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Enhancing pedagogical strategies through technology integration in basic teacher education program

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ABSTRACT

This study investigated enhancing pedagogical strategies through technology integration in basic teacher education programs. It sheds light on its significant influence on both educational management and instructional approaches. The investigation centred on experiences within Ghana's College of Education (CoE), contributing insights that align with the objectives of Sustainable Development Goal 4. A mixed-method approach was employed, integrating both quantitative and qualitative methods. The participants of the study consisted of 485 participants (469 tutors and 16 principals) selected from sixteen colleges by using cluster and simple random sampling techniques. Quantitative data were gathered by employing a structured questionnaire, while qualitative data were acquired through semi-structured interviews. The quantitative data underwent analysis using both descriptive and inferential statistics, while the qualitative data were subjected to an inductive analysis approach. The results revealed the noteworthy influence of age, gender, higher qualifications, and professional experience of principals and instructors on technology integration in education. Furthermore, key indicators such as smartphone usage and Microsoft Office 365 tools were found to be insufficient for facilitating technology integration. This inadequacy was attributed to managerial challenges like infrastructural limitations and resistance to change. It was recommended that the Ministry of Education should institute regular in-service training initiatives on technology integration. This step will empower the staff at CoE with the requisite knowledge and competencies to proficiently infuse technology in their roles.

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Introduction

Technology has emerged as a dynamic tool which can be used to change traditional teaching methods and transform the overall educational system. Integrating technology into teaching and learning has sparked a new era of learning characterized by profound transformations (Nkomo et al., 2021). This is because, with the advent of digital tools, online platforms, artificial intelligence, virtual reality, and interactive applications, the dynamics of information acquisition, dissemination, and assimilation in educational settings have been fundamentally reshaped. In the field of teacher education, for instance, the integration of technology stands as a leading tool for transforming learning

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experiences. The preparation of educators, armed with the requisite skills and knowledge to adeptly navigate modern classrooms, holds paramount importance. Teacher education programs must evolve to mirror the evolving demands of education, embracing innovative approaches that integrate technology into pedagogical practices.

In Ghana, the College of Education (CoE) plays a crucial role in the preparation of effective teachers for basic education, aiming to uphold the standard of education excellence in this modern digital age. This aligned with the Sustainable Development Goals (SDGs) outlined by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development. SDG Goal 4 aims to ensure inclusive and equitable quality education that contributes to personal and societal development, fosters lifelong learning, and supports the advancement of sustainable societies (United Nations, 2015). Recognizing the significance of SDG Goal 4, integrating technology into education is a critical aspect that cannot be overstated. This integration holds immense potential for achieving the goal, given its relevance in revolutionizing teaching methods, faculty recruitment, student admissions, classroom dynamics, financial oversight, and the management of libraries and laboratories (Forkosh-Baruch & Avidov-Ungar, 2019; Wine, 2016). Based on these roles, the Ministry of Education (MoE) (2015) has highlighted the need to use technology to foster critical thinking, collaboration, and adept communication and all essential skills for addressing the challenges of the 21st century.

To ensure the CoE curriculum aligns effectively with modern society's needs, efforts have been made by successive governments to equip both principals and instructors at the CoE with a strong grasp of technology, leveraging its potential to optimize performance and efficiency. Such proactive steps include implementing various initiatives, programs, and seminars aimed at upskilling CoE principals and instructors. These efforts are geared towards equipping them with the necessary technological knowledge. Moreover, in collaboration with Transforming Teacher Education and Learning (T-TEL), the National Council for Tertiary Education (NCTE) in Ghana has introduced an advanced Education Management Information System (EMIS) tailored specifically for CoEs. This sophisticated system is meticulously designed to bolster strategic planning, monitoring, evaluation, policy formulation, and decision-making processes within CoEs (NCTE, 2017). T-TEL, in addition to EMIS, has been instrumental in providing technological support, including cost-effective local intranet capabilities and trial-based e-learning resources to CoE colleges. These initiatives collectively serve to modernize and enhance the educational landscape for the betterment of CoEs and the education sector in Ghana.

Despite the efforts made by the governments of Ghana and other stakeholders to promote technology integration in teacher education, a study conducted by Osei & Konadu (2020) found that Ghana is inefficient in its allocation of education resources to attain SDG 4. This suggests that teacher education institutions in Ghana might be facing challenges in this regard. Yalley (2022) underscores the pressing need to address institutional challenges affecting technology integration. These deficiencies in institutions must be promptly attended to enhance the overall functioning of teacher education in the country. The Ministry of Education's statement emphasizes that the successful integration of technology into the education system requires a strong and unwavering commitment from principals and tutors (Ministry of Education, 2015). Given the reality of the problem, it becomes imperative to promote technology integration in teacher education. Hindrances impeding technology's adoption and implementation must be actively discouraged. This would require a coordinated effort from the research community to find out the challenges and propose strategies to enhance technology integration (Harold, 2012). It is against this background that this study seeks to investigate the dimensions of technology integration in management and teaching in teacher education. The research seeks to provide valuable insights that can inform improvements and innovations in technology integration within education settings.

The objectives of the study are as follows: (1) to determine the effects of gender, higher qualification, age, and work experience of principals and tutors on technology integration, (2) to examine the level at which tutors integrate technology in teaching, and (3) to find out challenges militating against technology integration in education management.

Literature review

Technology integration within teacher education entails leveraging computer hardware, software, and other relevant technological tools to enhance instructional practices and attain specific educational objectives (Nelson et al., 2019). This modern and forward-thinking approach to teaching and learning offers educational institutions the potential to optimize their time and resources. Younis (2016) emphasizes that integrating technology into education establishes vital links between management functions and both local and global computer networks, ultimately resulting in improved outcomes. This interconnected system streamlines day-to-day activities, organization, mentorship, supervision, and information sharing (Johannes et al., 2022), underscoring the significant impact of technological adoption on enhancing performance. Turner and Weickgenannt (2013) suggest that technology in education enables institutions to share external information and actively engage with information and communication technology as vital components of administrative processes. Moreover, a study by Nkomo et al. (2021) characterizes technology-based management as a dynamic and strategic approach, involving the operation of technology-driven systems that emphasize integration and utilize artificial intelligence to drive educational advancements.

