
Modelling Technology for Pre-Service Teachers

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Abstract. Technology tools, especially for educational purposes, keep surging up to serve the needs of both educators and learners. With the world being virtually taken over by the use of technology for professional discourse, teachers are making frantic efforts in trying to incorporate technology into teaching and learning. The objective of this study was to investigate how teacher educators are modelling technology for pre-service teachers and how this affects their use of technology in the classroom.

The study adopted a mixed method approach to bring to light the perspectives of teacher trainees and tutors in colleges of education on how teacher educators are modelling technology for pre-service teachers. The study also sought to find out how modelling impacts pre-service teachers in their attempt to use technology for instruction. It came to light that although there are challenges teacher educators face in modelling technology in terms of access to technology tools, a few especially, those teaching ICT courses do model technology for the students including technologies in their lessons whenever possible. However, teacher educators who are not from the ICT department fail to model technology for their students. This impacts negatively pre-service teachers' attempt to use technology for instructional purposes.

Key words: Technology, modelling, pre-service teachers, instruction, technology tools

Introduction

Teacher professional improvement is undeniably indispensable if technology offered to schools is to be used efficiently and effectively. Spending scarce resources in technological infrastructure without proper corresponding teacher professional development is wasteful. Research has shown that the introduction of technology for educational reasons has the potential to bring positive changes to teaching practices both inside and outside of the classroom. In a survey conducted by Bitterman, Goldring and Gray (2013) which captured more than 2,000 teachers and school principals across the United States, the teachers stated that technology aided them to become more effective (92% of respondents) and creative (88%). Both teachers and administrators agreed that technology had reinforced instruction, and functioned as a motivator for students, who were more prone to asking questions and participating in lessons. The demand from ministries of education and teachers themselves for professional development in the use of technology is outpacing the capacity of conventional approaches such as face-to-face training. Therefore, the investigator deemed it fit to recognize that apart from the direct instruction received from educators by pre-service teachers, technology has to be carefully modeled for trainee teachers so as to raise their confidence and find the need for incorporating technology into their instructional delivery. Largely, research backs the use of educational technology for instruction and indicates that it has a positive impact on learners and their learning. Lemke and Coughlin (1998) recommend that, under the right conditions, the use of technology for instruction "accelerates, enriches, and deepens basic skills; motivates and engages students in learning; helps relate academics to the practices of today's work force; increases economic viability of tomorrow's workers; strengthens teaching; contributes to change in schools; and connects schools to the world" (pp. 14-15).

Information regarding conviction of pre-service teachers in their capacity to use technology effectively centers on approaches to use computers. It makes sense to think this

way because one's ability to use computers is an important conjecturer of pre-service teachers' self-efficacy with technology (Delcourt & Kinzie, 1993). Researchers have established substantial increases in pre-service teachers' encouraging attitudes regarding the use of computers and technology as a direct result of participating in at least one university-based technology course (Gunter, 2001; Kinzie, Delcourt, & Powers, 1994; LePage, Lewis, & Casella, 1995; Milbrath & Kinzie, 2000). Good (1996) provides an exception to this pattern in a study in which attitudes toward computers improved after exposure to and experience with technology in their teacher education methods courses, and not in a separate technology course.

Johnson (2002), in a study that used e-mail as a means of dialoguing between pre-service teachers, in-service teachers, and students, found no significant difference in attitudes toward technology or perceptions of self-efficacy in using computers. This suggests that simply replacing standard face-to-face procedures with an electronic version is not enough to improve attitudes toward or confidence with computers and technology. If this will work, teacher educators will have to model the use of technology for instruction well for pre-service teachers and get them various demonstrations. Thereafter, pre-service teachers must be given the opportunity to use the knowledge and skills acquired to present lessons where they can be evaluated and possibly guided with post-lesson discussions on what they did right and what did not go right. This can be demonstrated when pre-service teachers go on both on-campus and off-campus teaching practice too.

Gunter (2001) reports that a separate, introductory technology course can significantly reduce computer anxiety if emphasis is placed on "authentic technology learning experiences" (p. 19). Sherry (2000) found similar effects, but only when experiences in a separate technology course were combined with the integration of technology into the pre-service teachers' other methods coursework. Pope, Hare, and Howard (2002) add the element of practice, reporting increased levels of confidence with technology when pre-service teachers engaged in a university technology course in combination with modelling of effective technology integration in their other courses and with field-based practice with integrating technology in the K-12 classroom.

Several researchers have presented factors other than the university-based courses which include effective modelling by teacher education instructors and field-based experience that have a significant impact on pre-service teachers' confidence with using technology. Other factors among which are prior experience using technology (Hunt & Bohlin, 1993; Liu, Reed, & Phillips, 1992; Sherry, 2000), level of recreational use of technology (Hunt & Bohlin, 1993), progress in a teacher education program (Liu, Reed, & Phillips, 1992), and the extent to which technology integration activities in university courses are perceived by pre-service teachers as relevant to their future jobs (Akaadom, 2020).

Despite research evidence showing the capability of technology to transform teaching and learning in the 21st century, the use of computers in the classrooms remains marginal among both practicing and pre-service teachers. These two sets of teachers do not use technology effectively which is quite worrying (Lim & Khine, 2006). In a study by Bayhan, Olgun, and Yelland (2002), it was found that 81.8% of the teachers in their study did not use computers for teaching and learning and this could be due to the lack of confidence and professional development. Apparently, analogous issues regarding teachers' lack of technology use were reported in the Great Britain. Jones (2004) conducted a literature review and found the lack of technical support, teachers' lack of confidence, and lack of realization of the advantages of using technology in their teaching among reasons that acted as barriers to effective integration of technology in teaching and learning. From another standpoint, Scrimshaw (2004) suggested some factors that supported technology use by teachers to be access to resources, professional development, and technical support.

