Technological Pedagogical Content Knowledge Preparedness of Student-Teachers of the Department of Arts and Social Sciences Education of University of Cape Coast

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Abstract
The proliferation of digital technology in the 21st century in teaching and learning requires that teachers and students constantly interact with instructional technologies. This places a herculean task on the door step of teacher educators to ensure that student-teachers graduate from their institutions of training with some knowledge domains that would help them to integrate technology, pedagogy and content in their teaching. This study assesses the Technological Pedagogical Content Knowledge (TPACK) preparedness of student-teachers in the Department of Arts and Social Sciences Education (DASSE) of University of Cape Coast (UCC), Ghana. It uses the descriptive survey design. The stratified simple random sampling technique was used to sample 370 student-teachers of DASSE for the study. Questionnaire was adapted for the data collection. Descriptive (frequencies and percentages, mean of means and standard deviations) and inferential statistics (independent t-test) were used to analyse the data. The study reveals that the student-teachers in DASSE, UCC have Technological Knowledge. The study also found that the student-teachers of DASSE, UCC lack Technological Pedagogical Knowledge. In addition, the study has found that the student-teachers of DASSE, UCC lack Technological Content Knowledge. Moreover, the study establishes that the student-teachers of DASSE, UCC lacked Technological Pedagogical Content Knowledge. Lastly, there is no statistically significant difference between the gender of the student-teachers of DASSE, UCC and their TPACK preparedness. Hence, this study recommends that lecturers should continue to model the use of technology so that student-teachers can increasingly update their technological knowledge through observation and learning. Again, the Academic Board of UCC should advice the teaching departments on the need to infuse technology in their courses they offer for student-teachers. Finally, the teacher education programme offered by DASSE, UCC should be reconceptualised to respond to the technological needs of student-teachers.
Keywords: Technological Knowledge, Content Knowledge, Pedagogical Knowledge, Technological Pedagogical Content Knowledge

1.0 Introduction
The emergence of digital natives and digital immigrants has changed the approach to classroom instruction (Sadera, 2001). Classroom instruction is now characterised by an acceleration of instructional technologies designed to increase efficiency, expand productivity, and ultimately enhance students' total learning experiences. Today, classroom instruction is not only dependent on the content and pedagogical knowledge of the teacher but also on the technological knowledge of the teacher and his or her ability to use technologies such as wikis, blogs, and YouTube videos for instructional-related purposes in and out of the classroom. These technologies, to a large extent, have a reciprocal relationship with teaching and learning. As many of these new technologies have emerged overtime, so has the call for educators (teachers, parents, administrators, NGOs, and others) to find meaningful ways of incorporating these technologies into the classroom heightened.

This concern from stakeholders of education has become necessary because many teacher education programmes focus only on the development of sound pedagogical skills and competencies to meet the varying needs of learners in the classrooms. Tantrarungroj and Suwannatthachote (2012) lend credence to this that teacher education is designed basically to equip student-teachers with the pedagogical content knowledge, skills, and attitudes that are required for classroom teaching. They further cite Koehler and Mishra (2008) and Shulman (1986) who had earlier on argued that, every teacher is expected to possess teaching expertise that is derived from a combination of content knowledge, pedagogical knowledge and knowledge of environmental context to support their argument. However, with the growing use of technology in the educational environment, teachers need to combine technological knowledge, pedagogical knowledge and content knowledge when teaching.

This suggests that educators of today must not only prepare their educational charges academically but technologically as well, because teachers must employ 21st century technologies in their teaching (Clark, 2013). Thus, it is paramount that teacher preparation programmes develop and implement instructional programmes that would help future teachers to fully understand ways in which technologies can be used to expand student learning (Sadera, 2001). Sadera (2001) postulates that helping student-teachers to learn how to integrate technology into the curriculum is a critical factor for the successful implementation of technology applications in schools. However, this feat is not always achieved since some graduate teachers continue to experience severe

challenges in bridging the gap between theory and effective classroom practice (Clark, 2013).

In Ghana, Mereku, Yidana, Hordzi, Tete-Mensah, Tete-Mensah and Williams (2008) indicate that pre-service teacher training programmes of colleges of education and teaching universities provide little opportunity for trainees to learn skills necessary to integrate technology in teaching. That is, those responsible for teacher development (colleges of education and universities) have not created significant or meaningful opportunities for student-teachers to fully understand and explore the epistemological and pedagogical implications of technology to classroom practice.

Similarly, other studies in different jurisdictions since the beginning of the 21st Century point to the fact that pre-service teachers are inadequately prepared on the use of technology for instructional purposes (Hew & Brush, 2007; NEA, 2008). Even when teachers use technologies, their use is limited to only supplementary ways such as production of lesson materials and preparation for content (Graham, Tripp, & Wentworth, 2007) or "for teacher-centred activities, including information gathering or presentation" (Sheffield, 2011, p. 96). Hew and Brush (2007) observe that one major challenge inhibiting teachers' satisfactory or effective use of technology is that they lack "specific technology knowledge and skills, technology-supported-pedagogical knowledge and skills, and technology-related-classroom management knowledge and skills" (p. 227). This view is corroborated by An and Reigeluth (2011) in USA who posited that teachers do not only lack knowledge about learner-centred instructions, but also lack "knowledge about ways to integrate technology into learner-centred instruction" (p. 59).

One major criticism that has been levelled against the preparation of teachers to use technology in teaching has been that technology is taught as a set of context-free and separate knowledge and skills in technology classes and workshops (Zhao, 2003; Pope, Hare, & Howard, 2005). The argument behind this criticism is that technology knowledge and skills alone are not sufficient for teachers to unleash the power of technology that would catalyse educational changes. In this regard, Strudler, Archambault, Bendixen, Anderson and Weiss (2003) posit that for student-teachers to be effectively prepared to integrate technology in their teaching, their university education should entail: educational technology courses; integration of technology into methods and other content courses; and integration of technology in the field placements. As a result, in USA, the National Council for Accreditation of Teacher Education (NCATE, 2008), in its effort to ensure that teachers are prepared to employ twenty-first century technologies, has developed the National Educational Standards for Teachers in Taiwan (Liu, 2011). These standards seek to have teachers employ twenty-first century technologies in their classrooms to support teaching, learning and the curriculum while enriching the learning environment and experiences of the student (Liu, 2011).