While acknowledging the pivotal role of technology in teacher education, Agyei (2014) brings to light certain drawbacks, such as the substantial financial investments required by governments to integrate ICT into education. These investments could inadvertently impede the pace of educational evolution, especially in a developing country like Ghana. This is because Mpuangnan et al. (2021) find limited evidence of computers enhancing teaching practices. Ewa et al. (2022) further underline that deficiencies in technology knowledge and skills among teacher educators during teacher preparation hinder effective integration. On the contrary, there are positive attitudes toward ICT integration in the CoE curriculum (Ewa et al., 2022) as educators' favourable perspectives have facilitated effective technology use in the classroom. The extent to which technology is embraced in education depends on computer availability within institutions (Kelemnesh, 2020). The frequency of utilization often corresponds to the number of accessible computers. Resources, which should be readily accessible within institutions (MoE, 2015), are sometimes unequally distributed, causing certain institutions to lag due to resource disparities (Suárez-Rodríguez, 2018). In regions like Ghana, resource providers such as the MoE and donor partners face limitations (NCTE, 2017), potentially hindering equitable access to technology. However, even with access, the capability to effectively employ these resources is not assured for teachers (Alanezi, 2016). Successful and judicious technology utilization necessitates the support of school principals (Hopkins, 2002). Principals play vital roles in encompassing facility maintenance, technology implementation, staff development, classroom teacher evaluation, budgeting, and ensuring a safe learning environment for all students (Banoğlu, et al., 2023).

The potential of technology integration in the teaching and learning process hinges on the proactive efforts of educational stakeholders, including management, teachers, and students. However, obstacles outlined by various researchers underscore the complex nature of this endeavour. Bećirović (2023) highlights that despite some educators' technological familiarity, reluctance to incorporate it into instruction can stem from challenges. Bingimlas (2009) identifies key challenges such as lack of confidence, competence, and access to resources among teachers. Moreover, NCTE (2017) reveals that

college staff in leadership roles often lack the necessary ICT skills and confidence, hindering effective implementation.

The absence of visionary leadership becomes evident when technology management is lacking, as Agyei (2014) suggests, raising concerns about government ICT education plans. Ellatif and Abdulmutalib (2013) emphasize that insufficient leadership in ICT is a major administrative hurdle. Madawi (2015) points out a scarcity of qualified personnel for new electronic management systems. This could persist as a challenge in institutions of higher learning. Other challenges identified by scholars like Alanezi (2019), NCTE (2017), and Mumtaz (2000) include limited resources, inadequate infrastructure, and resistance to change, posing significant barriers. Financial resources, vital for any institution's survival (Mahajan et al., 2016), are interconnected with technology use. Moreover, a lack of proper training for administrators in technology further complicates educational management (Alradhi, 2015), leading to trainers being ill-equipped to convey necessary knowledge. Given these complexities, the Ministry of Education (MoE, 2015) suggests measures like ICT integration, computer labs, internet access, and laptops for teachers and students. Agyei (2014) asserts that these facilities are effective if users possess adequate skills, warranting policy guidelines for proper usage (NCTE, 2017). Concurrently, training and retraining of educators (Fedorov et al., 2019) are essential to foster comfort with change. Acceptance of change, as noted by Scholkmann (2021) and Alhezzani (2021), fosters technology use in education. Notably, institutions resistant to change limit teachers' ability to manage technological innovations Hamlaoui (2021), prompting scrutiny of how the management of the CoE embraces technological shifts.

In conclusion, the preceding studies underscore enhancing pedagogical strategies through technology integration. Nevertheless, the rapid advancement of technology presents a formidable obstacle for teacher education institutions that struggle to align with evolving societal demands, primarily due to limited resources. As a result, these institutions, along with their management, instructors, and student-teachers, confront substantial challenges. Such challenges can be summarized as follows: (1) limited technology infrastructure, (2) limited experts and training in technology use in educational management, (3) resistant to change, (4) lack of funds to acquire needed resources and training of staff, and (5) lack of policy statement to regulate technology use in education.

Method

In this study, a mixed-method approach was employed, integrating both quantitative and qualitative methods. This research approach was chosen to capitalize on the unique advantages of each approach, facilitating a more thorough and multifaceted exploration of the research inquiry. As noted by Gay et al. (2012), mixed methods research proves especially valuable when confronted with inquiries that cannot be satisfactorily addressed using solely quantitative or qualitative methods. It allows researchers to triangulate findings, validate results, and provide a more complete picture of the phenomena under investigation (Creswell, 2003).

The population of this study consisted of principals, tutors, and student teachers of forty-six public CoEs located in all sixteen administrative regions of Ghana. However, the target population consisted of principals and tutors of sixteen CoEs selected from each of the sixteen administrative regions. To ensure an unbiased sampling process, a combination of clustered sampling and simple random techniques was utilized when selecting colleges and tutors. This method led to the automatic inclusion of principals in the sample. About 50 per cent of tutors were chosen from each college (30 each) and when combined with the 16 principals, this approach resulted in a total sample size of 496 (30×16+16=496).

Quantitative data were collected through questionnaires, while qualitative data were collected through methods like semi-structured interviews. The questionnaire made

up of five points Likert scale was designed for tutors to collect data about their demographical characteristics (age, gender, higher qualification & work experience in years), and the extent to which technology is integrated into teaching. While collecting qualitative data from the principals, interview questions were framed covering their demographic characteristics, challenges militating against technology integration in educational management and the way forward. The tools were further given to three experts in teacher education for validation. The experts were requested to judge the contents, grammar and language clarity of the questions and provide suggestions. The tool was therefore modified as per the suggestions given by the experts and was used to collect the data.

