

UNIVERSITY OF CAPE COAST

TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE  
PREPAREDNESS OF STUDENT-TEACHERS OF THE DEPARTMENT OF  
ARTS AND SOCIAL SCIENCES EDUCATION (DASSE) OF UNIVERSITY  
OF CAPE COAST

STEPHEN KWAKYE APAU

JULY2016

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BY

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of Education Studies, University of Cape Coast, in partial fulfilment of the  
requirements for the award of Master of Philosophy degree in Curriculum and  
Teaching

JULY 2016

## DECLARATION

### **Candidate's Declaration**

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature..... Date.....

Name: Stephen KwakyeApau

### **Supervisors' Declaration**

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by University of Cape Coast.

Principal Supervisor's Signature..... Date.....

Name: Prof.Osei Kwarteng

Co-Supervisor's Signature..... Date.....

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## ABSTRACT

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, 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.

KEY WORDS

Technological

Pedagogical

Content

Knowledge

Technology

Preparedness

Student-teacher

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DEDICATION

To my family

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## LIST OF ACRONYMS

DASSE – Department of Arts and Social Sciences Education

TK – Technological Knowledge

TPK – Technological Pedagogical Knowledge

TCK – Technological Content Knowledge

TPCK – Technological Pedagogical Content Knowledge

UCC – University of Cape Coast

## CHAPTER ONE

### INTRODUCTION

The proliferation of digital technology in the 21<sup>st</sup> 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. Extant literature seems not to agree as to whether student-teachers' technological pedagogical content knowledge is prepared to enable them enhance their teaching with instructional technologies (Liu 2011; Gill & Dalgarno, 2010; Zhou, Zhang & Li, 2011; Agyei, 2012; Agyemang, 2012; Clark, 2013). It is, therefore, important that student-teachers of the Department of Arts and Social Sciences Education (DASSE) in the University of Cape Coast (UCC) are assessed in order to fill the identified gap in the literature. The Technological Pedagogical Content Knowledge framework serves as the theoretical structure for this study. This chapter focuses on the background to the study, statement of the problem, purpose of the study, research questions, significance of the study, delimitation and limitations of the study, operational definition of terms and organisation of the study.

#### **Background to the Study**

The emergence of digital natives and digital immigrants has changed the approach to classroom instruction (Sadara, 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 21<sup>st</sup> 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 (Sadara, 2001). Sadara (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 21<sup>st</sup> 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 (Ertmer, 1999; Schrum, 1999; Stetson & Bagwell, 1999; Zhao, 2003; Pope, Hare, & Howard, 2005; Mishra & Koehler, 2006). 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 policies 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.

Again, from the global perspectives, there appears to be a disparity between pre-service teachers' gender and their TPACK preparedness (Erdogan & Sahin, 2010; Jang & Tsai, 2012; Lin, Tsai, Chai & Lee, 2013). Koh, Chai and Tsai (2010) examined pre-service teachers' TPACK and found gender difference on technological knowledge, content knowledge, and knowledge of teaching with technology. Also, Erdogan and Sahin (2010) examined pre-service mathematics teachers' TPACK and found that male pre-service teachers' TPACK were significantly higher than female pre-service teachers. However, a different finding was presented in a study by Jang and Tsai (2012) who found that TPACK of elementary science and mathematics teachers indicated no significant gender differences with the use of technology.

It was against this background that this work intended to assess the TPACK preparedness of student-teachers of DASSE, UCC during the 2015/2016 academic year to ascertain whether student-teachers have or do acquire the knowledge to use technology in teaching and whether gender differences exist in their TPACK preparedness.

## 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; Rodrigues, Marks, & Steel, 2003; 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 (Jang, 2009; 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 to Shulman (1986), the knowledge base for teaching in the 20<sup>th</sup> 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.

### **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. It also investigated whether there is a statistically significant difference between gender of the student-teachers of DASSE, UCC and their TPACK preparedness.

### **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?

### **Research Hypothesis**

The following hypothesis was also tested:

H<sub>0</sub>: There is no statistically significant difference between the gender of the student-teachers of DASSE, UCC and their TPACK preparedness.

H<sub>1</sub>: There is a statistically significant difference between the gender of the student-teachers of DASSE, UCC and their TPACK.

### **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.



### **Delimitations**

In terms of content, this study is delimited to the TPACK preparedness of student-teachers. The study focuses on the TK, TPK, TCK and TPCK preparedness of student-teachers as conceptualized in the TPACK framework. The assessment of student-teachers' pedagogical knowledge, content knowledge and pedagogical content knowledge preparation, however, does not form part of this study. This is because several studies have concentrated on student-teachers' pedagogical content knowledge preparedness (Hativa, Barak, & Simhi, 2001; Virii, 2003; Hashweh, 2005; Bosu, 2010; Lenhart, 2010; Hurrel, 2013). Also, it would have been appropriate to conduct such a study in all the teacher training institutions nationwide but the study is delimited to student-teachers of DASSE, UCC. DASSE has been studied in this work because it is one of the largest departments in UCC. It trains student-teachers and offers a variety of academic programmes.

### **Limitations**

The limitations of the study are mainly a function of the generalization of the findings of the study and the instrument that was used to collect data from the respondents. With regard to the generalization of the findings of the study, the fact remains that the relatively defined sample might not be large enough to permit the generalisation of the results to other teacher-training departments in the UCC or teacher training institutions in Ghana or to other countries in Africa. As such, the findings of the study are generalized to only the population of the study. On the instrument, research based on questionnaire does not provide in-depth information (Johnson & Christensen, 2012). This implies that the results would have been more in-depth and

accurate if respondents were interviewed since the researcher could have had the opportunity to ask further questions for the clarification of responses. Further, the instrument was made up of mainly close-ended items. This means that respondents were forced to take decisions on the items without allowing them room for their own responses. This may have also resulted in loss of some vital information that the research may not have covered. In order to cater for this limitation, the questionnaire was comprehensive enough to ensure that most vital issues were covered.

### **Operational Definition of Terms**

**Student-teachers:** Students engaged in teacher education programmes at undergraduate level. In this study, student-teachers and pre-service teachers are used interchangeably.

**Preparedness:** The readiness or confidence of student-teachers to use digital technology in an instructional process.

**Technology:** Emergent digital devices that can aid the teaching and learning process.

**Technological knowledge (TK):** Knowledge on emerging digital technologies.

**Technological Content Knowledge (TCK):** Knowledge of how to use emerging digital technologies to teach the subject matter.

**Technological Pedagogical Knowledge (TPK):** Knowledge of the existence, components and the capabilities of various technologies and how they can be applied in the teaching and learning process.

**Technological Pedagogical Content Knowledge (TPCK):** Knowledge of various technology-oriented teaching approaches that can be used to deliver subject matter.

### **Organisation of the Study**

The study is organized in five chapters. Chapter One covers the introduction of the study which centres on the background to the study, statement of the problem, purpose of the study, research questions, significance of the study, delimitation of the study, limitations of the study, and operational definition of terms. Chapter Two presents the review of related literature, with emphasis on conceptual framework as well as related empirical studies on the research questions that guided the study. Details of the method that was used in the investigation was presented in Chapter Three. This includes the research design that was employed, population, sample and sampling procedure, instrumentation, data collection procedures and method of data analysis. The fourth chapter presents the results of the data analysis. The chapter further discussed the results and the findings of the study. The final chapter, Chapter Five, summarizes the study to draw conclusions. Based on the conclusions, recommendations have been made to help identify and discuss TPACK preparedness of student-teachers of DASSE, UCC.

## **CHAPTER TWO**

### **REVIEW OF RELATED LITERATURE**

#### **Introduction**

This chapter focuses on the review of literature that relates to this study. The review of related literature permits a comparison of the concerns and findings of this study and similar pieces of research to provide a basis for accepting or refuting earlier conclusions. The conceptual framework for the study is discussed first. Empirical studies considered necessary for putting the main problem and the sub-problems in perspective are also discussed. For the purpose of clarity and simplicity, the review has been organized under the following sub-topics:

1. Conceptual Framework
2. Historical Development of the TPACK framework
3. Components of the TPACK framework
4. Empirical Review

#### **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). To better understand the TPACK framework and its components, it is first important to consider the historical development of the framework.

#### **Historical Development of the TPACK Framework**

The Pedagogical Content Knowledge (PCK) framework theorized by Shulman (1986) has been elaborated by many researchers especially in the

first decade of the 21<sup>st</sup> Century because the decade has seen the emergence and availability of new digital technologies which have gained importance in the teaching and learning process. Although technology (textbooks, overhead projectors and others) was in existence when Shulman propounded his knowledge base for teaching, technological issues were not envisioned to the extent that they are today (Koehler & Mishra, 2006). In a more current perspective, the term technology commonly refers to digital computer technologies, artefacts, and mechanisms employed in undertaking any endeavour. The emergence of these digital technologies in education has changed the learning environment, or at least, it has the potential to do so. Therefore, what has changed from the Shulman approach that was propounded in the 1980s is the requirements for learning how to apply technology in teaching. In order to meet this requirement, Shulman's notion of PCK has been elaborated by many researchers in the last decade (Savas, 2011).

The term TPACK first appeared in the literature in the year 2006, when Mishra first mentioned the idea of TPACK in the context of educational software design (Savas, 2011). Mishra, thus, brought together different issues which are often studied independently. The issues which were brought into the same package were the nature of the domain and its relation to educational theory and the process of design and evaluation of computer programmes. In brief, Mishra (1998) laid the foundation of the idea of TPACK by mentioning the integration of content, theory and technology.