In spite of this effort, research continues to find that most student-teachers and field teachers cannot integrate technology in their teaching as a result of the ineffectiveness of their teacher preparation programmes in ensuring that they acquire the knowledge to teach with technology. In China, Zhou, Zhang and Li (2011) found that in-service teachers were not well prepared by their teacher education programmes to use technology in teaching. Oren, Mioduser and Nachmias (as cited in Zhou, Zhang & Li, 2011) offered support to this view by observing that "most current teachers' pre-service preparation and subsequent in-service courses were devised in reference to traditional educational technology and settings. This renders student-teachers unfamiliar with the processes, interaction patterns, features and possibilities of technology-mediated educational transactions" (p. 944).

The situation is not different in Africa. In Malawi for instance, Kadzera (2006) indicated that there was minimal use of instructional technologies by tutors in the teacher training colleges and this accounted for the inability of most in-service teachers to incorporate technology in their teaching. Garba and Alademerin (2014) also revealed that student-teachers in Nigeria were not given adequate preparation in their universities and colleges of education to teach with technology in spite of the numerous polices and funds set up by the government. Similarly, in Ghana, Agyemang (2012) established that teachers' use of technology in teaching was very low due to the fact that they lack the skills to integrate technology in their teaching. The reason for this lack of skill, Agyemang intimated, is because teacher training programmes do not emphasize the acquisition of knowledge to blend technology, pedagogy and content. Agyei (2012), however, found that pre-service teachers' TPACK was effectively developed and that they are well prepared to use technology in the classroom. The literature on student-teachers' technological knowledge preparation, especially in Ghana, seems not to be consistent on whether or not student-teachers are adequately prepared to integrate technology in their teaching.

2.0 Statement of the Problem
The place of technology for teachers and students in the teaching and learning process cannot be overemphasized. Researchers have stressed the importance of the effective use of technology in teaching and learning (McFarlane & Sakellariou, 2002; Rogers, 2004). Through the use of technology, students' scientific investigations and reasoning can be constructively developed in order to help students connect constructed knowledge to practical work (McFarlane & Sakellariou, 2002). Additionally, the utilization of technology can help improve teachers'

attitudes, confidence, and instructional applications (Sorensen, Twidle, Childs, & Godwin, 2007), and help teachers understand scientific concepts and creativity (Rodrigues et al, 2003). Garba and Alademerin (2014) mention that the integration of technology in teaching makes the teaching-learning process activity-oriented, student-centred, and inquiry-based which eventually promotes the development of 21st century skills that are much needed to survive the challenges of living in the emerging knowledge societies. Therefore, teachers' knowledge to integrate content, pedagogy and technology has become important.

According Shulman (1986), the knowledge base for teaching in the 20th Century was the Pedagogical Content Knowledge (PCK) conceptualized in the mid-1980s in USA. However, following the advent of advanced technologies, Information and Communication Technologies (ICTs) have become an integral component of the day-to-day life of teachers and students (Arreman, 2005). It was thus argued that from 2005 the knowledge base for teaching in the 21st century was the technological pedagogical content knowledge (Liu, 2011). This suggests that teacher education should not emphasize only PCK but also TK.

Studies by Liu (2011) in Taiwan, Zhou, Zhang and Li (2011) in China, and Clark (2013) in USA, showed that student-teachers' are not prepared to integrate technology in their teaching. In Ghana, it seems only two studies, Agyei (2012) and Agyemang (2012), have been conducted to find out whether student-teachers have the requisite skills to teach with technology. For instance, Agyemang (2012) established from his study that teacher training programmes do not emphasize the acquisition of knowledge to blend technology, pedagogy and content and this makes teachers ineffective in teaching with technology. Agyei (2012) is, however, of the view that student-teachers were well prepared to integrate technology in their teaching. From this, it appears little is known as research findings do not seem to agree on whether the student-teachers' TPACK is adequately prepared to enable them integrate technology in their teaching.

It also appears from literature that apart from the study conducted by Agyei (2012) and Agyemang (2012) in Ghana, no other empirical studies have been conducted to find out whether student-teachers have the required knowledge to integrate technology, pedagogy and content. It is these gaps in knowledge that have motivated this study to assess the TPACK preparedness of student-teachers in DASSE, UCC.

3.0 Purpose of the Study
The thrust of this survey study is to assess the TPACK preparedness of student-teachers in DASSE, UCC. Specifically, the study assessed: the TK preparedness of the student-teachers; the TPK preparedness of the student-teachers; the TCK preparedness of the student-teachers; the TPCK preparedness of the student-teachers.

4.0 Research Questions
The following research questions guided the study:
1. What is the TK preparedness of student-teachers of DASSE, UCC?
2. What is the TPK preparedness of student-teachers of DASSE, UCC?
3. What is the TCK preparedness of student-teachers of DASSE, UCC?
4. What is the TPCK preparedness of student-teachers of DASSE, UCC?

5.0 Significance of the Study
The study focused on student-teachers' technological pedagogical content knowledge preparedness. Its findings bring to light the TK preparedness of student-teachers of DASSE, UCC. This would inform teacher-educators and the planners of the curriculum at DASSE, UCC to gain awareness on whether the programmes in the department are adequately preparing student-teachers' knowledge on technology. This may influence the department's endeavours to reconceptualise the teacher preparation programmes, if the need be.

Again, the findings of the study would create awareness among student-teachers on the knowledge base they require for effective teaching in the twenty-first century. By this, their technological consciousness would be awoken. Its implication is that, student- teachers' would be informed to pursue technologically viable ways of teaching in order to successfully to meet the demands of the twenty-first century classrooms.

In furtherance of the above, the findings would give a sense of direction to departments within the College of Education Studies on the kind of courses to provide and approve for student -teachers. This would especially heighten the impetus to include technology in the training of student-teachers.

Lecturers would also benefit from the study as the status of student-teachers' TPACK preparedness would be unravelled. This would inform the approaches they use to teach, whether they themselves have to learn more about technology, content and pedagogy or not. This would ultimately affect the lecturer's effort to build the technological pedagogical content knowledge base of the students to ensure that appropriate technologies are incorporated into the course, and during teaching practice, student-teachers are made to use technology in their teaching.

Moreover, the findings of the study have established whether differences exist in the TPACK preparedness of male and female student-teachers. This would inform teacher educators of UCC to plan their

programmes to respond to the technological needs of the gender of the student-teachers. Finally, the findings of the study serve as a primary document to other researchers who are interested in conducting further studies on the TPACK preparedness of student teachers.

