



Information and Communication Technology Acceptance
in Education: A Study of Pre-service Teachers in Ghana.

Stephen Adu Gyamfi

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ABSTRACT

This thesis employed the Technology Acceptance Model (TAM) to empirically explore factors influencing acceptance and integration of Information and Communication Technology as a tool for teaching and learning in pre-service teacher education in Ghana. This purpose was accomplished by extending the original technology acceptance model by adding six exogenous variables. Although, there have been few studies on the use of ICT in the Ghanaian education context, no studies have been done on this topic specifically on pre-service teachers offering a 3-year Diploma in Basic Education in Colleges of Education in Ghana. The study adopted mixed methods where first, a survey was conducted among 380 respondents studying a 3-year Diploma in Education programme in two colleges of education in Ghana. This was followed by interviews and observations among a number of teacher educators and pre-service teachers to collect additional qualitative data to triangulate with the quantitative results.

Empirical results obtained employing multiple step-wise regression analysis showed that all the eleven hypotheses tested were statistically supported by the data with the exception of hypothesis seven. Together, perceived usefulness, attitude towards use, leadership support and technological complexity explained 58 percent of the variance in actual use of ICT by the pre-service teachers. Attitude towards use, perceived usefulness, technological complexity and leadership support had direct and positive effect on the pre-service actual use of ICT. Among these constructs, technological complexity which is an exogenous factor was found to be the most dominant determinant. Contrary to the results of the prominent prior TAM studies, statistically, perceived ease of use had no significant influence on perceived usefulness. Altogether, LS, TC, PU and ATU were able to explain 58% of the variance observed in the users' actual use of ICT.

Erratic power supply, a lack of technical support and maintenance, poor Internet access, pressure from high-stakes testing and disconnection between the colleges and the practicum schools in the use of ICT were identified as major barriers to ICT integration in both colleges. Potentially, the study found shared-leadership as the most effective leadership approach to effective ICT integration as it brought all stakeholders with a vested interest in ensuring the success as they perceived themselves as partners in a common endeavour. In general, the participants expressed positive attitudes towards ICT and acknowledged it as a pre-requisite for teaching and learning in the 21st century. However, it was observed that majority of them were not competent in using the technology for pedagogical purposes.

The findings of this empirical research will serve as a useful practical guide to the policy-makers and practitioners about how to increase the use of the new technologies in teaching and learning within the Ghanaian pre-service teacher education in particular and developing world in general.

STATEMENT OF AUTHENTICITY

I hereby declare that the work in this thesis is my original work, gathered and produced especially to fulfil the purposes and objectives of this study. To the best of my knowledge it contains no material previously published or written by another person, except where due acknowledgement is made in the thesis.

SAdugyamfi

Stephen Adu Gyamfi

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TO

Mr. Malcolm Deall

(My English Father in Southampton, the United Kingdom)

Who supported me both financially and emotionally to make this thesis a reality.

Thank You so Much. God Bless You

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ABBREVIATIONS AND ACRONYMS USED

ATU ATTITUDE TOWARDS USE

FCUBE FREE COMPULSORY UNIVERSAL EDUCATION

ICT INFORMATION AND COMMUNICATION TECHNOLOGY

JHS JUNIOR HIGH SCHOOL

JSS JUNIOR SECONDARY SCHOOL

JUSTEP JUNIOR SECONDARY SCHOOL TEACHER EDUCATION PROJECT

MOEG MINISTRY OF EDUCATION GHANA

MOEYS MINISTRY OF EDUCATION YOUTH AND SPORTS

PEU PERCEIVED EASE OF USE

PU PERCEIVED USEFULNESS

SHS SENIOR HIGH SCHOOL

WASSCE WEST AFRICAN SENIOR SECONDARY CERTIFICATE
EXAMINATIONS

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CHAPTER ONE: INTRODUCTION

1. INTRODUCTION

In the context of rapid technological and economic development globally, the need for knowledgeable teachers to use Information and Communication Technology (ICT) effectively has become a pressing issue as more technology is placed in school classrooms (Dantoe, 2018; Davis, 2018; DeCoito & Richardson, 2018; Hsu, 2013; OECD, 2015; Taras & Kartoglu, 2018; U.S. Department of Education, Office of Educational Technology, 2017; UNESCO, 2016). Recent research studies have shown that 21st century students need to acquire digital age literacy skills and learn how to use ICT responsibly as a learning tool for acquiring information in their subject areas, solving problems, cultivating higher-order thinking and sharing knowledge creatively with multiple audiences beyond their classroom walls (Davis, 2018; Hsieh, 2018; Mouza, 2017; Project Tomorrow, 2017; Sosa, Salinas & Denito, 2018; Twinning, Raffaghelli, Albion, & Knezek, 2013). The researchers claim that the aforementioned skills are the key skills needed to survive in the 21st century knowledge economy (Maors, 2017; OECD, 2015). This indicates that Information and Communication Technology has become inseparable part of education (Maor, 2017). It is therefore, not surprising that most policy-makers, business leaders and prominent education practitioners world-wide consider it as a mandatory part of students preparation for the workplace in the 21st century knowledge-based economy (Lim, 2012; OECD, 2015).

Realising the pivotal role ICT plays in education, countries, both rich and poor, are searching for appropriate strategies for integrating these new technologies into their education systems in order to prepare their students to be competitive in the 21st century global economy. However, some recent research studies by some leading researchers have established that effective ICT teacher training is an important pillar for successful integration and sustainability of ICT in education (Buabeng-Andoh, 2015; OECD, 2017; Polly et al, 2010). This finding is consistent with recent study which claimed that for effective ICT integration to take place in the curriculum, it is critical to ensure that pre-service teachers are well-prepared prior to taking up teaching appointments. This suggests that pre-service teachers play pivotal role as agents of change in ICT integration in education.

However, in Ghana, a survey conducted by Pome in 2013 revealed that about 85 per cent of the new teachers graduating from the Ghanaian pre-service teacher educational institutions felt

they lacked the necessary skills to integrate ICT into their classroom (Pome, 2013). Supporting Pome's findings, a current survey by Kuranchie (2017) concluded that the current teachers in Ghana are not adequately prepared to teach using ICT, implying an inadequacy in the training of teachers.

Of significant importance to this study is the need to equip pre-service teachers with the ICT skills and knowledge for them to become change agents in ICT integration in the Ghanaian education system. It is believed that integrating ICT into pre-service teacher education will provide the future teachers with confidence to transfer their ICT knowledge and skills into their future classrooms (OECD, 2017; Zinger, Naranjo, Gilbertson & Warschaur, 2017). Several studies have also indicated that for effective integration of ICT to take place in pre-service teacher education, the pre-service teachers must be accepted by the pre-service teachers in the first place before considering training them to use the technology for teaching and learning purposes (Teo & Milutonic, 2015; Wong, 2015). This study explores strategies for integrating Information and Communication Technology as a tool for teaching and learning in pre-service teacher education institutions in Ghana, which is currently, a field vastly under-researched.

1.2. BACKGROUND TO THE STUDY

The rapid growth of Information and Communication Technology (ICT) in the last three decades has significantly transformed the educational landscape globally (Karlin & Ottenbreit-Leftwich, 2018; Tandeur, van Braak, Voogt & Prestridge, 2017; U.S. DOE, 2016).

Today, the concept of "literacy" has been redefined by some researchers to accommodate "digital literacies" (Al-Azawei, Parslow & Lundqvist, 2017). These researchers further strongly advocate that in the current information-age, learners have to be able to solve complex problems, think creatively and critically; and communicate and collaborate with others from diverse backgrounds. In this context, the use of ICT for the purposes of improving and enriching teaching and learning has received a great deal of attention world-wide.

In this regard, governments and education systems all over the world have placed high priority on the integration of ICT in education, in order to remain competitive in a global world (Brush & Saye, 2009; Mswazi et al, 2014; Persico, Manca & Pozzi, 2013). This phenomenon has placed great demands on education systems and schools, especially in the developing and emerging countries, to acculturate their students to be lifelong learners; to learn how to seek out new

information, think critically, and to show initiative to meet the challenges of the fast-changing world (Lim & Chai, 2008).

To this end, mastering ICT skills and utilizing ICT towards creating an improved teaching and learning environment is of utmost importance to teachers in creating a new learning culture in the 21st Century (Davis, 2018; UNESCO, 2013). However, in Ghana, the concern that teachers are being inadequately prepared by pre-service teacher education to be confident and competent users of ICT still remains, despite over a decade of ICT availability in the education system (MOEG, 2007). In their study “The State of ICT Education in Ghanaian Teacher Education Institutions” Kusi and Agyei (2008) revealed that most teacher educators in Ghanaian pre-service teacher training institutions regard the use of ICT to be the domain of ICT teachers, and where attempts are made to use ICT they are only being used as a glorified type writer. As a consequence, pre-service teachers often graduate with limited knowledge of how to integrate technology effectively into the classroom. This suggests that ICTs in classrooms are not used in ways that utilise the educational potentials of the technology.

Although a number of researchers have questioned the wisdom of the substantial investment in ICT in education (e.g. Cuban, 2013; Davis, 2018; Mtebe and Raisamo, 2014), a large body of research literature has shown promising results with respect to the benefits of ICT in education (Hayden, Ouyang, Scinski, Olszewski & Bielefeldt, 2016). It is widely believed that effective integration of ICT could revolutionize an outmoded education system; and cause a shift from a teacher-centred didactic pedagogy to a students-centred constructivist pedagogy and better prepare students for the 21st Century knowledge-based economy and accelerate national development efforts (Davis, 2009; BECTA, 2008; OECD, 2017; Lim, Chai & Churchill, 2011). Other researchers such as Lim, Lock & Brook (2011) posited that, ICT when properly infused and integrated into teaching and learning, it supports students’ in their own constructive thinking, allows them to transcend their cognitive limitations, and engages them in cognitive operations that they not have been capable of otherwise.

Moreover, recent studies have also confirmed that, it is now generally accepted that a country’s economic strength and prosperity in the 21st Century depend on its ability to utilise ICT in its education system in order to prepare students for the global knowledge economy (Fullan, 2011; Gyaase, & Adu Gyamfi, 2015; Lee, Goh, Fredriksen & Tan, 2008). This supports Davis (2009) and Hawisher & Selfe’s (2000) notion that Information and Communication Technology is

fundamental to society in the 21st Century and it is important that children are prepared, by acquiring ICT skills as part of their education.

Against this backdrop, many governments and educational systems around the world have realised that technological change is necessary for their education systems to remain relevant and competitive in the 21st Century knowledge-based economy (Rudd & Smith, 2007; Zhou, Zhang & Li, 2011). As a result, many countries, both rich and poor have embarked on specific initiatives through ICT to ensure that school education is preparing students to meet the challenges and demands in the information age (Karlin & Ottenbreit-Leftwich, 2018; UNESCO, 2013; USDOE, 2016).

For example, in 1999, (thus, sixteen years after declaration of “A Nation at Risk” in 1983), the United States government launched “Preparing Tomorrow’s Teacher to Use Technology (PT3)” initiative, with the aim to encourage the use of instructional technology in schools, with a long term goal to prepare future generations to be productive members of American society and the world at large (National Commission on Excellent in Education 1983). Recognising pre-service teachers as agents of change in their education system, the US Department of Education dedicated more than \$750 million to the project (PT3) focusing on innovative ways for preparing pre-service and in-service teachers to effectively integrate ICT in K-12 settings (Polly, Mims, Shepherd & Inan, 2012; Van Braak, Sang, Voogt, Fisser, Ottenbreit-Leftwich, 2011). The U.S. Office of Education report (2016) indicated that, as at the end of 2003, the PT3 initiative had supported 600,000 teachers to become technology-proficient.

In Europe, the need for training of pre-service teachers in ICT skills and pedagogical approaches is widely recognised. The European Commission Plan known as Framework V, contains the following statement: ‘Preparing teachers is perceived as the main critical success factor in deploying ICT in education’ (Davis, 1997). This clearly indicates that the role of pre-service teacher education in ICT integration had been recognised. Within the European continent, some countries have also undertaken a number of initiatives to transform their educational systems. For example, in 1997, the Dutch government considering pre-service teachers to play a pioneering role in the integration of ICT in their education system, established experimental teacher training institute to prepare teachers for “the school of the future”. The teachers were tasked to prepare young people for the knowledge society, in which the competency to use ICT to acquire and process information is very important (Drent & Meelissen, 2008; Plomp, ten Brummelhuis & Rapmund, 1996).

However, these rapid developments of ICT in pre-service teacher education are not limited to only the developed countries. Developing and emerging countries have also embraced ICT to transform their educational systems in order to remain competitive in the 21st century global economy.

In South America, as early as 1995, the Chilean government, recognising the pivotal role ICT plays in transforming education, embarked on an ambitious national ICT initiative known as “Enlaces.” The aim was to improve equity and quality education system to prepare students for the future workplace (Hinostroza, Hepp, & Cox, 2009). Chile’s experience and impressive success in transforming its education system through ICT has captured world attention. Chilean success has been attributed to the priority assigned to pre-service teacher related strategies, considering them as the cornerstone of their education system (Enlaces, 2008).

In Asia-Pacific region, Singapore, in order to modernise its educational system to prepare future generations launched a ground breaking ICT initiative known as “Towards Thinking Schools, Learning Nation” in 1997 (Lee, Goh, Fredriksen & Tan, 2008). As part of the initiative, Singapore, restructured National Institute of Education (NIE), the only teacher training institution in the country to equip the future teachers with ICT competencies to prepare students to thrive in a fast-changing and highly connected world (Organisation for Economic and Co-operation and Development (OECD), 2012). The success of the Singapore ICT initiative is a reflection of the nation’s enviable position at the summit of the world educational ladder. For example, the recent OECD global school rankings published in March 2015 among 76 countries puts Singapore at the top spot on the table and some African countries including Ghana placed among the the lowest achieving countries (OECD, 2015). Singapore has been a model for a number of countries in the world, including Malaysia and Mauritius.

Africa has not been left behind. A significant number of African countries such as Rwanda, South Africa, Seychelles, Tunisia and others, have also made dramatic inroads in the field of ICT in education. Rwanda, one of the poorest countries in the world with a painful history, through well-planned ICT initiatives in education has made a tremendous progress over the last decade in economic growth, with increase in per capita income (\$200 [2003] to \$230 [2005]), and decreases in poverty (Mukama & Anderson, 2009; Rwandan Ministry of Education, 2010). The curriculum of the teacher training education has been revised to reflect the growing demands for ICT knowledge and application.

Notwithstanding the exemplary initiatives discussed above, it is worth noting that there are alternative perspectives of the benefits of ICT projects that point to the fact that a number of ICT projects have been expensive and largely ill-directed.

One significant example is the ambitious and controversial United Kingdom's Government New Opportunities Fund (NOF) ICT initiative which took place between 1999-2003 (Conlon, 2004). Costing £230 million, and aimed to raise standards of students' achievements by making every United Kingdom teacher competent in the classroom utilisation of the new technology, the UK House of Commons Report (2005) described the initiative as the most complex and "largely unsuccessful" ICT professional development initiative ever undertaken in the United Kingdom. Evidence from other research studies supports this (Beastall, 2006; Davis, Preston & Sahin, 2009; Condie, Munro, Muir & Collins, 2005; Ofsted, 2004).

Similarly, as part of its educational reform, Mauritius in 2003 embarked on an ICT initiative known as School IT Project (SITP) aimed to equip primary pre-service teachers with ICT knowledge and skills. After completing their course from Mauritius Institute of Education (MIE), the only pre-service teacher institution on the island, they were subsequently posted to all the primary schools on the island. Surprisingly, however, when they went to the schools they found inadequate ICT facilities and some even had no such facilities at all. The direct consequence of the situation, according to Jhurree (2005), was frustration among the new teachers and a sense of disillusionment in the nation. The research findings from South Africa's *e-school* initiative, which aimed to equip their students with 21st century skills were not different from those of the United Kingdom and Mauritius (Du Plessis & Webb, 2012; Dagada, 2005).

1.3. LESSONS LEARNT FROM UNSUCCESSFUL PROJECTS

Lessons Learnt One:

There should be coordinated, integrated plans to support the projects. There should be a holistic approach to the conduct of the projects. Integration of ICT into the curriculum should be done at all levels of teacher training. Thus, the project should not be concentrated on only pre-service teacher education institutions. It should be holistic and not be concentrated at the pre-service teacher educational institutions. It should include the practicum schools and the school where the pre-service teachers will be teaching after their training.

Lessons Learnt Two:

The projects should focus on pre-service teachers instead of in-service teachers. Pre-service teachers embrace ICT more easily than the in-service teachers. This is because pre-service teachers have enough time to prepare to use ICT whilst in-service teachers are busy

Lessons Learnt Three:

The project should not be politically motivated but should be left to the professionals to implement it.

Lessons Learnt Four:

The project should not be politically-motivated and should be done in phases in small scales.

Training materials should be attractive to the teachers and senior managers in the Colleges and schools. They should be motivated to take active interest in the project.

Lessons Learnt Five:

Participation should be compulsory,

Issues relating to technology acceptance should be taken into consideration in the first, before integration. Thus, to achieve meaningful ICT integration, ICT need to be accepted in the first place before considering training them to use the technology for teaching and learning purposes.

The above listed lessons learnt from the unsuccessful ICT projects discussed in the previous section should be taken into consideration by the policy makers in Ghana when implementing the ICT project.

1. 4. STATEMENT OF THE PROBLEM

In the face of rapid technological and economic development globally, schools in Ghana have been under increasing pressure to better prepare students for the 21st Century knowledge-based economy and accelerate national development efforts (Buabeng-Andoh, 2015; MOEG, 2015). In line with this, the Ghanaian government has, for the past two decades, undertaken a number of ICT initiatives, with the aim to make new technologies integral part of students' learning

experiences with the view to equipping them with skills and knowledge necessary to succeed in the 21st century knowledge-based economy.