Pierson (1999, 2001) revealed the closest diagrammatic conceptualization of TPACK to the contemporary diagram of TPACK. In that diagram, there was the introduction of technology knowledge which Pierson

(2001) defined as “not only basic technology competency but also an understanding of the unique characteristics of particular types of technologies that would lend themselves to particular aspects of the teaching and learning process” (p. 427). Thus, Pierson (2001) made a claim that teachers do not only need knowledge on the subject matter they teach and how to teach it but there was the need to find ways to blend this knowledge base with technology. In essence, there was an indication that there was the need for teachers to have an extensive content knowledge and pedagogical knowledge combined with technology knowledge in order to integrate technology effectively in the teaching and learning process. This, Pierson described as “true technology integration”. Thus, as early as the first decade of the 21<sup>st</sup> Century, there was the global call for teachers to find ways to integrate technology in the teaching and learning process (Chapman & Mahlck, 2004). In furtherance to the global advocacy of technology integration in teaching and learning which had started as early as 2001, Gunter and Baumbach(2004) advocated “curriculum integration” which is explained as the effective integration of technology into the curriculum to meet the goals of the curriculum units and dealt with computer literacy, information literacy, and integration literacy.

On his part, Hughes (2004) also introduced the term “technology integrationists”. By “technology integrationists”, he meant the ability of a teacher to understand, consider, and choose to use technologies only when they enhance the curriculum, instruction and student understanding in a unique way. In view of this, Hughes advocated four principles through which technology integrationists can be raised from in-service and pre-service education. These principles are: connecting technology learning to

professional knowledge; privilege subject matter and pedagogical content connections, using technology learning to challenge current professional knowledge, and teaching many technologies. Thus, Hughes did not only recommend the need for the integration of technology in teaching and learning but further proposed the principles that would lead to the development of teachers, and position them for effective technology integration.

Angeli and Valanides (2005) similarly theorized the idea “technology integration”, but with a different label – the Information and Communication Technology (ICT)-related PCK. In Angeli and Valanides’ theorization, teachers were expected to have knowledge that would make them combine content, pedagogy and ICT effectively. The ICT-related PCK notion consisted pedagogical knowledge, subject area knowledge, knowledge of students, knowledge of environmental context and ICT knowledge. Just like Hughes (2004), Angeli and Valanides (2005) gave five principles as a guide to design ICT-enhanced learning which were considered as inseparable dimensions. These dimensions were to: identify topics to be taught with ICT, identify representations to transform the content, identify teaching strategies, select ICT tools to afford content transformations and support teaching strategies, and infuse ICT activities in classroom instruction (Angeli & Valanides, 2005).

In the same year (2005), Guerrero revealed that literature fairly expands many things that the business of education and school teaching demands of the teacher. Teachers are expected to have general pedagogical knowledge, subject matter knowledge, pedagogical content knowledge, knowledge of learners, theoretical knowledge, classroom knowledge, knowledge of context, craft knowledge, case knowledge, personal-practical

knowledge and curricular knowledge. These assemblage of competencies, Guerrero notes, leaves much to be desired. He, therefore, suggested that the teacher's knowledge that is necessary for teaching with technology in the twenty-first century is the pedagogical technology knowledge, given that technology is an indispensable catalyst for success in all human endeavours. This is succinctly expressed in his summary of the knowledge base of teachers as "Pedagogical Technology Knowledge (PTK)".

According to Guerrero (2005), there is the need for the integration of all activities that happen in the school. For instance, integrating technology knowledge into both curricular and extra-curricular activities. Guerrero viewed PTK as knowledge that goes beyond just knowing technology, but how to integrate technology into the teaching and learning process. He then added that teaching should be characterized by five central components. These components, as he mentioned, were the general principles of instruction, organization and classroom management specific to the application of technology in the classrooms, teachers' subject matter knowledge, understanding of how technology can make the subject matter more comprehensible for students, and content-specific nature of pedagogical technology knowledge.

Niess (2005) also labelled the idea of teaching with technology as technology pedagogical content knowledge. According to him, learning a subject matter with technology is one thing, and learning a subject matter with technology so that you could teach that subject matter with the help of technology is a different issue altogether. By implication, one could be taught with technology but it does not guarantee his ability to teach another person



with technology, unless he is taught how to. He, therefore, argued that it is pertinent for prospective teachers to be taught how to use technology to teach. This undoubtedly places some responsibilities at the doorstep of teacher educators. In that regard, Niess defines the outcomes of TPCK development in a teacher preparation programme to include four principal components of PCK. These components are:

1. An overarching conception of what it means to teach a particular subject integrating technology in the learning;
2. Knowledge of instructional strategies and representations for teaching particular topics with technology;
3. Knowledge of students' understandings, thinking, and learning with technology in a particular subject.
4. Knowledge of curriculum and curriculum materials that integrate technology with learning in the subject area (Niess, 2005).

This means that the idea proposed by Niess (2005) shares some semblance with the framework proposed by Guerrero (2005). This is because both of them expressed the need for teachers to possess a knowledge base that would enable them teach with technology.

The current conceptualization of TPACK has emerged with a series of publications in the field of teacher education and technology which spanned over a period of five years by scholars (e. g. Koehler, Mishra, Hershey, &Peruski, 2004; Koehler & Mishra, 2005; Mishra & Koehler, 2006; Koehler, Mishra, &Yahya, 2007). These studies ended with a proposal of the transactional model of effective technology integration with content and

pedagogy. The most comprehensive of all studies on TPACK can be found in Mishra and Koehler's (2006) study which presents a detailed description of the technology, pedagogy, and content knowledge, as well as the knowledge emerging at the intersections of these knowledge domains.

In 2007, Thompson and Mishra added the element of context to the TPACK framework which is described in terms of grade level of the students, schools or a class in which the technology is used. Thompson and Mishra (2008) proposed a change in the acronym for easier pronunciation and "to form an integrated whole, a Total Package" (p. 38) among the three fundamental knowledge domains; therefore, TPCK became TPACK. Here, the idea of the "Total package" shows the inter-relatedness and inter-dependence that exists between all the knowledge domains in the face of context. Simply put, teaching and learning would not be effective with the pre-occupation of some of the domains whilst ignoring others. It is in this regard that Kafylilo (2010) urges teachers to "develop an ability to flexibly navigate the spaces defined by the three elements of content, pedagogy, and technology and the complex interactions among these elements in specific contexts" (p. 5).

According to Koehler and Mishra (2009), teachers need to know what and how they apply technology in the unique contexts within their classrooms. Thus, there is the need for teachers to develop the knowledge required for technology integration in teaching whilst addressing the complex, multifaceted and situated nature of this knowledge. This shows that in order for teachers to effectively integrate technology in their teaching, they require a special form of knowledge termed as technological pedagogical content knowledge suggested by Mishra and Koehler (2006). Mishra and Koehler highlight

the complex roles of, and interplay among the three main components of a learning environment: content, pedagogy and technology. Thus, the TPACK framework emphasizes teachers understanding of technologies as well as pedagogical and content knowledge for successful teaching with technology (Koehler & Mishra, 2008). In view of this, Harris, Mishra and Koehler (2009) postulate that “TPACK emphasizes the connections among technologies, curriculum content, and specific pedagogical approaches, demonstrating how teachers’ understandings of technology, pedagogy, and content can interact with one another to produce effective discipline-based teaching with educational technologies” (p. 396). Voogt, Fisser, Pareja, Roblin, Tondeur and van Barack (2013) however note that the technology domain in TPACK is not how the technology can be integrated in education, instead, it is regarded as a separated domain that can be implemented in the teaching environment.

### **Components of the TPACK Framework**

In this section, the framework and the knowledge domains that underpins this study is explained in detail.

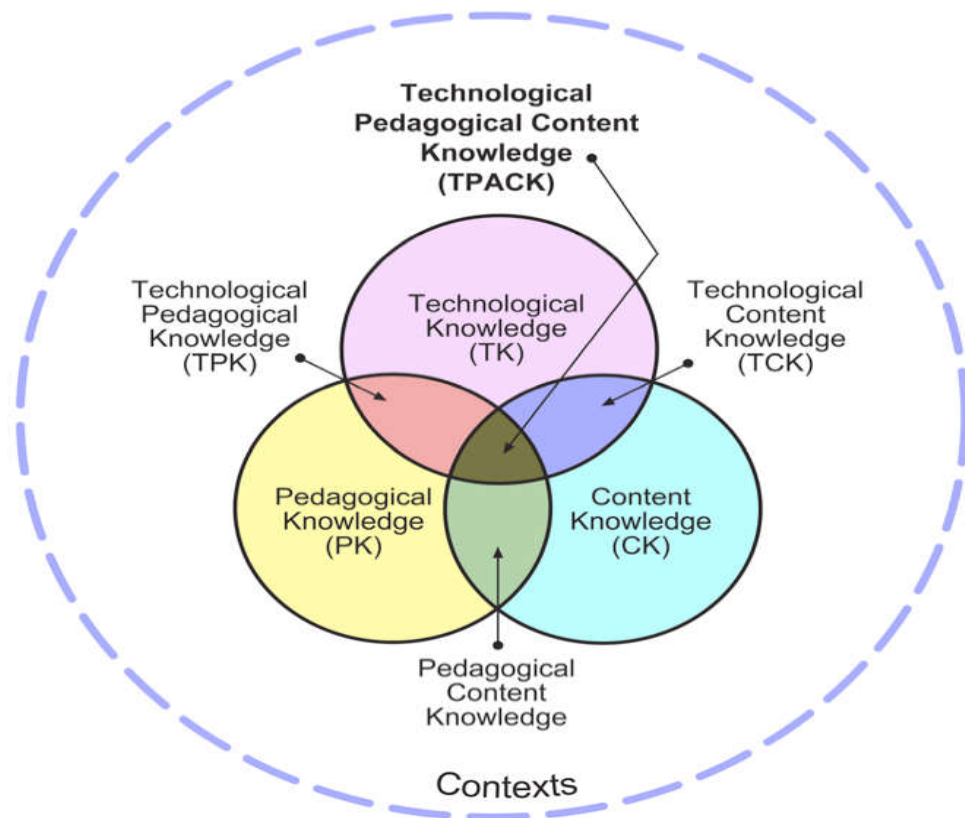


Figure 1: TPACK framework by Koehler and Mishra (2006)

As captured in the diagram, 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).