To administer the tools, the researcher obtained authorization from the college principals. Following the granted approval, a total of 496 questionnaires were disseminated among the participants. Subsequently, 485 questionnaires were collected within a span of three to five days, as 11 participants chose not to participate as they did not complete the questionnaire. The researcher further arranged a convenient meeting date with the principals for the interview. During each 40-minute session, the participants were allowed to familiarize themselves with the interview questions. Before the interview, the researcher obtained consent from each participant and recorded their responses, which were later transcribed into a notebook. Out of ethical concerns, the participants' names were not collected. Additionally, the participants were reassured that the collected data would solely serve research purposes and be treated with the utmost confidentiality. The successful outcome of the interview can be attributed to the rapport and trust established between the participants and the researcher.

Descriptive statistics, such as frequencies, percentages, Mean, and Standard Deviation. To further find out the relationships between groups, inferential statistics were applied. Specifically, Scheffe's post-hoc Test was executed to pinpoint significant differences among the groups with the p-value being significant at 0.05. Also, to analyse the qualitative data, the steps involved in the inductive analysis approach as cited in Mpuangnan et al (2022), Boru (2018), and (Yıldırım & Simşek (2006) were followed. This rigorous approach allowed for a robust exploration of the study and enhanced the reliability of the findings. Such steps are presented as follows:

(1) *Data Coding:* The collected data were categorized into broad sections. The sections could either be words, sentences, paragraphs, or pages conveying conceptual understanding and encoding.
(2) *Determination of themes:* The codes generated were categorized with each of the categories of code bundles is a focus to encode as a theme. And each of the themes focuses on a general case.
(3) *Organizing and describing data as per codes and themes*: the various categories of the generated themes and codes were presented and described understandably.
(4) *Interpretation of findings:* the category of themes and codes, which are presented in a particular manner were discussed, interpreted, and some conclusions by the researcher.

Results

Demographical data

The demographical data of the participants is shown in Table 1. The given data present an analysis of demographics based on four variables: Gender, Age, Qualification, and Work Experience. The data reveals that the gender distribution in the studied population favours males (57.3%) over females (42.7%). The age distribution is prominently centred around the 46-50 age group, encompassing the largest portion of individuals (23.1%). In terms of education, most of the population held a master's degree

(98.5%), while only a small fraction possessed a Doctorate (1.4%). Additionally, the data depicts a diverse spread of work experience, with the most prevalent range being 5-10 years (24.1%).

Table 1. Demographical data of participants

Category	Group	Frequency	Percentage
Gender	Male	278	57.3
	Female	207	42.7
	Total	**485**	**100**
Age	35-40	93	19.1
	41-45	107	22.1
	46-50	112	23.1
	51-55	97	20
	56-60	76	15.6
	Total	**485**	**100**
	Doctorate	7	1.4
Qualification	Masters	478	98.5
	Bachelor	-	-
	Total	**485**	**100**
Work experience in years	Below 5years	89	18.4
	5-10 years	117	24.1
	11-15	81	16.7
	16-20	103	21.2
	Above 20 years	95	19.6
	Total	**485**	**100**

Effect of gender on technology integration

Table 2 shows the effect of gender on technology integration in education management and teaching. It can be observed that males, with a mean score of 2.47 and a standard deviation of 0.53, exhibit a relatively higher level of technology integration compared to females, who have a mean score of 2.13 and a standard deviation of 0.41. The analysis reveals that gender has an apparent impact on technology integration among the surveyed individuals.

Table 2. Effect of gender on technology integration

Gender	N	Mean	Std. Deviation
Male	278	2.47	0.53
Female	207	2.13	0.41

Effect of age on technology integration

Table 3 presents data about the effects of age on technology integration. The data sheds light on how different age brackets embrace and assimilate technology, as depicted by their mean scores and standard deviations. Within these age groups, individuals aged 51-55 showed the highest mean score (2.38), signifying a more robust inclination towards integrating technology. Following closely is the 41-50 age group (2.27). Meanwhile, the 35-40 and 56-60 age brackets demonstrate marginally lower mean scores (2.13 and 2.09 respectively), indicating a somewhat less pronounced yet still noteworthy level of technology integration. The standard deviations, ranging from 0.52 to 0.55, suggest relatively consistent responses within each age cohort. This implies that the observed

disparities in mean scores genuinely reflect varying attitudes towards technology integration among these age groups.

Table 3. Effect of age on technology integration

Age	N	Mean	Std. Deviation
35-40	93	2.13	0.55
41-50	107	2.27	0.53
51-55	112	2.38	0.52
56-60	76	2.09	0.54

Post hoc analysis (Scheffe's Analysis) of significant differences of age in technology integration

Table 4 presents the Post hoc analysis of Significant Differences in age in technology integration. This post hoc analysis examines notable differences in the integration of technology based on different age categories. It provides the mean variations, standard errors, and levels of significance for various age-based comparisons. Specifically, individuals between the ages of 51 and 55 display a significant reduction in technology integration when compared to those aged 35 to 40 (with a mean difference of -0.25, and a significance level of p = 0.004) as well as those aged 41 to 50 (with a mean difference of -0.11, and a significance level of p = 0.133). Conversely, individuals aged 56 to 60 exhibit a noteworthy increase in technology integration in contrast to the 51-55 age group (with a mean difference of 0.29, and a significance level of p = 0.021). Furthermore, the 56-60 age range demonstrates a substantial decrease in technology integration in comparison to the 35-40 age group (with a mean difference of -0.04, and a significance level of p = 0.002). These findings indicate variations in the adoption of technology across diverse age ranges, highlighting significant distinctions primarily between the 51-55 age category and both the 35-40 and 41-50 age groups.