6.0 Conceptual Framework: TPACK
This study is underpinned by the Technological Pedagogical Content Knowledge (TPACK) framework conceptualized by Koehler and Mishra (2006) as an extension of the knowledge domains for teaching proposed by Shulman (1986). The TPACK is made up of seven constructs namely; Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK).
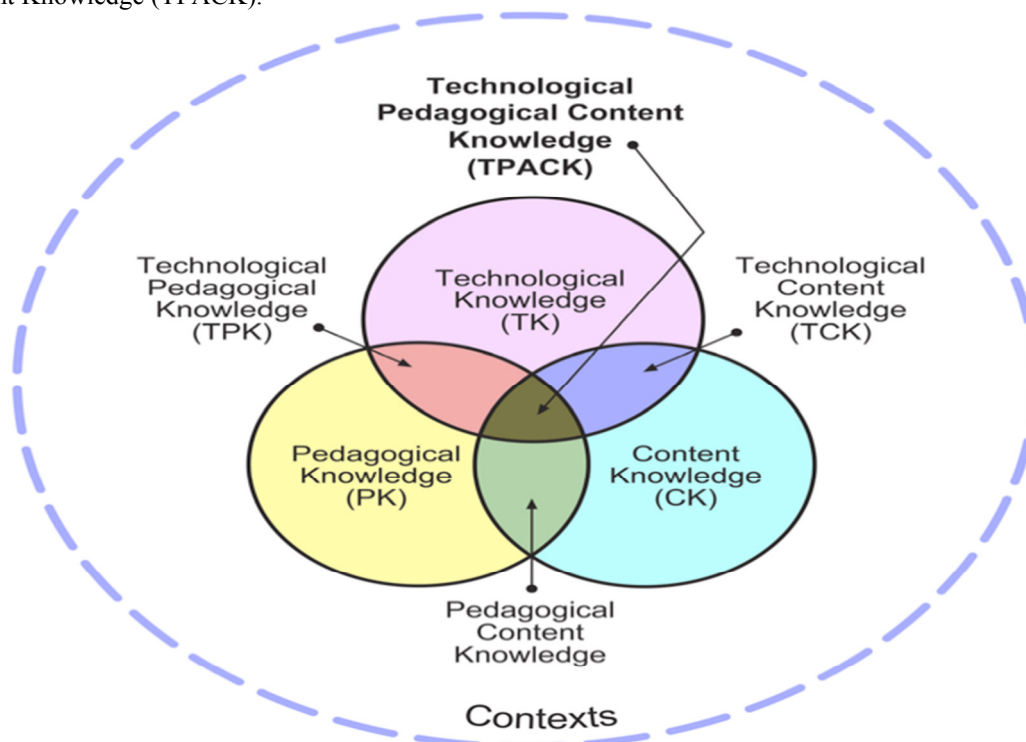

Figure 1: TPACK framework by Koehler and Mishra (2006)

6.1 Content Knowledge (CK)
Content Knowledge is knowledge about the actual subject matter that is to be learned or taught. For example, senior high school history, senior high school economics, or graduate level curriculum and its processes (Harris, Mishra & Koehler, 2007). Knowledge and the nature of inquiry differ greatly among content-areas and it is critically important that teachers gain this understanding. Shulman (1986) notes that CK includes knowledge of concepts, theories, ideas, organizational frameworks, knowledge of evidence and proof, as well as established practices and approaches toward developing such knowledge. It is important that student-teachers are effectively prepared by their teacher-education programmes to develop mastery over the content. As a result, Pfundt and Duit (2000) caution that the cost of not having a comprehensive base of content knowledge can be quite prohibitive. Students can receive incorrect information and easily develop misconceptions about the content area.

6.2 Pedagogical Knowledge (PK)
Pedagogical Knowledge (PK) is knowledge about the processes and practices or methods of teaching and learning. It encompasses knowledge of educational purposes, values, aims, and more. It is a generic form of knowledge that applies to student learning, classroom management, lesson plan development and implementation, and student evaluation. It also includes knowledge about techniques or methods used in the classroom; the nature of the target audience; and strategies for evaluating student understanding. A teacher with deep PK understands how students construct knowledge and acquire skills in different ways, and how they develop habits of the mind and dispositions toward learning. As such, pedagogical knowledge requires an understanding of cognitive, social and developmental theories of learning and how they apply to students in the classroom (Shulman, 1986). This makes PK "tools of the trade" and every teacher is required to possess it. This also means that student-teachers should be trained to possess this form of knowledge.

6.3 Pedagogical Content Knowledge (PCK)

Pedagogical content knowledge (PCK) is the intersection and interaction of pedagogical knowledge and content knowledge. PCK as used in this study is similar to Shulman's (1986) conceptualization of teaching knowledge applicable to a specific content area. PCK covers knowledge of the core business of teaching, learning, curriculum, assessment and reporting. It also deals with the awareness of students' prior knowledge, alternative teaching strategies, common content-related misconceptions, and how to forge links and connections among different content-based ideas. It also deals with the flexibility that comes from exploring alternative ways of looking at the same idea or problem, and more, which are considered as essential to effective teaching (Shulman, 1986).

In addition, the PCK addresses the process of knowing the multiple ways of representing and formulating subject matter. PCK, therefore, allows the teacher to focus on making concepts understandable, based on the abilities and interests of learners. In view of this, Shulman (1987 as cited in Koehler & Mishra, 2006) defines PCK to include, the most regularly taught topics in one's subject area, the most useful forms of representations of those ideas, and the most powerful analogies, illustrations, examples, explanations, and demonstrations. Shulman (1986) cautions that since there is no single most powerful forms of representation, the teacher must have at hand a veritable armamentarium of alternative forms of representation, some of which are derived from research whereas others originate in the wisdom of practice. Teachers are also expected to have an understanding of what makes the learning of specific topics easy or difficult; the conceptions and preconceptions that students of different ages and backgrounds bring with them to learning. If those preconceptions are misconceptions, teachers need knowledge of the strategies most likely to be fruitful in reorganizing the understanding of the learners.