### **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, the National Research Council of USA (2000) and 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.

### **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.

### **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.

### **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; Koehler & Mishra, 2005; Koehler, Mishra & Yahya, 2007; Mishra & Koehler, 2006, 2008). 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.

### **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 and 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 21<sup>st</sup> century. By implication, teacher education programmes must expose prospective teachers to ways of representing and formulating subject matter with repertoire of emerging digital devices.

### **Technological Content Knowledge (TCK)**

Technological Content Knowledge (TCK) is an understanding that technology and content influence and constrain each other (Mishra & Koehler, 2009). 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.

### **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 (2009) 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 literacy 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 21<sup>st</sup> 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.

### **The Relevance of the TPACK framework to the Study**

Educational policymakers share the opinion that technology is the answer to many issues associated with quality in education (LeCompte, 2004). In view of this, schools are acquiring technological tools to aid the teaching and learning process. Therefore, student-teachers must be trained to acquire the pre-requisites for integrating technological tools in classroom instruction. In fact, teachers must develop a working knowledge of software applications and ways in which they can coordinate their use for effective student learning. The implementation of this enterprise must take place on two fronts. First, the teachers of tomorrow must learn to use the tools themselves, and secondly, the tools must be applied in practice.

Again, as technology becomes more ubiquitous in society, there is an implied pressure that the use of technology must also become prevalent and transparent within the teaching and learning process (Ritter, 2012). Thus, as access to technology and its subsequent knowledge domains become more prevalent, its application within the curriculum and pedagogical utility becomes increasingly important to educators. Furthermore, the implications of how technology is utilized in constructing lesson plans, and how pedagogical and curricular decisions are made, become increasingly compelling. This has

led to the development of the TPACK framework to guide teachers develop the knowledge of integrating technology, pedagogy and content in the teaching and learning process.

The TPACK framework, therefore, provides a coherent structure that allows educators to better understand sound technology integration. Sound technology integration affects how educators make effective decisions regarding academic content and pedagogical methods (Ritter, 2012). The development of this sound knowledge requires the understanding of the TPACK framework.

The TPACK framework shows clearly how technology is integrated with the essential knowledge base for effective teaching in the 21<sup>st</sup> century. An understanding of student-teachers preparedness to integrate technology in their teaching is very important if any mark is to be made in this 21<sup>st</sup> century. The TPACK framework exemplifies the main knowledge domains of teaching with keen emphasis on technology integration into the pedagogic planning and activities that precede teaching and during teaching. To a larger extent, the TPACK framework sets a benchmark for meeting the status of a successful teacher in the 21<sup>st</sup> century. Therefore, assessing the presence or otherwise the Technological Knowledge (TK), the Technological Pedagogical Knowledge (TPK) the Technological Content Knowledge (TCK), the Technological Pedagogical Content Knowledge (TPACK) expertise in pre-service teachers in DASSE is well placed, as this would create the avenue for the measurement of the extent to which these pre-service teachers are prepared to teach with technology.

## **Benefits of Technology in Teaching and Learning**

Education has taken a dynamic approach in the 21<sup>st</sup> century. The era of technology has come to stay and teaching is expected to be facilitated by the use of technology. This is supported by UNESCO (2002) that educational systems are faced with increasing pressure to use new technologies to teach students the knowledge and skills they need in the 21<sup>st</sup> century. Fundamentally, student-teachers who are at the verge of graduating from college of education into the classrooms are expected to possess the skill of using technology to teach, not only in the local context where they receive their training but also in the international arena. LeCompte (2004) adds that not only do student-teachers need the skills in the use of technology but they need the skills to serve as technological leaders and peer advisors so that they can provide support to teachers as they attempt to keep pace with the quality and quantity of technology. The use of technological leaders means that, when student-teachers are prepared to teach with technology, they would not only enhance their teaching capabilities but also serve as an instrument in providing guided training to in-service teachers.

Teachers would need to be prepared and ready to integrate technology in their teaching in order to fully fit into this new era of teaching and learning facilitated by technology. Teachers can integrate technology in their teaching through a constructivist mind set. The constructivist view encourages teachers to use technology to “expand classroom boundaries, connect students to real-world events, and guide students to become independent learners” (Teo, 2009, p. 7) through active and cognitive learning. Watson (2007) indicates that the integration of technology into the classrooms is integral to providing the

education needed for the success of contemporary students (Watson, 2007), and that is the effective way of altering the educational process of the way teachers think. Technology equipped classrooms enhance the teaching and learning process by shifting the approach to classroom instruction from traditional methods to a more constructive method of teaching which ostensibly enhance students learning (Matzen& Edmunds, 2007).

Several scholars have indicated important roles technology play in this new era of teaching. Al-Alwani (as cited in Savas, 2011) indicates that the main benefit of technology in education is that it makes students independent learners who adjust their pace of learning according to their own pace by using Information and Communication Technologies (ICTs). This means that the use of technology in education ensures that students are proficient and reliant on their own abilities unlike the traditional classrooms where students' efficiency is dependent on the capabilities of the teacher and the pace of the classroom interaction. This also presupposes that students determine the pace of the learning process according to their own pace by using information and communication technologies.

Matray and Proulx (1995) posit that technology makes students more active and engage in lessons and stimulates teamwork. Students participation in the instructional process is heightened when the lesson is influenced by technology as most of the children play around with most of these technologies. Becta (2002) reports the advantages of using technology in education as greater motivation, increased self-esteem and confidence, enhanced questioning skills, promoting initiative and independent learning, improving presentation, developing problem solving capabilities, promoting

better information handling skills, increasing ‘time on task’, improving social and communication skills.

Roschelle, Abrahamson, and Penuel (2004) postulate that the use of technology in the teaching and learning process can provide support for student learning in four major dimensions: “active engagement, collaborative learning, real-world contexts and frequent and immediate feedback” (p. 253). Technology also assists the student learning by promoting “high-order thinking and metacognitive skills that are essential to meaningful learning” (Wang, Kinzie, McGuire, & Pan, 2010, p. 382). Wang et al. continue that technology can promote learning by developing interest and motivation, providing access to information, and scaffolding the learning process tactically and strategically. Brandstrom (2011) commented on the use of the internet in education by indicating that it facilitates learning, teaching and communication.

Digital storytelling platforms and wikis are increasingly being used in the teaching and learning process to motivate and encourage students by taking into consideration their abilities. The use of these tools allows students to develop and foster their self-efficacy through constructivist, student-oriented practices (Adcock & Bolick, 2011). These also allow students and teachers to co-construct knowledge and meaning, which promote constructivism in the classroom. The educational technologies enable teachers to be seen as classroom motivators and information mediators (Schneiter, 2010). The use of these educational technologies, in addition, allow teachers to present information in more than one format because the multimodal representation of information and ideas increases the chance that more



students will learn and retain information in the classroom (DeGennaro, 2010). In support of this, Schneiter (2010) elaborates that in teaching and learning, the use of various educational technologies can help students to understand, visualize, and engage with certain dynamic concepts.

Beyond the classrooms, Morris (2012) indicates that teachers use technology for planning, grading, data management, sharing and organizing resources, communicating with colleague teachers and parents, and video conferencing. Morris further asserts that in the classroom, teachers use technology for multimedia presentations, classroom demonstrations and explorations, class web pages and blogs, images and movie clips, concept mapping, digital storytelling, movie making, and the facilitation of group work and homework assignments. In all these instances, teachers use personal computers, interactive white boards, LCD projectors, presentation software, the Internet, various Web 2.0 applications, wikis, digital flex books, graphing calculators, spreadsheets and word processors, cell phones and other mobile devices, educational software, mobile data collection units, iPods and iPads, and digital/video cameras (Thieman, 2008; Hammond, Fragkouli, Suandi, Crosson, Ingram, Johnston-Wilder, Johnston-Wilder, Kingston, Pope & Wray, 2009; Schneiter, 2010; Steinweg, Williams & Stapleton, 2010; Adcock & Bolick, 2011).

Commenting on the role of technology to the teacher, Savas (2011) indicates that teachers profit from Information and Communication Technologies to keep record and organize students' information and enable the teachers to get more time for instructional activities. The use of technology in education also enhances the teaching and learning process as teachers are able

to communicate with students anytime from anywhere. Thus, with the use of educational technologies, teaching and learning is not limited to the classroom as has always been in the traditional classrooms. The use of technologies also ensures that teachers are more creative and are able to present instructional materials that are more interesting by the use of the properties of information communication technologies (Matray&Proulx, 1995). This means that teaching and learning becomes meaningful and interesting when they are supported by technologies.

Given the enormous role that technology play in teaching and learning in this digital world, it is very essential that student-teachers teach with the emerging technologies when they finally assume the mandate to teach as professional teachers. It is, therefore, very important to find out if student-teachers are prepared to integrate technology in teaching in order to proffer the necessary support or recommendations.

### **Empirical Review**

This section of the chapter focuses on related studies that have been conducted on the topic. This is particularly important in the study as it would provide the basis for comparison. The empirical review is organized in accordance with the research questions that have been formulated to guide the study.

### **Technological Knowledge Preparedness of Student-teachers**

Tyger (2011) conducted a study on student-teachers digital literacy and their technology integration efficacy in USA. The purpose of the study was to investigate perceived digital literacy levels and technology integration efficacy of pre-service teaching (PST) candidates. The study found that PST candidates

did not perceive themselves to have high levels of digital literacy. The study also revealed that most PST candidates did not perceive themselves to have a “good understanding” of digital literacy. The candidates believed they were at least fairly confident to integrate technology into their classrooms. In addition, the study showed that as PST candidates’ perception of digital literacy increases so does the PST candidates’ confidence to integrate technology into their classrooms and schools. Lastly, the study revealed that the PST candidates believed that they understood digital technology and were confident in using that technology, and plan to use technology in their classrooms, but a high percentage did not see themselves using technology multiple times per day or helping students to use technology as part of the learning process.