Table 4. Post hoc analysis of significant differences of age in technology integration

Age Ranges (A)	Age Ranges (B)	Mean Difference (A-B)	Std Error	Sig.
35-40	41-50	-.14	.43157	.217
	51-55	-.25	.13002	.004
	56-60	.04	.12201	.002
41-50	35-40	.14	.43157	.217
	51-55	-.11	.21643	.133
	56-60	.18	.11472	.019
	35-40	.25	.13002	.004
51-55	41-50	.11	.21643	.133
	56-60	.29	.17014	.021
56-60	35-40	-.04	.12201	.002
	41-50	-.18	.11472	.019
	51-55	-.29	.17014	.021

Effect of work experience on technology integration

Table 5 shows the extent to which work experience in years affects technology integration in education management and teaching. Among the groups, 89 participants with less than 5 years of experience display an average satisfaction score (Mean) of 2.28, accompanied by a moderate degree of variability (Std. Deviation = 0.38). Comparatively,

117 individuals with 5-10 years of experience show a slightly higher average satisfaction score of 2.43, with somewhat increased variability (Std. Deviation = 0.51). In the 11-15 years of experience category, 81 individuals exhibit the highest average satisfaction score of 2.57, along with a moderate level of variability (Std. Deviation = 0.53). Participants with 16-20 years of experience, numbering 103, demonstrate an average satisfaction score of 2.39, accompanied by a moderate level of variability (Std. Deviation = 0.47). Lastly, 95 individuals with over 20 years of experience have an average satisfaction score of 2.34, with a moderate degree of variability (Std. Deviation = 0.45). The data indicates that as work experience increases, there is a general trend of higher average satisfaction scores, which implies a higher level of technology integration satisfaction. However, the relationship is not strictly linear, as evidenced by Group 3 having the highest average score despite not having the longest work experience.

Table 5. Effect of work experience on technology integration

Work experience in years	**N**	**Mean**	**Std. Deviation**
Below 5years	89	2.28	0.38
5-10 years	117	2.43	0.51
11-15	81	2.57	0.53
16-20	103	2.39	0.47
Above 20 years	95	2.34	0.45

Post hoc analysis (Scheffe's Analysis) of significant differences in work experience on technology integration

Table 6 presents a Post hoc analysis of Significant Differences in work experience on technology integration. Each year group signifies the mean work experience disparity between the two groups, accompanied by the standard error and the level of significance (Sig.). For example, individuals with work experience in years above 20 years, generally exhibit more experience with significance levels of .000, and .001 compared to those with below 5, and 5-10. This underlines the vital role of disparities in average work experience between principals and tutors in shaping their respective levels of technology integration.

Table 6. Post hoc analysis of significant differences in work experience on technology integration

Work experience in years (A)	**Work experience in years (B)**	**Mean Difference (A-B)**	**Std Error**	**Sig.**
Below 5years	5-10	-.15	.13177	.261
	11-15	-.29	.21013	.173
	16-20	-.11	.11205	.025
	Above 20 years	-.06	.13101	.018
5-10	Below 5years	.15	.11003	.017
	11-15	-.14	.10411	.006
	16-20	.04	.10317	.005
	Above 20 years	.09	.01641	.005
11-15	Below 5years	.29	.21013	.173
	5-10	.14	.12201	.006
	16-20	.18	.11472	.003
	Above 20 years	.23	.11343	.001
16-20	Below 5years	.11	.13002	.025
	5-10	-.04	.10317	.005
	11-15	-.18	.43157	.003

Work experience in years (A)	Work experience in years (B)	Mean Difference (A-B)	Std Error	Sig.
Above 20 years	Above 20 years	.05	.11014	.000
	Below 5years	.06	.11472	.018
	5-10	-.09	.10317	.005
	11-15	-.23	.11343	.001
	16-20	-.05	.11014	.000

The level at which tutors integrate technology into teaching

Table 7 illustrates the degree to which technology integration takes place in teaching among CoE tutors in Ghana. The data highlights that tutors commonly employ smartphones for communicating vital information to students via WhatsApp, indicated by the highest mean score (2.71) and a significant level of .003. Microsoft Office 365 tools, including Word, PowerPoint, and Excel, also play a significant role with a mean score of 2.67 and a significance level of .004. Additionally, platforms facilitating collaborative document editing, such as Microsoft Word Online and Overleaf, are moderately utilized, as reflected by a mean score of 2.41 and a significance level of .005. However, various other aspects were less prevalent among tutors. For instance, tutors exhibited inadequate familiarity with programming and coding, as evidenced by the lowest mean score (2.01) and a significance level of .023. The availability of Smart Boards within institutions lagged, as indicated by a lower mean score (2.03) and a significance level of .024. Similarly, the utilization of design tools like AutoCAD and Tinkercad was relatively infrequent, with the lowest mean score (2.1) and a significance level of .003. Notetaking and organizational tools such as Evernote and OneNote posed challenges for tutors, as evidenced by a mean score of 2.07 and a significance level of .021. Moreover, the irregular use of Online Assessment and Quizzing platforms like Quizlet and Socrative was observed, with a mean score of 2.09 and a significance level of .028.

Table 7. The level of technology integration technology in teaching

Sr No.	Item	Mean	Std D.	Sig.
1	Tutors demonstrate enthusiasm for technology integration	2.07	.21402	.013
2	Tutors use smartphones to communicate vital information to students on WhatsApp	2.71	.28107	.003
3	Tutors engage students in pre-lesson tutorials to teach essential technology skills required for the lesson	2.01	.01019	.026
4	Regular in-service training on technology integration is available for tutors	2.13	.12010	.009
5	Institution's laptop computers are available for tutors	2.19	.02741	.007
6	Accessible internet facilities for tutors	2.87	.32011	.002
7	Institutions have Smart Boards	2.03	.13221	.024
8	Tutors use video and multimedia tools like YouTube	2.17	.12412	.016
9	Tutors use notetaking and organization e.g., Evernote & OneNote	2.07	.21411	.021
10	Tutors use collaborative document editing e.g., Microsoft Word Online & Overleaf	2.41	.12104	.005

Sr No.	Item	Mean	Std D.	Sig.
11	Learning analytics and data tools e.g., Turnitin, Urkundi & iThenticate for plagiarism	2.39	.13311	.007
12	E-book and digital resource platforms like VitalSource RedShelf, & JSTOR	2.11	.03132	.011
13	Microsoft Office 365 (Word, PowerPoint, Excel)	2.67	.10211	.004
14	Google Workspace (Google Docs, Google Slides, Google Sheets)	2.21	.12420	.008
15	Data analysis and visualization using Excel	2.52	.10413	.004
16	Printing and design using AutoCAD & Tinkercad	2.07	.21217	.021
17	Academic social networks and research using ResearchGate, Academia.edu & Mendeley	2.13	.13114	.019
18	Learning Management Systems e.g., Moodle, & Canvas	2.15	.13311	.007
19	Online Assessment and Quizzing e.g., Quizlet & Socrative	2.09	.12811	.028
20	Online collaboration and communication through Microsoft Teams, Zoom, & Google Meet	2.63	.20415	.004
21	Familiar with programming and coding	2.01	.12150	.023