Thus, PCK encompasses knowledge of pedagogies and the planning processes that are appropriate and applicable to the teaching of a given content at any given time (Abbitt, 2011). For effective teaching, Harris et al. (2009) maintains that knowledge of teaching and learning, assessment procedures, awareness of students' prior knowledge and content-related misconceptions are very essential. The awareness of these issues constitutes teachers' PCK. It deals with how to design specific subject matter or problems and teach it effectively to suit learners of diverse abilities.

Thus, the acquisition of only CK is as useless as content-free skills (Shulman, 1986). This means that teachers' possession of content knowledge without the skills that will make it comprehensible to students renders it invaluable in the teaching and learning process. In view of this, there is a herculean task on student-teachers to find the appropriate means of ensuring that they have knowledge of the content and knowledge of the pedagogy which forms their PCK.

6.4 Technological Knowledge (TK)

Technological Knowledge (TK) refers to knowledge about standard technologies such as books, chalk and blackboard, and more advanced technologies like the internet and digital video (Koehler, Mishra, Hershey & Peruski, 2004). TK involves the knowledge that is required to operate particular technologies. These include knowledge of operating systems and standard sets of software tools such as word processors, spreadsheets, browsers and e-mail. Mishra and Koehler also added knowledge of how to install and remove peripheral devices, install and remove software programmes, and create and archive documents. It is however important to note that, TK is not static. This presupposes that teachers would have to acquaint themselves with special sets of TK that would help them adjust to new technologies that would emerge with time. In this regard, it is imperative for teacher training programmes to be designed to accommodate the dynamic nature of technology.

6.5 Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge (TPK) is knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and how teaching might change as a result of using particular technologies (Mishra & Koehler, 2006). Graham, Cox and Velasquez (2009) see TPK as the knowledge of general pedagogical activities that a teacher can engage in using emerging technologies. Again, Schmidt, Baran, Thompson, Mishra, Koehler and Shin (2009), view TPK as "knowledge of how various technologies can be used in teaching and the understanding that using technology may change the way teachers teach" (p. 125). To Owusu (2014), TPK is knowledge of using technology to implement different teaching methods.

From these definitions, it is clear that TPK deals with how teachers are able to make their subject matter knowledge comprehensible and accessible to students through the use of technologies. Therefore, TPK is an understanding that a range of tools exist for a particular teaching task, the abilities to choose a teaching tool based on its fitness, strategies for using the teaching tools, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies. Again, it becomes obvious that technological content knowledge is pre-requisite for technological pedagogical knowledge. This is because knowing about the

existence of technological aiding devices is crucial, and the art of knowing how to effectively introduce these devices to the appropriate contents or topics and at what particular time in the instructional process epitomizes the whole idea expressed here. It should be noted, therefore, that it is also a general pedagogic activity that embraces teacher craft; thus the whole business of improvising and being innovative so that the ultimate result yields effective content delivery to students. Students going through their pre-service preparation programme should therefore be conscious of this noble demand of the profession in the 21st century. By implication, teacher education programmes must expose prospective teachers to ways of representing and formulating subject matter with repertoire of emerging digital devises.

6.6 Technological Content Knowledge (TCK)

Technological Content Knowledge (TCK) is an understanding that technology and content influence and constrain each other (Mishra & Koehler, 2006). This shows that there is a bidirectional relationship between technology and content. On one hand, content constrains the representations given with technology, and on the other hand, technology can constrain the kinds of representations possible. This view is in consonance with the views expressed earlier by Mishra and Koehler (2006) that technological content knowledge is about the manner in which technology and content are reciprocally related. That is to say that technology constrains the representation of the subject matter taught. Conversely, technology affords the types of content to be taught. Mishra and Koehler, therefore, indicate that teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be enhanced by the application of technology, and this knowledge must be flexible enough to permit time and context adjustment. In view of this, Clark (2013) suggests that technological content knowledge must be "flexible, creative, and adaptive" to enable teachers manage, direct and employ technology in context-specific ways.

6.7 Technological Pedagogical Content Knowledge (TPCK)

Technological Pedagogical Content Knowledge (TPCK) is a form of knowledge that goes beyond the three separate components such as technological knowledge, technological content knowledge and technological pedagogical knowledge. TPCK is a synergistic construct that combines these separate knowledge base for effective teaching. Koehler and Mishra (2006) and Owusu (2014) posit that TPCK treats technology, content, and pedagogy in unionism and blends the three separate constructs (content, technology and pedagogy) in a complex relationship. It is the understanding that arises from the interactions and interplay between and among technology, content, and pedagogical knowledge that forms the basis of meaningful technology integration in teaching. They further argue that TPCK underlies the basis of good teaching which is informed by technology and requires an understanding of the representation of concepts using technologies. It also embraces the deployment of pedagogical techniques that use constructive ways to teach content, knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face.

The TPACK framework suggests that the integration of technology in teaching and learning requires a thoughtful interweaving of all three sources of teacher knowledge: technology, pedagogy and content. The basis of this argument as suggested by Mishra and Koehler (2006) is that there is no single technological solution that applies for every teacher, every course or every classroom activity. As a result, Mishra and Koehler notes that quality teaching requires the understanding of the complex relationships between technology, content and pedagogy, and using this understanding to develop appropriate, context specific strategies and representations. Therefore, teacher preparation programmes should prepare student-teachers towards the use of a more comprehensive framework for teaching such as TPACK. This lends credence to Clark's (2013) position that technology integration should form the basis of teacher preparation in relation to specific Pedagogical Content Knowledge (PCK). This is to enable student-teachers understand how to employ twenty-first century technology for instructional purposes. Clark (2013) further proposes that for student-teachers to be prepared to integrate technology in their teaching, three conditions must be followed;

1. Student-teachers need to acquire foundational technological knowledge and technical literary to deal with technologies.
2. Student-teachers should be afforded opportunities to experiment with how to combine this technology-specific knowledge with their knowledge of pedagogy.
3. Student-teachers should be able to repurpose technology in their efforts to integrate 21st century technology into their specific instructional settings.

In essence, student-teachers should be given ample opportunity to learn about technologies and how they can connect these technologies with their pedagogical practices to change classroom instruction.

7.0 Methodology

The research adopted the descriptive survey design. This design was adopted for the study because it enables the researcher to describe, observe and document aspects of a situation as it naturally occurs rather than explaining it.

Thus, by using this design the researcher hoped to ascertain meaningful or useful diagnosis of the situation since it involves describing, recording, analysing and interpreting conditions that exist. Therefore, the descriptive survey was deemed an appropriate design for assessing the TPACK preparedness of student-teachers of the University of Cape Coast.