For example, as early as 2004, the Ministry of Education Youth & Sports (MOEYS) launched an ambitious large-scale educational reform known as *Ghana e-Schools Initiatives* (Farrell, 2006; MOEYS, 2007). Being part of the New Partnership for African's Development (NEPAD), this nation-wide ICT initiative was to ensure that majority of the people in the country have required skills to function in the Knowledge Economy (Evoh, 2007). Again, the project aimed to create a comprehensive transformation of the Ghanaian education system in order to equip students for the 21st century. With its original aim with more emphasis on the important role of teacher training, it lost its focus on using ICT to enhance teaching and learning but remained focused on giving the pupils and teachers a mere set of ICT skills. Although, the initiative also aimed to connect about 50 per cent of primary and secondary schools in Ghana to the Internet, there was no comprehensive framework at the national level to the training of teachers in the appropriate use of the technology. As a consequence, the interest of the teachers to use the technology dissipated.

Again, in 2007, the Government again introduced the One Laptop Per Child Policy (OLPC) initiative, popularly known as "Baah-Wiredu One Laptop Per Child." The OLPC initiative aimed to achieve one of the Ghanaian Educational Reform's key objectives: increasing equity and quality in educational opportunities for all Ghanaian children (Bassi, 2009; Gaisie-Nketia, 2008). The government announced the first batch, 10,000 units of computers dubbed "wonder machines" (XO laptops) for distribution in schools across the country in 2007 (MOE, 2007). These laptops, according to the Ministry, could be operated using solar power and thus have the potential capacity to bridge the "Digital Divide" between urban and rural areas in the country. However, a further issue remained, that of ensuring complete Internet access.

As part of the Ghanaian government's commitment to build a better Ghana through science, technology and innovation, the Ministry of Environment, Science and Technology with the support and collaboration with the Ministry of Education, the Ministry of Communications and the Ghana Education Trust Fund (GETFUND) initiated a Better Ghana Laptop Project in 2011. Under the Project, individuals apply to the Ministry of Environment Science and Technology for the laptops, while institutions are assigned a quantity of the laptops after a needs assessment (MOEG, 2013). As at August 2015, the government had distributed over 450,000 laptops to a

number of schools, especially, those in the deprived areas (MOEG, 2015). This is indeed a testament to the importance being placed on education and training in the use of ICTs by government of Ghana, to improve learning outcomes to prepare young people for the information economy in the 21st century.

Unfortunately, despite good intentions and investment of huge resources, the initiatives have been found to be ineffective. The education system continues to have the tradition of rote learning and memorisation with little emphasis on creative problem solving. While ICT has reached most of the schools in Ghana (especially those in the cities), there are numerous problems with the adoption and diffusion of ICT as part of teaching and learning at the school system in Ghana (Agyei & Voogt, 2012; MOEG, 2015). The legitimate question that needs to be asked and answered is: since accessibility and availability are no longer much a problem, why are the teachers not using ICT in their classrooms?

Pome (2012) noted that the major problem that bedevilled the initiatives is that the policy makers in the centralised Ghanaian education system focus their efforts mainly on equipping schools with more technological resources, and students access to the technology, but pay little attention to the teachers' professional development and their capacities to apply these new technologies to enhance learning. Similarly, Buaben-Andoh, (2015) concluded in their study that pre-service teachers in Ghana are not fully prepared to teach with ICT, and recommended the need for a comprehensive programme in pre-service teacher education to enable student teachers to acquire skills and knowledge in teaching with ICT. This implies that the lack of teacher training is considered as a significant hindrance to ICT adoption and integration in the Ghanaian education system.

Given that the most direct and cost-effective way to educate teachers about technology is through the pre-service education they receive in their teacher education programmes (Gao., Wong, Choy & Wu, 2010; Ng & Lim, 2010), this study advocates that, for Ghana to compete and excel in the 21st century information and knowledge-based economy there is the need to ensure that teacher education programmes prepare teachers for adoption and effective integration of ICT in the classrooms. This supposition is based on research studies which advocate that designing and implementing a successful ICT-enabled teacher preparation programme is the key factor to fundamental, wide-ranging educational reforms (Jimoyiannis & Komis, 2007). Therefore, this study takes the stance that integrating ICT into pre-service

teacher education will provide future teachers with confidence to transfer their ICT knowledge and skills into their future classrooms (Buabeng-Andoh, 2015; U.S.DOE, 2017).

1. 5. OVERARCHING AIM OF THE STUDY

To explore factors influencing pre-service teachers' acceptance and integration of ICT as a tool for teaching and learning in pre-service teacher education in Ghana.

Within this overall aim, the thesis has three specific objectives:

- i. Examining relationships among variables associated with ICT acceptance among the pre-service teachers.
- ii. Identifying factors that promote or inhibit the successful integration of ICT the pre-service teacher institutions.
- iii. Devising strategies to facilitate effective integration of ICT in these institutions.

1. 6. KEY RESEARCH QUESTION

How can pre-service teacher institutions in Ghana equip the prospective teachers with the ICT skills and knowledge needed to teach in the twenty-first century classroom?

Specific research questions that guided the thesis were as follows:

- i. What are the relationships among the variables associated with ICT acceptance among the pre-service teachers?
- ii. What factors promote or inhibit successful integration of ICT in pre-service teacher education in Ghana?
- iii. What strategies could be adopted to facilitate effective ICT integration in these institutions?

1.7. SIGNIFICANCE OF THE STUDY

The current study is timely and relevant for the following reasons:

During the last two decades, the acceptance and integration of ICT into pre-service teacher educational context has received intense and growing educational and research interest (Hsu, 2013; Manfra & Spires, 2013; Davis, 2018; Lim, Lock & Brook, 2011; Teo, 2014; Tezci, 2011). This is based on the proposition that pre-service teacher institutions play a pioneering role in the integration of ICT in education, since they are responsible for the education of the

teachers of tomorrow. These teachers must be able to prepare young people for the knowledge society, in which competency to use ICT to acquire and process information is very important (U.S. DOE, 2016). However, a review of literature on integration of ICT in pre-service teacher education in Ghana revealed that no studies have been done on this topic in Colleges of Education that offer 3-year Diploma in Basic Education. Consequently, this study pioneers a systematic investigation of ICT integration in pre-service teacher education in Ghana. Its findings will contribute to filling the knowledge gap that exists in the area of ICT in education, especially that which involves pre-service teachers in Ghana.

Secondly, this study has a potential to contribute to the existing debates on relevance of the TAM as framework to explain and predict ICT acceptance and integration in pre-service teacher educational context.

Finally, it has been identified that the few research studies that investigate ICT acceptance and integration in pre-service teacher education in the developing world, including Ghana, are mainly conducted by international organisations relying on Western experts to conduct such research. Despite the great value of such research conducted by these seasoned scholars (Evoh, 2007; InfoDev, 2005; SchoolNet Africa, 2004), there is a caution that this is still an “outsiders” perspective. Conceivably, any local context can conceal itself to these outsiders; a new culture, new relationships and local power structure can mislead outsiders in myriad ways. Therefore, as the author is Ghanaian and a former teacher in the Ghanaian education system, this will help touch certain issues that might be elusive to “outsiders.”

1.8. SCOPE OF THE STUDY

The study was organised into Six Chapters. Chapter One discussed the introduction and background to the study. Chapter Two focused on the national context of the study while Chapter Three discussed the related literature review of the study. Chapter Three was organised into two main parts. The first part consisted of six key concepts which formed the literature review of the study, while the second concentrated on the theoretical framework of the study. The first part began by discussing the rationale for ICT integration in education in the global context. This was followed by the beliefs and attitudes of pre-service teachers towards the use of ICT in education. Subsequently, infrastructure needed for ICT integration was discussed. ICT professional development and technology leadership were also discussed. Part two of the study discussed the theoretical framework of the study. Chapter Four described

the design and methodology of the study While Chapter Five focused on data analysis and the results of the study. Chapter Six considered summary of the key findings, recommendations and conclusions.

1.9. DEFINITIONS OF CONCEPTS AND TERMS.

Table 1.1. DEFINITIONS OF CONCEPTS AND TERMS USED IN THE STUDY

TERM USED	MEANING
Practicum	Periods of time during Initial Teacher Education that pre-service teachers attached to schools to experience what it means to teach
Ghana Education Service	Main institution in Ghana which promotes education in the first and second cycle schools. It involves in the teacher education and postings to all parts in the country.
Practicum schools	Schools where the pre-service teachers do their teaching practice
Pre-service teachers	Student teachers in Colleges of Education
ICT	Information and Communication Technologies, comprises. hardware, software, networks and media, all network linked via telecommunication for the collection, storage, processing, transmission and sharing of information. Note: Definition of ICT in this thesis was tied to the Ghanaian context at a specific period of time whilst acknowledging the limitation that ICT is not static but it is always in the state of flux.
Teacher educator/tutor	Teacher trainer or teachers who teach pre-service teachers. Teacher educator and tutor mean the same in this study.
ICT integration	The effective, efficient and widespread use of ICT by all stakeholders in all the field of education. With meaningful ICT integration, teachers know when, why, and how specific tools should be used to facilitate learning.
Pre-service teacher institutions	Known as Colleges of Education in Ghana. There are 38 them which provide necessary conditions to prepare prospective teachers for primary/Junior High Schools in Ghana.
Knowledge Economy	Refers to an economy in which growth is dependent on the quantity, quality, and accessibility of the information available, rather than the means of production.
Exogenous Variable	It simply refers to an external variable. Examples in this study are Technological complexity, Computer self-efficacy, Technical support, pedagogical beliefs and others.
Endogenous Variable	It simply refers to an internal variable. Examples in this thesis are Perceived Usefulness, Perceived Ease of Use, Attitude Towards Use.

1.10. SUMMARY OF THE CHAPTER

The chapter commenced with the introduction and background to the study. It also discussed examples of some successful and unsuccessful ICT initiatives across the globe to draw lessons from. After that the purpose of the study was established while the research questions guiding the study were presented. The significance and the scope of the study were considered. The Chapter was concluded by explaining the terms and concepts used in the study.

CHAPTER TWO

THE NATIONAL CONTEXT OF THE STUDY - GHANA

2.1. INTRODUCTION

Chapter One explored the introduction to the study. This Chapter discussed the national context of the study. The national context of the study is Ghana. This section has been organised into four sub-sections. First, general characteristic of Ghana regarding geographical settings, Second, considered the demographic and socio-economic conditions. The Chapter further discussed Ghanaian education system as a whole and pre-service teacher education in particular. ICT policy on education and the extent of ICT usage in pre-service teacher education. The Chapter concluded by discussing teacher education in Ghana and the need to transform it through effective integration of ICT.

Figure.2.1. MAP OF GHANA



Source: The CIA World FactBook (2014).

The country context of the thesis is Ghana, a politically stable country within the West African sub-region. Ghana was the first African country in Sub-Saharan Africa to gain independence in 1957 after nearly a century of British colonial rule. Geographically, Ghana borders Cote

d'Ivoire in the West; Togo in the East; Burkina Faso in the North and the Gulf of Guinea (South Atlantic Ocean) in the South (see Figure 2.1). Administratively, the country has been broadly divided into ten regions with Accra as its capital city. It covers an area approximately 238,533 square kilometres, populated by 26.44 million (World Bank 2014) with 64 per cent of them economically active (Ghana Statistics Service [GSS], 2014).

Ghana is predominantly a christian country, whilst 71.4 per cent of the population are Christians, 17.6 percent are Moslems, 5.2 per cent practise traditional religion and other religions constitute 5.8 percent (2010 census). As in most low middle-income countries, the 2010 Population and Housing Census (PCH) results showed that Ghana has a youthful population consisting of a large proportion of children under 15 years and small proportion of elderly persons (65 years and over). The structure of the country's population as at 2014 is as follows: 0-14 years (36%), 15-24 years (18.7%), 25-54 years (33.8%), 55-64 years (4.8%) and 65 years and above (4.1%). The total national dependency ratio is 71.6 per cent whilst youth dependency ratio is 65.6 per cent (2014 est.). The higher percentage of the youth population (over 54 per cent) has a huge implication on demand for education, particularly in primary and secondary levels.

Committed to education, the government of Ghana spends over 8 percent of its GDP on education, which exceeds the global average of about 5 per cent (OECD, 2015). For example, compared with South Africa which is the most developed country in Africa, Ghana government expenditure on education increased from 5.1 per cent in 2010 to 8.1 per cent in 2011, as against South Africa's 5.7 per cent to 6.0 per cent in the same period (World Bank 2014). This is a clear testimony of the importance the Ghanaian government attached to the development of education. However, these expenditures in education do not give us commensurate output in term of enrolment, retention and results at all levels of the education system.

According to the World Bank's (2014) report, Ghana achieved a substantial 106 per cent in primary school enrolment rate, and completion rate of 95.67 per cent in 2014 compared with the total Sub-Saharan Africa's rate of 108 per cent and 69 per cent respectively in the same period (World Bank, 2014). However, at the junior high school level (JHS), the rate dropped to 78 percent and even sharper decline occurred between the JHS and senior high school (SHS) levels where the rate of enrolment falls below 40 per cent. At the Tertiary level, only 12 per cent of the population of tertiary age are enrolled. Despite the rate of drops in the higher education levels, Ghana's primary school enrolment (106%) and retention (95.6%) rates are

one of the highest in Sub-Saharan Africa. Apart from Algeria which achieved 106%, Ghanaian neighbouring countries such as Benin (76%), Burkina Faso (63%) and Cote D'ivoire (97%) are below Ghana's achievement (World Bank, 2014).

Although at primary level, Ghana has made significant gains in terms of enrolment, this does not translate into their retention in the JHS and SHS and even worse in the tertiary level. This is clearly unsatisfactory as the enrolment rates vary greatly and drops sharply as one ascends the educational ladder. With some changes in the education such as improved management, supervision and meaningful integration of ICT into the curriculum a lot more can be achieved. It is in this light that researcher supports the 2007 Ghana education reforms which stressed on the need for a greater emphasis on effective use of ICT for teaching and learning purposes (MOEYS, 2008).

The growing economic prosperity coupled with Ghana's democratic political dispensation has made the country a regional power in the West African sub region. With its current Gross Domestic Product (GDP) of US\$ 38.65 billion, Ghana achieved Lower Middle-Income status in 2010 (World Bank, 2014), and in 2011 recorded one of its highest GDP growth (14.0 %) for the last two decades. Recording high GDP of 14.0 per cent a half-decade ago (IMF, 2015a), there has not been sustained growth in the subsequent years. For the first time, since 2011, Ghana's GDP growth in 2014 of 4.2 per cent has fallen below the Sub-Saharan African average of 5.0 (IMF, 2015a) and against the target rate of 7.1 percent (GSS, 2015). Although Ghana's inability to sustain its economic growth momentum is an issue of concern, it is important to recognise that falling growth rates are not exclusive to Ghana. It is now a global phenomenon. Even though most advanced economies appear to be emerging from the economic doldrums, the world economy generally continues to suffer from the global economic crisis with far-reaching consequences, particularly, for emerging and middle-income economies like Ghana (IMF, 2015a). The global economic and financial crisis coupled with Ghana's elevated status to the lower middle-income economy in the last five years has affected the growth of the economy since most of the donor support from the advanced economies and donor organisations are not forthcoming as it used to be. Consequently, the country had to fend for itself.

Against this backdrop, the country experiences one of the highest inflationary rate in Sub-Saharan Africa, as the World Bank put its current rate of inflation at 15.5 percent compared with its neighbouring countries such as Burkina Faso (-0.5) per cent, Cote D'ivoire (-1.4) percent (World Bank, 2015). However, Ghana's rate is not the worst in the Sub-Saharan Africa,

as it is lower than that of Sudan which recorded 29.9 per cent (World Bank, 2015). Life expectancy at birth in the country currently stands at 61 years. While more than half of the total population resides in the urban areas (50.9 per cent), 65 per cent of the active workforce is self-employed in the informal sector (GSS, 2010). This is mainly as a consequence of a lack of job opportunities at the formal sector. Compared with the 2000 census data, the level of literacy has improved tremendously from 54.1 per cent in 2000 to 71.5 per cent (Male: 78.3%; Female: 63.3%) in 2010 (GSS, 2012).

Ghana, like many other Sub-Saharan countries, has over the years been confronted with the challenge of unemployment. The CIA World FactBook (2014) puts the country's current unemployment rate at 5.2 per cent (2013 est.). The figure given by this authoritative source above do not reflect the realities on the ground. The unemployment rate in Ghana, especially graduate unemployment, has reached unprecedented heights. This has even given rise to the birth of "Unemployed Graduate Association" of Ghana with current registered membership of over 24, 647 (Ghana News Agency, 20 July 2015). This is partly due to the proliferation of private universities in the country and most significantly, a disconnection between industries and the Higher Education institutions. For example, apart from the eight public universities, over thirty-eight private universities have been established in the country within the past two decades (ISSER, 2015). These universities churn out thousands of graduates who are unable to find job placements. For example, in 2011/2012 academic year, the University of Ghana alone produced 5046 graduates. It is estimated that the graduates coming out from all the universities, both public and private, may reach 60, 000 every year (ISSER, 2015). Looking at this huge figure, it is not likely the country will be able to employ even a third of these graduates. This unfortunate situation is largely due to the fact that Ghana lacks industries and job places to absorb these huge number of graduate, let alone those who do not have qualifications. More importantly most of the courses in the universities are out of date and do not fit for the purpose in the 21st century labour market.

Addressing this challenge, the government of Ghana has over the years, developed policies and project-specific interventions, aimed at creating jobs for the people, particularly, the youth. Notable among them are: National Service Scheme, (NSS) and National Youth Employment Programme (NYEP). However, the weaknesses of these programmes are that they provide only short term employment. For example, fresh graduates are engaged in the National Service for just a year and had to leave after that for a permanent employment. Knowing that NSS and NYEP are not sustainable, a more sustainable programme to encourage the youth, especially,

those with higher education, to take agriculture seriously, the government has over the years rolled out several programmes such as Youth in Agriculture Programme (YIAP), Agricultural Mechanisation Centres (AMSEC), National Food Buffer Company (NAFCO) and National Fertilizer and Seed Programme (NFSSP) (ISSER, 2015). Despite these good policies and project-specific interventions, there are still challenges. A long term solution to this problem is urgent. Thus, there is a need for a new and radical educational policy to make the education system responsive to the 21st century labour market. The policy-makers need to find more effective ways to integrate ICT into teaching and learning to provide teachers with learning environments that supports 21st century pedagogies and provide students with 21st century skills they need to succeed in future. A better way for achieving this, is to invest more effectively to ensure that teachers are at the forefront of designing and implementing this change. Therefore, the ground work must start from pre-service teacher educational institutions in the country. The discussion of the national context of this study will not be complete without the discussion of sectoral contribution to the GDP. Table 2:1 describes the pattern observed between 2011 and 2014.