The teacher is the key to effective use of technology in the educational system and it is important for teachers to understand the precise role of technology in teaching and learning so that they can learn to cope effectively with the pressure created by the continual innovation in educational technology and constant need to prioritize the use of technology (Zhao, Hueyshan, & Mishra, 2001).

Research has equally shown that teachers' perceptions and attitudes towards technologies influenced the effective use of these technologies in teaching and learning (Paraskeva, Bouta, & Papagianna, 2008). While stakeholders in education expect teachers to engage technology in ways which are consistent with their beliefs that technology will impact on teaching and learning, it must be borne in mind that teachers are faced with many variables that interact with each other to either facilitate or discourage the acceptance of technology. Some of these include personal factors, such as computer self-efficacy (Paraskeva et al., 2008), technical factors such as technological complexity (Thong, Hong, & Tam, 2002) and environmental factors such as facilitating conditions (Ngai et al., 2007). Given the critical role of educators, and the contributions that teachers make in supporting or inhibiting the integration of computer technology in the classrooms, the need to understand teachers' acceptance of technology so as to model technology use for them by teacher educators calls for an investigation to verify if indeed in the course of their training, technology is being modelled for them. The successful use of technology in teaching and learning depends heavily on the significance of technology acceptance, which provides an insight into issues relating to teachers' adoption and usage of technology as a result of modelling. Ghana in recent years has developed and introduced the National Teachers' Standard (NTS), the National Teacher Education Curriculum Framework (NTECF) and 4-Year B. Ed Curriculum based on these framework and standard with the aim of improving teacher education to enhance the performance among pre-service and in-service teachers. In addition to these, the country has also developed a national Pre-Tertiary Curriculum Framework and introduced a Standards-Based Curriculum for Basic and Second cycle schools to serve as a new benchmark with the goal of producing students with requisite 21st century skills for lifelong learning in line with the sustainable development goal four (SDG4). One crosscutting issues that run through the new Standards-based curriculum and the framework is the use of technology to support teaching and learning in all subject areas. This is in line with the critical role computers, mobile devices and technology plays in promoting behavioral, cognitive and constructivist learning principles in the classroom (Roblyer & Doering, 2016).

The current study departs from the research literature by focusing on how teacher educators are facilitating the learning of teaching with technology through the courses they teach and how well they were assisting pre-service teachers to function well using technology for instruction. This was a case where a model in which the skills of teacher education faculty who were both teaching technology courses and/or not, and not students, were addressed in an attempt to increase the level of modelling and integration of technology in courses at the teacher training institutions. Specifically, the goal of this study was to discover whether or not confidence in specific skills and instructional practices improved and increased despite a lack of direct technology instruction as described above. The results of the studies demonstrate that it is possible to increase students' confidence in their skills of using and integrating technology into their instruction, without relying on the traditional, disconnected technology course for pre-service teachers (e.g. Levin & Wadmany, 2006; Ertmer, Ottenbreit-Leftwich, & Tondeur, 2016). Teachers in recent times depend mostly on the use of technology to search, analyze and validate information for planning lessons and communicating same to their students, keeping in touch with parents and staying current with modern teaching strategies (Akaadom, Takramah & Anagbonu, 2020). The potential role of ICT in transforming teaching and learning cannot be overemphasized. When student-teachers observe their teachers teach with computers, mobile

devices and related technologies in the course of their training, it is expected to influence their teaching experience and serve as an important motivating factor that could inform their attitude and preparedness to integrate technology into subject-specific content areas of their classrooms upon graduation. Handler (1993), hold forth that observing cooperating teachers use computers during the student-teachers' teaching experience is one of three important factors that influence teacher's feeling of preparedness to use computers, mobile devices and related technologies for instruction in their classroom. As reported by Albion, 1996; Albion, 1999; Kent and Giles, 2017; Oliver, 1993, teacher's self-efficacy for technology integration is a significant factor in understanding and predicting patterns, frequency and success of technology use by teachers.

The main objective of this study was to investigate into the perspectives of pre-service teachers' training in the colleges of education in Ghana about how teacher educators were modelling the use of technology for instruction and how this affects their training and professional development. This is because there is a clarion call on all teachers to use as much as possible, technology to deliver instruction as this helps to improve learners' attainments in their studies (Veen, 2012).

Methods

Descriptive research design was adopted for this study. This methodology focuses more on the "what" of the research subject than the "why" of the research subject. The descriptive research method primarily focuses on describing the nature of a demographic segment, without focusing on "why" a particular phenomenon occurs. In other words, it "describes" the subject of the research, without covering "why" it happens. As the motive of this investigation was to find out whether or not teacher educators appropriately model technology for pre-service teachers, the researcher found this method appropriate enough for this study. The respondents for the study were final year students ($N=417$) from eight colleges of education in Ghana. Random selection of schools and subjects were done to ensure that the results of the study could be generalized to the population under study. The data that were collected were cross-checked and cleaned to ensure that mistakes likely to have existed in the data were identified and corrected in the responses and the information given were relevant. The data was analyzed and presented using descriptive statistics (Mean, Standard Deviation, Percentages and Frequencies).

Results and Discussion

Table 1 below provides responses on pre-service teachers' approaches to modelling by teacher educators to assist them to incorporate technology into teaching and learning.