From the findings of Tyger’s (2011) study, pre-service teachers’ technological knowledge is not at a high level to ensure that they enhance their teaching with technologies which presupposes that most pre-service teachers may struggle to cope with the technological demands of twenty-first century classrooms. Preservice teachers can only be aligned to technological trend if they are made to know the various technologies that could enforce teaching. This would go a long way to help them to integrate technology in teaching. As such, if technological knowledge is developed, the student-teachers would develop technological schema that would help them to learn emerging technologies. This would help to develop their confidence in the use of technology as indicated by the researcher that the knowledge of technology was directly related to preservice teachers’ confidence. Such confidence would be necessary in integrating technology in teaching.

In another study, Savas (2011) investigated pre-service teachers' perceived technological pedagogical content knowledge regarding genetics. The study showed that pre-service science teachers partially agreed that they have knowledge on genetic technologies. The study also found that most pre-service teachers were not interested in technology as a whole but rather in communication technology and information technology which makes their knowledge in technology very low. The study further established that student-teachers may have knowledge on digital devices that enhances their communication but not on other technological tools. It is a worrying situation to discover that preservice teachers do not have technological knowledge. The findings of Savas suggest that maybe teacher educators do not really use technology in teaching that is why students seem not to have interest in the use of such technologies. One could also assume that teacher education programmes, where the study was conducted, do not have courses which expose students to technology and how it can enhance teaching and learning.

Smith (2012) conducted a study on teachers' views of their pre-service education programme in USA. The research focused on how teachers' were influenced and changed by a pre-service education programme with technological focus and how that experience extended into their subsequent teaching practice. On technological knowledge, the study found that teachers are 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. Their programmes also prepared them on accessing resources on the internet, connecting the projector to the computer, and organizing data into files.

Interestingly, unlike Tyger (2011) who indicated that student-teachers are not prepared to use technology, Smith found otherwise. Smith discovered that student-teachers were adequately prepared by their teacher education programmes to use technology. Hence, it is likely that such student-teachers would appreciate the use of technology than the student-teachers in the study of Tyger. If student-teachers are to be prepared to fully integrate technology, then such technologies should be incorporated in their courses of study as indicated by Smith. Such exposure to technology is likely to provide them with basic knowledge that would help them in appreciating and adopting technologies in the classroom.

Easter's (2012) study corroborated the position of Smith's (2012) study. Esther's study focused on preparing pre-service teachers and technology literacy in USA. The study revealed that the teacher preparation programme provided pre-service teachers with the knowledge of technology integration during their preparation programme through the use of technology. A look at Esther's study indicates that pre-service teachers may be technologically proficient to teach with technology since they have been exposed to such training. Esther's study could have been further enriched if the views of pre-service teachers were also considered in addition to the faculty members. This would have highlighted how such technology modelled instruction actually influenced students' proficiency in technology. It is, however, interesting to find that at the university level, efforts are made to educate students on the use of technology.

The acquisition of technological knowledge is not solely dependent on the colleges of education as studies have indicated that the roles of other

stakeholders before schooling can also influence teachers' use of technology. Yoon (2012) confirmed this from his study at USA that student-teachers learn more about technologies even before they opt for teaching. This means that students are exposed to the use of technologies before they enter their teacher training institutions. Elsewhere, Juarez (2014) indicates that parents in their own capacity had influenced their children with the use of technology in learning but such approach is quite limited and narrow. It could be argued from this point that if such an exposure is further built upon in teacher training institutions, student-teachers would have sharpened their competencies in the use of such technologies in teaching. In addition, Yoon's study established that pre-service teachers had limited exposure to content-specific technologies, except educational websites during their training. If educational institutions put in technology specific content courses to address student-teachers technological needs, it would go a long way in fully preparing students in integrating technology in their teaching.

In addition to the findings of Yoon (2012), Clark (2013) shows that not only do student-teachers develop technological skills before entering teacher training programmes but also develop it when engage in field experience. Clark established from his study in USA that pre-service teacher education programmes did not make student-teachers effective in teaching with technology. This is because when technology was used by college professors in training student-teachers, it was mainly for assignments. Such an approach was neither purposeful nor rigorous and this did not help pre-service teachers to understand how to integrate technology in teaching until they began their field experiences and internships.

In USA, Spazak (2013) conducted a study on secondary school pre-service teachers' perception of their preparedness to integrate technology in their teaching. The study found out that the pre-service teachers were prepared to effectively integrate technology and that the teacher education institutions are also taking an active role in preparing pre-service teachers better to integrate technology into the classroom. It is not surprising that student-teachers in these developed countries are well prepared to integrate technology in their teaching. This is because, these developed countries, particularly, USA are well-resourced technologically (Hoekman, Maskus, & Saggi, 2004). Student-teachers seem to be well prepared when found in institutions that are well resourced with technological tools. This shows that such exposure to technology helps them to developed their knowledge and competency in the use of such technological tools.

In a similar study in Malaysia, Raman (2014) measured the confidence and competency level of pre-service teachers with the use of technology in their daily practice. The study established that the pre-service teachers had skills in using basic ICT applications needed to equip them to use Microsoft applications such as word processing, presentation, email, web browser, web search, web 2.0 and social network compared to using desktop publishing software, database, multimedia development and other advance applications. Such skills can be used to develop interesting and catchy teaching and learning materials for teaching. It is believed that most often students do not enjoy the way teaching is done in the traditional classroom which uses traditional technologies such as chalk and others (Joshi, 2012). One would

wonder if student-teachers in Ghana are really prepared in the same way to use these technologies to enhance their teaching experiences.

Owusu (2014) assessed New Zealand high school science teachers' technological pedagogical content knowledge. The study showed that there was a greater use of ICT with regard to the preparation of lessons by teachers as compared to how they used ICT for other teaching activities. Majority of the teachers used ICT to search for information for their lessons and for instructional delivery. The study also revealed that most teachers were using ICT tools to help their students to view images and objects which facilitated the understanding of the concepts they were teaching. In addition, the study revealed that the teachers were confident and comfortable when it came to installing a new computer programme on their computer whilst some of the teachers indicated that they had not had sufficient opportunities to work with a range of technologies and do not know how to solve their own technical problems as well as keep up with new technologies. Although the study realized that the teachers knew about a lot of technologies, they lacked the technical skills they need in order to use these technologies and could not learn technology easily on their own.

To consolidate on the need for student-teachers to possess technological knowledge in USA, Juarez (2014) found in his study that technological advancements become outdated within thirty days or less. It is, therefore, paramount that creative ways are sought and developed to provide the latest information on technology on a daily and consistent basis for teachers. This supports the argument that student-teachers need to be given the foundational knowledge in technology which would give them the edge in



learning emerging technologies. Such knowledge would provide teachers with the necessary schema to learn to use emerging technology in teaching. The fast changing trends with regard to the use of technology makes it imperative that such knowledge is acquired for easy teaching and learning.

Oz (2015) assessed pre-service English teachers' technological pedagogical content knowledge. The study revealed that the pre-service teachers' had the ability to learn technology easier. Again, the pre-service teachers were found to have technological skills, and possessed the knowledge about how to solve their technological problems. Also, the pre-service teachers had knowledge on how to keep up with developments in new technologies. However, the study found that the pre-service teachers had not had the opportunity to work with different technologies, and did not have knowledge on different technologies. It can, therefore, be inferred that even though teachers lack knowledge in employing different technologies in their lessons, they were ready prepared to learn the use of technologies. It is important that student-teachers are given this knowledge before they graduate in order to enable them integrate technology in the teaching and learning process.

#### **Technological Pedagogical Knowledge Preparedness of Student-teachers**

In Turkey, Ekrem and Recep (2014) examined pre-service English as a Foreign Language (EFL) teachers' TPACK competencies. The purpose of the study was to understand the TPACK competency of pre-service English teachers. The study found that the pre-service English teachers can constitute positive learning atmosphere in the language classroom by using technology while their technology knowledge is not at the desired level especially when they encounter any technical failure. One of the essence of quality teaching

and learning is to provide quality teaching environment that promotes effective student learning. Indeed, if technology helps to ensure this effective quality teaching outcome, then it is a paramount need for educational institutions to train teachers to possess such knowledge in technology to effectively use them in the classroom.

Owusu (2014) also established that the in-service teachers he studied were in a better position to use technologies to effectively enhance their pedagogical practices to engage students in the teaching and learning encounter. The study specifically indicated that, teachers can choose technologies that enhance the teaching approaches for a lesson and students' learning of a concept. In addition, teachers can choose technologies that are appropriate for their teaching and apply technologies to different teaching activities, effectively manage a technology-rich classroom, use technology to help assess student learning as well as use technology to actively engage students in the teaching and learning process. If in-service teachers possess the skills of using technology in improving their pedagogical activities, then it is very necessary that student- teachers are given these skills during their training.

In Turkey, Tinmaz (2004) assessed pre-service teachers' technology in relation to their subject area. The study showed that that pre-service teachers were graduated with a less than moderate level of competency in teaching with technology. It could be seen that whilst Owusu (2014) used in-service teachers and found that they possessed pedagogical knowledge, Tinmaz used student-teachers and had a contrary findings. There seems to be no clarity as to whether student-teachers have technological pedagogical knowledge. This is

because student-teachers are those who graduate from teacher education institutions to take the position of in-service teachers. Hence, to say that in-service teachers have such knowledge base and student-teachers lack it becomes very difficult to be accepted. This provides the basis to conduct this study.

