching approaches in this research highlight a shift toward more technology-driven pedagogy. Educators have embraced diverse tools. However, the data also reveal that the frequency of professional development activities related to digital technologies remains low. For instance, only 8% of respondents attend workshops on digital pedagogy often, and a mere 6% always do so. This low engagement indicates a need for structured initiatives to inspire more educators to explore and implement innovative methods. Despite these challenges, the willingness of a significant proportion of educators to experiment with digital technologies signals a readiness for change, provided institutional and policy support are strengthened.

CONCLUSION

The findings provide a comprehensive understanding of the current state of digital infrastructure, digital competencies, and innovative technology-driven teaching practices in Ghanaian universities. The results revealed that teachers' educators demonstrated moderate to significant confidence in their skills, a mixed but promising landscape regarding digital infrastructure and access. While a significant proportion of respondents acknowledged the availability of some digital tools, challenges remain, particularly in terms of equitable access, reliable connectivity. These limitations underscore the need for enhanced investment in digital infrastructure to support effective teaching and learning.

POLICY RECOMMENDATIONS

To address the challenges related to access and reliability of digital tools, universities and the government must prioritize investments in digital infrastructure. Policies should aim to expand and upgrade campus-wide internet connectivity, ensuring stable and high-speed access. Lecture halls should be equipped with modern teaching technologies such as smartboards, projectors, and multimedia systems. Furthermore, institutions should establish resource centers where educators can access advanced digital tools and technologies to enhance their teaching and research. Reliable electricity supply and alternative power sources such as solar energy should also be integrated to ensure uninterrupted digital teaching and learning.

Institutions should implement regular and compulsory training programs for university teachers to build their digital competencies. These programs should cover essential skills such as online course design, digital assessment techniques, and the use of multimedia content creation tools.The government, in collaboration with universities, should implement programs to subsidize digital tools such as laptops, tablets, and software licenses for teachers and students. Access to affordable data packages or institutional Wi-Fi should also be prioritized to facilitate seamless digital engagement. Furthermore, funding for research into digital pedagogy and the development of innovative teaching methods should be made available to encourage academic exploration in this area.

Creating a culture of collaboration among educators is vital for fostering digital innovation. Universities should establish teaching and learning centers or digital teaching communities where faculty can share experiences, best practices, and resources. Mentorship programs

should be introduced, pairing experienced digital educators with those who are less familiar with technology. These collaborative efforts can accelerate the adoption of digital tools and create a supportive environment for teachers navigating the transition to digital education.

Finally, institutions should establish systems for continuous monitoring and evaluation of digital technology usage in teaching and learning. Regular feedback from teachers and students should inform adjustments to training programs, infrastructure improvements, and policy updates.

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