Table 1. Responses on pre-service teachers' approaches to modelling to help incorporate technology into teaching and learning

Statement	SD	D	U	A	SA	TOTAL	M	ST.D
My training as a teacher places emphasis on the use of technology in teaching and learning	34 (8.2)	47 (11.3)	39 (9.4)	213 (51.1)	84 (20.1)	417 (100)	3.6 4	1.163
I am exposed to different technologies at my college by my tutors	41 (9.8)	91 (21.8)	53 (12.7)	176 (42.8)	56 (13.4)	417 (100)	3.2 8	1.224
Tutors demonstrate the use of different technologies by themselves	47 (11.3)	66 (15.8)	76 (18.2)	174 (41.7)	53 (12.7)	417 (100)	3.2 9	1.208
Students are expected to show ability to integrate technology during teaching practice sessions	24 (5.8)	57 (13.7)	76 (18.2)	203 (48.7)	57 (13.7)	417 (100)	3.5 1	1.070

I am required to model the use technology by my department/college administration/syllabus to teach at all times	41 (9.8)	98 (23.5)	65 (15.6)	154 (36.9)	59 (14.1)	417 (100)	3.2 2	1.232
I can choose technologies to use in my classroom that improve what I teach, how I teach and what students learn	26 (6.2)	59 (14.1)	53 (12.7)	222 (53.2)	56 (13.4)	417 (100)	3.5 4	1.098
I can offer leadership in assisting others to coordinate the use of content, technologies and teaching approaches at my school and/or district.	32 (7.7)	44 (10.6)	58 (13.9)	216 (51.9)	66 (15.9)	416 (99.8)	3.5 8	1.112
My major subject(s) education tutors appropriately model combining content, technologies and teaching approaches in their teaching.	54 (12.7)	216 (51.8)	60 (14.4)	54 (12.9)	43 (8.3)	417 (100)	3.4 9	1.120
My instructional technology tutors appropriately model combining content, technologies and teaching approaches in their teaching.	37 (8.9)	54 (12.9)	67 (16.1)	214 (51.3)	44 (10.6)	416 (99.8)	3.4 2	1.119
My "teaching methods" tutors suitably model combining content, technologies and teaching approaches in their teaching.	67 (16.1)	200 (48.0)	49 (11.8)	65 (15.6)	36 (8.6)	417 (100)	3.4 7	1.185

Results were presented as SD : Strongly Agree; D : Disagree; U : Uncertain; A : Agree; SA : Strongly Agree; M : Mean; ST.D : Standard Deviation (Mean : 1 – 2.4 Low; 2.5 – 3.4 Moderate; 3.5 – 5 High)

Pre-service teachers responded to the issue of whether or not their teacher training program placed any emphasis on the use of technology in teaching and learning. From Table 1, 71.2% (n=297) responded positively to their teacher training program placing emphasis on the use of technology for instruction. 56.2% (n=232) positively confirmed their exposure to different technologies, with a calculated mean (standard deviation) of 2.38 (1.224) indicating low agreement as a result of variations in the responses of the pre-service teachers.

As part of their training, the researcher was very particular about how pre-service teachers were being taught to use different technologies for instructional purposes. For this, 58.8% (n=245) admitted to being exposed to different technologies to enable them to teach with it. Apart from being exposed to different technologies, the researcher further wanted to find out if indeed tutors demonstrated the use of these different technologies to pre-service teachers. Here, the majority of pre-service teachers (54.4%, n=227) agreed to tutors demonstrating the use of different technologies as part of their training. This response yielded a mean (standard deviation) value of 3.29 (1.208), a fairly high indication that pre-service teachers felt tutors demonstrated the use of different technologies in line with their training.

If pre-service teachers were exposed to different technologies, taught how to use different technologies, and their tutors demonstrated the use of different technologies to them, then it was expected of them to show their ability to integrate technology during teaching practice sessions and thereafter. Pre-service teachers were asked whether they were expected to show ability to integrate technology in their teaching during teaching practice. There was a 62.4% (n=260) majority that affirmed that they were expected to show their ability to integrate technology in their teaching during teaching practice sessions. The researcher sought to find out if the use of technology by pre-service teachers for instruction was a requirement by their

college department, college administration or it was the syllabus that required them to use technology for instruction at all times of instructional delivery. There was a positive response of 51% (n=213) to this. With a mean (standard deviation) of 3.22 (1.232), this was an indication of internal consistency of the responses that they were required to use technology for instruction by college administration/department/syllabus.

A greater number of respondents (66.6%, n=278) confirmed that they could select technologies to enhance instruction in the classroom. With regards to using strategies that combined content, technologies and teaching approaches that pre-service teachers learned about at college for the benefit of their students in their classroom, 66.5% (n=277) agreed that they could effect the combination of content, technologies and teaching approaches in their teaching.

In order to extend the skills and knowledge acquired through the teacher training program from college, the researcher intended to find out how confident pre-service teachers were to provide leadership through modelling in helping others to coordinate content, technologies and teaching approaches in their respective schools and/or districts. In response, 67.8% (n=282) were positive about it.

Modelling for technology integration by teacher educators has been another effective way of training teachers to integrate technology in teaching and learning. Thus specifically, the researcher sought to find out how this was being done in training pre-service teachers in the selected colleges of education in Ghana. Pre-service teachers responded to whether their major subject area tutors appropriately modeled combining content, technologies and teaching approaches in their teaching. There was 64.7% (n=270) affirmations from pre-service teachers with a mean (standard deviation) value of 3.49 (1.120) signifying that major subject(s) tutors appropriately modeled combining content, technologies and teaching approaches in their teaching. In the instances where instructional technology teacher educators appropriately modeled combining content, technologies and teaching approaches in their teaching as a way to train pre-service teachers to integrate technology into their instruction in the classroom, 61.9% (n=258) agreed to this.