The target population of the study was all student-teachers in DASSE, UCC in the 2015/2016 academic year. The accessible population was level 400 student-teachers. Only level 400 student-teachers were involved in the study because they had spent more years in the university as student-teachers. Thus, had done majority of the courses that prepare student-teachers effectively for teaching in the 21st Century, and were therefore in the position to provide appropriate responses for the study.

A total of 375 student-teachers of DASSE, UCC were sampled for the study. The researcher's decision to select 375 from a population of 566 student-teachers was influenced by Bartlett, Kotrlik and Higgins (2001) table for determining sample size. According to Bartlett, Kotrlik and Higgins (2001), the minimum figure that could be sampled from a population of about 600 is 235. However, the researcher used 375 student-teachers for the study in order to increase external validity. To ensure that the sample was more representative of the population in each school, the systematic sampling technique was employed. This was selected the respondents according to a random starting point and a fixed periodic interval. An interval of 2 was calculated by dividing the population size by the desired sample size. Questionnaire was used to collect data for the study. The questionnaire was adapted from Chai, Koh and Tsai (2010), Chai, Ng, Li, Hong and Koh (2013), Nordin, (2014), Schmidt et al. (2009), Archambault and Crippen (2009), Graham, Burgoyne, Cantrell, Smith, Clair and Harris (2009). The decision to use this instrument was because it had reliability coefficients of 0.7 and above for the various constructs of the TPACK framework. All the items on the questionnaire were close-ended because according to Cohen, Manion and Morrison (2003), they are quick to compile and straight forward to code, and do not discriminate unduly on the basis of how articulate the respondents are. The items on the questionnaire were structured on a five point likert-type scale that ranged from "Strongly agree (SA) =5, "Agree" (A) =4, "Uncertain" (U) =3, "Disagree" (D) =2 to "Strongly Disagree" (SD) =1. The use of the five point likert-scale was informed by the suggestion by McKelvie (as cited in Owusu, 2014) that five-category scale is more reliable as compared to the other scales. Besides, most of TPACK surveys especially those that served as a model for this study used a five-point Likert scale. The questionnaire was subsequently pre-tested in the University of Education, Winneba. This institution was chosen because the characteristics of pre-service teachers were not substantially different from their counterparts in the University of Cape Coast in terms of their entry behaviours and ages. The questionnaire was piloted among 37 pre-service teachers in the University of Education. The Cronbach's alpha reliability of the instrument from the pilot study was 0.962. Fraenkel and Wallen (2000) assert that "for research purposes, a useful rule of thumb is that reliability should be at .70 and preferably higher" (p.179). The instrument was not modified since none of the items were found to be misleading. The pilot test took place in November 2015 whilst the data collection took place in February, 2016. Frequencies and percentages, mean of means and standard deviations were used to analyse the obtained data.

8.0 Results and Discussion

8.1 Demographic Characteristics of the Respondents

The demographic characteristics of the student-teachers which were considered section included: gender, age and the programme of study. These demographic characteristics were considered important because they could aid the analysis of the research hypothesis that was formulated. Again, they would provide and enrich the understanding about the category of respondents who were involved in the study. The results are presented in Tables 1.

Table 1 - *Gender of Respondents*

Gender	No.	%
Male	243	65.7
Female	127	34.3
Total	370	100

Source: Field Data, 2016

Table 1 shows that majority (65.7%) of the respondents were males whilst 127(34.3%) were females. This shows clearly that there is a gender disparity in the respondents used for the study. The relatively large number of male student-teachers lends credence to the general assumption that the Ghanaian educational system admits more males than females (Atuahene & Owusu-Ansah, 2013). This would, however, not have any negative impact on the findings of the study as the sampling was based on the representativeness of the gender of the respondents as described in the population.

Table 2 - *Age of Respondents*

Age	No.	%
20 years and Below	21	5.7
21-25 years	291	78.6
26-30 years	50	13.6
30 years and above	8	2.2
Total	370	100.0%

Source: Field Data, 2016

Table 2 shows that 291(78.6%) of the respondents were between the ages of 21-25 years whilst a few of the respondents were 30years and above. The age distribution of the respondents is located within what Prensky (2001) describes as 'digital natives'. According to the Prensky, people born after 1984 fall within this description. Therefore, the assumption is that the students within these age categories may have had the opportunity to interact with the internet, laptops, digital cameras, and many other digital technologies that allow them to instantly capture or communicate with their world. It could therefore be argued that when their training programmes are informed by technology they are likely to acquire adequate technological pedagogical content knowledge quicker. Consequently, this would go a long way to ensure that they become effective teachers in the 21st century. Their ages also presume that they are ideal for the teaching profession as they would bring much energy and commitment to the teaching and learning process, especially, when they have the expertise that would aid teaching with technology as demanded by the teaching profession in the 21st century.

Table 3 - *Programme of Study of Respondents*

Programme	No.	%
B. Ed Accounting	65	17.6
B. Ed Management	119	32.2
B. Ed Social Science	102	27.6
B. Ed Arts	49	13.2
B. Ed Social studies	35	9.5
Total	370	100.0

Source: Field Data, 2016

Table 3 shows the programme of study of the respondents. It is seen from the Table that, the majority (32.2%) of the respondents were reading B.ED Management, and only a few (9.5%) of the respondents were reading B. ED Social studies. It appears that DASSE trains more teachers in management relative than in the other disciplines. This is apparent because the sample, as drawn from the various programme, was proportionate to the population.

8.2 Main Discussions
This section deals with the discussion of the data from the field to address the research questions that were formulated to guide the study. The five point Likert scale questionnaire that was administered was analysed using mean of means and standard deviations. From the analysis, a mean of 3.50 and above showed the agreement of the respondents to the statement whilst a mean of 2.4-3.4 meant the respondents were not sure of the statement. However, a mean of 2.40 and below showed disagreement of the respondents to the statement. A standard deviation below 1.0 showed that the responses from the respondents were homogeneous and heterogeneous when it was above 1.0.

Research Question One: What is the Technological Knowledge (TK) Preparedness of Student-teachers of the Department of Arts and Social Sciences Education?

Research question one sought to find out the TK preparedness of student-teachers of DASSE, UCC. In view of this, there was an attempt to ascertain the outlook of the student-teachers regarding their TK. The results are presented in Table 4.