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

Juarez (2014) conducted a study on transforming literacy instruction. The study revealed that the growing e-book and e-libraries satisfy the new generation of learners who prefer to have in-hand access to information in contrast to previous generations which relied on paper or hard back texts. The study further established that 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 help to provide students with the foundations they require in learning content and pedagogy, but that they should also be provided with the latest ways to integrate technological advances and strategies to change the way the students acquire and retain knowledge and information.

Owusu (2014) found from his study that the teachers knew about technologies that they could use for teaching specific concepts in their subject matter, and how their subject matter could be represented by the application of technology. The study also revealed that the teachers know about technologies that they can use for enhancing the understanding of specific concepts in their subject matter and use technological representations (i.e. multimedia, visual demonstrations, and many more) to demonstrate specific concepts in their

subject matter. Furthermore, the study established that the teachers could use various types of technologies to deliver the content of any subject matter and use technology to make students observe phenomenon that would otherwise be difficult to observe in their subject matter. One could attest that today's classroom teaching has taken a new dimension directed by technology. It is obviously seen that technology has indeed infiltrated the teaching of content as it facilitate easy representation of concepts and ideas. The use of such technologies to represent content would be certainly appreciated by contemporary learners.

### **Technological Pedagogical Content Knowledge (TPCK) Preparedness of Student-teachers**

Smith (2012) found from his study, which focused on teachers' views of their pre-service education programme, that the pre-service teachers had numerous opportunities throughout their training programmes to observe faculty modelling the use of technology with different pedagogical strategies. The study also found out that the pre-service teacher education programme of the participants enabled them to use a range of technology within their classes. It was further revealed that a number of teachers had been using technology such as videos, accessing information on the internet, producing websites, and presentation software to augment their practices. It is clear from Smith's study that modelling of pre-service teachers and the opportunity to practice using technology result in pre-service teachers adopting teaching pedagogies that are enabled by technology.

In Australia, Finger, Jamieson-Proctor and Albion (2010) conducted a study on beyond pedagogical content knowledge. The study aimed at

presenting the case for the importance of technological pedagogical content knowledge. The study revealed that the pre-service teachers expressed strong interest in using ICT for personal purposes and had a strong interest in using ICT for teaching and learning purposes. Pre-service teachers also found to exhibit a moderate level of ICT use for teaching and learning. The study further established that pre-service teachers were moderately confident to use technology in the teaching and learning process. In order to make the pre-service teachers proficient and confident in teaching with technology, the TPACK framework should serve as the guideline for teacher education. The TPACK framework emphasizes that the cardinal knowledge base for teaching and learning is technological pedagogical content knowledge. Such a knowledge base is what is argued to effectively transform content into students understanding through appropriate pedagogical strategies (Koehler & Mishra, 2006). Pre-service teachers are expected to possess adequate technological pedagogical knowledge in order to appeal to students.

In USA, Byker (2014) conducted a study on needing TPACK without knowing it. The purpose of the study was to describe the integration of an instructional technology lesson in an elementary social studies methods course. The study found out that pre-service teachers identify technological knowledge as an increasingly necessary part of their future teaching careers. Secondly, the study found out that many pre-service teachers in the study perceived technology to be useful in teaching, but they were unsure about how it was to be utilized. An implication could be drawn that pre-service teachers were not adequately prepared to effectively combined technology, content and pedagogy in teaching as at that time the study was conducted. This is probably

why the study further found that the pre-service teachers were puzzled about the various ways to integrate social studies content and pedagogical knowledge with their technological understandings. Hence, the study concluded that the pre-service teachers were likely to separate technological knowledge from pedagogical and content knowledge rather than integrate the knowledge areas.

Owusu (2014) also established that the teachers could teach lessons that appropriately combined their subject matter, technologies, and teaching approaches and would be able to select technologies to use in their classrooms to enhance what they thought, how they thought and what students learned. The study of Owusu further found out that teachers could use strategies that combine content, technologies and teaching approaches in their classroom and can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at their school. Also, the teachers could choose technologies that enhance the understanding of the content for a lesson and are able to use technology to create effective representations of content that departs from textbook approaches as well as use technology to facilitate scientific inquiry in the classroom while being able to find and use online materials that effectively demonstrate a specific scientific principle.

Whilst some studies claim that teachers have TPACK, others refute such a claim. This study has made the search for teachers' TPACK to continue. For instance, Garba and Alademmerin (2014) explored the readiness of Nigerian colleges of education towards pre-service teacher preparation for technology integration. The researchers found that the level of technology integration and pedagogical practices in a course, was very low because it was more

theoretical than practical. The researchers concluded that much was still needed in Nigerian colleges of education. It could be deduced that pre-service teachers would not be in the capacity to effectively combine technology, pedagogy and content because their teacher education programme only emphasizes the blend of pedagogy and content in teaching. Since Nigeria has common characteristics with Ghana, one is likely to conclude that the same issue exists in Ghana. An empirical justification is very essential to find out if students in Ghana are in the position to effectively integrate technology, pedagogy and content in their lessons.

In USA, Lee, Smith and Bos (2014) conducted a study on pre-service teachers' technological pedagogical knowledge. The study aimed at investigating the notion of technology integration that supports instructional effectiveness. The study found out that the respondents were overwhelmingly positive in their perceptions of their own technology use. Thirty percent (30%) had neutral perceptions about their abilities to perform more abstract competencies, including "using technology for real world problem solving," "discussing ethical issues," and "discussing technology diversity issues". The study also found out that the participants were willing to teach with technology because of its attractive features and not transparently focused on content or learning goals. The study further found that the appropriateness of their choice of technological tool appeared to be related to the quality of their conceptual understanding of the pedagogy. It appears from the literature that student-teachers, in the so-called "developed countries", are well prepared to integrate technology, pedagogy and content than their counterparts in so-called "developed countries". Globalization has made it possible for teachers to

move from one geographical area to another as teachers. Therefore, teacher training programmes should be structured to meet the global technological.

Gill, Dalgarno and Carlson (2015) studied pre-service teacher preparedness to use ICTs for teaching and learning in Australia. Their study revealed that the development of technological knowledge is impacted most significantly during professional placement. They also found that experience in the classroom can enable and hasten the development of the awareness of issues and pedagogical sensitivity with regard to ICT. This means that the experience that teachers bring from their prior studies or from their social and private lives do not necessarily translate into awareness of use for teaching. Thus, by observing ICT use for teaching and learning, student-teachers are ultimately provided with the opportunity to become critical with the use of technology in teaching and learning.

Roig-Vila, Mengual-Andrés and Quinto-Medrano (2015) conducted a study on primary school teachers' TPACK in Spain. The study showed that the teachers were more knowledgeable in non-technology-related TPACK model areas such as content knowledge, pedagogical knowledge and their intersection. The teachers were, therefore, not knowledgeable in the technology related constructs in the TPACK framework such as TCK, TPK and TPCK. Teachers did not think they would be able to solve technical problems or own much knowledge about different technology elements. The teachers also expressed varied opinions when it came to keeping up to date with important new technologies, both in terms of using technology for fun purposes and regarding the availability of sufficient opportunities to work with different technology elements. This could be that teachers had not been much engaged



in technology driven classrooms, and also not exposed to high use of technology in their daily endeavours. Thus, the study indicated that teachers were not sure of how to combine content, pedagogy and technology in the classroom. In view of this, curiosity sets in to find out from student-teachers in Ghana whether their educational institutions are training them effectively to teach with technology. In the case of Ghana, Agyei (2012) found that the pre-service teachers enacted their lessons using an activity-based instructional approach in which technology was integrated to help students to explore concepts and perform authentic task. Contrarily to this finding, Agyemang (2012) established that the extent to which teachers used technology in teaching was very low. Hence, it is directly observable from the Ghanaian perspective that a consensus has not been reached as to whether teachers can teach with technology. This makes this study essential.

#### **Gender of the Student-teachers and their Technological Pedagogical Content Knowledge preparedness**

Technology, by its nature, is considered masculine because of its etymology. It comes from the Greek word “tekne”, translated in English as “wood maker” (Daker, Dow & McNamee as cited in Savas, 2011). In view of this, researchers (Erdogan & Sahin, 2010; Jang & Tsai, 2012; Lin, Tsai, Chai & Lee, 2013) have been interested to find out if the use of technology is gender sensitive.

Tinmaz (2004) studied pre-service teachers’ technology perception in relation to their subject area. The study identified males as being confident in the use of technology in teaching and learning more than their female counterparts. The study found that male teachers had higher mean scores than

female teachers for all scales (Technology Perception Scale (TPS) and sub-scales, and Computer Competency Scale (CCS). Again, Spazak (2013) found a significant difference between male and female pre-service teachers with respect to TK. The study indicated a high-level of self-efficacy among participants in favour of male teachers. Thus, male teachers in the study had moderately higher perceived self-efficacy levels than females. Confidence scale t-test values for males was ( $M = 4.64$ ,  $SD = .33$ ) and females was ( $M = 4.35$ ,  $SD = .56$ ;  $t(77) = -2.302$ ,  $p = .024$ , two-tailed). The magnitude of the differences in the means (mean difference =  $-.29$ , 95%  $CI$ :  $-.53$  to  $-.039$ ) was found to have a moderate effect (eta squared =  $.06$ ). Hence, the magnitude of the difference as found in Spazak's study was 6%. This means that the male teachers are likely to prefer to teach with technology than the females.

Similarly, Karaca (2015) investigated pre-service teachers' TPACK based on a variety of characteristics. The results of the study showed that there was a significant difference in the scores for male pre-service teachers ( $M=125.4$ ,  $SD=17.4$ ) and female pre-service teachers ( $M=132.5$ ,  $SD=15.1$ );  $t(140) = 2.63$ ,  $p = 0.01$ . It suggested that gender had an effect on pre-service teachers' TPACK and female pre-service teachers had higher TPACK values than male pre-service teachers. By implication, the extent to which the male teachers interact with technology is higher than the females. There is, therefore, the need to give both male and female student-teachers equal exposure to technology and how they can be incorporated into the teaching and learning process. This would adequately prepare both male and female teachers for the teaching demands of the 21<sup>st</sup> century.