Most technical subjects such as English Language, Mathematics, Science, etc. had special course models designed to help train pre-service teachers to effectively teach those subjects to their students. These course models are usually titled “Methods of Teaching”. The researcher sought to find out if tutors handling these “teaching methods” courses appropriately modeled content, technologies and teaching approaches in their teaching to help instill a sense of the use of technologies in instruction as part of training pre-service teachers. With regards to this, 64.1% (n=267) confirmed this assertion. Responses on the approaches to incorporate technology into teaching and learning in respect of pre-service teachers’ training in college average scores ranged from 2.38 to 3.64 demonstrating low to high scores regarding their training approaches to integrate technology.

Qualitative Results on Approaches to Incorporate Technology into Teaching and Learning

Data from interviewed participants was also collected for the approaches colleges employed in training pre-service teachers for technology integration to identify if there are opportunities of modelling technology for pre-service teachers. Both teacher educators and pre-service student teacher focus group participants were interviewed. The major theme yielded sub-themes which included placing emphasis on the use of technology, technology courses taken in colleges as part of pre-service teachers’ technology training, teacher educators’ modelling of technology, assessment strategies used to evaluate technology courses in colleges, and colleges’ main modes of instructional delivery for teaching students to acquire technology

skills. The table below presents the results on the approaches adopted by colleges to help pre-service teachers acquire knowledge and skills to model technology for instruction.

Themes and Sub-Themes on Approaches to Integrate Technology into Teaching and Learning

Themes	Sub-themes	Related issues
Approaches to incorporate technology into teaching and learning in college	Emphasis on technology	• Only ICT department places emphasis on technology training. • ICT is a core subject for all college students. • ICT syllabus loaded to equip student teachers with technology skills. • Student teachers learn technology integration via drill and practice, PowerPoint presentation, multimedia, etc. • Pre-service teachers use technology experience from college during teaching practice where facilities are available.
	Technology courses	• Three ICT courses only, two examinable, one non examinable for entire college program. • Courses are all about learning Microsoft application programs like Word, Excel, PowerPoint and drill and practice. • Courses only teach about basic computing. • Training only limited to use of computers. • No hardware courses included. • Very limited practical sessions.
	Teacher educators' modeling of technology	• Most college tutors fail to model technology for student teachers. • Only ICT tutors use and model technology for instruction. • Teaching methods courses have no technology integration components. • ICT itself has no teaching methods course.
	Assessment of technology courses	• Examinations are mostly multiple-choice questions and theoretical in nature. • No practical sessions in examinations; practical questions are answered on paper. • Pre-service teachers can, to some extent, develop a fully integrated technology lesson given a learning goal.
	Internet use	• Tutors obtain lots of information from internet to support teaching. • Student teachers browse for more information to support teaching and learning. Tutors direct student teachers to useful websites to support training. • Most colleges are without internet connectivity.
	Colleges' modes of instructional delivery	Basically through lecture, demonstrations in computer laboratory, and peer mentoring.

Emphasis on Technology

The question of pre-service teachers' training placing emphasis on the use of technology was posed to tutors and responses revealed that much emphasis was rather placed on technology use by the ICT department and not by the other departments of the institutions. The picture painted was that it is the ICT department of colleges that mostly use technology for instructional delivery and training of pre-service teachers. It was revealed that ICT was a core subject for all college students irrespective of one's area of specialization as reflected in the comment:

The training of our students places a lot of emphasis on the use of technology and that is the reason why ICT is a core subject for all college students irrespective of one's area of specialization. The national teachers' standards demand that teachers integrate ICT into their teaching. (T1)

The college ICT syllabus had been designed in such a way that it took care of all the major aspects in building students' knowledge and soft skills in technology for its use in the classroom. In some instances, it was revealed that pre-service teachers did ICT course modules in areas such as curriculum integration with ICT, but the content and skill for technology development for pre-service teachers was not enough. Teacher educators revealed that the college ICT syllabus was very much loaded to such an extent that it specified which tools and how technology could be integrated in teaching students. This was evident in the comment:

The syllabus sometimes specifies how to integrate technology into teaching and learning. A new syllabus, which is to be released as from next year, expects all tutors from various departments to use technology to deliver instruction. For this reason, projectors have been supplied to various departments for use so that tutors can prepare their own PowerPoint presentations to teach with them. (T4)

To further indicate that a lot of emphasis was placed on the training of pre-service teachers so as to help them integrate technology into their teaching, the content designed to assist them was carefully planned to equip them to deliver instruction successfully in the classroom. This is illustrated in the comment:

In second year second semester, students do technology integration in the classroom where they learn about 'Drill and Practice', how to use only one or two or more computers to deliver instruction and the challenges that beset them in the classroom. In all of this, they do only the introduction which, to me, is not enough. (T1)

When pre-service teachers were interviewed on the same issue, they had so much to say to buttress what their tutors had said. However, they claimed that although much emphasis was placed on technology use, it seemed like they only did the introduction of the actual stuff they felt they needed to know. SFG3 PS15 asserted that:

ICT is a core subject for all college students. Our only problem is that we do only three courses throughout our study in college but only two of them are examinable. Besides that, what we do in those courses are not enough to equip us to teach with technology thoroughly because these courses only teach us the fundamentals of computing where we do a bit of the internet, spreadsheet, networking, etc.