Table 4 - *Technological Knowledge (TK) Preparedness of Student-teachers*

Statement	Mean	SD
I have the technical skills I need to use technology.	3.79	1.05
I have the knowledge to learn technology easily.	4.21	0.90
I can solve the problems that I encounter when using technology.	3.44	1.09
I know different types of technology.	3.53	1.01
I can install a new programme that I would like to use.	3.71	1.29
I can create and edit a video clip.	2.94	1.31
I can create my own website.	2.77	1.36
I can save an image from a website to the hard drive of my computer.	3.90	1.21
I can send an email with an attachment.	4.09	1.16
I can create a basic presentation using PowerPoint or a similar programme.	3.69	1.25
I can create a document with text and graphics in a word processing programme.	3.44	1.41
Mean of Means/Average Standard Deviation	3.52	1.11

Source: Field Data, 2016

Table 4 presents the results of the data collected on the TK of student-teachers of DASSE, UCC. Majority (M = 3.79, SD = 1.05) of the respondents agreed that they had the technical skills to use technology. The respondents were heterogeneous in their responses. In simple terms, student-teachers, to a greater degree have the ability to accept and use varied technologies. For instance, the majority (M = 4.21, SD = 0.90) of them were of the view that they had the knowledge to learn technology easily. This finding is remarkable because, technology, like the environment, keeps changing, therefore student-teachers who are prospective teachers should be ready to learn the new emerging technologies.

Again, student-teachers indicated that they were abreast with varieties of technology (M = 3.53, SD = 1.01). This further confirmed their acceptance of technology. One could also estimate that, given this finding, student-teachers would be most likely to perform tasks that require technological consciousness. It was, therefore, not surprising that the majority (M = 3.71, SD = 1.29) of the student-teachers revealed they could install a new programme that they would want to use. They could also save images from a website to the hard drive of their computers (M = 3.90, SD = 1.21), send emails with attachments (M = 4.09, SD = 1.16) and create presentations using PowerPoint ICT resources (M = 3.69, SD = 1.25). These are attributable to the fact that students are made by their lecturers to send and deliver assignments via the emails and through oral presentations. Most universities are also "going digital" where they use the e-learning platform in order to make teaching and learning accessible to all learners despite the busy schedules of lecturers. Such a platform is good in enhancing student-teachers technological knowledge and making them appreciate the use of digital tools (Zhang & Martinovic, 2008).

Nevertheless, student-teachers were ambivalent about their ability to solve problems that they encountered when using technology (M = 3.44, SD = 1.01). They also hinted that they were uncertain if they could create their own websites (M = 2.77, SD = 1.36) and edit video clips (M = 2.94, SD = 1.31). It appears that, even though student-teachers seem plausible or attached to technology, their awareness on technology is not at the desired level of acceptance (Ekrem & Recep, 2014). This further gives room for the presumption that student- teachers are, as well, going to be faced with the challenge of using more sophisticated technology resources such as video processing, web page development, creating reusable learning objects, data base, multimedia and composition, as reported in a study by Raman (2014).

Overall, the mean of means (mean = 3.52) suggests that student-teachers have technological knowledge and as such their level of technology awareness or consciousness is appreciably high. This direction of the response suggests that student-teachers may be able to teach with technology when they assume the mandate as classroom teachers. The finding, however, contradict the findings of Owusu (2014) and Roig-Vila, Mengual-Andrés and Quinto-Medrano (2015) that teachers do not think that they own much knowledge about different technological elements and cannot keep up with new technologies. Again, the findings of Savas (2011) that most pre-service teachers were not interested in technology as a whole is refuted by the finding of this study.

Although student-teachers have technological knowledge, it is important that these student-teachers are given the necessary support to interact and play with technologies. Juarez (2014) cautions that technological advancements become outdated within thirty days or less. In view of this, creative ways must be sought and developed to provide the latest information on a daily and consistently on-going basis for teachers so that teachers can interact and work with emerging digital devices.

Research Question Two: What is the Technological Pedagogical Knowledge (TPK) Preparedness of Student-teachers of the Department of Arts and Social Sciences Education?

Research question two sought to find out the TPK preparedness of student-teachers of DASSE, UCC. In view of this, there was an attempt to ascertain the outlook of the student-teachers regarding their TPK. The results are presented in Table 5.

Table 5 - *Technological Pedagogical Knowledge (TPK) Preparedness of Student-teachers*

Statement	Mean	SD
I can use technologies that enhance the teaching approaches for a lesson.	2.50	1.45
I can use technologies that enhance students' learning of a lesson.	2.34	1.30
My teacher education programme has stimulated me to think more deeply about how technology could influence the teaching approaches I use in the classroom.	2.03	1.27
I can use technologies that are appropriate for my teaching.	2.08	1.34
I can apply technologies to different teaching activities.	2.06	1.22
I can use technologies to assess students learning.	2.33	1.30
I can use technology to introduce my students to real world scenarios.	2.44	1.34
I can assist my students to use technology to plan and monitor their learning.	2.40	1.31
I can assist my students to use technology to construct different forms of knowledge representations.	2.26	1.29
I can assist my students to collaborate with each other using technology.	2.08	1.27
I can use technology to motivate students.	2.16	1.32
I can use technologies to improve communication with students.	2.33	1.35
I can use technologies to improve my teaching skills	2.30	1.36
I can use technologies to improve the presentation of information to learners.	2.26	1.37
Mean of Means/Average Standard Deviation	2.25	1.31

Source: Field Data, 2016

Teachers have come to employ ways that can effectively facilitate the teaching approaches during the delivery of their subject matter. Technology seems to be one of such effectual tools in facilitating the teaching approaches in a lesson. Earlier results affirmed that student-teachers in DASSE, UCC have high awareness about technology. However, the outcome of this research question suggests that the student-teachers of DASSE, UCC are uncertain as to whether they can use technologies to enhance their teaching approaches (M = 2.50, SD = 1.45). It was, therefore, not surprising that the student-teachers alluded to the fact that they did not keep up with certain technologically-enhancing attitudes. For example, majority (M = 2.34) of the respondents disagreed to the statement that they could use technologies that enhance students' learning. The seeming connotation brought forward by this revelation is that even though student-teachers have technological knowledge, they cannot integrate it into their pedagogical practices.