Table 2:1 Sectoral Contributions to National Output 2011 – 2014 (% of GDP)

Sector \ Year	2011	2012	2013	2014
Agriculture	25.3	22.9	22.4	22.0
Industry	25.6	28.0	27.8	28.4
Services	49.1	49.1	49.8	49.6

Source: Ghana Statistical Service, 2015

The importance of service sector to the national output is clearly shown in Table 1. Services, the largest sector, registered a growth rate of 5.6 per cent in 2014, down from 10.0 per cent in 2013. Despite the sector's decline in growth in 2014, it still remains the largest sector with a share of 49.6 per cent of the GDP, falling only marginally from its 2013 share of 49.8 per cent. (Institute of Statistical Social and Economic Research [ISSER] (2015)). The industrial sector, which constitutes the second largest sector, grew even much slower at 0.8 per cent in 2014, up from 27.8 per cent in 2013, to 28.4 per cent in 2014. In the agricultural sector, growth also fell from 22.4 per cent in 2013, to 22.0 per cent in 2014. This indicates that the growth of two out of the three major sectors fell between 2013 and 2014. However, the slow growth in the industry between 2013 and 2014 is worrisome, given Ghana's quest for industrialisation

(ISSER, 2015). Additionally, despite the solid growth of agriculture in the recent years, its contribution to national output continues to decline. This has been the trend since the sector peaked at a 25.3 per cent share of the GDP in 2011, with the sector experiencing a slight decline in its share of GDP to 22.0 per cent in 2014, compared to a 22.4 per cent in 2013. This trend, according to 2014 ISSER report, has largely resulted from the rapid expansion in the oil and services sectors, which have shrunk the contribution of the agricultural sector in relative terms, even though the sector has been expanding in absolute terms.

Ghana's exports continue to be dominated by primary commodities, predominantly gold and cocoa, and by crude oil since 2011. Crude oil export increased from US\$2976,06 million in 2013 to US\$3724.97 million in 2014, a 25.3 per cent increase. Cocoa exports increased by 15.4% in total value, from US\$2,267.39 million in 2013 to US\$2612.87 million in 2014 (Bank of Ghana [BOG], 2015). On the contrary, gold exports recorded US\$4,388.06 million in the same period, declining from its 2013 value of US\$4,965.7 million (Bank of Ghana, [BOG] 2015). The country's main export destinations are the United Kingdom, Germany, France, Italy, Japan, Italy, Netherlands and United States. Like most lower middle-income countries, Ghana's imports are mostly industrial supplies, capital and consumer goods, oil and foodstuffs, with China, United States, Belgium, United Kingdom, and France as the main sources (GSS, 2015). Even though the government of Ghana, with support from other non-governmental organisations (NGO's) in Ghana, has been active in the promotion of ICT in every socio-economic sphere and in steering the country towards the information age (Government of Ghana, 2012), the basic facilities with regard to information and communication technology are significantly inadequate compared with countries such as Mauritius and South Africa, two major countries in Africa which have made inroads in ICT in Education. Table 2.2 below details various technology indicators for Ghana compared with Mauritius and South Africa. Table 2.2. ICT Indicators in Ghana compared with Mauritius and South Africa.

Technology Indicator (2012)	Ghana	Mauritius	South Africa
Population (in millions)	24, 658, 823 (2014)	1, 331,155 (2014)	48,375, 645 (2014)
Internet Users **	1.297 million	290,000	4.42 million
Internet Host Sites	59,086	51, 139	4.761 million
Mobile Cellular	25.618 million	1.1485	68.4 million
Telephone main lines	285, 000	349,100	4.03 million

Source: CIA World FactBook (2014).

** 2009 statistics as 2012 not available.

Considering the populations of the three countries, viz-a-viz the number of the Internet users, only 5% of the Ghanaian populace use the Internet, compared with 9% in South Africa and 28% in Mauritius, implying that Ghana is lagging behind. Having compared the Ghanaian ICT indicator with two leading African countries with ICT in education the next section considers the overview of the education system.

2.2. OVERVIEW OF GHANAIAN EDUCATION SYSTEM

Although Ghana's education system had previously been recognised as one of the most highly developed, and effective, in Africa, South of Sahara (Foster, 1965), by the 1980s it was in near collapse and viewed as dysfunctional in relation to goals and aspirations of the country (Scadding, 1989; Tonah, 2006). The aim of this section was to provide an overview of important aspects of Ghanaian education system. The section has been divided into two parts. The first part traces some of the major changes (Policies and Acts) that had taken place in education system in Ghana since 1957 to shape the education system to its current state. The second part focuses on the structure of the current education system and issues regarding the use of ICT for pedagogical purposes. However, to begin with, a brief historical and political events preceeded the independence will be briefly discussed to provide some background to the development of education in Ghana.

2.3. HISTORICAL AND POLITICAL PERSPECTIVES

Until 1987, the education system in Ghana was based on the British model of education (Graham, 1976). Initial efforts to provide education in the country started with the work of the missionaries. As early as 1876, the Methodist missionaries established the first secondary school, Mfantipim School in the country (Bude, 1983). Gaining popular support, the missionaries increased their activities and established more schools and Colleges such as Adisadel College (Anglican) in 1910, St Augustine's College (the Catholics) in 1930, Wesley Girls High School (Methodist) in 1935 and in 1848, the first teacher training college was established by the Presbyterian Mission at Akropong Akwapim (McWilliams, et, al., 1975). This attests to the fact that the missionaries played a pivotal role in the introduction of formal education in the country.

Early attempts by the colonial government to improve Ghana (the then Gold Coast) education system was by Governor Sir Gordon Guggisberg during the period between 1919 and 1925 (Graham, 1976). Guggisberg emphasised a need for better teaching and learning and improved

management of schools and in 1924 built the Achimota School. However, despite his laudable idea to improve the education system, the shortage of teachers and inadequate funding meant that his plans were hardly achieved. Having discussed briefly the missionaries and the colonial governments contributions to education, the next focus would be on Policies and Acts that shaped the Ghanaian education system to its current state.

(i) Accelerated Development Plan (ADP) for Education of 1951 and 1961

In 1951, Dr Nkrumah laid before the Parliament, an “Accelerated Development Plan” for Education. Having received the Parliamentary approval, “the Accelerated Development Plan” [ADP] was implemented in January 1952, with an appointment of Mr. Kojo Botsio, as the first Minister for Education. This plan led to a massive expansion of education to speed up the pace of educational development in Ghana.

According to McWilliam et al., (1975), ADP had two key objectives:

- To increase the rate of literacy in the country by providing more educational infrastructure;
- To use the schools to train more people who would provide the human resource needs of the country.

Realising the importance of trained teachers for the expansion of the education system, the 1961 Education Act opened new teacher training colleges, expanded the existing ones and made provision for the training of the unqualified teachers in the field through various short-term in-service training programmes. According to the Ministry of Education report in 1957, at the time of implementing ADP, there were twenty teacher training Colleges in Ghana (Ministry of Education Report 1957:13). Acknowledging the pivotal role teachers’ play in improving the quality of education, the number of teacher training colleges increased to thirty at the time of Ghana’s Independence in 1957 (Ministry of Education Ghana, 1957). Thus, through ADP, Dr. Nkrumah increased the number of teacher training colleges by ten within the period (McWilliam et al., 1976). Through ADP, teachers’ numbers also increased by 1,000 between 1951 and 1953, with the yearly output rising from 420 to 1,108 trained teachers from teacher training colleges. Based on this, enrolment in pre-tertiary education doubled in the period (1951-1961), and as a result, Ghana was acclaimed as having the most developed education system in Africa (Ghana’s Human Development Report, 1998). Another remarkable feature that worth noting is that, the 1961 Educational Act made a very significant effort at

reducing discriminatory tendencies that characterised the early colonial education system. The Act laid a firm foundation for a national education system in Ghana that is devoid of discrimination. The Act which made it officially mandatory for children of school going age to go to school states in section 2 (1):

Every child who has attained the school going age as determined by the Minister shall attend a course of instruction as laid by the Minister in a School recognised for the purpose by the Minister.

The Free Compulsory Universal Basic Education (FCUBE) enshrined in the 1992 Constitution of Ghana is a brainchild of this important Act. Following this, the next policy document to discuss is the Dzobo Committee of 1973 and the New Structure and Content of Education policy of 1974.

(ii) The Dzobo Committee of 1973

Based on the criticisms that, the education system in Ghana prior to the 1970's was being elitist in character and selective, the then military government (National Redemption Council [NRC]), under the leadership of Colonel Ignatius Kutu Acheampong established an Educational Review Committee to recommend reforms in the education system in the country. Under the chairmanship of Professor N. K. Dzobo of the Faculty of Education, University of Cape Coast, the Committee was named Dzobo Committee (Dzobo, 1974). Being described as the first major post-independence reform in the pre-tertiary education in Ghana, it was also generally referred to as *The New Structure and Content of Education (NSCE)* (Ministry of Education Ghana (1975).

The underlying reasons for the reforms were as follows: First, it was contended that as a result of the colonial administration, Ghana inherited an educational system, which prepared people only to run an administration and an economy totally reliant on demands of other countries, instead of that of Ghana. As a consequence, it was strongly felt that there was the need for a new system of education that would teach Ghanaian youth to be self-reliant on their own resources for the rapid development. Again, it was found that the prevailing education system inherited from the colonial administration was not responsive to the needs of the socio-economic needs of the country. Lastly, there was the need to place emphasis on science and technological education which was not the case of the prevailing educational system (MOEG, 2002).

The key features of the 1974 Dzobo Committee recommendations were as follows: first, it included a Two-Year Kindergarten Education for children between the ages of four and six years followed by a Nine-Year Basic First Cycle Education. This consisted of six years Primary for children between the ages six and twelve; and three years Junior Secondary School (JSS) for children between twelve and fifteen years. From the Junior Secondary School, there would be a selection into the following terminal courses, namely Two-Years Senior Secondary (Lower) course leading to the GCE 'O' Level, or Three-Year Technical, Vocational and Commercial Courses. Students from Senior Secondary (Lower) would then pursue another Two-Year Senior Secondary (Upper) course to obtain the GCE 'A' Level, or enter the Teacher Training Colleges and the Polytechnics. Also, those from the Technical, Vocational and Commercial schools enter the Polytechnics or Technical Teacher Training Colleges. Finally, students from the Senior Secondary (Upper) would proceed to the university to pursue a three-year undergraduate programme.

However, despite its laudable intentions, the Dzobo Committee recommendations, which were due to be in operation from 1975, could not be implemented due to a serious economic recession that Ghana experienced at that time. The education system then continued to be based on the British colonial system, which was described as elitist, and train people for administrative purposes. In response to this, and under pressure from the International Monetary Fund (IMF) and the World Bank, a new programme was implemented in 1987.

It is important to recognise that the period between 1966, where Dr. Kwame Nkrumah, the first President of Ghana's government was overthrown through coup d'état and 1981, was heavily characterised by political instability in the country as a results of successive military takeovers. The political instability coupled with the rise in oil prices in the early 1970's resulted in economic decline in the country. Worse of all, the period of a harsh and repressive revolutionary zeal on the part of the military regime of 1981 resulted in a significant number of trained and highly qualified teachers leaving the country for greener pastures in the neighbouring countries especially, Nigeria (Akyeampong, et al., 2007). Education in the country, therefore, was faced with crisis, ad hoc measures, and frequent changes in the education policy. Teaching and learning in the schools deteriorated to the extent that the majority of the school leavers were considered illiterate. As a consequence, the confidence in Ghana's once enviable education system was shaken. In the early 1980's, a number of calls were made by the concerned Ghanaians for a curriculum that would be responsive to the needs

of the nation. With support from the World Bank and International Monetary Fund (IMF), the Government of Ghana in 1983 launched the Economic Reform Programme (ERP). Soon thereafter, in 1987, the Government launched a major reform of the education system, again with heavy involvement of the World Bank. This reform is referred to as “the dawn of a new era in Ghana Education”, as it completely phased out the British colonial education system in the country.

(iii) *1987: The Dawn of a New Era in Ghana Education*

In all its manifestations, the 1987 education reforms marked a new epoch of education in Ghana (Morsy, 1987). A dramatic change in education system in Ghana occurred in this period when the revolutionary leader Flight – Lieutenant Jerry John Rawlings despite the huge criticisms, mastered the political will and made unprecedented changes in the country’s education system. The military leader, responding to the needs of the people of Ghana by making the country’s education system responsive to the realities of the day, implemented the revised version of the 1973 Djobo Committee Education Reform recommendations based on 1986 Evans-Anfom Committee report (Ministry of Education Ghana 1986).

As an integral part of its plan for economic recovery, the government initiated the 1987 Education Reform Programme (ERP) to reverse the decline in the education system. The 1987 reforms aimed to make it possible for school leavers in the country to leave at any point of exit from the system with skills that enable them to be employable. Other major goals were to expand access to, and improve the quality basic education in order to make the education more relevant to Ghana’s socio-economic needs. It aimed to ensure sustainability of the reform programme after the economic adjustment period (MOE, 1987). Apart from the aforementioned aims, Evans-Anfom Committee also made the following recommendations: First, the revised Djobo Committee of 1973 advocated the concept of “comprehensive” Junior Secondary Schools to teach academic and practical skills to all pupils. They recommended that pupils attending the junior secondary school be given the chance to test a variety of practical courses. Those who showed propensity for practical education were to be encouraged to enter vocational and technical institutions, whilst others with good academic continued with the curriculum associated with the traditional secondary education system.

Secondly, the 1973 proposed reforms recommended a 6 – 3 - 2 – 2 secondary structure. That is 6 years in primary school; 3 years in junior secondary; 2 years in secondary lower; and two

years in secondary upper. The revised 6 – 3 – 3 structure of the 1973 proposed reforms a 6 – 2 – 2 had 6 years of primary education; 3 years of junior and 3 years senior secondary education was adopted in 1987. The new junior and senior secondary school concept (JSS concept as it was popularly called) implemented in 1987 constituted a significant departure from the British colonial model of 5 – 2, thus, five years in secondary and two years in sixth form education. This was the first time, in the history of Ghana, that the government shifted the secondary education structure away from its original British model to American/Japanese patterns. The assessment structure in the secondary school, which consisted of G.C.E. Ordinary and Advanced Levels, was completely phased out. The ten-year elementary school system, inherited from the missionaries and British colonial administration, was also phased out entirely. Sixth form education and four – year teacher cert ‘A’ entry came to an end. The teacher training entry qualification was also upgraded to Post-Secondary Certificate (Post Sec.). The new structure which consists of nine years of basic school, three years of secondary education and three years of tertiary education is discussed in detail in section (1.8.3).

Although, the 1987 reforms was heavily criticised by a cross-section of the people in Ghana as a failure, it was not a complete failure as painted in some Journals, Newspapers and Radio Broadcasting. It achieved some successes. Notable among them were: First, it increased enrolment levels significantly into senior high schools (SHS) from 146, 000 in 1987/1988 to 842, 587 in 2012/13 academic year. Additionally, the number of public/private senior high schools in the country increased from 585 in 2005/2006 to 840 in 2012/2013 (MOE, 2015). It made the education system better aligned to the needs of the country by introducing vocational course such as Technical Skills, Vocational Skills, Life Skills and Visual Arts (MOE, 1987). Most importantly, it represented a bold attempt to reduce educational expenditure, by reducing the number of years spent in pre-tertiary education from 17 to 12 years, by phasing both the G.C.E. Advanced and Ordinary levels out completely.

The 1987 educational reforms did not specifically target the teacher training institutions for reforms. However, there were certain implications of the reform for teacher training, due to the expected changes in the curricula of the basic education level. For example, the objectives of the revised school curricula place a lot of emphasis on hands-on activities and student-centred approaches to teaching. In response to these changes in the basic education, the ODA/British Council, in collaboration with the Teacher Education Division of the Ministry of Education, launched the 4-year Junior Secondary School Teacher Education Project (JUSSTEP) from

1989-1993. JUSSTEP targeted all the 38 public teacher training colleges in five subject areas including Mathematics, English, Science, Technical Skills and Education for improvement. However, Akyeampong et al., (2007) were of the view that not enough attention was given to some of the critical aspects of the teacher training system, to make them responsive to the kind of changes that were being introduced. For example, according to him, although innovative instructional/learning and assessment were introduced at the classroom level, the teacher training assessment remained unchanged. In effect, the JUSSTEP reforms, intended to improve the competence of teachers, to improve the quality of teaching and learning in the basic schools, did not make the desired impact.

Despite the aforementioned achievements of the 1987 educational reforms, the reforms were bedevilled by a number of challenges and criticised as still not meeting the needs of the country. In 1994, an Education Reform Review Committee (ERRC) was set up to evaluate the achievements of the 1987 reforms. It found that although the Education Reform Programme (ERP) had achieved increases in enrolments and improvements in school facilities, teaching and learning outcomes remained significantly poor.

Based on these problems, in 1996 the Ghanaian government embarked on a major donor-funded reform programme called the Free Compulsory Universal Basic Education (FCUBE) programme which touched nearly all levels of the education system and attempted to address the perennial problem of access, curriculum relevance, teacher training and physical infrastructure. It is worthy to note that the FCUBE initiative goes back to the 1951 Accelerated Development Plan with a renewed commitment to the idea of the Free Compulsory education for all school children aged between 4 and 15 years.