With the kind of curriculum being used to train pre-service teachers, the researcher further probed if pre-service teachers were capable of using content-specific tools like simulations, graphing calculators, web tools, etc. to support teaching and learning. The researcher had to explain some of these tools to participants as they did not know what they were. With the kind of explanation offered participants, they responded by saying:

Yes we do but not all. Those that are available, we do use them and in some cases, we are taught how to use them in teaching our students. Sometimes too, we are assigned to work on some of these as group projects where tutors provide support whenever the need arises. (SFG2, PS9)

Pre-service teachers were mandated to take some courses in ICT as a means to equip them mainly to teach with technology. The researcher, therefore, sought to find out how pre-service teachers' technology courses were helping them and how they were using the technology experience gained from college during their teaching practice and thereafter. It was revealed that the Ministry of Education and the Ghana Education Service were aware of the pitfalls in terms of resources and provision of tools and equipment in schools so they had made it optional for teachers in schools to use them when available. T2 asserted that:

The use of technology for instruction is optional during teaching practice and because it is a core module, teachers are bound to use it. If available, some use it; if not, they don't. And there are no punitive measures for those who fail to use it because the ministry is aware of the lack of tech resources in our schools. I can say with confidence that only about 5% of the public schools countrywide may have access to ICT facilities.

Pre-service teachers felt that even though their training for technology integration was not the best, they still did their best to use technology for instruction any time it was available. They felt that as far as they were concerned, they used the experience they gained from college during their on-campus teaching practice and implemented it when they went to the field even though the conditions were not the same. This is reflected in the comment:

We do the best that we can because there are so many problems we encounter both at college and the schools where we go to teach. It's either the training in college is not adequate or facilities are lacking both at college and/or the schools where we are posted to teach. (SFG2, PS8)

Pre-service teachers were probed to verify if they could use technology tools to process data and report on results. To them, some of these things were taught at college and when it came to writing letters, reports, memos, etc., that was not a problem at all. This is what they had to say:

We are taught Microsoft Word and Excel at college on how to use these applications to write reports, letters, etc. and prepare students' reports as well. We are capable of using Excel to report on students' assessments and reports and even build a small database with it. (SFG4 PS17)

Most of the tools pre-service teachers mentioned were Microsoft Word and Excel. They hardly mentioned database programs such as Microsoft Access for keeping students' records. However, from the discussions, they were confident with using Microsoft Word and Excel in all they do.

Technology Courses

The researcher further sought to learn if the prescribed courses to assist pre-service teachers for technology integration met the specified goals. Teacher educators were very blunt to point out that this was never met. One tutor noted the reason for this as:

The need to personally develop skills to teach with technology is never met. This is because courses are loaded with many topics and there are time constraints too which do not help meet the specified goals. (T4)

Pre-service teachers were very desperate to learn to teach with technology but felt their training was not enough to equip them with the skills needed to teach with technology. They claimed that much of their training did not consider the practical aspect of technology training and for some reasons, they were trained to work with only the computer and not with other technology tools. They cited a number of factors that hindered them from meeting the specified goals:

Since the ICT courses do not teach us sufficiently, they cannot meet the specified goals. We don't tend to do more practicals so we lack the skills needed to meet the specified goals. (SFG4, PS16)

On the contrary, some other pre-service teachers felt it did. They maintained that the only technological tool they had been trained to teach with was the computer and to some extent, the topics they handled whilst on teaching practice were aligned to the topics they had been taught at college as expressed by SFG2 PS4 below:

It meets the specified goals because those of us who are fortunate to teach the ICT subject in the Junior High Schools (JHS) were taught the same topics at college.

The subject of training college students for effective technology integration in lessons in the classroom is mostly shaped by the structure of the college curriculum. Are courses prescribed by the curriculum enough to prepare pre-service teachers for effective technology integration? This is what one teacher educator had to say:

Three basic things hinder the training of college students for effective technology integration. 1). Courses are not enough. 2). Time to learn technology is very limited. 3). Resources for their training is lacking in a number of colleges in Ghana. Here at this college, we don't have the tools so most courses do not use the integration of technology tools. This influences them so much so that when pre-service teachers go to the field, they also don't use the tools in their teaching even though we are doing our best. (T3)

To some other tutors, they felt the training of pre-service teachers for technology integration had been limited to just the use of computers whereas there are several other tools that could help them in their training. They went ahead to claim that even with the use of computers, pre-service teachers only learnt about software and never about hardware. They contended that in the event of hardware problems, pre-service teachers would not be able to solve them This is illustrated in T2's comment:

The courses prescribed by the curriculum are not enough to prepare pre-service teachers for effective technology integration because students do not do anything hardware. All they do is software programs like Ms Word, Excel, PowerPoint, etc. without any hardware. How would they solve hardware problems when they come across any?

Pre-service teachers felt the technology course modules they did in college had prepared them enough to enable them to integrate technology into their content areas in the classroom. Some tutors who handled the ICT courses in college felt the little pre-service teachers did in college should enable them to teach with technology in the classroom. They however, felt that what hindered the implementation of teaching with technology was the non-availability of technology resources in the schools:

With the little tech training they receive from college, they should be able to teach with technology in the classroom. The only problem is the availability of facilities, which still remains the biggest challenge. Perhaps it might interest you to know that even normal classrooms don't have sockets to power tech tools for their use. (T1)

Pre-service teachers felt that given the opportunity, they could use technology to deliver instruction to some extent, and contended that they could be fully trained with a little more technology training to add up to what they learnt from college:

I can say 50% of us can use technology to deliver instruction in class fully without any support. Because of this I think we would need more technology training by maybe enrolling in a computer training school to learn more. If we were to do IT as a major program and not as a core subject, that can also help. (SFG2 PS6)

The zeal with which pre-service teacher participants wanted to learn technology to teach with it was overwhelming. However, they were beset with challenges that were hindering their professional training.