Challenges militating against technology integration in educational management

To identify the challenges militating against the integration of technology in educational management, qualitative data were collected from a diverse group of sixteen principals, each representing a distinct College of Education (CoE) within the sixteen regions of Ghana. While facilitating analysis, unique codes were assigned to each of the participating principals. These codes were utilized to identify specific recurring themes that emerged from the data. The assigned codes for the principals are as follows: P1 (Principal 1), P2 (Principal 2), P3 (Principal 3), P4 (Principal 4), P5 (Principal 5), P6 (Principal 6), P7 (Principal 7), P8 (Principal 8), P9 (Principal 9), P10 (Principal 10), P11 (Principal 11), P12 (Principal 12), P13 (Principal 13), P14 (Principal 14), P15 (Principal 15), and P16 (Principal 16). The qualitative data generated three broad themes and nine sub-themes as presented as follows: (1) Technology infrastructure (Unequipped computer laboratory, Inadequate ICT tools, Lack of maintenance culture, Unstable power supply), (2) Technical know-how (Limited knowledge of the use of technology for management purposes, Lack of in-service training on technology use, Technology policy), (3) Financial issues (Irregular financial flow for payment of bills, Lack of funds for repairs and maintenance of ICT tools, Inadequate financial support or aid from donor partners).

The details of the qualitative analysis are presented below as per the emerging themes.

Technology infrastructure

The sub-themes used to determine this theme (Technology infrastructure) include an unequipped computer laboratory, inadequate ICT tools, a lack of maintenance culture, and an unstable power supply. The participants made direct statements as found in the following paragraphs in addressing the theme. The details of the codes are presented as follows.

Unequipped computer laboratory: P3 said *we have an almost empty computer laboratory. Many computers and furniture are broken down. Since we cannot rely on this computer laboratory for management support, it, therefore, becomes a challenge to use technology for managing our everyday affairs. We will appreciate it if the government or*

any Non-Governmental Organisation (NGO) can furnish it for us. According to P6, *fire guts our computer laboratory and destroyed almost everything. That was our technology centre. Since the laboratory got burnt, we have not been able to operate so much with technology. We have been taking ICT support from individuals which is not enough as per our numbers. We are making efforts to rebuild it but due to financial problems, the pace is slow.* P9 opined that *we don't have a computer laboratory to support this idea of using technology in management. We have been relying on private businessmen for ICT support. Since a computer laboratory is needed to house most of the technology tools, the absence of it poses a major challenge. We have made plans to build one but the support from the government is not encouraging.* P10 added that *our computer laboratory is not spacious enough to accommodate many students. Due to a large class side, there is too much pressure on the computer laboratory. For this reason, we cannot rely on it for management assistance.* P13 revealed that *a heavy storm had ripped off and destroyed most of the ICT tools in our computer laboratory. We have reported to the necessary authorities and hoping to get it restored. Since then, we have been managing this college without using technology. Before, the incident, the laboratory was supportive of management.* P15 expressed that, *we don't have a computer laboratory except for a few computers in the typing pool. Maybe, because our college is newly established. The computer tutors have been using their personal computers. We hope the government will remember this college in the next budgetary allocation.*

Inadequate ICT tools: P1 said *I have a personal computer and accessories provided by the college for management purposes. However, most of the tutors and members of my management team don't have computers and accessories in their offices. Therefore, it is difficult to employ the idea of using technology in management since it is teamwork.* P3 revealed that *computers in this college are not enough. Also, the internet connection here is not reliable. We have a wired LAN network which is not working due to unreliable internet connectivity. Therefore, we have limited the internet connectivity to only the administrative areas. This is not motivating technology in management.* P4 responded that *our ICT tools like computers, printers, projectors, and routers are limited, weak and outdated. Even the computer in my office is not working properly. Only a few desktop computers in the computer laboratory are in good working condition. We are calling on donors to do us a favour in this regard*. P8 said *my college has only one projector, one audio speaker and one interactive Whiteboard which are kept in the computer laboratory for use. Also, most of the computers including the one in my office are not working. All the tutors and students depend on this limited technology when the need arises. Therefore, it is a challenge for me to manage this institution by using technology.* P10 asserted that *we have over one hundred thousand students and about one hundred teaching and non-teaching staff. But the working computers in the computer laboratory are less than fifty. Also, networks, both MTN and Vodafone, are poor and their internet is not reliable. All these factors affect effective management in this college.*

Lack of maintenance culture: P4 opined that *some of our ICT tools like computers, printers, and projectors have spoilt and are out of use because we don't regularly service them. This can be attributed to scarce and expensive spare parts.* P7 added *the major service providers here like MTN and Vodafone don't carry out regular maintenance works especially in low catchment areas to facilitate internet accessibility. Perhaps, they need to decentralize the service for the sake of proximity.* P9 revealed that *sometimes, we can also be partly blamed for the non-functioning of some ICT tools. For instance, we don't clean and maintain our computers and accessories thoroughly. And when they are eaten up by the dust, they stop working. This is the case with most of our computers in the laboratory.* P14 revealed that *we are reluctant to repair the broken computers and other tools like printers and routers because of pressure on them. When we repair them, they will still spoil and incur more debt for the college. This is because the number of users is more than the tools.*

Unstable power supply: P2 said *our main power source is from the Electric Company of Ghana (ECG) and Volta River Authority (VRA). Therefore, an* electricity

supply is not reliable in this college. Lights go out frequently unannounced. Since technology goes with a constant flow of electricity, we are therefore disadvantaged here. P5 opined that *we have been experiencing irregular electrical power supply in this college. The power can go out promptly thereby interrupting activities and spoiling computers. For this reason, we have not been enjoying technology here to the fullest.* P11 revealed that *our lightning is so poor that it goes on and off almost every day. This eventually spoils our ICT gadgets and renders most of them useless. This is not motivating to rely on technology for management in this college.* P12 said that *electricity is a major challenge in this college. We don't have a regular flow of electrical energy. Thus, we use the tools whenever the power is on. Since we cannot use the power supply, we cannot afford to risk our gadgets.* P16 revealed that *the electricity supply goes off and comes on at any time. This practice has spoilt most of our ICT tools. Also, the electrical company has been billing the college so exorbitantly that we cannot afford to pay. These have affected the rate at which we use technology in our management practices.*

Technical know-how

The sub-themes that were used to report this theme (technical know-how) include Limited knowledge of the use of technology for management purposes, Lack of in-service training on technology use, Lack of confidence to try new things and Technology Policy.