(iv) Free Compulsory Universal Basic Education (FCUBE)

In 1994, seven years after the inception of the New Education Reform Programme in 1987, the results of poor performance of school pupils at age 12 led to the setting up of yet another Education Review Committee to review the education system. At this time, only 6% of the pupils at grade six in public schools tested nation-wide, achieved a criterion score of 60% and above in English. Even worse, less than 3% achieved a criterion score of 55% and above in Mathematics (Ministry of Education Ghana, 1994). The Ghanaian Ministry of Education, ascertaining the reasons for such lack of impact of the reforms on teaching, learning and pupils' achievement, introduced the Free Compulsory Universal Basic Education Programme

(FCUBE) in 1996. This was initiated as a constitutionally mandated charge of the 1992 Constitution which gives impetus to the provision of education as a basic right for all Ghanaians. Article 38 sub-section 2 states:

The Government shall within 2 years after parliament first meeting after coming into force of this constitution draw up a programme for the implementation within the following ten years for the provision of a free, compulsory universal basic education.

This constitutional provision quoted above mandates all the children in Ghana aged between 4 and 15 years to have a Free Compulsory Education from kindergarten to the junior high school level. Since education holds the key to Ghana's socio-economic development, this free compulsory aspect of education enshrined in the 1992 Ghanaian Constitution should be enforced by all Ghanaian governments. However, successive governments in Ghana, though some have made modest success, in general they had failed to fully enforce this vital constitutional provision (Peace Fm online, 28 July 2015). This has resulted in a number of children still roaming in the streets, instead of being in school. It was, therefore, not surprising that, in May 2015, the Progressive Peoples' Party (PPP), one of the minor political parties in Ghana took President Dramani Mahama's National Democratic Congress' (NDC) government to court for their failure to implement this important policy but unfortunately, the court threw out the PPP's suit (Myjoyonline, 31 March 2014) arguing that the implementation of the policy is subject to availability of resources. The FCUBE which was launched in 1996 and designed to address the weaknesses of the 1987 Education Reform in two five-year phases from 1996 to 2005 did not live up to the expectation. As such, on January 17, 2002, the New Patriotic Party (NPP) government of President John Agyakum Kuffour (2000 – 2008) inaugurated a Presidential Committee on Review of Education Reforms in Ghana to review the 1987 education reform (Government of Ghana, 2002).

(v) 2007 Education Reform

Following the concerns raised, Mr. J. A. Kuffour, the then President of the Republic of Ghana, inaugurated a twenty-nine member committee to review the 1987 education reforms. Under the chairmanship of Professor Josephus Anamoah-Mensah, the then Vice Chancellor of University of Education, Winneba, the Committee was tasked to review the entire educational system in the country with the view to making it responsive to the challenges of the nation (Government of Ghana, 2002). Working under the theme: "Meeting the Challenges of Education in the Twenty-First Century," the Committee presented their report in 2002. Among

other things, the committee recommended the introduction of Science and Technology, especially, Information and Communications Technology (ICT) for teaching and learning in order to improve the quality of education at all levels. They also recommended radical transformation of the education system to suit the field of work and employment. In addition, they call for the preservation of cultural identity and traditional indigenous knowledge and creativity. The reform also intended to ensure 100 percent access to basic education (see FCUBE), placing high priority on technical/vocational education and training and improving the quality of instruction.

Interestingly, the Anamoah-Mensah Report recommended a similar structure to that of the Evans-Anfom Report of 1986 which gave birth to the 1987 Education Reform. However, it brought some few significant changes: First, it included the two-year Kindergarten education as part of the mainstream education. This was the first time in the history of Ghana that Kindergarten officially became an integral part of the Basic Education to prepare children between the ages four and six years before they enter primary school. The apprenticeship training was also to formalise the training of school leavers in the various trades. The Committee maintained the 3-year Junior Secondary School (JSS) but increased the 3-year Senior Secondary School (SSS) to four years. The aim of increasing the number of years in the Senior Secondary Schools from three to four years was to ensure that the students have adequate time to prepare for the West African senior high school Certificate Examination (WASSCE). This was a consequence of the large percentage of students who usually fail at the final examinations.

Another remarkable feature worth noting was that the Committee also renamed the education system junior high school (JHS) and senior high school (SHS) to replace the existing junior secondary and senior secondary schools. One of the key features recommended by the Committee that needs to be recognised in this study was the introduction and inclusion of Information and Communication Technology (ICT) as a core subject at both the junior high school and senior high school levels.

The final significant recommendation by the committee, which needs to be emphasised, was the recognition of pre-service teacher education and its improvement. These included the upgrading of all the teacher training colleges in the country to diploma awarding institutions. They were to use the title “Colleges of Education” and all the 38 public ones were affiliated to the University of Cape Coast. The implementation of the Anamoah Mensah Reforms began in

September 2007. It was faced with initial problems, such as delay in the supply of syllabi and textbooks needed for the smooth take-off of the programme. The teachers were not adequately prepared, in terms of training, to implement the reforms and anticipated problem of inadequate classrooms and other facilities, as students were to enter the fourth year of Senior in September 2010. These problems were later dealt with as the implementation of the reform progressed. However, the change of government in 2008, which brought National Democratic Congress (NDC) back to the government, caused the reversion of the 4-year senior high school back to the original 3 years, as recommended by the 1987 educational reform, due to reasons unknown.

In spite of the fact that Ghana's education system has come far, the increasing challenges of the 21st century global economy demand that it should be re-engineered if it is to provide quality professional support programmes to teachers, especially, at the basic education level. This would make them more responsive to national goals and aspirations, as well as global demands.

2.4. CURRENT STRUCTURE OF GHANAIAAN EDUCATION SYSTEM

It is important to recognise that the integration of ICT into pre-service teacher education in Ghana cannot be tackled without discussing the structure of the education system. In line with the Educational Reform (2007), the Ghana education system is presently structured as follows:

Table 2.3. STRUCTURE OF GHANAIAAN EDUCATION SYSTEM

CYCLE	LEVEL	INSTITUTIONS	STARTING AGE	YEARS
Tertiary	Tertiary	Universities, Polytechnics Professional Institutes Colleges Of Education	19+	4yrs
Second	Senior High School (SHS)	Grammar/Vocational Technical/Agricultural/ Apprenticeship Programme	15	3yrs
First	Basic Education (Free Education)	Juor High School (JHS)	12	3yrs
		Primary School	6	6yrs
		Kindergatten	4	2yrs

Source: Government White Paper Report of Review of Educational Reforms (2013)

Under the current system, the basic education cycle consists of two years of pre-school, six years primary and three years of junior high schooling. This is followed by a three-year senior high schooling cycle, and tertiary sector comprising universities, several forms of technical

institutes, polytechnics, and other diploma awarding institutions such as teacher training colleges (now Colleges of Education) and nursing training.

The basic education cycle is free and compulsory and comprises 9 years in primary and junior high school. Children enter primary school at the age of six, which is designed to expose the pupils to variety of ideas and skills. In the primary school, nine subjects are studied, including English, Mathematics, Science, ICT and five others.

As shown in Table 2.4 below, enrolment in public primary schools was 3,160,894 in 2013/2014 showing an increase of 0.14% on the 2012/2013 figure of 3,156,572. Enrolment in private schools is 956,258, representing an increase of 0.73% when compared with the 2012/2013 figure of 949,341. The higher percentage increase in enrolment in the private schools shows the lack of confidence the Ghanaians have in the public schools at the basic education level. With better facilities, such as computers, classrooms with cutting-edge learning resources, committed teachers, they have a higher pass rate. The total enrolment in both the public and private primary schools was 4,117,152, showing an increase of .27% compared with the 2012/2013 figure of 4,105,913.

Table 2.4. Number of Primary School Pupils by Type of Education, 2012/2013 – 2013/2014			
TYPE OF EDUCATION	NUMBER OF PRIMARY SCHOOL PUPILS		
	2012/2013	2013/2014	% Change
Public	3,156,572	3,160,894	0.14
Private	949,341	956,258	0.73
Total	4,105,153	4,117,152	.27

Source: Ministry of Education, Ghana, 2015

There is an automatic promotion throughout the primary school and the JHS, using internal examinations except for pupils with weak performances, who repeat with parental consent.

The JHS level of education, which offered the subjects of Agricultural and General Science, Pre-vocational skills, Pre-technical skills and Social study, was meant to be work-oriented. It also equipped pupils with basic skills and knowledge to enter the SHS. Therefore, at the JHS 3, pupils sat the external examinations known as Basic Education Certificate Examinations [BECE] to determine their admission into the SHS. The successful candidates enter SHS and other Vocational and Technical institutions. However, those who fail, enter labour market at this stage, or have a second chance to resit the examination. Proponents of the JSS concept argued that the system would attract more students into technical, vocational, business, and

agricultural institutions. Thus, those students who did not gain admission into the SSS would be better equipped to enter the job market. As indicated in Table 2.5 below, enrolment in public JHS was 1,178,344 in 2013/2014 showing an increase of 1.8% over the 2012/2013 figure of 1,157,827. Enrolment in private JHS is 295,577, representing an increase of 0.3% the 2012/2013 figure of 294,758. Thus, the total enrolment in both the public and private JHS is 1,473,921, showing an increase of 1.5% when related to the 2012/2013 figure of 1,452,585.

Table 2.5 Enrolment in Junior High Schools by Types of Education, 2012/2013 – 2013/2014			
TYPE OF EDUCATION	ENROLMENT IN JHS		
	2012/2013	2013/2014	% Change
Public	1,157,827	1,178,344	1.8
Private	294,758	295,577	0.3
Total	1,452,585	1,473,921	1.5

Source: Ministry of Education, Ghana, 2015

After JHS, students may choose to go into different streams of SHS comprising General Arts, General Science, Agriculture, Business, Vocational and Technical Education. The objectives of the Secondary education are to prepare the students for higher education and/or for a vocation, which enables them to take their place in the society. At the final year in SHS, the student sat the West African Senior Secondary Certificate Examinations (WASSCE) to determine their admission to the Universities, Polytechnics, Colleges of Education, Nursing Training and several others. As shown in Table 2.5 below, enrolment in public senior high school in 2013/2014 academic year was 684,388, showing a decrease of 11.2% over the 2012/2013 enrolment of 770,925. In the private sector, the enrolment was 66,318, representing a decrease of 7.5%, when compared with the 2012/2013 figure of 71,662. The total, in both the public and private senior high schools, is 750,706, showing a decrease of 10.2% in relation to the 2012/2013 enrolment of 842,567. Whilst enrolment in primary (.27) and JHS (2.5) increased, that of SHS (-10.2) decreased substantially.

Table 3.5. Enrolment in Senior High Schools by Type of Education, 2012/2013 – 2013/2014			
TYPE OF EDUCATION	ENROLMENT IN SENIOR HIGH SCHOOLS		
	2012/2013	2013/2014	% Change
Public	770,925	684,388	-11.2
Private	71,662	66,318	-7.5
Total	842,587	750,706	-10.2

Source: Ministry of Education, Ghana, 2015

It is worthy to note that the percentage increase in enrolment in both primary and JHS is as a result of a number of the government policy interventions in basic education. These included Free Compulsory Basic Education, ‘Capitation Grants’ (*a school grant which has been introduced to compensate for the fees*), School Feeding Programme and Free School Uniforms and Textbooks for primary and JHS pupils (MOEG, 2015). In the same vein, it is also commendable that public spending on education improved from 5.5 per cent of GDP in 2010 to 8.1 per cent of GDP in 2011 which is one of the highest in the world. However, the JHS completion rate of 70 per cent nationally and male-female rate completion ratios of 75:65 percent in the 2012/2013 leaves much to be desired, since this is the level that all children are supposed to go through to complete the basic education. At the SHS level, the gross enrolment rate declined sharply to 37 per cent nationally, whilst male-female completion ratio remained 40:34 for 2012/2013 academic year (World Bank, 2014; MOEG, 2013).

Without doubt, there is a need for additional efforts to encourage the students by example, by providing modern ICT infrastructure and equipping the teachers with the requisite skills to teach the students with ICT. Endowed with a lot of natural resources, Ghana needs an educational system that would help produce young men and women, not only with skilled labour-based competencies that would help it compete favourably in the world-wide technological arena, but also enable it tap its own resources at the highest level of efficiency.

However, problematically, the design of the education system still continues to be informed by the 20th behaviourist perspective as the core philosophy, despite the reforms. The assessment system is driven to a large extent by the examination system and the students are too heavily focused on passing exams through private extra tuition and rote learning. This exam-focused system discourages students’ analytical and technical skills which are pre-requisites in the 21st century global knowledge economy (The Forum for Education Reform (FFER), 2013). As a consequence, there is widespread concern about quality of education at all levels in Ghana today. However, much more concern has been expressed on the pass rate at basic and secondary levels, as good quality higher education is built on how strong the foundation level is. Whilst passing with good grades is not a comprehensive indication of quality, it is a good proxy to the quality of education, especially at the basic level.

The table 1.7 below shows the pass rate from JHS to SHS from 2006-2011 for the *Basic Examination Certificate Examinations (BECE)*.

Table 2.6. Pass Rate from Junior High School to Senior High School (2006 – 2011).

Year	No of Pupils (Sat)	No of Pupils Passed	Percentage Passed (%)
2006	308, 383	190, 924	61.95
2007	320, 247	196, 240	61.27
2008	338, 292	210, 282	62.15
2009	395,649	198, 642	50.21
2010	350,888	172, 359	49.12
2011	375, 280	176, 128	46.93

Source: The Forum for Education Reform (2013).

Examination of Table 2.7 demonstrates that, taking 2008 out; there has been a downward trend of pass rate which paints a gloomy picture for the future the education system. This problem could be attributed to the change in government in 2008. The National Patriotic Party (NPP) ruled the country from 2001-2008 but their government lost power to the National Democratic Congress (NDC), which has been in power ever since.

Even though many solutions have been suggested (e.g. improvement of infrastructure, reduction of the subjects taught at the basic level to arrest the situation (FFER, 2013)), this study advocates effective and meaningful ICT integration into the entire the education system, as the most effective solution, as many recent studies have shown that, when ICT is used as a tool within instruction to support learning, students' learning is enhanced (Kafyulilo, Fisser & Voogt, 2011; Vrasidas, 2015). This brings to the fore the need to examine the extent of ICT usage in the education system.

As digital technologies are now an integral part of any modern education system, ICT has been introduced into the entire education system and has been examinable in both JHS and SHS since 2007 (Curriculum Research Development Division [CRDD] 2007).

Although the original focus was on integration of the technology into the teaching and learning of all the subjects in the basic and secondary schools, it is taught as a distinct subject, encompassing basic computer skills and common applications such as word processors, spread sheets, databases and Internet applications (MOE, 2009).

With support from non-governmental (NGO's) donor organisations, and especially Parent-Teacher Association (PTA's), most of the basic and secondary schools in Ghana have modern ICT and Internet facilities, enabling students to deepen their connection to the outside world (Government of Ghana, 2007). Despite these encouraging developments, a review of documents of NGOs that are spearheading ICT implementation, in collaboration with the government, reveal that most schools now benefiting from the ICT are either located in urban areas or are classified as premier Junior or senior high schools (Government of Ghana, 2012) suggesting that there is still a rural-urban digital divide. Besides, having teachers to teach competently with the ICT has been major challenge, as most of the teachers do not have adequate training in the use of ICT-centred teaching techniques in their teacher training programmes. As McKinsey (2007, 7) notes, "the quality of an education system cannot exceed the quality of its teachers". It is therefore, vital to recognize that the success of what Ghana hopes to achieve in education hinges on the quality of its teachers. Against this backdrop the next two sections discuss pre-service education in Ghana and the extent to which ICT is utilized in these institutions.

2.5. PRE-SERVICE TEACHER EDUCATION IN GHANA

Pre-service teacher education in Ghana has changed dramatically over the last two decades (Newman, 2013). In 2008, a landmark institutional change took place as part of the government policy to make the nation's education responsive to the needs of the 21st century. As a result, all the 38 public-owned Initial Teacher Training Institutions (ITTIs) that offered certificate programmes to prepare teachers for basic schools in Ghana, were upgraded to Diploma-awarding institutions (Newman, 2013). In 2012, the Colleges of Education Act (Act 847), was passed to give legal backing to the new status of the institutions (Government of Ghana, 2012). All the 38 public teacher training colleges are now affiliated to the University of Cape Coast and award the Diploma in Education to their students after successful completion of their 3-year programme. The first batch who started in 2007 and completed their Diploma in Basic Education programme in 2010, qualified for the award of the Diploma in Basic Education.

Despite the existing Colleges of Education being upgraded with Diploma-Awarding Institutional status, the need to improve the quality of output of the colleges to meet the 21st century standards is still clear. The use of ICT to teach effectively in these institutions is still low and, therefore, the standards do not conform to the 21st century classroom practices.

As indicated earlier in this study, about 85 per cent of the new teachers graduating from the Colleges in 2012 felt they lacked the necessary skills to teach with ICT in their classrooms (MOEG, 2012). In this ever-changing, rapid-changing, high-tech, interconnected world, it is believed that the role of pre-service teacher institution is vital and extremely important to be able to appropriately prepare pre-service teachers to face the challenges of the 21st century classrooms. There is a believable perception across the political divide in the Ghana that an overhaul of the current teacher training system can enhanced the nation's best asset (the human resource) as the consequence of neglect in this area will severely undermine the country's development (The Forum for Education Reform (FFER) (2013). As already indicated over the last two decades, pre-service teacher education in Ghana has undergone a number of modifications. These modifications are as a consequence of policy changes which are aimed at producing well trained teachers to meet the educational needs of the country at various times (MOEG, 2007). These changes have resulted in the production of different cohort of teachers with different kinds of certificates. These are summarised in table below:

Table 2.8. Teacher Education Programmes and Qualifications in Ghana.

LEVEL	COURSE DURATION	ENTRY LEVEL	CERTIFICATE AWARDED	TEACHING LEVEL
Higher Education (Non Graduate)	3 Years	Senior High School	Diploma in Basic Education	Primary & Junior High School
Higher Education (Undergraduate)	3 Years	Senior High Sch. Or Dip.	Bed Degree	Senior High Sch./ College of Edu.
Higher Education (Postgraduate)	1 Year	Degree Holders (e.g. BA/BSc.)	Postgraduate Cert in Edu. (PGCE)	Senior High Sch./ College of Edu.