Assessment of Technology Courses

The assessment strategy used for measuring the ICT courses was considered to see how effective it was to help pre-service teachers to successfully master technology integration at

college. With this, teacher educators were not convinced it was the best of options in helping equip students for technology integration. This was evident in the comment:

I have always questioned the assessment strategy used in assessing our students. The nature of questions makes students examination-oriented instead of developing the skill for technology integration. They are assessed mostly on only four topics out of the total of eight broad topics in the syllabus. Multiple choice questions which mostly center on some selected topics, makes students very selective in an attempt to pass their exam. In the exam, there are no practicals to test students' skills in IT. In instances where practical questions are set, everything is answered on paper. (T1)

Teacher educators had a strong conviction that there should be a paradigm shift from the present assessment methods employed in evaluating pre-service teachers' knowledge and skills in technology training. This is because the present assessment strategy used in measuring college students' technological skill was not helping them in acquiring the skills needed to use technology effectively for technology integration in pre-service teachers' lessons in the classroom. This is what one tutor had to say:

The assessment method worsens the situation. It's all about examinations and questions set for them are all theoretical questions. No practical work is included so when they come for ICT lessons and you teach them, it's like you are wasting their time because they will only have to 'chew and pour' to pass their exams. Besides, ICT in first year is non-examinable. There is no such thing as practical work like they do in home economics and the sciences. I think the strategy has to be changed. (T4)

Pre-service teachers shared the same sentiments with their tutors. They felt that the University of Cape Coast (UCC), which is the examining body, did not demand them to answer any questions which are practical in nature. To them, everything they did was purely theoretical and that was not helping them in acquiring the practical skills they needed to be able to use technology in the classroom. This was evident in the comment:

The assessment strategy used by UCC is mostly written with no practicals. The practical questions are supposed to be answered on paper. E.g. How can you create an e-mail account? Is this not practical? But you have to write all the steps on paper and it's not helping at all. The paper exam is not really helping us master technology for its use. (SFG3 PS12)

Given the kind of technology training for pre-service teachers, was it possible to develop their own ideas for technology integration given a learning goal? Teacher educators felt they could, to some extent, but with some difficulty, especially considering the kind of training they received from college. They still maintained that the difficulties stemmed from the limited time given to pre-service teachers to learn technology and the non-availability of resources needed for their training.

They can but with difficulties because of insufficient knowledge in the area of technology. We do teach them all that just that they only do a little over one hour in a whole week which is not enough. (T4)

Pre-service teachers felt they could combine content with technology to deliver instruction in the classroom. They felt their technology training though, was inadequate. They felt they could develop a lesson for instruction with technology given a learning goal. One pre-service teacher participant noted that:

Any lesson one prepares, one needs to get the appropriate teaching and learning materials and this helps one to select the right teaching and learning materials to teach with. With this in mind, we are able to do a lot and always guided. (SFG4 PS17)

Pre-service teachers said they sometimes had to arrange to see their ICT tutors in order to obtain further assistance when they wanted to deliver instruction with technology but were faced with difficulties.

Internet Use

Teacher educators and pre-service teachers were probed on how they used the internet to support teaching and learning. Whilst some colleges faced problems with internet access, others had access and were using it to benefit teaching and learning. In most cases, getting access to the internet was a big challenge for some colleges and for that matter, those who had smartphones had to rely on them to connect to the internet to be able to browse for information to support classroom instruction and make meaning of what they do in the classroom. Both tutors and pre-service teachers made use of useful websites for teaching and learning both within the classroom and outside of it. This is affirmed by T4:

Any topic I teach, I consult the internet first to get all the information I need. I give students too web addresses to get a lot more information on their courses. In some instances, we direct them to visit useful websites. E.g. ERIC (Educational Resource Information Center) and also teach them how to look for sites where they can locate useful information. Group assignments are also given to students to be submitted online.

Pre-service teachers, however, felt the internet was a resource which contains virtually all the information they needed to support them to teach and learn at the same time. They however, complained that apart from the internet being absent from some colleges, those with access had challenges with connectivity which kept going off when they needed it. Respondent SFG1 PS5 observed that:

Our college is now being connected to Wi-Fi so we don't have access to the internet for now. Instead, those with smartphones use them and it helps them a lot to study. Basically, we use the internet for research purposes to acquire more information/content for our college program.

Pre-service teachers believed the internet is a huge resource where they can obtain a lot of information to assist them with their teacher training program and for that matter, college administrations would do well to get all colleges connected to benefit them and their tutors as well, since a lot of them also depend on the internet.

Colleges' Mode of Instructional Delivery

The approaches the colleges employed to train pre-service teachers to incorporate technology in instruction were also questioned. Teacher educators revealed that there were organizations that had identified the gaps in colleges in their attempt to equip all tutors to help them use technology to deliver instruction in the classroom and were offering them assistance to that effect. The approaches adopted by tutors/colleges to help teachers learn and acquire technology skills for use was also discussed. Tutors had this to say:

Basically, we use the lecture method to train student teachers to incorporate technology in their lessons. We try our very best to teach the basic things they need to be able to use technology to deliver instruction in the classroom. (T4)

The methods we use to train our college students are basically demonstrations and mentoring. We always have to demonstrate what they need to do first for them to see and then have a hands-on practice on it so what we do is that we go round to inspect how they are faring with the task assigned to them and whenever there is a problem, we assist them to overcome them. (T1)

College students are first taught how to assemble a desktop computer with cables and connect it to a projector for use in class. Then, with regards to the programs, they learn, we model it for them to see so that they can also do same. (T1)

Transforming Teacher Education and Learning (T-TEL), a non-governmental organization is trying to equip all college tutors for technology use so that we can model the use for technology for our students. (T3)

Pre-service teachers however, said the approaches colleges resorted to, to train them to use technology for instruction in the classroom had basically been lecturing, demonstrations through their practical sessions, and in some instances, modeling of technology use where their tutors encouraged them to do the same when they left college because of its enormous benefits to the student and the teacher alike. They also believed the T-TEL program would equip more teacher educators to resort to technology use, which could transform the face of instruction in the near future.