Limited knowledge of the use of technology for management purposes: P3 revealed that *I have a personal computer in my office and can use it for basic tasks like receiving and sending emails. I cannot use it to perform complex management tasks. I require more in-service training to be able to use it judiciously.* P7 opined *that I have attended a couple of computer workshops as a principal of this college yet, I cannot use technology to perform some complex management tasks. I still have more room for improvement.* P9 said my *ICT tutors have been assisting me to use my computer. They help in the installation of programs and work on office automation. Without their help, it will be difficult for me to use a computer. This should suggest to you that some principals of my age need help to use technology in educational management.* P13 revealed that *I have two laptop computers, one for my office work and another for my house. However, my knowledge of ICT is not in-depth. Most of the time, I rely on computer experts to get some work done. This means, I still require training on specific ICT skills needed for educational management.* P16 said *I have some knowledge about ICT which may not be sufficient to deal with complex issues relating to technology. I suggest workshops and in-service training in this regard can help.*

Lack of in-service training on technology use: P1 opined that *I have been participating in workshops for professional development. However specific workshops on the use of technology in educational management need to be relooked at. I have not gotten enough of it. Perhaps, this is a reason why I am not conversant with some of the management programs on my personal computer.* P7 said *I do attend seminars and workshops on educational management. While such workshops are not regular, many others are technology-focused. Because of insufficient training in technology, I don't have the confidence to try new things related to technology. Since new ideas keep popping up every day, it is prudence that principals undertake in-service training courses on technology to address management challenges.* P8 asserted that *regular in-service training on technology use is essential for principals. This is because we need to update our knowledge and skills to meet the needs of society. It has been over a year now since I attended a workshop of this nature.* P10 said *training on technology use has not been regularly organised for the principals. I have been relying on my computer teachers for assistance. Since they are not experts in educational management, there are many things they cannot help me with. I am suggesting that mandatory workshops or seminars should be organized for us at least twice every year.* P11

said *we have started a B.Ed. curriculum, but I never thought it would be operated this far without adequate training on the use of technology to manage it. Since the world is going digital, I am envisaging more training programmes on technology.* P15 opined that *my staff and I, have not had enough training on technology. And looking at the management tasks in my college, it will be appropriate for my management team and I, to undertake regular in-service training on technology to adjust to this modern era of technology.*

Technology policy: P2 asserted that *I know for a fact that ICT policy at the college level is mandatory. We have an institutional policy here to regulate the operations of ICT. As far as management is concerned, that policy has not achieved enough. Maybe, the challenges are beyond the policy. Therefore, we need an external policy on technology to support our local policy.* P5 said *I am aware of ICT policy, particularly on system maintenance. This policy seems not effective as many of our computers are out of use. I believe this policy can be revamped.* P7 revealed that *I have managed to formulate a policy to protect my ICT centre. We have bought antivirus software to protect our computers. Also, we ensure that passwords are placed on some sensitive data like examination results and certificates. If we had the financial means, we would have gone further to purchase some powerful firewalls to protect our data.* P9 said *I don't think we have a documented policy at the college level. Also, I don't remember any national policy regulating technology use in the colleges. However, we have made some policies to regulate and protect our computers in the college. For instance, we have a password policy whereby each staff member and each student has a secret password to the internet. Moreover, we have data recovery plans guiding users to make backups every day. Since this is a government institution, a general national ICT policy is critical.* P11 opined that *we have an institutional ICT policy that has been helping us to protect our ICT tools. Some of the policies include internet passwords, and permission to use computers and accessories. However, some users flout the policies and get punished. This means, the policies are not powerful enough and must be looked at.*

Financial issues

Financial issues are the third theme that emerged from this study. The sub-themes that were used to determine this theme include irregular financial flow for payment of bills, insufficient funds for repairs and maintenance of ICT tools, and inadequate financial support or aid from donor partners.

Irregular financial flow for payment of bills: in addressing this code, P4 said *the management of this college does not have a regular income that can pay for electricity bills that will be incurred because of using technology. You and I know that computers, printers, air conditioners, and many other ICT tools, consume a lot of electrical currents and can generate high bills for the college to pay. Since we don't have a means of payment for such high bills, we have decided to suspend operations of certain tools like 24/7 internet connectivity, and heavy printers and air conditioners in offices. The government needs to investigate this issue.* P6 asserted that *this college's main source of Internal Generated Funds (IGF) for paying utilities is fees from the student teachers. However, the student teachers don't pay their bills on time as most of them depend on the students' allowance for survival. Since the students' allowance does not flow regularly, we have become financial handicaps in managing our resources. Therefore, we entreat the government to regularize payment of students' allowance to help us manage the institution effectively.* P7 said *we cannot raise enough money to pay our utilities. Even now, we have received notices of disconnection from our service providers for non-payment of service bills. We are afraid to incur more debt when we use technology extensively for managing this college.* P10 said *it has not been easy for us to raise money to pay our outstanding bills in this college. This is because money from the government of Ghana cannot suffice all the expenditures here including payment of utility bills. For the past many years, our students used to help with their allowances. This was the era they received allowance regularly. Now, because of the transition of the colleges to tertiary status, things have changed resulting in the payment of students' allowances in*

instalments. Therefore, most of them still have not paid their bills in full. This affects the management and ought to be looked at. P12 opined that *whenever we have been billed for either electricity or internet, we go through hell to pay. This is because the college has no money. And we have been disconnected on many occasions. This is affecting the rate at which we use technology here. We are appealing to philanthropists to come to our aid.* P16 asserted that *we like to use technology all the time due to its significance. But we do not know where to always get money to pay our bills. We have bill areas that have not been cleared because of financial bankruptcy. We do not know which money to rely on for this matter. That is why we cannot fully rely on technology in this college.*