Moreover, Roig-Vila, Mengual-Andrés and Quinto-Medrano (2015) found out from a study they conducted in Spain that significant differences appeared in all the knowledge sectors associated with technology, such as technological knowledge; TK for men ( $M=3.56$ ;  $SD= 0.75$ ) and women ( $M=3.07$ ;  $SD=0.90$ );  $t(222)= 3.023$ ,  $p=0.002$ , TCK in males ( $M=3.90$ ;  $SD=0.86$ ) and females ( $M=3.52$ ;  $SD=0.96$ );  $t(222)=2,320$ ,  $p=0.021$ , as well as in technological, pedagogical and content knowledge TPACK among males ( $M=3.72$ ;  $SD=0.84$ ) and females ( $M=3.38$ ;  $SD= 0.98$ );  $t(222)= 2.043$ ,  $p=0.042$ . Similarly, Oz (2015) showed from his study that males have higher mean scores in relation to all the TPACK constructs. This means that more male teachers have technological knowledge and are also proficient in integrating technology and pedagogy in their teaching than their female counterparts. It is, therefore, essential that the training for both males and females at their institutions should emphasize innovative ways of bridging the gap between males and females so that they would be at par in teaching with technology in their future classrooms.

Koh and Chai (2011) also found from their study in Australia that male teachers scored significantly higher than female teachers on TK and CK while male mathematics teachers had higher significance scores on the seven TPACK components than female mathematics teachers. This meant that males dominated females in using technology in the teaching and learning process. The domination of males in using technology than females, however, is based on the premise that females are naturally weak in educational technologies which affect how educators prepare student-teachers to teach with technology (Hanton, 2015).

Alazzam, Bakar, Hamzah and Asimiran (2012) studied the effects of demographic characteristics, educational background, and supporting factors on ICT readiness of technical and vocational teachers in Malaysia. The study showed that there was a significant effect of gender on teachers' ICT readiness at  $F(3,319) = 6.01, P < .05$ . Thus, the significant difference in the use of ICT skills in the teaching and learning is a function of gender. Among gender, the ICT skills for men ( $M = 2.50, S.D. = .68$ ) was greater than it was for women ( $M = 2.29, S.D. = .53$ ). Ucar, Demir and Higde (2014) study in Turkey also found that the scores of TPACK self-confidence of both pre-service science and physics teachers on gender basis indicated no significant differences. Raman (2014) found that there was no difference in terms of gender of the pre-service teachers and their confidence in integrating ICT on TPACK.

Cetin-Berber and Erdem (2015) investigated Turkish pre-service teachers' technological, pedagogical and content knowledge using the "Survey of Pre-service Teachers' Knowledge of Teaching and Technology" developed by Schmidt, Baran, Thompson, Mishra, Koehler and Shin (2009). The study sought to determine if significant differences could be found in pre-service teachers' perceptions of TPACK when examined by gender, age, educational programme, year of study, kind of instruction (day or night education) and field experience. The study found that there was a significant difference for the TK between female ( $M = 20.767, SD = 3.914$ ) and male ( $M = 22.623, SD = 4.114$ ) students;  $t(480) = 4.707, p = 0.000$ .

Moreover, Lin, Tsai and Lee (2013) studied in-service teachers in Singapore and found out that females felt less confident in TK, TPK, TCK,

and TPCK. The same study showed that pre-service teachers had no significant difference on PK and TK with regard to their gender.

In addition, studies conducted by Sang, Valcke, van Braak and Tondeur (2010), Lambert and Gong (2010), and Hammond, Reynolds and Ingram (2011) showed that gender did not play a significant role in the integration of technology into individual classrooms. This meant that student-teachers' gender did not determine their preparedness to integrate technology in their teaching. Jang and Jsai (2012), Albion, Jamieson-Proctor and Finger (2010) and Lee and Tsai (2010) found out there were no significant differences regarding gender differences in the teachers' TPACK.

It is empirically clear that no conclusion has been reached as to whether or not there are gender differences between student-teachers preparedness in integrating TPACK into teaching. Can the same be said with regard to student-teachers in Ghana? Thus, the question left to be answered is, is there a statistically significant difference between male and female student-teachers and their preparedness to teach with technology in Ghana, specifically, student-teachers at the UCC.

### **Chapter Summary**

This chapter has reviewed literature related to the study. The TPACK framework was the theory on which the study is based. The theory contains seven constructs, namely, Technological Knowledge, Content Knowledge, Pedagogical Knowledge, Pedagogical Content Knowledge, Technological Pedagogical Knowledge, Technological Content Knowledge and Technological Pedagogical Content Knowledge. This framework measures teacher effectiveness based on their ability to amalgamate all the constructs in

the framework to ensure effective teaching. In essence, current teacher education programmes should emphasize the blending of technology, pedagogy and content in teaching. This would facilitate and inspire students learning and creativity, and promote and model digital teachers. Again, the use of technology can help in designing and developing digital age learning experiences and assessment, and modelling digital age work and learning.

Some empirical studies have that student-teachers felt they had the knowledge and were adequately prepared to teach with technology. Other researchers also found that student-teachers lacked technological knowledge and were not ready to teach with technology. The empirical review further showed that technology has its gender dimension. Whilst some research findings showed that there were gender differences between student-teachers preparedness to teach with technology, others found otherwise. Consequently, it is very difficult to conclude whether or not teaching with technology is gender sensitive. In view of this, it is imperative to conduct this study to ascertain the TPACK preparedness of student-teachers of DASSE, UCC and to find out if their TPACK preparedness is influenced by gender.

## CHAPTER THREE

### METHODOLOGY

#### **Introduction**

This chapter discusses the methodology that was adopted for the study. It covers the research design, population, sample and sampling procedure, data collection instrument, data collection procedure and data analysis.

#### **Research Design**

The research adopted the descriptive survey design. According to Ary, Jacobs and Rezavieh (2002), the design permits the gathering of information from a large sample of people relatively quickly and inexpensively. Again, the survey design helps in reporting things as they prevail without necessarily explaining them, which in this case the situation as prevailing in the Department of Arts and Social Science Education as far as TPACK preparedness of student-teachers is concerned. Fink (2001) concurs that the descriptive survey 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.

In addition, most surveys are based on samples of a specified target population and this study is not different. Surveys are designed to provide a snapshot of how things are at a specific time. In this study, there is no attempt to control conditions or manipulate variables, hence, the descriptive survey

design was considered most appropriate. The study was basically aimed at gathering useful data on those conditions and variables that cannot be manipulated. Lastly, the descriptive survey design was considered the most appropriate for the study because it also had the potential of providing a lot of information from the student-teachers within a short period of time.

The descriptive survey, however, is not without limitations. These include the danger that the significance of the data can become neglected if the researcher focuses too much on the range of coverage to the exclusion of an adequate account of the implications of those data for relevant issues, problems, or theories (Kelley, Clark, Brown & Sitzia, 2003). Kelley, Clark, Brown and Sitzia (2003) further intimate that the private affairs of respondents may be pried into and there is therefore the likelihood of generating unreliable responses and difficulty in assessing the clarity and precision of questions that elicit the desired responses.

The following measures were, however, employed to minimize the effects of the weaknesses that accompany the descriptive survey. Pilot testing was carried out, to review vague and indefinite statements to better bring out the intended meaning. Respondents were also assured that their responses would be treated with strictest confidentiality and were meant for academic purposes only.

### **Population**

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 21<sup>st</sup> Century, and were therefore in the position to provide appropriate responses for the study. Table 1 shows the population distribution of the student-teachers.

Table 1- *Population Distribution for Level 400 Student-teachers*

Programme	Number	Male	%	Female	%
Bachelor of Education (Accounting)	99	72	73	27	27
Bachelor of Education (Arts)	77	39	51	38	49
Bachelor of Education (Management)	180	119	66	61	34
Bachelor of Education (Social Sciences)	155	107	69	48	31
Bachelor of Education (Social Studies)	55	38	69	17	31
Total	566	375		191	

Source: Student Records and Management Information System (SRMIS) Unit, UCC, (2015)

### **Sample and Sampling Procedures**

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.

The proportionate stratified sampling technique was used to determine the sample size that was to be selected in each stratum (academic programme) since the student-teachers were already in their respective programmes of study. Table 2 shows the sample distribution selected in each stratum.

Table 2 - *Sample Distribution for Student-teachers Population*

Programme	Number	Male	%	Female	%
Bachelor of Education (Accounting)	66	48	73	18	27
Bachelor of Education (Arts)	51	26	51	25	49
Bachelor of Education (Management)	119	79	66	40	34
Bachelor of Education (Social Sciences)	103	71	69	32	31
Bachelor of Education (Social Studies)	36	25	69	11	31
Total	375	249		126	

Source: Field Data, 2016.

Again, the simple random sampling technique was used to sample the unit for the study. Specifically, the lottery method was adopted to obtain the sample unit for the study. This was done by first collecting the list of registered students from the SRMIS Unit, UCC. The list was organised according to students' programme of study and gender. Having identified the number of respondents required from each programme, the researcher ensured that the number of males and females captured by the study was representative. Therefore, with each programme, male student-teachers were

dealt with separately from female student-teachers. For instance, in the B.Ed. Accounting programme, numbers were assigned to students on a piece of paper and placed in a basket. Each paper was picked and replaced until the required number of males (48 out of 72) was reached. The same process was followed for the selection of the required number of females (18 out of 27) for the study. At large, the same process was repeated for the rest of the programmes separately. This technique was used because the sampling method is free from preconception and unfairness that could manifest on the part of the researcher.