Teacher Educators' Modelling of Technology

The issue of modelling as a means to train pre-service teachers to incorporate technology into their instruction was dealt with where tutors and pre-service teachers threw more light on it by sharing information on how major subject area tutors, instructional technology tutors, and teaching methods tutors, were appropriately combining content, technologies and teaching approaches in their teaching. While tutors admitted that it was mostly the ICT tutors who modelled technology for instruction for pre-service teachers, most tutors did not model technology for them with the exception of a few. They cited lack of technology facilities as the main reason why most teachers shunned the use of technology in their instruction. T3 asserted that:

When it comes to the issue of modelling, this is mostly done by the ICT tutors. For other subject areas, no, just some few. Sometimes even if the few ones try to do so, facilities do not permit them. (T2)

Some other tutors contended that modelling technology for pre-service teachers does not only have to involve the use of projectors and computers. They indicated that videos of events like festivals could be captured and showed as a movie to students to learn cultural values and other attributes in some related courses. They further questioned why the ministry and the education service deemed it fit to have well equipped workshops for other subject areas such as home economics and the technical skills subjects where pre-service teachers are taken to have practical skills training but not for ICT:

I don't think tutors model technology as a means for training students. All I know is some few Science and Mathematics tutors use projectors when teaching, but I personally don't see that as a means to model technology for our students for technology integration. They must have special technology sessions where technology is properly modeled for students as part of their training like they do for the technical programs such as the home economics class where they do proper cooking and those in the fine arts class. (T3)

Pre-service teachers felt the same when they said that apart from their ICT tutors who used computers and projectors to teach them, other tutors did not. They felt that some tutors could have found it difficult to use technology to deliver instruction in the classroom. Only a few of their tutors, mostly the Science and Mathematics tutors, occasionally used ICT tools like calculators and projectors to teach them. They equally revealed that their syllabuses were very much loaded so tutors ignored using technology for instruction because they felt it would delay them leading to their inability to complete their syllabuses:

Our tutors may not be able to use technology to teach us. It's only our Science and Mathematics tutors who sometimes use the projector to teach us. The rest don't aside our ICT tutors. (SFG4 PS19)

Our tutors don't model teaching with technology for us but we don't blame them because of lack of time and equipment to be used. Some of them also feel that when they use technology, it would waste their time so they always resort to the traditional methods of teaching. (SFG3, PS15)

Tutors also noted that most college tutors do not model technology to be emulated by pre-service teachers because some of them were born before the advent of computing and have

never made efforts to learn to teach with technology. Instead, they were content with the traditional way of teaching, hence, students also do same when they go to the field.

Pre-service teachers could not agree more with their tutors by saying that their training is affected by a myriad of problems which included lack of resources and time mainly. They argued that they needed more training in using technology to teach and that their program should be structured in a way that gives them more practical training. They felt their technological training was inadequate and that, what they even learned in their ICT lessons was mostly theoretical and not practical. This is affirmed by SFG2 PS6 who said:

Most of our tutors do not model technology for us. They hardly use it. We are sometimes tempted to think that they don't know how to use it. For us too, we are not able to teach well with technology. We need more skills training in Information Technology. We need more hardware courses to be able to handle hardware problems as and when they come. Besides, there should be more practical work. With this kind of training, if we really need to teach with technology in the classroom, then the best thing to do is to enroll in a computer training school because over there, one learns more of IT than in college. In college, we are only taught the basics.

Apart from the lack of technology facilities in schools where pre-service teachers went to teach, some tutors also felt that their training did not equip them enough to deliver instruction using technology in the classroom. They however, advised that students should also not rely solely on the technology they learn in college but could improve upon that by enrolling in computer training schools to enhance their knowledge about computing. This was affirmed by T4:

The lack of technology facilities in colleges and schools where they (pre-service teachers) go to teach does not give them the opportunity to put into practice the little they learn in college. Some students even feel reluctant to teach using technology even though tech resources may be available in the schools where they go to work. This is because they feel their training has not prepared them enough to teach with it. I feel students should not rely on college ICT education alone, as this may not help much. They can enroll in computer schools to further their knowledge in IT. This same lack of facilities in college prevents other tutors from modelling technology for pre-service teachers even though I can say some tutors are not so well versed in using technology for instruction.

Some tutors however argued that if colleges can mount diploma programs in information technology for students to specialize in it alongside the program they are doing, they would know more about ICT to be able to teach with it without much difficulty.

There are course modules for all subjects in the major areas of study for college students that did special courses termed as “Methods of Teaching”. These courses taught pre-service teachers the best methods employed in teaching various subjects. For this reason, the researcher wanted to find out if these modules included technology integration components or whether the ICT program had its own teaching methods course module. The answer most tutors gave was that these courses contained no technology integration components as revealed in the comment:

The teaching methods courses have no technology integration components. These courses deal with how to teach the various subjects but without technology integration components. Student teachers only learn about technology during ICT lessons. (T3)

They noted that the ICT program has not got any teaching methods component as some other subjects like Science, Mathematics, English Language, etc. do. This is affirmed by T1:

As far as I am concerned, teaching methods courses have no technology integration components which aid or teach students on how to use technology to teach their lessons. It is only when they do ICT as a course that they get the opportunity to learn how to teach with technology.