Source: Ghanaian Ministry of Education (2007)

Unlike countries like the United Kingdom, Finland, Singapore and others especially in the developed world, where teacher training is mostly undertaking only at the university level, in Ghana there are two major pathways to enter teacher education (see, Table 1.7). The first category is the graduate teachers (BEd/PGDE) who study in the designated universities (e.g. University of Cape Coast and University College of Education, Winneba) purposely to teach in the senior high schools and Colleges of Education in the country. The second category constitutes teachers who study in the country's thirty eight Colleges of Education for the

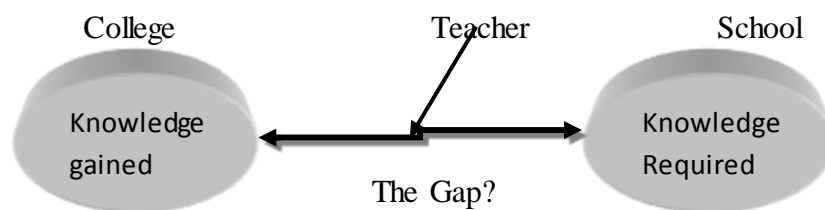
Diploma in Basic Education award. These teachers teach at the primary and junior high school levels. This second category is the focus of this study for the following reasons:

First, they constitute the majority of teachers in the country [about 75 %] and they teach in the foundation stage of children's education (MOE Statistics, 2011). Studies conducted by the Asian Development Bank (ADB) have shown that the early years of a child's education are critical for developing the foundations for future intellectual and social development of a nation (ADB, 2008). The study further indicated that good quality higher education outcomes begin with a good grounding in primary and junior high schools. Thus, Higher Education in Ghana can only build on what has been acquired at the basic level. Closely related to the above reason is the research evidence which shows that returns to the overall investment in education differs by the stage of development of a country (Asian Development Bank [ADB], 2009). The study indicated that, while in high-income countries the returns on investment are greater in tertiary education, in low-income countries basic education is the best investment (ADB, 2009). With this evidence in mind, the focus of this study on future basic education teachers is appropriate. Undoubtedly, this category of teachers were selected since it has been documented that African governments, including Ghana, often devote more attention and resources to secondary schools and higher education levels than achieving basic education (Yusif & Yussof, 2010). This suggests that the results of the study will have important policy implications for the country. However many research studies and policy-paper reports (e.g. OECD, 2012; Singapore's Intelligent Nation Plan, 2015; New Zealand Government ICT Framework, 2008:23 and Australian Government's Education Revolution Strategy 2010) show that in order to succeed in today's knowledge economy, investing in early age education is crucial to lay the foundation for economic growth. This in line with one of the core objectives of Ghanaian government education plan to mould the minds of the children at the basic levels (Ministry of Education Youth and Sports Ghana (MOEYS) (2008). These prominent examples clearly affirm that targeting teachers who teach at the foundation level of the education system is of paramount importance. Therefore, equipping this category of teachers with ICT skills to especially enhancing teaching and learning in this sub-section of our education system is a necessity.

2.6. EXTENT OF ICT USE IN PRE-SERVICE TEACHER EDUCATION IN GHANA.

A research study conducted in Ghana by Agyei and Voogt in 2011 indicated that the quantity and quality of pre-service teachers' technology experiences, included in their pre-service teacher education programmes, is a crucial factor influencing teachers' adoption of technology

for pedagogical purposes. Recognising the role of pre-service teacher education as vital and extremely important to appropriately prepare teachers to meet the challenges of the education system, the government of Ghana, in September 2007, officially introduced ICT into all the Colleges of Education as part of the initiative to improve quality of teaching and learning in all schools in Ghana (Newman, 2013). Today, even though ICT is not fully widespread in all the pre-service teacher institutions in Ghana, evidence show that there is no single College of Education in the country that does not have at least one ICT laboratory. Even more important, most of the institutions that are connected to the Internet also have their own websites (Owusu, et al., 2010). However, whereas the ICT policy centres on the integrated use of ICT within the teaching and learning process, the teachers demonstrate basic technology skills in the areas of Internet and communications, spreadsheets, word processing, and presentation software (Government of Ghana, 2012). Mereku, et al., (2010) found that ICT integration in Ghanaian Colleges of Education is limited to largely teacher-centred information gathering, and the few teachers' who use the technology, used it for information transmission rather than the facilitation of students' knowledge construction. With basic ICT knowledge, the teachers are not conversant with the integration of the technology for pedagogical purposes. As a consequence, teaching with ICT in basic schools in Ghana becomes impossible to achieve. This is because serving teachers do not experience an ICT immersed curriculum in their professional preparations and they pass on what they receive. Insufficient training of teachers in their teacher training programmes has created a gap between the knowledge gained at the Colleges of Education and knowledge required in the basic schools. This has been depicted diagrammatically below:



This means that a pedagogically effective and sustainable use of ICT in the pre-service teacher institutions is far from being reality, despite the government efforts to infuse ICT in the entire education system (Newman, 2013). To meet the schools' requirements, there is a need for a paradigm shift in teacher training, a new paradigm which puts ICT at the core of teaching and learning, to transform the current pedagogical approach in the pre-service teacher education programmes (Unwin, 2005).

2.7. GHANA ICT POLICY ON EDUCATION (2015)

The 2015 ICT policy on Ghanaian education was originally drafted in 2003 and underwent a series of reviews (e.g. 2006; 2008) before attaining its current status. The aim of the policy is to: *transform the educational system to provide the requisite educational, and training services and environment capable of producing the right types of skills and human resources required for developing and riving Ghana 's information and knowledge based economy and society'*”(Ghana ICT Policy in Education, 2015, p.16).

The policy is hinged around 3 key pillars:

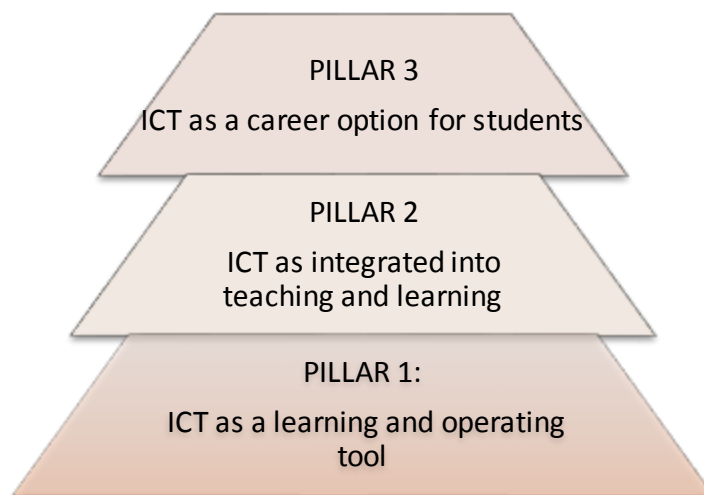


Figure 2.2. Pillars of Ghanaian ICT Policy

With its inception in 2003 as a draft document, it aimed to achieve its goal, that by 2015 every learner in Ghanaian education system would be ICT capable. This was to be achieved in these 3 phases:

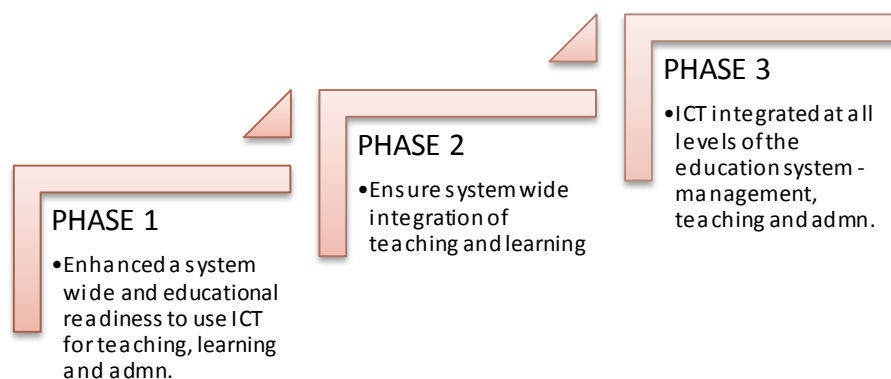


Figure 2.3. Three Phases of Ghanaian ICT Policy.

However, as at 2016, a year after the 2015 deadline, even the phase 1 has not been achieved. This bring to the fore, whether the teachers and students are ready to accept the technology.

2.8. SUMMARY OF THE CHAPTER

The Chapter discussed the national context of the study. The chapter described geographical position of Ghana which is the national context of the study in relation to the rest of its neighbours. It also briefly described the economic and political situation in Ghana. The Chapter also focused on historical and political backgrounds of Ghanaian educational context. It described the current structure of Ghanaian education system. The extent of ICT use in pre-service teacher education was considered. The Chapter concluded with the discussion on current ICT Policy in Education.

The next Chapter focuses on the related literature review of the study.

CHAPTER THREE: LITERATURE REVIEW

3.1. INTRODUCTION

Chapter Two discussed the national context of the study. The present Chapter presents the literature associated with the context of the study and establishes the basis on which the research questions in the study are explored. Based on current literature in pre-service teacher education, learning theories and ICT integration models, the overarching purpose of the study is to explore factors that influence pre-service teachers' acceptance and integration of ICT as a tool for teaching and learning in pre-service teacher education in Ghana. The study seeks to answer the key research question:

How can pre-service teacher institutions in Ghana equip the prospective teachers with the ICT skills and knowledge needed to teach in the 21st century?

The Chapter is organised into two major parts. The first part focuses on the review of the relevant literature on acceptance and integration of ICT in pre-service teacher education context based on five distinct bodies of scholarly literatures, whilst the second part discusses the theoretical framework of the study.

3.2. RATIONALE FOR ICT IN EDUCATION – GLOBAL CONTEXT

Newhouse (2004) contended that before a country or any educational system decides to implement ICT in education, it is necessary to critically consider the rationale for the initiative. Newhouse pointed out that there is little or no point in providing ICT in education, unless such a rationale has been established. The main focus of this section is to establish rationale for integrating ICT in education in the global context. The section is organised into two subsections. First, a brief critique of the impact of ICT in education will be considered. Following this, the study discusses the main rationale for integrating ICT in education.

Since the inception of ICT in education, one of the most discussed policy questions has been its impact on educational outcomes (Lambert & Jones 2013; Mouza, 2017; UNESCO, 2016; Cuban, 2013). It is widely believed that the use of ICT in education can help enhance the quality of education with advanced methods, improved learning outcomes and enable reform or better management of educational systems (Lim, 2016). Business leaders and policymakers worldwide consider it as a mandatory part of student preparation for the workplace (Aldunate

& Nussbaum, 2013) Against this background, considerable resources have been invested to justify the place of ICT in education, and many research studies have revealed the benefits and gains that can be achieved by students, teachers and administrators (American Association of Colleges of Teacher Education (AACTE), 2009; Dantoe, 2018).

However, other prominent researchers have questioned the wisdom of the substantial investment in this new digital technology in education (Cuban, 2013; Davis, 2018; Maor, 2017; Vrasidas, 2015). These researchers argue that the increase in the use of ICT is far more problematic than is typically acknowledged by the proponents of the so-called digital age. Mueller, Wood, Willughby, Ross & Specht (2008) for instance, claim that it is scandalous that so much money is allocated for computers and the Internet with so little evaluation. Oppenheimer (2003), ably supported by Polly, et al., (2010) have also raised serious questions about overselling the advantage of new digital technology by the rich nations, whilst Cuban (2013) bemoaned the fact that computers are oversold and underused. These critics contend that there is no good evidence that the use of ICT significantly improves teaching and learning.

The above researchers rightly made the point that frequently, new technologies are introduced in pre-service teacher education institutions, especially in the developing world without giving much thought to how best to use the technology to enhance students' learning outcomes. For example, in Ghana the general assumption that, once hardware and software are readily available in schools, ICT integration will automatically follow, is still the norm (Buabeng Andoh, 2015). For example, as part of its "Better Ghana Agenda" programme, the government of Ghana in 2012 distributed laptops to individuals and few educational institutions without any provision or plan for their innovative use. As part of the programme, individuals were asked to apply for the laptops online and those whose names were picked as successful, congregated at the 'State House' for a special ceremony for collection of the computers. Such an approach of distributing computers does not bring about innovation in, and the improvement of, teaching and learning with ICT. Thus, merely giving computers to students without making necessary provision for their professional development is of no significant to improve students learning outcomes.

The findings of the aforementioned studies (e.g. Cuban, 2013; Polly et al., 2013; Vrasidas, 2015) are consistent with the current situation in Ghanaian educational context. In Ghana, although the government has provided ICT in most of the pre-service teacher institutions, but

the teacher educators are not using are not using the technology to enhance their teaching skills to improve the pre-service teachers learning outcomes but merely teach ICT as a stand-alone course (Buabeng-Andoh, 2015). Although equipping the pre-service teachers with ICT skills is regarded as a prerequisite for effective ICT integration, it is now recognised that such stand-alone courses are not sufficient to prepare effective ICT-using teachers. Therefore, teacher education programmes should be evolved to include subject-specific ICT courses (U.S. DOE, 2017) in order to prepare the pre-service effectively to use the technology for pedagogical purpose (Koehler and Mishra, 2009).

In spite of divergent views within the scholarly community regarding impact of ICT on teaching and learning, some research studies have shown significant increases in the achievement scores of using ICT as teaching and learning tool (Mouza, 2017). Vrasidas (2015) observed that although the benefits of the use of ICT in education may not be universally recognised, a commonly held view is that students attending schools with better ICT resources perform at a higher level than other similar schools (Vrasidas, 2015). In the US, research evidence revealed that there is far-reaching public support for the integration of ICT in education (U.S. DOE 2017). The study revealed that 69% of Americans believe that the use of ICT has improved the quality of instruction in their local schools; whilst 82% believe that schools should invest more in ICT for instructional purposes (U.S. DOE, 2017).

In more recent research conducted by the International Society for Teacher Education, it was revealed that a student exposed to ICT in K-12 instruction performs 12 points higher than a student without technology-enhanced instruction (U.S. DOE, 2016). This implies that effective integration of ICT tools into learning and teaching has a positive effect on students' outcome. However, it is important to recognise that the widespread use of ICT in teaching and learning is so sparse that few generalisations seemed warranted. Having critiqued the impact of ICT usage on teaching and learning, attention, the study moved to discuss why countries invest in ICT in education.

A number of studies (e.g. Kozma, 2008; O'Hara, et al., 2013; Tandeur, van Braak, Voogt & Prestridge, 2017; Hawkrigde, 1990) have identified a number of key rationales that drive countries to design policies and implement ICT in education. However, this study considered four key rationales proposed by Hawkrigde (1990), which were purposely designed for a developing world context.

Hawkrige (1990) discerned four different rationales that drive policies related to the implementation of ICT in education. He pointed out that countries invest in ICT in education based on the following four rationales.

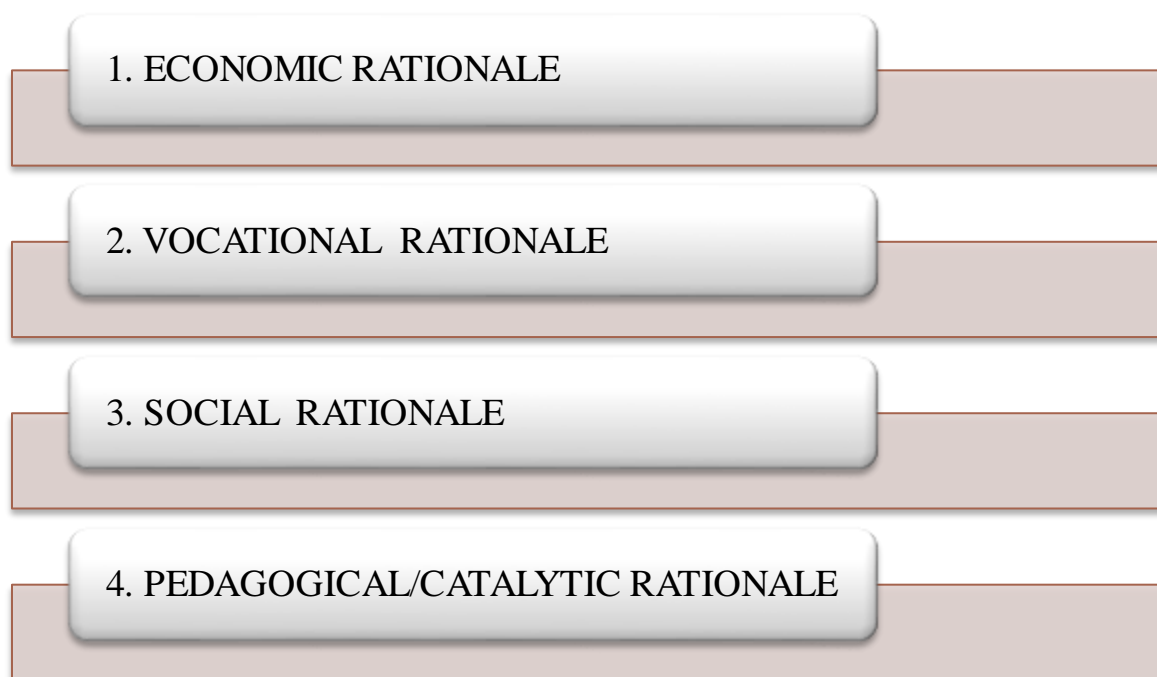


Figure 3. 1. RATIONALE FOR INVESTING IN ICT IN EDUCATION

Source: Hawkrige (1990)

Following the above sequence (see Figure 3.1) the first rationale to consider is economic. Hawkrige (1990) posited that many countries invest in educational technology (ICT) for the role it can play in preparing the future workforce and supporting economic development. The economic rationale is based on the premise that the development of ICT skills is necessary to meet the need for a skilled work force, as learning is related to future jobs and careers (Shinenger, & Murray, 2017). Against this background, many countries have designed policy documents that lend support to economic rationale for investing in ICT in education.