### **Data Collection Instrument**

Questionnaire was the instrument employed to find out the preparedness of the TPACK of student-teachers of DASSE, UCC. 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 of its reliability and validity. The instrument was adapted because Punch (as cited in Owusu, 2014) suggested that for a complex and multidimensional variable, it is appropriate to use an existing instrument if one exists. With regard to internal consistencies, this questionnaire had a reliability coefficient of 0.7 and above for the various constructs of the TPACK framework. However, some items were modified to suit the focus of the research whilst others were used as was found in the original documents of the authors.

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 the 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 divided into five sections based on the research questions that guided the study. Section A focused on the demographic characteristics of the respondents. Section B, made up of 11 items, dealt with the TK of the student-teachers. Section C which was made up of 13 items considered the TCK of the student-teachers. Section D dealt with the Technological Pedagogical Knowledge of the student-teachers with 6 items. Section E focused on the TPACK of the respondents also with 9 items.

### **Test for Validity and Reliability of Instrument**

The authors Graham, Burgoyne, Cantrell, Smith, Clair and Harris (2009); Chai, Koh and Tsai (2010); Schmidt, Baran, Thompson, Mishra, Koehler and Shin (2010); Chai, Ng, Li, Hong and Koh (2013); Nordin (2014) whose survey items were adapted for this study, conducted different validity tests on their instruments. However, the researcher found it appropriate to ensure that the instrument for the study was valid and reliable because the adapted instruments were used in Singapore, Asia, and USA. The instrument was, therefore, given to the researchers' supervisors to help determine the

content validity of the instruments. The suggestions that were provided by the supervisors were incorporated into the final instruments. The suggestions by these supervisors led to modifications, deletions and additions of some items on the questionnaire. Items that were not clear in meaning were deleted. Items that the supervisors thought were necessary but were not included were added to the instrument. Having experts who reviewed the instrument as urged by Archambault and Crippen (2009) ensured that items were complete, relevant and arranged in appropriate format which yielded a high level of content validity.

The questionnaire was subsequently pilot-tested among 37 student-teachers in the University of Education, Winneba. This institution was chosen because the characteristics of student-teachers were not substantially different from their counterparts in the University of Cape Coast in terms of their entry behaviours and ages. The 37 student-teachers were selected because they constituted 10% of the sample projected for the larger parent study. According to Connelly (2008), extant literature suggests that a pilot study sample should be 10% of the sample projected for the larger parent study. The main purpose of the pre-test was to validate the appropriateness of the items. The responses from these student-teachers were used to determine the reliability of the instrument.

The Cronbach's alpha reliability of the instrument from the pilot test 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 that was used for the pilot study 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.

### **Data Collection Procedures**

Three hundred and seventy five (375) questionnaires were administered to student-teachers in February, 2016. The administration of the questionnaires was done in a week. The researcher explained the questionnaire items to the respondents in order to elicit accurate information from the respondents. The respondents were informed about the purpose of the investigation and participants were free to withdraw from the study at any time they so wished because participation was voluntary. No pressure or intimidation was put on any respondent just to elicit responses from him or her. For the assurance of confidentiality and anonymity of all respondents, no respondent was required to write his or her name, phone numbers or anything that might have a link with the identity of the student-teacher. In all, 370 questionnaires were retrieved from finally. The number represented a return rate of 98.7% of the questionnaires that were administered.

### **Data Processing and Analysis**

In order to address the research questions that were formulated to guide the study, the data obtained from the respondents was filtered to remove any irrelevant responses before coding. The data was then processed with the Statistical Package for Service Solution (SPSS 21.0). Descriptive and inferential statistics were used to show the direction of the responses. The descriptive statistics including frequencies and percentages, mean of means and standard deviations were used to analyse research questions one (1)

through to research question four (4). Inferential statistics, specifically, independent t-test was used to analyse research question 5.

### **Chapter Summary**

The chapter dealt with the discussion of the methodology that was adopted for the study. The descriptive survey design was employed for the study. The simple random sampling technique was used to sample 375 respondents for the study. Questionnaire was adapted, Archambault and Crippen (2009), Graham, Burgoyne, Cantrell, Smith, Clair and Harris (2009), Schmidt et al. (2009), Chai, Koh and Tsai (2010), Chai, Ng, Li, Hong and Koh (2013), Nordin, (2014) for the data collection. The overall internal consistency of the instrument was .892. Descriptive and inferential statistics were used to analyse the data that was obtained from the questionnaire. The descriptive statistics including frequencies and percentages, mean of means and standard deviations were used to determine the responses of the research questions 1-4. Inferential statistics, specifically, independent sample t-test was used to analyse the research hypothesis.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### **Introduction**

The chapter presents the results of the data collected from the field to assess the TPACK preparedness of student-teachers of DASSE, UCC. The chapter is presented in two sections. The first section deals with the demographic characteristics of the respondents. The second section focuses on the discussion of the main data to address the research questions that were formulated to guide the study.

#### **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 3-5.

Table 3 -*Gender of Respondents*

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

Source: Field Data, 2016

Table 3 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 4-*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 21<sup>st</sup> 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 21<sup>st</sup> century.

Table 5-*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 5 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.

### **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 6.

*Table 6-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
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Table 6, continued

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 6 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, contradicts 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 7.

Table 7-*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
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I can use technologies to improve my teaching skills	2.30	1.36
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Table 7, continued

I can use technologies to improve the presentation of information to learners.	2.26	1.37
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Mean of Means/Average Standard Deviation	2.25	1.31
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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 questions 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). However, literature abounds (e. g. Hooper & Reiber, 1995; Syed, 2010) to 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 8.

Table 8 -*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

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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 8, 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 TPACK 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 9.

Table 9-*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

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Table 9, continued

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

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Source: Field Data, 2016

Table 9 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 learners 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.

**Research Hypothesis:  $H_0$ : There is no statistically significant difference between the gender of the student-teachers and their Technological Pedagogical Content Knowledge preparedness.**

The research hypothesis sought to establish whether there was a significant difference between gender of the student-teachers and their TPACK preparedness. In order to address this hypothesis, an independent sample t-test was conducted. The result of the independent sample t-test is presented in Table 10.

Table 10-*Difference between Male and Female Student-teachers TPACK Preparedness*

Gender	M	SD	<i>t</i>	df	<i>p</i>
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Male	2.59	0.55	2.25	368	0.25
Female	2.46	0.47			

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$p > 0.05$

From Table 10, it can be observed that there is a difference between male and female student-teachers in relation to their TPACK preparedness. This is evident from the mean values recorded, mean of males (M=2.59, SD=0.55) and mean of females (M=2.46, SD=0.47). This implies that male student-teachers seem prepared in TPACK than female student-teacher. Thus, the level of TPACK preparedness of males exceeds that of the females by .13.

The results of the t-test, however, show that there is no statistically significant difference in the TPACK preparedness of males (M=2.59, SD=0.55) and females (M=2.46, SD=0.47);  $t(368) = 2.25, p = 0.25$  (two tailed). This situation might have occurred as a result of the seeming inability of the teacher education programme offered DASSE, UCC to prepare both males and females to use technology in the teaching and learning process. By implication, both male and female student-teachers could struggle to teach their subject matter with technology after graduating from the respective programmes of study.

The findings confirmed the findings of earlier studies that were conducted in other countries. For instance, the findings were in line with the findings of Jamieson-Proctor, Finger & Albion (2010) and Lee and Tsai (2010) that there were no significant differences regarding gender differences in the teachers' Technological Pedagogical Content Knowledge TPCK. Also, Sang, Valcke, van Braak and Tondeur (2010), Lambert and Gong (2010), and Hammond, Reynolds and Ingram (2011) showed that gender did not play a

significant role in the integration of technology into individual classrooms. Similarly, the study corroborated the findings of Cetin-Berber and Erdem (2015) that there was no significant difference between the perception of females and males in terms of TCK, TPCK and TPACK. The findings further support that of Raman (2014) which showed that there was no statistically significant difference in terms of gender of the pre-service teachers and their readiness to integrate technology in the teaching and learning process. Equally, the findings validate that of Ucar, Demir and Higde (2014) that there was no statistically significant difference in the TPACK self-confidence of both pre-service science and physics teachers on the basis of gender.

The findings, however, contradicted the findings of earlier studies. For instance, the study contradicts the findings of Tinmaz (2004) that males are prepared to use technology in teaching and learning more than their female counterparts. Again, the findings are inconsistent with the findings of Spazak (2013) that males have moderately higher technology perceived self-efficacy levels than females. In addition, the findings dispute the findings of Karaca (2015) that female pre-service teachers have higher TPACK than males. The findings further rebutted that of Lin, Tsai and Lee (2012) that females felt less confident in technology knowledge, technological pedagogical knowledge, technological content knowledge, and technological pedagogical content Knowledge. Lastly, the study refuted the findings of Alazzam, Bakar, Hamzah and Asimiran (2012) that there was a significant effect of gender on teachers' ICT readiness and their ICT skills.

### **Chapter Summary**

The chapter has shown that student-teachers in DASSE, UCC have TK. The student-teachers may find it easy to adjust to new digital devices that may emerge with time. The study also revealed that the student-teachers of DASSE, UCC lacked TPK. The study further found out that the student-teachers of DASSE, UCC lacked TCK. Moreover, the study established that the student-teachers of DASSE, UCC lacked TPCK. Lastly, there was no statistically significant difference between the gender of the student-teachers of DASSE, UCC and their TPACK preparedness.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **Introduction**

This is the final chapter of the study report. The summary of the research report is first presented. From the key findings that emerged from the study, conclusions are reached to aid the generation of appropriate recommendations for policy formulation.

#### **Summary of the Study**

The thrust of this study was to assess the TPACK preparedness of student-teachers in DASSE,UCC. In order to address the specific objectives of the study, the following research questions were formulated:

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?