Lack of funds for repairs and maintenance of ICT tools: To address this code, said, *most of my ICT tools like computers, printers, and projectors have broken down and are out of use because the college has no money for repair work. Already, we have exhausted the money generated from the IGF. This suggests that our IGF is not enough perhaps, due to government policy. To promote technology in this college, we require a permanent computer technician employed by the government to fix our computers for us.* P3 said *we must replace some broken accessories in most of our technology tools to function properly. However, there are no funds as most of the tools are costly. That is why you can see those computers and printers packed there. They have not spoilt beyond repairs. If we get money today, we can call a technician to make them work again.* P8 revealed that *computer accessories are costly nowadays. If we want to use our little resources to repair our broken computers, we will not succeed. The last time we tried servicing and upgrading the computers in my office here and that of my deputy's, it cost us a lot. Therefore, we are painfully compelled to wait until funds are available- maybe, from the government and donors. By then, we can review some of our computers for management purposes.* P10 said *when we invite a technician to service your computer in this institution, he will mention some amount of money that we don't have as a service charge. In order not to embarrass ourselves as management, we pay attention to a few computers that keep the institution running and avoid many others. Although all the others are important, particularly for management's sake, we can't do otherwise. We are planning to appeal to old students for support.* P14 asserted that *this is a newly established institution yet, we don't have financial clearance to hire a computer technician. We hire the services of outside technicians and the bill they give us after service is too exorbitant that we can't afford. This is because the college has no money.*

Inadequate financial support or aid from donor partners: for this code, P2 said *the government can't finance everything in this college. We need more support from donors. Therefore, we are calling on more donor partners to come to our aid. We are positive that if we get more donor partners, they can support us financially to be able to manage this institution effectively.* P5 said *our main donors are T-TEL and the Old Students. They have been helping in diverse ways. For instance, they have been donating some ICT tools to us on some occasions. Since new courses are emerging and we also need to upgrade ourselves technologically to be abreast with time, more support is required. However, it looks awkward and embarrassing to always go back to these two groups for financial support. Therefore, we are asking for more donor partners to assist us either in cash or in kind.* P7 opined that *the money that comes from the Ghana Education Trust fund (GET fund) is not enough to cover every expenditure in the college. In many cases, it is not enough to cover repair work in the college. Therefore, we believe if we get more helping hands from donor partners, we can fix and upgrade all our computers and other tools needed for effective management.* P9 revealed that *we do appreciate whatever gifts we have received from our philanthropists. We are also grateful to our donor partners for supporting the college all this while. However, in as much as our student population increases almost every year, we believe technology is a need, especially for management. Therefore, we are expecting more technology tools from donor partners and philanthropists in this regard. Also, if any organization is willing to support us financially, they are welcome.* P11 said *this academic year is almost ended but we have not received money from any donor or philanthropist. Also, our financial expectations from the government this year have not yet been met. This should suggest to*

you that the college has not received financial support from anywhere for management. This is a reason why we have a challenge with making maximum use of technology in this college.

Discussion

The data about this study were presented under demographical statistics of the participants, the extent to which tutors integrate technology into teaching and challenges militating against technology integration in CoE. The data indicated more male than female participants among CoE principals and tutors raising concerns about gender imbalance in the context of technology integration. This gender imbalance can have far-reaching effects. Without equal representation, technology solutions and innovations may be developed with a limited range of viewpoints, potentially leading to products and services that do not adequately address the needs of diverse populations. This supports Sovacool et al (2022) that women have been underrepresented in science, and technology fields, which can lead to unequal access to and influence over technological innovation. The world outside of the classroom is diverse, and students need to be prepared to interact and work with people of all genders in their future careers and personal lives. Ojiambo and Robert (2020) agree that diverse leadership teams bring a variety of perspectives and ideas, which can be crucial for effective decision-making, especially when it comes to incorporating technology into education management.

Also, it was found that most of the participants hold master's degrees, which is a requirement as per the CoE Act of 2012, suggesting a positive link between educational qualifications and technology integration. Principals and tutors with master's degrees are more likely to have been exposed to technological advancements during their education and may be better equipped to integrate technology into educational management and teaching practices. This could lead to more effective implementation of technology-driven strategies to enhance learning experiences and administrative processes within the CoEs. The data further suggest that experience plays a crucial role in the successful integration of technology in teaching and management. Principals and tutors with more years of working experience may have a better understanding of how to effectively integrate technology into teaching and management practices, resulting in higher satisfaction. This finding is aligned with Margarita et al. (2022) emphasizing the significance of instructors' technological proficiency and educational background in driving technology engagement. Additionally, findings from Mireille et al. (2022) and Raman and Thannimalai (2019) reveal that increased years of professional experience are linked to successful implementation and the creation of an enriching learning environment. These insights suggest that the principals and tutors of CoE likely possess the essential competence and practical know-how to proficiently guide and oversee the seamless integration of technology.

Moreover, the data offered insights into the current state of technology integration among CoE tutors in Ghana. The prevalence of smartphone usage, Microsoft Office 365 tools, and collaborative document editing platforms were notable resources commonly available for use at the college level. These resources enhance communication, collaboration, access to information, and the overall efficiency of processes in both domains. As technology continues to evolve, these tools will likely play an increasingly significant role in shaping how management and teaching practices are conducted. This finding aligns with the idea that mobile devices are valuable tools for educational communication (Ahmed & Parveen, 2020). Also, Microsoft Teams, Zoom, and Google Meet facilitate remote collaboration and virtual communication and have gained significance in blended and online learning environments (Martin & Parker, 2014). However, there is room for improvement in areas like programming, advanced design tools, note-taking, organizational tools, and online assessment platforms. This information underscores the importance of targeted interventions and strategies to enhance technology integration in teaching practices among CoE tutors in Ghana. This is because proficiency in

programming and coding is increasingly valuable for tutors, as it enables them to design interactive activities and integrate computational thinking into the curriculum (Voogt et al., 2015).