The Government of Republic of Ireland policy document 1997 for example, stated:

knowledge and familiarity with technology would be an important
dimension of employability in the information society.
(Department of Education, Northern Ireland, 1997:15).

Again, in Queensland, a ‘Smart State’ view of teaching, learning and assessment advocated the use of ICTs to adequately prepare students for present and future technologically focused worlds and workplaces (Education Queensland, Queensland State Education – 2010). With an economic imperative as the major focus, David Milliband, the then Minister of State for School Standards in England, in his foreword to ‘Framework for teaching ICT capability in Key Stage 3 noted:

Information and communication technology (ICT) is more vital now than ever.
We must ensure that young people have a knowledge and understanding of hardware and software, and also that they can harness the power of the Internet and the rapidly expanding world of digital communications. By giving them the skills and confidence to use ICT effectively, we are making it easier for them to find good jobs.
(Milliband, 1997:3).

The above quotation underscores the economic imperative for the United Kingdom in investing in ICT in education, since educational achievement is linked to the future economic well-being of the country (Somekh, 2008).

This rationale is not limited to only the developed world, some countries in the developing world, especially those in Africa and South-East Asia, see digital technology in education as fulfilling their economic goals. For example, the African Heads of State (African Union, 2004) in their 2004 summit in Addis Ababa, Ethiopia, discussed the potential for ICTs to promote job creation and make education more available within the continent. Similarly, Jordan, faced with persistent high unemployment and poverty, introduced an ICT initiative known as The Educational Reform for Knowledge Economy (ErfKE) in 2003, with the top priority of the development of the nation’s human capital (Meyers et al., 2016).

Another significant rationale adopted by many countries is vocational. As the need for well-prepared professionals is a societal need, this rationale is based on the assumption that students should be prepared to function adequately as professional workers in the technological society (Hawkrige, 1990). By learning ICT skills, it is believed that students become better prepared for work that increasingly involves the use of ICT (Mouza, 2017) therefore, the focus of this rationale is about teaching students to learn how to operate, and learn using, computers.

Wellington (2005) argued that the vocational rationale has been the major pressure for pushing ICT into education. It should be recognised that even though Wellington’s (2005) assertion

could be true in the early 1990's, as most countries were focusing on producing computer scientists and IT professionals, it is not entirely true at this current stage of ICT development in education, especially in the developed world, that the vocational rationale is the major pressure for pushing ICT in education. It could still be true in most developing countries but the major focus in most countries now is the pedagogical rationale, which helps students to pursue higher-order thinking and problem solving skills (Valulleh, 2018).

However, one would agree with Hawkrige (1990) who observed that most developing countries placed much emphasis on the vocational rationale, and much less on socio-economic and pedagogical ones, when it comes into integration of ICT in education. In Ghana, for example, it was common in the late 1990's to see the majority of the students, especially the "drop outs" from the secondary school go to private institutions especially, to learn about computer software and hardware as a vocational qualification. In its advanced form, students pursue computer science courses in the universities to become computer scientists.

Besides the economic imperative, many countries have also focused more on the potential social impact of ICT, and many governments have justified ICT investments with policies that This promote their use to share knowledge and enhanced social cohesion (Buang-Andoh, 2015). rationale builds on the belief that all students should know about and be familiar with ICT in order to become responsible and well-informed in the rapidly growing information economy. According to Hawkrige (1990) since schools prepare children for life, they should prepare them for effective use of ICTs. However, some countries, especially those in the developing world are finding it difficult to equip students with relevant ICT skills. Within this perspective, ICT capability is a prerequisite for participation in both society and the workplace, and its inclusion in the curriculum offers a means to ameliorate any possible digital divides between the haves and the have-lesses that exist in within the population (OECD, 2012). This rationale focuses on technology skills as an end in themselves, and in many countries ICT is introduced as a separate subject in school, in order to teach students a number of technical skills (Plomp, Anderson, Law & Quale, 2003). The use of ICT in pre-service teacher education in Ghana can comfortably fit into this rationale, as the teaching of ICT is basically to equip the students with ICT skills but not to teach them to use the technology for pedagogical purposes.

Additionally, most governments, especially those in the developing world, feel that modernisation of schooling involves bringing computers into schools (Kozma, 2005). This is consistent with the situation in Ghana and Africa in general. For example, in Ghana and many

other African countries there has been a significant focus on the level of computer provision and technology infrastructure in schools (Unwin, 2006). The notion that putting more computers in schools means the modernisation of schools is flawed (Fobih, 2007). For example, in 2010, the government of Ghana distributed 450,000 laptops into various primary and secondary schools in the country (MOEG, 2010) but no provision was made to equip the teachers, who would help the students to put the technology to productive use. However, the focus in the 21st century has shifted toward emphasising the use of ICT as a pedagogical tool for improving learning by promoting active student learning and engagement in higher-order thinking (Niederhauser, Salem & Fields, 1999). This leads us to the final and much more important for the purpose of this present study, the pedagogical/catalytic rationale.

The pedagogical rationale is based on the popular notion that ICT can play a particularly important role in supporting education reforms and transformation (Means, 2006; Means & Olson, 1995). The proponents of this rationale advocate that ICT can help children to move away from rigid curricula, rote learning and teacher centred-lessons, by giving more control to children for their own learning. In such an environment ICT use helps students pursue higher-order thinking and problem-solving skills.

Many educational systems in the world today favour this rationale as an effective way for schools improvement. For instance, the current Education Queensland curriculum policies, guidelines and frameworks document a need for innovative and purposeful use of technologies, to achieve pedagogical aims and improved students learning outcomes (*Education Queensland, Queensland State Education, 2010*).

This rationale supports most current educational reforms across the world by emphasising what are sometimes called “21st Century skills”, i.e., qualities that prepare students for the knowledge economy, such as creativity, information management, communication, collaboration, and the ability to direct one’s own work and learning (Partnership for the 21st Century, 2005; National Centre on Education and the Economy, 2006).

The Ghanaian ICT in Education policy document stresses the need to integrate ICTs to transform the education system, in order to produce the right type of skills and human resources required for developing and driving Ghana into the knowledge-based economy and society (Ghana ICT Policy, 2003; Ministry of Education Youth & Sports, 2008). However, in the actual classroom the ICTs, if used, conform to the requirements of the classroom, rather than to

transform teachers' practice. Thus, the teachers use the technology but without changing their pedagogy.

Though the distinctions between the four rationales discussed above are important. Recent research studies have revealed that there is a growing convergence between the economic, social, and educational rationales (Kozma, 2008). In his analysis of various countries' design, development and implementation of ICT policies in education, Kozma (2008) identified a number of key rationales that drive countries to design policies to implement ICT in education. His analysis revealed that whilst most countries focus on multiple rationales (e.g. Singapore, Hong Kong and Finland) there are few others who still implement ICT in education to support economic growth, or to promote social development or to advance educational reforms. It would be a mistake for the Ministry of Education in Ghana to focus entirely on just one of these four rationales. Two or three of them needed to be advanced simultaneously to justify putting computers in schools. Socio-economic rationales seemed to be prevalent, even though some educational institutions are beginning to embrace the technology for teaching and learning purposes.

Given that issues of teacher change are central to any discussion of ICT integration in education, the next major focus is to examine the beliefs and attitudes of the teachers towards ICT integration.

3.3. BELIEFS AND ATTITUDES TOWARDS ICT INTEGRATION

Pre-service teachers' beliefs and attitudes have a large influence on their choice to use ICT for teaching and learning purposes (Kim, Lee, Spector, and DeMester, 2013; Tandeur, van Braak, Sang, Voogt, Fisser & Ottenbreit- Leftwich, 2012; Finger, 2006; Sipilä, 2010). As Pajaras (1992:328) puts it, "understanding teachers' beliefs help improve their professional preparation," implying that, an understanding of the current beliefs and perspectives that teachers hold may serve as a good starting point for discussion about effective integration of ICT into pre-service teacher education in Ghana.

3.3.1. DEFINING BELIEFS AND ATTITUDES

According to Liehtinen, Nieminen and Viiri (2016), in studying pre-service teacher beliefs and attitudes, the concepts need to be defined. Pedagogical beliefs are defined as the beliefs that teachers hold, pertaining to the nature of teaching and how teaching should be carried out (Hammond, 2011; Paakarri, et al., 2015). However, in defining attitude, this study adopted

Zachariah's definition. Zachariah (2003) defined attitudes as mental concepts that depict favourable or unfavourable feelings towards a person, group, policy, and instructional strategy, or particular discipline.

Touching on pedagogical beliefs, Ozgun-Koca, et al., (2010) contended that there is much confusion, uncertainty and contestation over what pedagogy actually is. According to these scholars pedagogy is likely to mean different to different people, with researchers and policy makers approaching the notion from different perspectives and conceptual standings. They further postulated that pedagogical beliefs are the complex views of teachers' knowledge, skills, and abilities used in the reasoning, managing and ways of responding to the interactions of teaching and learning (Paakkari, 2015:135). Many researchers elaborate on the aspect of changing pedagogical beliefs (Ogun-Koca, et al 2010.). Moving from defining beliefs and attitudes in pre-service educational context, the role of them for effective ICT integration is under research during the last decade.

3.3.2. PEDAGOGICAL BELIEFS ABOUT ICT INTEGRATION

The pertinence of pedagogical beliefs in educational innovations was captured by Kagan (1992:85) who noted that "the more one reads studies of pre-service teachers' beliefs, the more strongly one suspects that this piebald form of personal knowledge lies at the heart of learning." In a similar vein, Pajaras (1992) was of the view that understanding pre-service teachers beliefs helped improve their professional preparation. This implies that, an understanding of the current beliefs and perspectives that pre-service teachers may hold may serve as a good starting point for discussion about their acceptance and integration of ICT for instruction

As already defined, pedagogical beliefs are beliefs that pre-service teachers hold, pertaining to the nature of teaching and how teaching should be carried out (Hammond, 2011; Lehtinen, & Nieminen, 2016). Pedagogical beliefs are broadly organised into two major categories, namely, traditionally oriented beliefs and constructivist oriented beliefs. Many researchers are of the view that teachers' pedagogical beliefs and teaching philosophies influence the way ICT is accepted and the degree of technology integration within classroom practices (Finger, 2006; Lehtinen, Nieminen & Viiri, 2016; Teo, 2014). This suggests that the extent to which ICT will be effectively integrated into pre-service teacher education instruction depends on the type of pedagogical perspective adopted by the pre-service teachers.

Although some researchers such as Lim, Chai & Churchill, 2011, still do not agree with the above assertion, in general, it is believed that pre-service teachers whose philosophies favour constructivist-oriented beliefs and student-centred approaches are found to be more likely to integrate ICT in their future classrooms in a substantial and intellectually fruitful way (Jimoyiannis, 2012). For example, Judson (2006) noted that pre-service teachers who adopt constructivist instructional models use ICT both frequently and in a more advanced capacity than those who do not. Again, pre-service teachers with more traditional pedagogical beliefs are found to implement more traditional or “low-level” technology use. On the otherhand, Hermans, Tondeur, van Braak & Valcke (2008:149) noted “traditional beliefs had a negative impact on integrated use of ICT. Other researchers such as Lim and Chai (2008) also argued that pre-service teachers with traditional pedagogical beliefs, even when placed in a technology-rich classroom, may continue to use technology to support didactic or traditional skills-and-fact oriented instructions. This implies that, for pre-service teachers to adopt ICT for pedagogical purposes, there is a need for them to change their pedagogical beliefs from traditional behaviourist beliefs to a constructivist one.

However, Sandholtz and Reilly (2008) were of different opinion. They were of the view that some pre-service teachers may hold constructivist pedagogical beliefs, but may fail to perceive or take up the affordances of ICT tools because they may not be competent in using the technology, or because of the constraints of their socio-cultural contexts. This may be true in the Ghanaian pre-service teacher education context. For example, in his study of 4 schools in Ghana, following 12 pre-service teachers in their beliefs in using ICT for instructional purpose, a survey by Teye (2014) found that although 3 of the pre-service teachers held constructivist beliefs but they could not utilise the computers for instructional purposes due to a number of constraints such as insufficient time to plan instruction, inadequate technical support, lack of leadership support and access to computers with reliable Internet connection and others. However, Teye cited pressure from parents and schools themselves to ensure their pupils do well in end-of-course examinations as the most important constraint. This suggests that the teachers and the parents see the use of computers for teaching as “waste of time.” As to them it would not contribute positively to the students final examination results. This finding is consistent with the work of Cuban (2003) who bemoaned that computers are oversold and underused.

Complementing Teye's (2014) survey, the earlier study by Tonah (2006) found that the Ghanaian school curricula and the educational legislation for the past two decades placed the development of critical thinking among the priorities of formal education. However, in practice, teaching is still based on a teacher-centred, didactic, very examination results'oriented approach. Given that the majority of the pre-service teachers in Ghana have been taught and have been receiving their professional training, in the traditional learning environments, they tend to perceive teaching as disseminating information and learning as a passive activity, with students holding little responsibility for their own learning. Thus, having deep-rooted beliefs in teacher-centred learning, which is inconsistent with the teaching and learning with ICT (Angeli & Valanides, 2008), they may find it difficult to ICT for pedagogical purpose. As a consequence, to encourage pre-service teachers to adopt constructivist pedagogical beliefs when they become teachers, there is a need to engage them in examining and changing their traditional pedagogical beliefs.

Some researchers found that changing pre-service teachers' beliefs about teaching and learning with ICT in the classroom has been found to be always a challenge (Lim & Chai, 2008) since pedagogical beliefs are formed over many years of experiences from life as pupils in the classroom (Lehtinen, et al., 2016) to the variety of professional contexts they encounter. However, Muiji and Reynolds (2008) argued that belief systems are dynamic mental structures that are susceptible to change by practical experiences. The teacher education programmes, especially, at the pre-service stage, play a critical role in facilitating teachers' transformation in their instructional practices by shifting their pedagogical beliefs. However, if pre-service teacher education programmes merely teach learning theories and concepts, they are unlikely to have an effect on changing pre-service teachers' beliefs and instructional practices (Kagan, 1992). Changing pre-service traditional pedagogical beliefs successfully to constructivist oriented beliefs to achieve successful integration of ICT, the teacher educators in the pre-service teacher educational institutions should clearly communicate the importance of ICT integration in all subject areas and demonstrate it through visible role modelling expectations. Setting good personal examples by the teacher educators teaching with the technology in their respective subject areas it will empower the pre-service teachers to gradually change their deep-rooted traditional behaviourist pedagogical beliefs. However, the problem is that the teacher educators who are supposed to model the use of ICT for the pre-service teachers to emulate it are themselves not competent to teach with ICT. Therefore, there is a need for the leadership in the pre-service teacher institutions to organise relevant continuous professional

development for the teacher educators to equip them with relevant ICT skills and knowledge so that they would be able to teach with ICT.

3.3.3. ATTITUDES TOWARDS ICT INTEGRATION

The importance of attitude as a precursor to ICT integration in pre-service teacher education has attracted much attention from researchers and practitioners in the last two decades (Lehtinen, Nieminen & Viiri, 2016; Teo & Milutonic, 2015; U.S. DOE, 2017). Although, attitudes were not historically considered as major factor for ICT integration (Venkatesh, 1996), it now widely recognised as a major predictor for ICT integration in pre-service teacher education (Teo & Milutinovic, 2015; Yang & Kwok, 2017). For example, a number of studies have indicated that a major reason for studying pre-service teachers' attitude is that, they are a major predictor of the future use of ICT in instructional settings (Gulbahar & Guven, 2008; Teo, 2014). Again, many empirical research studies in different parts of the world have shown that successful integration of ICT in pre-service teacher education depends, to great extent on pre-service teachers' attitude, whether positive or negative can affect how pre-service teachers respond to ICT (Venkatesh & Balah (2008), For example, Teo (2008) in his study at the Institute of Education in Singapore concluded that pre-service teachers who had positive attitudes towards ICT felt more comfortable in using the technology. However, those students with negative attitudes resisted using the technology. This suggests that in order to achieve successful integration of ICT in Ghanaian pre-service teacher education system, there is a need to critically examine the pre-service teachers attitude first. Considering the pivotal role pre-service teachers are expected to fulfil in the process of integrating ICT in the Ghanaian education system, understanding of how they react to ICT is essential.

3.4. TECHNOLOGY INFRASTRUCTURE

In the process of ICT integration, the importance of reliable and high quality ICT infrastructure is undeniable (Rudra, Pradhan, Girijasankar & Tapan, (2018). Without reliable and high quality ICT infrastructure, meaningful ICT integration will not be possible. Countries all over the world that are serious to achieve meaningful integration of ICT in their education systems place a priority to the development of quality ICT infrastructure such as electricity, reliable Internet connection, telephone lines and a cutting edge state-of-the art building to accommodate the

modern technologies (International Telecommunication Union [ITU], 2018;Ministry of Education, Singapore, 2016; U.S. DOE, 2017).

For example, in the United Kingdom, two flagship initiatives, Building Schools for the Future (BSF) and the Primary Capital Programme (PCP), ICT infrastructure accounted for £200 million in 2009 financial year (British Educational Technology & Training Preview,[BETT] 2010).In the same year the American government also invested \$40 million in ICT infrastructure in fourteen higher-education teacher education colleges to transform teacher preparation programmes to guarantee teacher effectiveness (AACTE, 2009). Similarly, Singapore, in their bid to support the third phase of their “Masterplan for IT in Education” (MPTE) to further enhance teaching and learning, committed approximately 610 US\$ million to provide ICT infrastructure within a period of 10 years (UNESCO, 2012). All these huge investments in ICT infrastructure serve as lesson that, if Ghana government wants to achieve successful integration of ICT in the pre-service teacher education programmes then there is a need for huge investment in ICT infrastructure.