This hypothesis was also formulated:

H<sub>0</sub>: There is no statistically significant difference between the gender of student-teachers of DASSE, UCC and their TPACK preparedness.

H<sub>1</sub>: There is a statistically significant difference between the gender of student-teachers of DASSE, UCC and their TPACK preparedness.

The descriptive survey design was adopted for the study. The stratified simple random sampling technique was used to sample 370 student-teachers of DASSE for the study. Questionnaire was adapted 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) for the data collection. The overall internal consistency of the instrument was .892. Descriptive and inferential statistics were used to analyse the data that was obtained from the questionnaire. The descriptive statistics including frequencies and percentages as well as mean of means and standard deviations were used to determine the responses of the research questions 1-4. Inferential statistics, specifically, independent t-test was used to determine the research hypothesis.

### **Key Findings**

The following are the key findings that emerged from the study:

1. The study revealed that the student-teachers in DASSE, UCC have TK. The student-teachers may find it easy to adjust to new digital devices that may emerge with time.
2. The study revealed that the student-teachers of DASSE, UCC lacked TPK.
3. The study found out that the student-teachers of DASSE, UCC lacked TCK.

4. The study established that the student-teachers of DASSE, UCC lacked TPCK.
5. There was no statistically significant difference between the gender of the student-teachers of DASSE, UCC and their TPACK preparedness.

### **Conclusions**

From the key findings that emerged from the study, the following conclusions are drawn. First, the student-teachers of DASSE, UCC have TK. By implication, the student-teachers would appreciate the use of emerging digital devices in the teaching and learning process. Therefore, with the necessary training, the student-teachers may be able to cope with the technological demands of the 21<sup>st</sup> century classrooms.

Second, the lack of TPK of student-teachers of DASSE, UCC implies that the student-teachers would adopt instructional pedagogies that are devoid of emerging digital technologies when they assume mandate as teachers. Thus, since some instructional pedagogies align themselves with some emerging digital devices, student-teachers may teach their lessons without the use of these pedagogies. Again, the classrooms of these student-teachers are likely to be boring since student-teachers would not employ appropriate technologies that may stimulate the interest of learners in the teaching and learning process.

Third, student-teachers of DASSE, UCC lacked TCK. In effect, student-teachers are likely to depend more on textbooks and other traditional materials to present their subject matter than technologies.

Fourth, student-teachers lacked TPCK. This implies that student-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.

Finally, there exists no statistically significant difference between the gender of the student-teachers of DASSE, UCC and their TPACK preparedness. This means that one's readiness or preparedness to integrate technology in the teaching and learning process is not dependent on his or her gender. By implication, when equal platforms are given to both males and females during their training programmes, they may all be efficient in blending technology, pedagogy and content in teaching their subject matter.

### **Recommendations**

From the key findings of the study and the conclusions drawn, the following are recommended:

1. Lecturers should continue to model the use of technology so that student-teachers can increasingly update their technological knowledge through observation and learning.
2. The Academic Board of UCC should advise the teaching departments on the need to infuse technology in their courses the offer for student-teachers. This would help develop the technological content knowledge of the student-teachers.
3. The teacher education programme offered by DASSE, UCC should be reconceptualised to respond to the technological needs of student-teachers. This would ensure that both males and females have adequate knowledge and skills on how to use emerging digital



devices to enhance the teaching and learning of their subject matter.

4. To enhance the effectiveness of student-teachers after graduation, it is recommended that the Ghana government together with other stakeholders in education should continue to invest and retrain teachers on the use of emerging digital devices in the teaching and learning process as part of the induction programmes that are organized for teachers. This would help prepare the teachers effectively for the demands of the 21<sup>st</sup> century classrooms.

### **Suggestions for Further Research**

The study assessed the TPACK preparedness of student-teachers of DASSE, UCC. The study was purely quantitative. To further extend literature in this area, the following areas are suggested for further studies.

1. A comprehensive study should be conducted on the same topic on a larger sample size across other teacher training departments in the university so that the findings could be generalised to the university. Lecturers could also be included in such a study to compare their responses to that of the students to ascertain whether lecturers are making effort to ensure student-teachers are trained to teach with technology.
2. Other research approaches should be used to replicate the study to see if the findings would be the same. The mixed method especially would add complementarity to the instruments used in the current study.

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## APPENDICES





B. Ed Arts [ ]

B. Ed Social Studies [ ]

**SECTION B: TECHNOLOGICAL KNOWLEDGE (TK)**

**PREPAREDNESS OF STUDENT-TEACHERS**

Please indicate the extent of your agreement or disagreement with the statement by ticking [√] **Strongly Disagree, Disagree, Uncertain, Agree, and Strongly Agree** (please select only one) to reflect your opinion.

Statement	SD	D	U	A	SA
1. I have the technical skills I need to use technology					
2. I have the knowledge to learn technology easily					
3. I can solve the problems that I encounter when using technology					
4. I know different types of technologies					
5. I can install a new program that I would like to use					
6. I can create and edit a video clip					
7. I can create my own website					
8. I can save an image from a website to the hard drive of my computer					
9. I can send an email with an attachment					
10. I can create a basic presentation using PowerPoint or a similar programme					
11. I can create a document with text and graphics in a word processing programme.					

**SECTION C: TECHNOLOGICAL PEDAGOGICAL KNOWLEDGE**

**(TPK) PREPAREDNESS OF STUDENT-TEACHERS**

Please indicate the extent of your agreement or disagreement with the statement by ticking [√] **Strongly Disagree, Disagree, Uncertain, Agree, and Strongly Agree** (please select only one) to reflect your opinion.

Statement	SD	D	U	A	SA
12. I can use technologies that enhance the teaching approaches for a lesson.					
13. I can use technologies that enhance students' learning of a lesson.					
14. My teacher education program has stimulated me to think more deeply about how technology could influence the teaching approaches I use in the classroom					
15. I can use technologies that are appropriate for my teaching					
16. I can apply technologies to different teaching activities					
17. I can use technology to assess students learning					
18. I can use technology to introduce my students to real world scenarios					
19. I can assist my students to use technology to plan and monitor their own learning					
20. I can assist my students to use technology to construct different forms of knowledge representation					

21. I can assist my students to collaborate with each other using technology					
22. I can use technologies to motivate students					
23. I can use technologies to improve communication with students					
24. I can use technologies to improve my teaching skills.					
25. I can use technologies to improve the presentation of information to learners.					

**SECTION D: TECHNOLOGICAL CONTENT KNOWLEDGE (TCK)  
PREPAREDNESS OF STUDENT-TEACHERS**

Please indicate the extent of your agreement or disagreement with the statement by ticking [√] **Strongly Disagree, Disagree, Uncertain, Agree, and Strongly Agree** (please select only one) to reflect your opinion.

Statement	SD	D	U	A	SA
26. I know how my subject matter can be represented with the application of technology					
27. I know about technologies that I can use for enhancing the understanding of specific concepts in my subject matter.					
28. I know about the technologies that I have to use for the research of content of my subject matter.					
29. I can use appropriate technologies					



(e.g., multimedia resources, simulation) to represent the content of my teaching subject.					
30. I know about technologies that I can use for enhancing the understanding of specific concepts in my subject matter.					
31. I can use technology representations (i.e. multimedia, visual demonstrations, etc.) to demonstrate specific concepts in my subject matter.					

**SECTION E: TECHNOLOGICAL PEDAGOGICAL CONTENT  
KNOWLEDGE PREPAREDNESS OF STUDENT-TEACHERS**

Please indicate the extent of your agreement or disagreement with the statement by ticking [√] **Strongly Disagree, Disagree, Uncertain, Agree, and Strongly Agree** (please select only one) to reflect your opinion.

Statement	SD	D	U	A	SA
32. I can teach lessons that appropriately combine my subject matter, technologies, and teaching approaches					
33. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn					
34. I can use strategies that combine content, technologies, and teaching approaches in my classroom					
35. I can use technologies that enhance					

the understanding of the content for a lesson					
36. I can find and use online materials that effectively demonstrate a specific principle in my subject area					
37. I can use technology to facilitate scientific inquiry in the classroom					
38. I am able to use technology to create effective representations of content that departs from textbook approaches					
39. I can structure activities to help students to construct different representations of the content using appropriate technologies (e.g., Webspiration, Mindmaps, Wikis).					
40. I can create self-directed learning activities of the content knowledge with appropriate technologies (e.g., Blogs, Webquests).					
41. I can design inquiry activities to guide students to make sense of the content knowledge with appropriate technologies (e.g., simulations, web-based materials).					

APPENDIX B

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

DEPARTMENT OF ARTS & SOCIAL SCIENCES EDUCATION

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UNIVERSITY POST OFFICE  
CAPE COAST, GHANA

Our Ref: DASSE/ ED/PCT/14/0006

Date: 9<sup>th</sup> February, 2016

Your Ref: \_\_\_\_\_

TO WHOM IT MAY CONCERN

LETTER OF INTRODUCTION

The bearer of this letter **Mr. Apau Stephen Kwakye** is a graduate student of the Department of Arts and Social Sciences Education of the University of Cape Coast, Ghana.

He requires some information from your institution for the purpose of writing a thesis as a requirement for the pursuit of M. Phil Degree Programme. His topic is **“Technological Pedagogical Content Knowledge preparedness of student-teachers of Department of Arts and Social Sciences Education, University of Cape Coast.**

I would be grateful if you would kindly allow him to collect the information from your institution. Kindly give the necessary assistance that Mr. Apau Stephen Kwakye requires from you.

I will appreciate any help that you may be able to give.

PROF. KOFI TSIVANYO YIBOE  
HEAD OF DEPARTMENT

DEPARTMENT OF ARTS AND  
SOCIAL SCIENCES EDUCATION  
UNIVERSITY OF CAPE COAST  
CAPE COAST, GHANA