Pre-service teacher participants further pointed out that the teaching methods courses they did at college never contained any technology integration components. They however said the teaching methods courses mainly dealt with the traditional ways of delivering instruction which they deemed as the most common approaches. One participant had this to say:

We never saw anything like that from college. In fact, there is no 'teaching methods' for ICT. Unlike the other subjects, the ICT program hasn't got its own teaching methods. It is only in ICT modules that we are taught how to teach with technology. (SFG2 PS10)

Pre-service teachers were of the opinion that if ICT had its own teaching methods, it would go a long way to assist them.

Suggestions to Improve Training for Technology Integration

Both teacher educators and pre-service teachers were asked the suggestions they would offer to make their training more pragmatic and effective for technology integration, given an opportunity. Tutors felt that there should be more information technology training for tutors and that government and non-governmental organizations should help resource the colleges and the schools where pre-service teachers go to work after school. Some tutor participants had this to say:

Government and non-governmental organizations should come to the aid of the colleges to assist them with training personnel and provide technology materials for their use. (T2)

There should be a resource room for all colleges where simulations for teaching landforms, the circulatory and digestive systems, etc can be done. This would make lessons more practical for students. There should be IT training too for tutors as most of them are not technologically inclined. (T4)

I believe that the curriculum for colleges should be re-designed to include technology integration for all subjects. There is the need for restructuring for tutors to model technology for college students. (T3)

However, pre-service teachers had a number of suggestions to make regarding their training for effective technology integration into instruction. Some of them included:

Colleges should reduce the number of subjects so that it can pave way for more time in learning technology and technology courses. But before that is done, more technology equipment should be provided for the colleges. (SFG2 PS10)

More teacher educators at the colleges should be trained to use technology in order to model technology use for students. I heard the T-TEL program is for a few selected colleges. If it is true, it should be extended to all colleges in the country not only a few selected ones. This can go a long way to help. (SFG1 PS2)

The theory and practicals of ICT should go hand-in-hand; there shouldn't be more practicals than theory. There should be a balance between the two. (SFG4 PS16)

More tutors should be sensitized to use technology for its enormous benefits. Aside that, all assessments in ICT should be in a practical form as this is what we would need when we go to the field. By so doing, this would even help the so many ladies who fear technology courses to overcome their fears. (SFG3 PS14)

Most pre-service teachers advocated more practical skills training because they believed that was most important. They felt with more practical work, they would be equipped with the necessary technological skills to teach with technology without any fear, to derive maximum benefits both for students and teachers alike.

Discussion

The results of this study clearly showed that in general, teacher educators fail to model technology for pre-service teachers. The study revealed that teacher education institutions do not place emphasis on the use of technology in teaching and learning. It was not mandatory for pre-service teachers to use technology for instruction. This finding concurs with Akaadom and Maphosa (2016) where in a study they found out that resource management and utilization in the training of pre-service teachers for technology integration into instruction in some selected colleges of education in Ghana was at a low ebb. The lack of technology resources in the colleges selected for the study as well as schools where pre-service teachers went on teaching practice made it difficult to use technology. Pre-service teachers reiterated that they are mostly not exposed to technology at their colleges by their teacher educators. This may be attributed to teacher educators' inability to use technology themselves for instruction. This finding is in line a study finding by Ottenbreit-Leftwich, Liao, Sadik, and Ertmer (2018) that teacher educators in most underdeveloped countries lack the skills to use technology themselves for instruction. Dinçer (2018) attribute this to the lack of support for teacher educators who mostly did not get the opportunity to learn to teach technology during their teacher training programs. In this present study, it was revealed that tutors at the colleges of education where teachers are trained do not use variety of technologies and so it was difficult for them to model the use of technology for the benefit of pre-service teachers. Although it was expected that students demonstrate the ability to integrate technology into instruction and model the use of it by their college administration at all time, they still failed to do so. This agrees to Segal and Heath (2020) study where they identified that teacher educator technology competencies in a field-based literacy methods course though mandated them to use technology for instruction, instructors still failed to integrate technology into instruction because they lacked the competencies to do so. The researcher in this present study verified the ability of pre-service teachers to choose appropriate technology tools to teach particular concepts and their response was positive. If that was anything to go by, it gives credence to their positive response to offer leadership in assisting others to coordinate the use of content, technologies and teaching approaches at their respective schools. In a study by Cochran-Smith, Stringer Keefe, and Carney (2018), they identified that teachers were positive about selecting technology tools for instruction and possibly offer help to those that might need it. To whether or not instructional technology teacher educators model technology appropriately for pre-service teachers, pre-service teachers affirmed that they do. However, they indicated that their major teaching subject tutors as well as their methods tutors failed to model technology for them. This concurs with a study finding by Shifflet and Weilbacher (2015) about teacher beliefs and their influence on technology use where it was indicated that teacher educators failed to appropriately model the use of technology for pre-service teachers for instruction. Based on the above discussion, it is recommended that teacher educators are given in-service training on technology use by their institutions and other stakeholders to be able to appropriately integrate technology into instruction and intuitively model its use for pre-service teachers.

Conclusion

Education is vital to economic growth by developing a skilled work force and increasing productivity. It is equally vital to social development, as it empowers people to improve their health, environment, and governance. The use of technology for instruction cannot be underestimated in the 21st century as it is the new norm. It is therefore being concluded from the study that teacher educators should take modelling technology for teacher training very seriously and work all out to assist them to develop the habit of integrating technology in teaching for the betterment of instruction as a whole.

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