In this study, the discussion on ICT infrastructure for successful integration of ICT in pre-service teacher education is centred on four main pillars articulated by the UNESCO (2011). It is widely believed that these pillars work together for a successful integration of ICT in any education system that is serious in achieving meaningful ICT integration. The four pillars have been depicted in Figure 3.2 shown below:

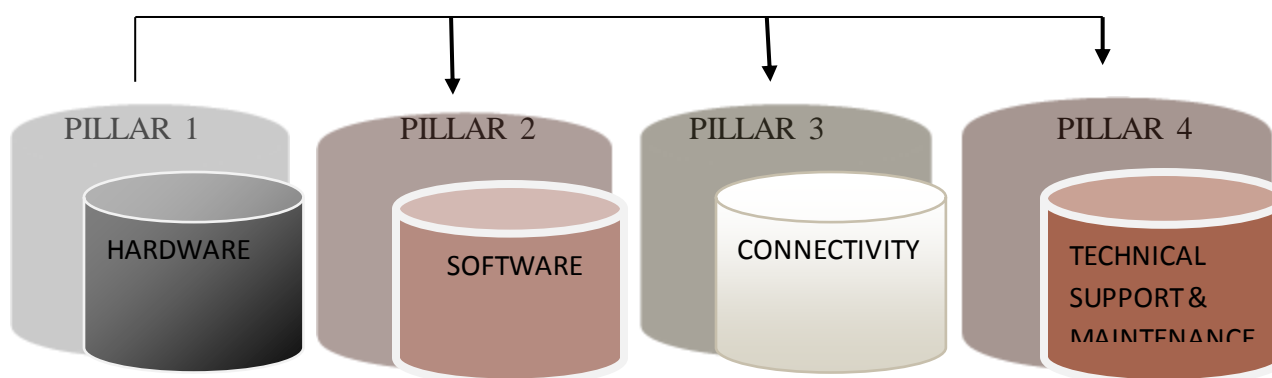


Figure 3.2. FOUR PILLARS OF EDUCATIONAL TECHNOLOGY INFRASTRUCTURE (UNESCO,2011)

From Figure 3.2 above the first pillar to discuss is hardware. Provision of hardware is seen as a threshold condition upon which successful integration of ICT is built. In many countries,

especially those in Africa, provision of hardware is recognised as the pre-requisite for ICT integration in pre-service teacher education in particular and education in general (OECD, 2015). In the United States, for example, it was found that the intervention of government by issuing pre-service teachers' with their own laptops, helped them developed positive attitudes towards the technology and increased their confidence in using 'ICT for teaching and learning (Karlin, et al., 2018). In Ghana, the government through various interventions in which information and Communication Technology integration remained a key priority. As at December 2016, the government had distributed more than 60,000 RLG computers to schools nation-wide under the Basic School Computerisation Project (MOE, 2017). In the same vein, Buabeng-Andoh, (2015) pointed out that provision of hardware has been the common ICT infrastructure that one can easily find in Ghanaian pre-service teacher institutions, even though some of them might be obsolete or not functioning well. Buabeng-Andoh's findings hold true in Ghana as all the successive Ghanaian governments' ICT initiatives have concentrated on purchasing hardware, rather than meeting the training needs of the teachers' capacity to use the technology (MOE, 2014). For example, in 2004, government embarked on the Baah Wiredu One Laptop Per Child initiative in which 10,000 laptops were distributed. Again, in 2015, government in conjunction with RLG, a local computer manufacturing company introduced "Better Ghana Laptop" project and distributed about 15,000 laptops to both teachers and students in a number of schools in the country all with the aim of given students more access to modern technologies, however, students are not using the computers for learning. The results of these initiatives have been an influx of thousands of computers into most educational institutions in the country. Again, some school buildings have been renovated and rewired to make way for ICT installation (MOE, 2016).

Next pillar to consider is software. It has been noted that the power of hardware is expressed in the software applications they run (ITU, 2018). In some educational systems, especially, those in the developed world have specific software for specific subjects such as Geography, Mathematics, Science and others. However, in Ghanaian pre-service teacher education, the most common software is the productivity software such as word processing, excel and presentation software.

One particular pillar of ICT infrastructure that has been changing global educational landscape rapidly in the last two decades is Internet accessibility. This pillar would be

discussed in detail from global perspective to the Ghanaian context. Internet connectivity which hitherto, has been a major barrier to ICT integration, especially in the developing world including Ghana in the last three decades is now changing educational landscape, due to its rapid growth in the global arena (ITU, 2018). According to 2018 International Telecommunications Union report, globally, mobile broadband subscriptions have grown more than 20 percent annually in the last five years and reached 4.3 billion by 2017 (ITU, 2018). The report also indicated that the global Internet bandwidth grew by 32 percent between 2015 and 2016 (ITU, 2018). However, Africa experienced an increase of 72 percent during the period, making the continent the highest of all regions in the world (ITU, 2018). This exponential increase in the global Internet subscriptions is much felt in Ghana. For example, Ghana National Communication Authority (NCA) July 2018 report supported ITU 2018 global report. The report indicated that, there has been an exponential growth of high speed mobile broadband which is more affordable than the fixed broadband in the global arena. In Ghana, NCA, (2018) report supporting ITU (2018) report indicated that there has been substantial growth in the number of people who use Internet. As a result of this exponential growth of the use of Internet and the Ghanaian government open door policy, there has been a proliferation of international and local mobile network operators which provide affordable mobile broadband access. Examples of these private mobile broadband providers which provide affordable Internet access are Vodafone Ghana, MTN, Glo and Air TEL/Tigo and several others. Apart from these private companies, government is also making strenuous effort to bring high-speed Internet access to the door steps of all Ghanaians, especially in educational institutions. Again, realising that the slow, unreliable dial-up connections can no longer support rich multimedia content and also to boost the Internet connectivity across the country, the government, in April 4, 2013 commissioned 600 kilometre Eastern Corridor Fibre Optic Broadband Infrastructure Project. Funded by the Danish Government at the cost of US\$38 million, the project was designed and implemented by Arcatel-Lucent, a leading innovator in the field of networking and communications technology. The purpose of this cutting-edge project is to bridge the rural-urban digital divide and promote ICT applications to support education, e-government, health and several others (Ghana Government Website, April 4, 2013).

Again, in August 2017, government commissioned Abenase Telephony in Abenase in the Eastern Region with the aim to bridge rural-urban gap access to the Internet. Despite the government efforts to increase Internet access, there remains a lack of high-speed Internet

connections in most educational institutions compared with business organisations (Afari-Kumah 2015). However, due to the affordability of mobile broadband, the pre-service teachers can use their own mobile broadband while in school to supplement what they have in the schools. Mobile broadband, though affordable and easy to use it has limitations such as small bandwidth, which makes it difficult for downloading materials and sometimes difficult to connect due to improper fixing of the sim card.

Fibre Optic development by the government is increasing fixed broadband in most of the pre-service teacher educational institutions (NCA, 2018).

As posited by UNESCO (2013), providing pre-service teacher educational institutions with machines, proper software and reliable connectivity is pointless without making provision for technical support and maintenance. In support, ISTE (2018) indicated that for a successful ICT integration to take place in teacher education, there is a need for a consistent and reliable assistance for maintaining and reviewing ICT digital resources. This indicates that the availability of technical support and maintenance is one of the critical factors for effective ICT integration. However, in the developing world, especially in Africa, unfortunately, most policy makers often fail to consider this as a critical factor as an integral part of the overall planning of ICT integration process especially at the initial stages. For example, in Nigeria, Olakulehin (2007) found that technical support and maintenance posed a significant challenge to ICT integration in teacher education, as they are often left in the hands of casual “amateurs,” since the promise of after-sales service is hardly met by ICT vendors. A similar study conducted in South Africa found that school administrators saw the shortage of technical personnel as a major obstacle to the integration of ICT in teaching and learning. The situation in Nigeria and South Africa is not different from Ghana. In Ghana, Buabeng Andoh (2015) observed that although different pre-service teacher educational institutions faced a variety of challenges, one which was critical across all the institutions was technical support and maintenance.

Zinger, Naranjo, Gilbertson & Warschauer (2017) indicated that most ICT initiatives, especially in the developing world do not make provisions for professional development especially at the initial stages. With this challenge in mind, the study move to discuss ICT professional development.

3.5. ICT PROFESSIONAL DEVELOPMENT (ICT-PD)

The purpose of this section was to examine the kind of teacher professional development needed for a successful integration of ICT into pre-service teacher education. This section has been organised into three subsections: The first section examines approaches for effective ICT-PD. Followed by teacher educators' ICT professional development approaches in Ghana and compare it with the literature to see whether there are gaps. The final section discussed ICT training for pre-service teachers in Colleges of Education in Ghana.

Teacher's professional development aimed at integrating ICT in teaching and learning has become a critical components in education world-wide (Karlin & Ottenbreit-Leftwich, 2018; Liao, Ottenbreit-Leftwich, 2018; U.S. DOE, 2017; Zinger, Naranjo, Gilbertson & Warschauer, 2017). Similarly, in the pre-service teacher educational context, the extent to which the teacher educators have the knowledge and skills for modelling the use of ICT in their own teaching process (Karlin, Ottenbreit-Leftwich, 2018; Meyers, et al., 2016; Liao, Ottenbreit-Leftwich, Karlin, Glazewski, & Brush, 2017) is recognised as one of the most critical factors for a successful integration of ICT (Longhurst, et al., 2016; U.S. DOE, 2017). However, studies have shown that when pre-service teacher education institutions implement ICT initiative, it is not always accompanied by effective professional development (Liao et al., 2017; Project Tomorrow, 2017; U.S. DOE, 2016). This finding is consistent with the situation in the Ghanaian pre-service teacher educational context. In Ghanaian pre-service teacher educational context, teacher educators' professional development has not been considered as a priority compare to the pre-service teacher's ICT training needs (Buabeng-Andoh, 2015). Without highly-motivated, dedicated and well-prepared teacher educators, ICT integration into pre-service teacher education is likely to fail (Buabeng-Andoh, 2015; UNESCO, 2016). To this end teacher educators in Ghana must understand how ICT can open up new possibilities to enhance their teaching and learning (Lim, 2016). Therefore, to achieve a successful integration of ICT in pre-service teacher education, teacher educators should be made aware that, in addition to developing technical skills, professional development helps to establish a deeper understanding of paradigmatic shift from viewing ICT as a stand-alone course to a pedagogical tool (Koehler & Mishra, 2009).

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ICT-PD. Followed by teacher educators' ICT professional development approaches in Ghana and compare it with the literature to see whether there are gaps. The final section discussed ICT training for pre-service teachers in Colleges of Education in Ghana.

While efforts to strengthen teacher educators' ICT-PD can take many forms, a large body of recent literature has identified specific approaches necessary for their success (Karlin, & Ottenbreit-Lefwich, 2018; Liao et al., 2017; Meyers, et al., 2016; Mouza, 2016; O'Hara, 2013; U.S. DOE, 2016) which are outlined below:

- Sustained and continuous: Continuous professional development is widely recognised across professions as necessary part of maintaining and developing professional expertise (Jaras & Katoglos, 2018). Research studies have shown that teacher educators perceive long-term sustained ICT-PD support as being effective (Longhurst, et al., 2016; O'Hara et. al., 2013). For example, a 2016 study in the United States found that teacher educators who participated in a 2-year ICT-PD increased their ICT knowledge and skills and changed their ICT integration practices. Additionally, it helped increase their students' achievements at a significantly higher rate than did their colleagues who participated in only 1 year of ICT-PD and those who did not participate. This suggests that sustained and continuous professional development has a greater impact on ICT integration practices than the short-term one-size-fits-all approach.
- Personalised to the individual teacher's needs. According to Saunders (2014) if teacher educators do not think a professional development is useful and supportive to address their professional learning needs they are less likely to implement the ICT implementation ideas. On the other hand, several studies have found that teacher educators perceive ICT-PD as effective when it takes their specific needs into consideration (Karlin & Ottenbreit-Leftwich, 2018; Meyers, et al., 2016; Longhurst, et al., 2016). Therefore, to achieve effective professional development, technology leaders in charge of ICT-PD in Ghana, should incorporate a variety of implementation approaches to address the teachers individual needs and preferences.
- Situated in Context: This means that ICT-PD takes into account the context (For example, school resources available, classroom environment) that the ICT will be used within (Duran, et al., 2011; Longhurst, et al., 2016; O'Hara, et al., 2013). This approach poses a challenge to ICT-PD activities in Ghana since most of the ICT-PD activities take place far away from the institutions within which it will be used. For example, on the 1st of September, 2015, Ministry of Education in collaboration with RLG, a local

computer manufacturing company in Ghana organised ICT-PD for 31,000 teacher educators at Accra Technical Training Centre, an institution which has nothing to do with the training of teachers (Daily Graphic, 1st September, 2018). Although, one may argue that probably the venue was chosen due reliable ICT resources (e.g.computers and Internet access), space and proximity, taken the teacher educators away from the context within which they teach

- Situated in Authentic Experience: Authenticity can be seen as a key ingredient in successful ICT-PD (Liao, et al., 2017; O'Hara, et al., 2013). Although, authenticity in learning can be understood in several ways. In the context of this study, authentic learning experiences include hands-on and pedagogically-focused activities
- Hands-on: Meyers et al., (2016) posit that for ICT-PD to be effective, teacher educators should be given the opportunity to use and work with the technology. Mouza (2011) found that teachers develop ICT competences where they designed and implemented ICT-enhanced instruction during their ICT-PD sessions. Mouza, further found that the teachers not only need ICT knowledge but also need pedagogical knowledge in using ICT.
- Pedagogically-focused: Other researchers have also emphasised the importance of focusing on pedagogical aspects of ICT integration during PD sessions (Erthmer, & Ottenbreit-Leftwich, 2013). In a similar vein, Karlin & Ottenbreit-Leftwich (2018) put forward that teacher educators tend to have more uses of ICT if they can see pedagogical value of using the technology. In another vein, if they cannot see any pedagogical value, they would not use it (Liao, et al., 2017). This suggests that when implementing ICT-PD in Ghana its pedagogical value should be taken into cognizance to ensure its effectiveness for the teacher educators to use the technology.
- Evaluation: Evaluation at the end of ICT-PD has been considered essential (O'Hara et al., 2013). Meyers et al., (2016) indicated that to understand full impact of teacher educators' ICT integration practices, multiple measures of evaluation should be used. According to Karlin and Ottenbreit (2018) effective ICT-PD should be evaluated using multiple evaluation measures to determine its effectiveness. However, some often fails to move beyond self-reported questionnaire.

To support the best practices of sustained ICT-PD with authentic experiences, Liao, Ottenbreit-Leftwich & Brush indicated that various levels of support are needed. Below are the levels of supports:

- Levels of Support

Liao, et al., (2017) categorised the levels of support for ICT-PD into two different levels namely:

- Personalised Support: According to Karlin, & Ottenbreit-Leftwich, (2018), in order to achieve a successful ICT integration, follow-up support should be provided to the teacher educators. Coaching and mentoring approaches have been shown to be particularly, effective in offering personal support to the teacher educators (Meyers et al., 2016). In these models of support, the coach or mentor, is typically a technology integration specialist (Karlin & Ottenbreit, 2018) who is skilled in ICT integration. In the process of ICT integration, the mentor the coach usually offer 1-on-1 advice, trouble shooting, modelling, planning and additional support to the teacher educators. The next level of support to consider is Community support
- Community of Practice: Community of Practice. The next level of support comes from Community of Practice. Over the last three decades, the concept of Community of Practice has been gaining attention. A community of Practice is a sustained social network of individuals who share a common set of core values and knowledge that is grounded on common practice (Wegner, McDermontt & Snyder, 2002). When forming a Community of Practice, Kopcha (2012) recommended that a teacher or technology expert guides the activity to make ICT-PD activities more effective. Kopcha (2012) further suggested that prior to establishing Community of Practice, ICT-PD developers should have well-prepared activities and support to help teachers change their beliefs and attitudes toward ICT. Working within such a community, Blitz (2013) indicated that teacher educators understanding about effective use of ICT is deepened through exploration, interpretation and negotiation.

With technology changing rapidly, are teacher educators changing their preferences for ICT –PD content and format at the same rate? On-line professional development programs are becoming increasingly popular for maintaining and developing professional expertise (Bates, Phlan & Moran, 2016). The Internet and mobile communication technologies have greatly expanded opportunities for team of teacher educators to reflect and collaborate with each other and experts outside (Blitz, 2013). One on-line approach for ICT-PD which has received maximum attention is Professional Learning Communities (PLC) (Blitz, 2013).

While a large body of literature on effective ICT-PD planning and implementation approaches exist, research studies and reports continue to show that teacher educators perceive ICT-PD as ineffective (Longhurst, et al., 2016; Meyers, et al., 2016; U.S. DOE, 2017). Again, while the literature suggests that effective ICT-PD should be offered in sustained and continuous manner, ICT-PD approaches in Ghana tend to be conducted as a single one-time event (O'Hara, et al., 2013). Despite its prevalence, the challenge remains to differentiate ineffective ICT-PD from effective ICT-PD (O'Hara, et al., 2013).

In summary, the literature suggested that the best practices for teacher educators' ICT-PD approaches should include planning based on teacher educators' needs analysis, implementing through sustained continuous methods, content and delivery should be hands-on (O'Hara, et al., 2013), situated in the actual College classroom where the technology will be used and evaluating using multiple evaluation measures in order to determine its effectiveness.

Comparatively, while the literature suggested that effective ICT-PD approaches should be highly intensive and long-running (O'Hara, et al., 2013), the situation in Ghanaian pre-service teacher educational context tends to be single, one-time event focused on a specific technology (Meyers, et al., 2016). Examining the connections between the ICT-PD approaches in Ghana and the research-based approaches in the literature, the researcher suggests that for effective ICT-PD to take place in Ghana the ICT-PD should be aligned with the individual teacher educators' needs.

Having reviewed the literature pertaining to effective approaches for ICT-PD, the next focus is to examine ICT-PD approaches in the Ghanaian pre-service teacher education context.