It appears the challenges associated with this revelation manifests in many other ways. For example: student-teachers cannot use technologies appropriately; they cannot apply it to different teaching activities; they can use it to assess students' success; neither can they use it to motivate or assist students any way that can heighten the academic gains of pupils. Table 7 highlights more of these seeming challenges. This is certainly going to make it difficult for student-teachers to see the essence of technology in classroom practices, as these prospective teachers cannot unleash technologies to aid the teaching and learning process (Lu, 2014). Hooper and Reiber (1995) support the claim that technology is expected to facilitate the activities in the classroom and to enhance students learning.

The problem is apparent because majority (M = 2.03, SD = 1.27) of the student-teachers hinted that their teacher education programme do not stimulate them to think more deeply about how technology could influence their pedagogical practices. In other words, the student-teachers were of the view that the teacher education programme did not in any way inspire them to critically think critically as far as the influence of technology on teaching approaches is concern. Hence, for student-teachers to effectively appreciate the integration between technology and pedagogy, there is the need for a concentric effort between both the college lecturers and the student-teachers driven by the curriculum or educational programme on the use of technology in teaching (Alev, 2003).

The overall mean of means (M = 2.25) suggested that student-teachers technological pedagogical awareness was relatively low. This implied that, generally, there was a disconnection between students' knowledge of technology and their ability to adeptly use their knowledge to affect their methodological competencies. By implication, these students were left out when it comes to technological dynamism in the classroom. Thus, student-teachers missed out on the benefits that accrued to having a technological touch to one's teaching. It could be presumed that student-teachers would not use technological tools such as excel and other useful software to assess and provide immediate and statistically important feedback to learners on their academic performance. In effect, it is really devastating to know that student-teachers possessed technological knowledge (M = 3.52) but could not integrate the knowledge they had with pedagogy in order to facilitate classroom interaction.

The finding of this research question is partly in line with the findings of Tinmaz (2004) which reported that pre-service teachers in Turkey were graduated with a less than moderate level of competency in teaching with technology. In support, Lee, Smith and Bos (2014) found from their study that the pre-service teachers were

not knowledgeable about how they could perform more abstract competencies, including using technology for real world problem solving, discussing ethical issues, and discussing technology diversity issues.

On the contrary, Owusu (2014), in his study reported that teachers could choose and apply technologies that were appropriate for different teaching activities. Again, Oz's (2015) conclusion that pre-service teachers had knowledge of how to evaluate software, tasks and students' performance in a technologically oriented classroom is apparently refuted by these findings. Smith (2012) also found that teachers were exposed to a wide range of technologies throughout their programme, including: Smart boards, science probes, and clickers; PowerPoint presentations, digital portfolios, photo stories, learning objects and websites and this stimulates them to use technology in the teaching and learning process, which is not entirely the case in this study.

Research Question Three: What is the Technological Content Knowledge (TCK) Preparedness of Student-teachers of the Department of Arts and Social Sciences Education?

Research question three sought to find out the TCK preparedness of student-teachers of DASSE, UCC. In line with this, there was an attempt to ascertain the outlook of the student-teachers regarding their TPACK. The results are presented in Table 6.

Table 6 - *Technological Content Knowledge (TCK) Preparedness of Student-teachers*

Statement	Mean	SD
I know how my subject matter can be represented with the application of technology.	2.13	1.23
I know about technologies that I can use for enhancing the understanding of specific concepts in my subject matter.	2.11	1.21
I know about the technologies that I have to use for the research of content of my subject matter.	2.10	1.22
I can use appropriate technologies (eg. multimedia resources, simulation) to represent the content of my teaching subject.	2.06	1.17
I know about technologies that I can use for enhancing the understanding of specific concepts in my subject matter.	2.06	1.18
I can use technology representations (i.e., multimedia, visual demonstrations, etc.) to demonstrate specific concepts in my subject matter.	2.12	1.18
Mean of Means/Average Standard Deviation	2.10	1.2

Source: Field Data, 2016

Student-teachers ability to determine which specific technologies can best be used in teaching subject specific content is crucial as far as pedagogical content knowledge is concerned. Results from Table 8 show the level of student-teachers technological content knowledge. As seen from Table 6, majority (M = 2.13, SD = 1.23) of the student-teachers disclosed that they did not know how their subject matter could be presented with the application of technology. This implies that when given specific array of technologies, student-teachers would find it difficult to select suitable technologies to present the teaching of their respective contents. It is well known that, student-teachers are likely to be accustomed to the 'traditional' technologies such as the chalk, chalkboard, pens, books and many others.

The majority (M = 2.11, SD = 1.21) of the respondents, however, indicated that they did not know about technologies that they could use for enhancing the understanding of specific concepts in their subject matter. Here, the emphasis was on relatively more advanced technologies other than the traditional ones. Just as each concept in the syllabus is presumably well-taught using a particular method of instruction such as discussion, question and answer, dramatization, among others, specific technologies could also determine the teaching of specific concepts. Nevertheless, the student-teachers could not determine the technology to use to teach specific concepts in their various subjects. It appears that the challenges arise from the fact that the student-teachers were ignorant of the kinds of technologies they could use to undertake research on the content they teach (M = 2.10, SD = 1.22).

Overall, the mean of means (M = 2.10) points to the fact that student-teachers' technological content knowledge is relatively low. Technologies seem to have come, among many other things, to help teachers to develop and progress in their teaching. As such, this era of knowledge explosion places burden on teachers in ensuring that they flow with current truth and fact that are technologically informed (Toyama, 2011). Classroom teaching goes with a lot of explanations, questioning and demonstrations in order to foster understanding. Teachers' inability to demonstrate mastery of content and pedagogic proficiency (as identified in research question three) in the face of technology is likely to make their classrooms boring and ineffective, coupled with denied in-depth understanding of concept on the part of students. The implication of the finding puts something on the plates of teacher educators in this context. Efforts should be geared toward the integration of technology into the teacher education curriculum in order to provide way for the total accomplishment of the prospective teacher. In the view of Juarez (2014), providing integration of technology into the curriculum and into all content areas requires that educational leadership at every stage sees the need to remain in a status of technological vigilance. This would provide students with the foundations they require in learning content and pedagogy and

the latest ways to integrate technological advances and strategies to change the way learners acquire and retain knowledge and information.