The data further found three broad categories of challenges that were hindering the principals from executing the management tasks successfully. The first broad category of the challenges was technology infrastructure. In this category, many challenges emerged such as an unequipped computer laboratory, inadequate ICT tools, a lack of maintenance culture, and an unstable power supply. This is to say that the computer laboratories were not equipped with ICT tools like; desktop computers, projectors, seats, and regular internet connectivity (Fedorov et al, 2019). Although some ICT tools such as projectors, audio speakers and smart boards were seen, most of them were broken down and out of use. This was mainly because some users did not take proper care of it (Agyei, 2014). Another factor that could have contributed to the breakdown of the ICT tools was an unannounced electric power outage. As the colleges depended on ECG and VRA for power, there was little concern for an alternative source of power like; generators, solar power, and deep-cycle batteries. This has caused many electrical gadgets to spoil thereby affecting access to the computer laboratory. For this reason, users were allowed to use ICT tools under the strict supervision of the ICT tutors. This finding is consistent with Inan and Lowther (2010), the use of technology in education also depends on the availability of computers in the institution.

According to the data, the second broad category of the challenges affecting technology use in CoEs in Ghana was technical know-how. Under this category, it was found that most of the principals had limited knowledge of the use of technology for management purposes. While tutors did not have offices with Personal Computers, most of the principals had laptop computers and accessories in their offices but could not use them to achieve the intended purpose. A similar finding was arrived at by NTCE (2017), and Bingimlas (2009). On a similar note, the principals were not receiving adequate in-service training on the use of technology for management. Tondeur et al. (2017) opine that human resources training on the use of modern technologies is a tool that can be used to facilitate effective management. Therefore, regular in-service training can be recommended for the principals to build their confidence and develop knowledge and skills in the use of technology in management. Technology policy was also identified as an obstacle affecting technology use in CoEs. It was found that there was no universal policy that regulated the use of technology in colleges. This implies that Ghana's ICT for Accelerated Development (ICT4AD) Policy document (2003), with the main mission to "transform Ghana into an information-rich knowledge-based and technology-driven high-income economy and society", has not been achieved. Although there were local policies at the institutional levels to check the operations of ICT activities like; internet usage, viruses, and printing, the national ICT policy may not be viable enough to hold management to task.

Another broad category of the challenges affecting technology use was financial issues. Burgess and Connell (2020) found that there is a correlation between the financial stand of an institution and its technology use. It was discovered that most of the CoEs did not have regular financial flow for payment of bills. Some of the bills were mainly utility bills from the ECG, VRA, and internet service providers. Failure to pay the utility bills would lead to disconnection of service and ultimately, technology in educational management would be affected (Mahajan et al. 2016). It was also found that the majority of the CoEs were not equipped with adequate funds for repairs and maintenance of ICT tools. Maybe, this could be one of the reasons why broken desktop computers, printers and projectors were heaped in the respective computer laboratories. While some computers and accessories needed to be replaced, others were to be serviced. However, many of the principals found it difficult to raise money internally for maintenance purposes. Further interaction with the principals revealed that financial assistance from their donor partners like the T-TEL, World Bank, USAID, and UNICEF could not suffice the

day-to-day running of the colleges. Other research studies such as Mpuangnan et al., (2021) and Schwille and Dembele (2007) found that CoEs in Ghana required complete autonomy to decide on resource mobilization and expenditure to achieve the educational goal.

Conclusion

This study sought to enhance pedagogical strategies through technology integration in basic teacher education programs. The significance of technology integration is underscored by its pivotal role in advancing Sustainable Development Goal 4, which aims to ensure inclusive and equitable quality education for all. The finding about instructors' age, gender, higher qualifications, and work experience in relation to technology integration emphasizes the necessity for a robust and comprehensive approach to training and professional development. Observable indications that highlight instructors' proficiency in incorporating technology into pedagogy serve as valuable yardsticks for evaluating the effectiveness of educational methods.

Nonetheless, the approach to integrating technology into education is not without its challenges. There are management issues that hinder the optimal utilization of technology, necessitating proactive and strategic solutions. These challenges span from limitations in infrastructure to resistance against change, and addressing them requires collective efforts from educational institutions, policymakers, and stakeholders. As we look to the future, charting a comprehensive path forward requires a multifaceted strategy. Educational institutions should prioritize ongoing teacher training, tailored to accommodate the diverse characteristics of instructors to facilitate technology integration. Policymakers should allocate resources to strengthen infrastructure and ensure equitable access to technological resources. Collaborative ventures between academia and industry can foster innovative solutions to overcome management obstacles and enhance the seamless integration of technology. Consequently, the success of Ghana's Center of Excellence principals in effectively utilizing technology for managerial roles hinges on the resolution of these types of challenges.

Based on the findings of this study, the following recommendations could be given to improve technology integration in educational management and teaching. First, the Ministry of Education should introduce regular in-service training programs on technology integration to equip staff of CoE with knowledge and skills in using technology. Second, the government of Ghana should initiate a national project that focuses on technology integration. This would raise awareness concerning the importance of technology in educational management and teaching. Third, the Ministry of Education should provide financial assistance purposely for the maintenance of ICT tools and payment of utility bills. Fourth, the CoE in Ghana should be given full autonomy to generate funds internally to mark their expenditure. Fifth, a quota for female workers should be provided by the government to promote women in teacher education. Moreover, an alternative source of power like; generators, solar power, and deep-cycle batteries should be provided in all the CoEs. This will substitute power from the ECG and the VRA during light out. Last but not least, the Ministry of Education should review the ICT for Accelerated Development (ICT4AD) Policy document (2003) and incorporate new possibilities for colleges to engage in new ways of using technology in educational management and teaching. The current surge of ICT in teacher preparation requires urgent attention. While this study revealed some strengths of the principles, certain management challenges hindering affecting technology integration were found. Therefore, further research could be conducted in this area by investigating the integration of ICT in educational management. Also, further research could be taken up on the effectiveness of ICT teachers in developing 21st-century skills.

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