What has been found in this study does not support the findings of Owusu (2014) that teachers know how their subject matter can be represented by the application of technology. Owusu (2014) further noted that teachers in New Zealand can use technological representations (i.e. multimedia, visual demonstrations, and many more) to demonstrate specific concepts in their subject matter. Owusu's finding might have been influenced by the context in which the study was conducted. This is because, it is expected that New Zealand, all other things being equal, would have their teachers exposed to technology than teachers in Ghana.

Research Question Four: What is the Technological Pedagogical Content Knowledge (TPCK) Preparedness of Student-teachers of the Department of Arts and Social Sciences Education?

Research question four sought to find out the TPCK preparedness of student-teachers of DASSE, UCC. In this regard, there was an attempt to find out TCK preparedness of the student-teachers. The results are presented in Table 7.

Table 7 - *Technological Pedagogical Content Knowledge (TPACK) Preparedness of Student-teachers*

Statement	Mean	SD
I can teach lessons that appropriately combine my subject matter, technologies and teaching approaches.	2.09	1.11
I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.	1.97	1.14
I can use strategies that combine content, technologies, and teaching approaches in my classroom.	1.79	1.00
I can use technologies that enhance the understanding of the content for a lesson.	1.84	1.06
I can find and use online materials that effectively demonstrate a specific principle in my subject area.	1.93	1.13
I can use technology to facilitate scientific inquiry in the classroom.	2.18	1.29
I can use technology to create effective representations of content that departs from textbooks approaches.	2.26	1.26
I can structure activities to help students to construct different representations of the content using appropriate technologies (e.g., Webspiration, Mindmaps, and Wikis).	2.23	1.20
I can create self-directed learning activities of the content knowledge with appropriate technologies (e.g., Blogs, Web quests).	2.23	1.23
I can design inquiry activities to guide students to make sense of the content knowledge with appropriate technologies (e.g., simulations, web-based materials).	2.29	1.24
Mean of Means/Average Standard Deviation	2.08	1.12

Source: Field Data, 2016

Table 7 presents the result on student-teachers TPCK. This construct critically looks at how student-teachers can effectively integrate the other earlier constructs discussed for effective classroom instruction. The TPCK construct summarises the TPACK theory. From the framework, teachers should be able to ensure learners' understanding with the appropriate integration of technology, pedagogy and content knowledge. Student-teachers when equipped with TPCK would ensure learners' comprehension of the subject matter.

Results from Table 9 shows that majority (M = 2.09, SD = 1.11) of the student-teachers indicated that they could not teach lessons that appropriately combined their subject matter, technologies and teaching approaches. Earlier findings from this study had suggested that the student-teachers have relatively low knowledge in how technology could influence their subject matter delivery and choice of methodologies. As a result of this identified challenge, majority (M = 1.97, SD = 1.14) of the student-teachers stated that they could not use technologies in their classroom that enhance what they taught, how they taught and what the students learned. Coupled with this, they intimated that they could not find and use online material that effectively demonstrated specific principle in their subject area; they could not use technology to facilitate scientific inquiry in the classroom; they could not also use technology to create effective representations of content that departed from textbook approach (see Table 9).

In a nut shell, the mean of means (M = 2.08) suggests that student-teachers' technological pedagogical content knowledge is relatively low, this would impede effective teaching in this 21st century classrooms (Guzey, & Roehrig, 2009). TPACK addresses three crucial areas in teaching: enhancing what is taught (content) with technology, enhancing the choice of methods (pedagogy) with technology; and enhancing students learning with technology (Mishra & Koehler, 2006). This is a unified knowledge that all student-teachers need to possess. However, the findings strongly demonstrated that student-teachers did not have this unified knowledge. This only means that the desired accomplishment expected of the school system would be greatly impeded. For instance, the knowledge economy seems to be facilitated highly by online materials. Again, discovery as well as enquiry learning has been a useful approach in teaching this new era of leaners where they are supposed to

search for their own information under the guidance of the teacher. Therefore, it is important for student-teachers to have the capacity to fully explore online materials with appropriate authorities in order to explain specific principles forming the main strands in their subject areas. The current situation leaves the researcher envisaging that student-teachers would continually remain in the shadows of emergent technologies if they are not given adequate training to effectively combine these critical elements. Therefore, it is important that student-teachers should be armed with this skill of using technology to facilitate scientific inquiry in the classroom.

The findings confirm the findings of Roig-Vila, Mengual-Andrés and Quinto-Medrano (2015) that the teachers were not sure of how to combine content, pedagogy and technology in the classroom; how to elaborate a didactic unit where contents, technological elements and the didactic approach can combine; and neither do they clearly know how to choose the technology that will subsequently be used to complement what is taught or how to utilise classroom strategies that combine contents, technology, and didactical approaches. Garba and Alademerin (2014) finding also concur to this finding when they reported that the level of technology integration in pedagogical practices is very low. This obviously affects the pedagogical practices of the student-teachers.

The findings, however, contradict the findings of Smith (2012) who established that teachers use technology to augment their teaching practice, such as: videos, retrieving information from the internet, producing websites, and presenting information to learners. The contradiction extends to the findings of Owusu (2014) that teachers could choose technologies that enhance the understanding of the content for a lesson; and the findings of Oz (2015) that pre-service teachers have the ability to choose technologies that enhance students' learning for a lesson and adapt the use of the technologies about different teaching activities.

9.0 Conclusions

It is concluded from the findings of the study that since some instruction pedagogies align themselves with some emerging digital devices, pre-service teachers may teach their lessons without the use of these pedagogies. Again, the classrooms of these pre-service teachers are likely to be boring since pre-service teachers would not employ appropriate technologies that may stimulate the interest of learners in the teaching and learning process. Pre-service teachers are also likely to depend more on textbooks and other traditional materials to present their subject matter than technologies. The pre-service teachers may find it difficult to use technological skills, pedagogical practices and content representations that may inure to the benefit of the learner in the teaching and learning process. It is recommended that Lecturers should continue to model the use of technology so that pre-service teachers can increasingly update their technological knowledge through observation and learning.

The Academic Board within the university should also take it as a responsibility to advice the teaching departments on the need to infuse technology in the courses they offer for student-teachers. This would help develop the technological content knowledge of the pre-service teachers. To enhance the effectiveness of pre-service teachers after graduation, it is recommended that the government together with other stakeholders in education continue to invest and retrain the teachers as part of their induction programmes. This would help prepare the teachers effectively for the demands of the 21st century classrooms.

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