3.5.1. ICT-PD FOR TEACHER EDUCATORS IN GHANAIAN CONTEXT

This section examined the approaches to ICT-PD in the Ghanaian teacher education context which are outlined below:

- ICT-PD takes the form of occasional workshops, normally lasting less than a day, most often focusing on discrete ICT skills, with their connections to classrooms left to the teachers' imagination (Mereku et al., 2010). Such episodic workshops, disconnected from practice, do not allow the teacher educators the time for trying out their ideas back

in classroom and reflecting on . This is inconsistent with the literature which subscribed to offering an extended period of time through multiple sessions (Longhurst, et al., 2016). For example, on 1st September, (2015) 3,100 teacher educators attended ICT-PD at Accra Technical Training Centre lasting 3 months Daily Graphic, 1st September, 2015, 1st September, 2015. At the opening ceremony, the Minister of Education indicated that the program would be in two phases. She indicated the phase 2 which would involve 5000 teachers would be held at Opoku Ware Senior High School in Kumasi (Daily Graphic, 1st September, 2015)

- Allows for teacher educators to have hands-on experiences and practice time and sometimes participants are given computers after the workshop as an incentive. (Daily Graphic, September, 1, 2015)
- The focus of ICT-PD is mainly updating teachers' basic ICT skills and knowledge.
- Not situated in College context, often organised far away from the College context. For example, 1st September, 2018, 3100 teacher educators attended ICT-PD at Accra Technical Training Centre (Daily Graphic, 1st September, 2015)
- Planning does not take the teacher educators' varying personal needs into consideration but based on state needs
- Implementation is delivered through presentation instead of coaching and mentoring.
- Not pedagogically-focused
- No evidence of evaluation at the end.

Although, some of the approaches adopted in the Ghanaian educational context were consistent with the literature, it was found that ICT-PD was not sustained and continuous, situated in the context within which it will be used and above all the ICT-PD activities are not evaluated at the end to confirm their effectiveness.

From the above discussion, it could be deduced that more personalised, sustained and situated professional development is needed to effectively support teacher educators ICT integration.

Next, the study considered ICT training for pre-service teachers in Colleges of Education

3.5.2. ICT TRAINING FOR PRE-SERVICE TACHERS IN COLLEGES OF EDUCATION

In recent years, the government of Ghana has paid much attention to ensure that school teachers especially, are proficient in teaching with ICT (Buabeng-Andoh, 2015; MOE, 2016). Currently, there are 38 public Colleges of Education which are geographically distributed across the country. All pre-service teachers in Colleges of Education are exposed to at least one discrete course which exposes them to productivity skills such as word processing, excel, data base, Internet and presentation tool. ICT is taught mainly in the computer laboratories by technical persons, thus, teachers with expertise in ICT skills. This is true in other pre-service teacher education programmes in Ghana. For example, at the Faculty of Education at the Catholic University College of Ghana where they offer ICT in Education, the course title “BED Computer Science” even clearly indicates that the purpose is to offer purely stand-alone technical course but not for pedagogical purpose. The ICT courses in the Ghanaian pre-service teacher institutions mainly focus on stand-alone technical skills. As a consequence, the pre-service teachers are not able to transfer their skills to classroom when they become full-fledged teachers Buabeng-Andoh, (2015). Although, equipping pre-service teachers with basic ICT skills has been recognised as a predictor to successful ICT integration, it is now widely recognised that such stand-alone ICT training courses are not sufficient to prepare effective ICT-using teachers.

3.6. PRINCIPALS’ LEADERSHIP IN ICT INTEGRATION

Introduction of ICT in pre-service teacher education has placed unique pressures on principals. Numerous studies have demonstrated that principals are key figures in successful integration of ICT in pre-service teacher education institution (Fullan, 2012; Leithwood and Aza, (2016). Therefore, knowledge of how Principals effectively manage staff and students use of ICT is essential. Numerous studies have demonstrated that principals in pre-service teacher institutions are key figures in successful integration of ICT in pre-service teacher educational context (Fullan, 2012; Leithwood and Aza, (2016). However, in Ghana, principals hardly demonstrate interest in leading technological change in their institutions. This may be due to several reasons including:

- The age of the principals

- Their beliefs about teaching and learning
- Lack of effective professional development
- Their attitudes towards the technology

Although many researchers have argued that the success of a principal in leading a change depends on the leadership style adopted (e.g. Mynard 2009), a large number of current researchers are of the view that, no single style of leadership can prove effective in achieving effective integration of ICT into teaching and learning. Yu & Prince (2016) contended that a variety of leadership styles are appropriate in attempting to integrate ICT in unique settings. However, there has been a significant interest and support for shared leadership in leading ICT integration in educational settings (Fullan, 2013). According to Brown & Litrach (2011) shared leadership, which is grounded on collaboration, shared-purpose, responsibility and recognition of leadership irrespective of one's role or position within pre-service teacher education, has proven to be the most favoured model to achieve the meaningful integration of ICT in teaching and learning. This leadership model sees a paradigm shift, from a focus on the leader as individual, to a focus on the phenomenon of leadership, enacted through various parties in multiple relationships with leadership intent and capacity to achieve valued goals. Supporting the above researchers' views, Mynard put forward that successful leaders in the 21st century pre-service teacher education are those who promote successful leadership in other members of staff, and not those who still hold on to the leader-centred, heroic and individualistic views. This suggests that the leadership style of the principals in Ghanaian pre-service teacher educational institutions has been one of the major barriers to successful integration of ICT in those institutions. In Ghanaian pre-service teacher educational institutions, to become a principal one has to pass through a number of ranks before attaining the position of Principalship, so people become principal at their old age, and as the customs and traditions in Ghana demand. The principals command great respect and sometimes hardly would some of the junior staff approach them for advice or assistance. Again, due to their age, most of them attended schools and universities where there were no computers. So some of them see computers as waste of time and stick to the status quo. Therefore, introduction of ICT in most of these institutions are often met with resistance, especially the principals who are supposed to lead the change. Given the challenges faced by the principals in Ghana, how can we motivate them to lead successful ICT integration in their respective institutions.

Many experts in the field of educational leadership and innovation (Bush, 2011; Fullan, 2013) strongly argue that for effective ICT integration to occur in pre-service teacher education, there

is the need for a proactive and visionary leadership to inspire and facilitate all the stakeholders in developing a shared-vision for educational technology. For example, Leithood, (2013: 16) states that “outstanding leaders have vision of their institutions – a mental picture of a preferred future-which is shared with all in the institutional community.” Vision needs to define the “why” of change, the desired direction and all other general parameters of what needs to be done, in order to determine that change is successful.

Therefore, for the principals to become proactive to lead ICT integration in their institutions, government help them to have sufficient knowledge in order to anticipate and address the change problem and related issues. Strategic planning and goal setting become key functions of effective technology leadership. Without a clear sense of direction, planning and decision-making about ICT integration process can remain uncoordinated. The vision should be articulated in a manner where all are in agreement, which secures the commitment of all in the pre-service teachers’ educational community, with an opportunity for leadership widely dispersed in the institution. Vision has been regarded as an essential component of effective educational leadership for the last two decades (Bush, 2012). A study in Australia by Dempster and Logan (1998) in 12 educational institutions revealed that 99 per cent of the teachers expect the principals to express their visions clearly, whilst 98 per cent expect the leaders to plan strategically to achieve the vision.

Although shared vision with clearly stated goals are vital ingredients in achieving ICT integration, Bush (2012) noted that it is a mistake to believe that a shared vision is sufficient for effective ICT integration and pre-service teacher education improvement. For him, to achieve effective integration, the principals should be able to monitor the teacher educators, as well as the students in the process of ICT integration. With strong monitoring the principals would be able to gather evidence of the impact of ICT in the classroom and data about areas where modifications of the initiative may be needed. Congruent with Bush (2012), is an earlier study conducted by Buabeng Andoh (2015) in two Colleges of Education in Ghana which revealed that effective monitoring of ICT integration motivated teachers to use ICT consistently, as they found the process being monitored as the Principals were interested in implementing the innovation.

Like every innovation, the principals are expected to lead the change efforts acting as “change agents” ensuring the successful integration of ICT across the curriculum. For example, Webb (2004) in his research in 50 Tasmanian educational institutions found that the role of the

principals in acting as initiators was considered an important function in the process of ICT adoption. On the contrary, a study by Wilder (2012) in four pre-service teacher institutions in Namibia found a lack of both good exemplars and role model of the principals dissipated the interest and enthusiasm of the teachers, hence resulting in the failure of the initiatives.

By fulfilling change agent responsibilities, the principals in Ghanaian pre-service teachers institutions must focus directly on the change process, by actively challenging the status quo and systematically considering new and better ways of doing things. In the Ghanaian pre-service teacher education sector, it has been found that the majority of the principals who are supposed to lead technology integration do not use the technology themselves, since they have secretaries who do their typing for them. Experts say there is a link between principals' ability to make informed decisions and their personal use of the technology. Increasing their own competence in using ICT is of vital importance for the pre-service institutional leaders who wish to successfully integrate ICT in their institutions. This leads us to consider the ICT professional development of the principals in leading a change.

It is worthy to note that, it is difficult to support an innovation about which one has a little or knowledge. Knowledgeable and effective principals are extremely important in to lead the integration efforts in determining . From the discussion so far, one can boldly say that most of the principal pre-service teacher educational leaders may be uncertain about implementing effective technology leadership strategies for ICT integration, because they may believe their own knowledge of ICT is inadequate to make meaningful recommendations. Actually, principals in Ghanaian pre-service teacher institutions have a dual role to play concerning ICT professional development in their institutions. First they must ensure that they receive appropriate training on ICT in order to increase their own skills and knowledge and effectively inspire and lead their staff in integrating ICT across the curriculum (Fullan 2012). Second the principal must promote the professional development of their staff in order to help them integrate successfully in the teaching and learning process (Leitwood & Aza, 2016).

Although reviewing the related literature is necessary, reviewing the literature alone was not enough therefore, there was the need to look for theories and models to guide the study. In the following section the main theoretical underpinnings of this study are discussed.

3.7. THEORETICAL FRAMEWORK OF THE STUDY

Theoretical grounding of the study draws from Technology Acceptance Model (TAM) but as illustrated in Figure 3.4 below the study would first explore learning theories before moving to discuss the Technology Acceptance Model, the theoretical lens for the study.

This section is represented in Figure 3.4.

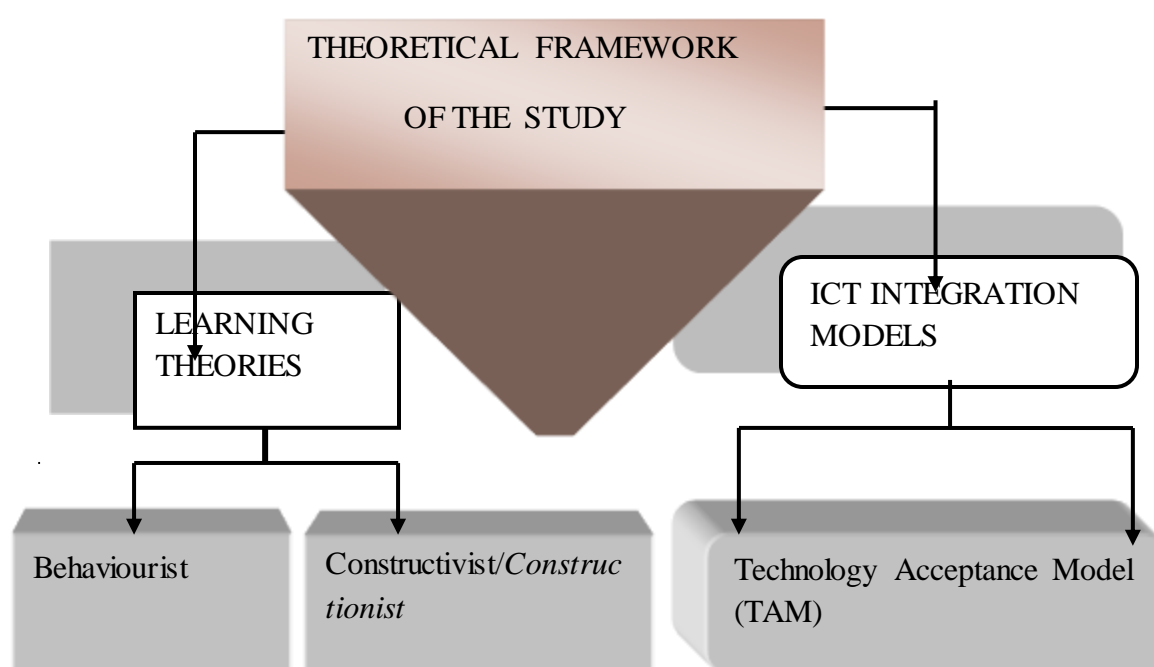


Figure 3.4. THEORETICAL FRAMEWORK OF THE STUDY

In the following sections the theoretical framework of this study is discussed:

3.7.1. LEARNING THEORIES

According to Mitchell & Laski (2013) in developing learning materials for technology use in education, learning theories must be adopted for effective and efficient instruction. Various theories have been propounded by different scholars in attempting to explain the effective learning process in both 20th and 21st centuries. However, Harasim (2012) posited that in the threshold of the 21st century, three dominant views prevail in the educational arena – Behaviourism, Cognitivism and Constructivism. This view has been supported and

corroborated by many educational scholars, who claimed that this view represents, broadly, the major trends in the way learning is conceptualised, and provides some distinctively different guidelines for instructional practice.

This section discusses learning theories as background to the ICT integration in teaching and learning environment. The first learning theory to discuss is behaviourist perspective followed by Constructivist and constructionist respectively.

3.7.1a. BEHAVIOURIST THEORY

This section presents the context and learning pedagogy of behaviourist theory and its role to the development of learning technology.

Developed in the late 19th century, behaviourism has been widely recognised by many educational researchers as the first major theory of learning and represented a radical leap forward in terms of human science (Harasim, 2012). Although the development of behaviourism is associated with many scholars (e.g. Skinner, 1938; Thorndike, 1932), Frederick Skinner, an American psychologist is generally considered to be the most influential of behaviourist theorists (Skinner, 1968). According to Skinner (1938) behaviourism is a learning theory based on the idea that behaviour can be controlled and modified, based on the antecedents and consequences of behaviour. Employing metaphor to explain the theory, Shunk (2012) noted that behaviourism relies on the *sponge* method of teaching, where the goal of the learners is to absorb what they are given until the examination, at which time the information is wrung out from them. This theory is deeply rooted in the Ghanaian education system, including pre-service teacher education, where the high-stake testing culture to help students pass tests is prevalent.

With its central premise of learning as conditioning, the theory is organised into two main categories namely Classical conditioning and Operant conditioning. Propounded by Pavlov, as a result of his experiments with a dog, food and a bell, the central locus of Classical Conditioning is that the repetition of a certain behavioural pattern makes that pattern automatic. The theory was first applied to animals and then to humans. As an alternative to Pavlov's work, Skinner in 1930s formulated Operant Conditioning which is a well-known behaviourist theory in most educational settings, even today.

The prevailing pedagogy of behaviourist learning is aimed at achieving the correct behaviour (Skinner, 1938). In this perspective, learning is considered as response acquisition and viewed as a mechanistic process in which successful responses are automatically strengthened according to environmental feedback. Within this environment, the learner is a passive recipient whilst the teacher's role is the active dispenser of knowledge. This kind of traditional instruction is often called transmissive instruction because it assumes that knowledge can be transferred from teacher educators or transmitted by computer and acquired by the students. Feedback, which rewards corrects responses and punishes incorrect ones, is the norm. Instruction focuses on increasing the number of correct behaviours in the learners' repertoire. 'Drill and practice' is the epitome of instruction (Mayer, 1998).

This model, as already indicated, is consistent with the situation in the Ghanaian education system. In Ghana, teaching is still recognised as process of conveying ideas to students, and teachers who are better communicators are considered better teachers. Unlike a constructivist learning environment, where teachers act as facilitators and guide students, the traditional role of Ghanaian teachers is to pass on their expertise to their students, to learn the information and reproduce it for examination and tests, without necessarily processing it to change their practice. Memorization of facts, as well as the ability to follow rules, determines a student's success and, therefore, to be successful, a high level of engagement is needed by the students in order to acquire the knowledge and skills possessed by their teachers.

Behaviourism, though it still remains as a popular orientation in the Ghanaian educational system, has been widely criticized by majority of modern educational researchers and scholars, on the grounds that the theory does not encourage active learning since it is based on fixed rules and procedures and the memorisation of facts (Jonassen, 1995; Harasim, 2012). It is also found to discourage learners from developing higher-order level of thinking, which is much needed in the 21st century Information Age (Harasim, 2012).

Despite the criticisms of behaviourist theory, it is important to recognise that the modern instructional technologies, which have gained increased importance and influence for constructivist researchers and instructional designers, owed their theoretical foundations to the behaviourist school tradition (Harasim, 2012; Edwards, 1970). Tracing the history of modern educational technologies and their impact on the modern education system and society at large, one cannot underestimate the role played by teaching machines, programmed instruction and Computer-assisted Instruction (CAI) which were developed in the behaviourist school context.

Developed by Pressey in 1926, and updated by Skinner in 1950's under the name Programme Instruction (PI), teaching machine and programmed instruction dominated the field of education in the 1950's and 1970's. Based on Skinner's theory of "verbal behaviour" PI was a means to accelerate and increase conventional and educational learning (Skinner, 1968). Consisted of self-teaching with the aid of teaching machine, PI presented materials in a structured and logical and empirically developed sequence. Studies have shown that PI allowed students to progress through a unit of analysis at their own rate, checking their own answers and advancing only after answering correctly (Harasim, 2012). Although, a large number of technological devices have since been introduced, PI was the advent of the high-speed digital computer that made a flexible and sophisticated teaching approach possible (Blitzer, 1973). In the same period (1950's) Computer-Assisted Instruction (CAI) which has been described as the earliest example of modern educational technology, was developed for teaching and learning. Essentially, based on a drill-and-practice approach to learning, the programme designer controlled the learning and not the learner.

Research studies (e.g. Tomei, 2003) have found that pre-programmed computer-based learning has been used extensively in the past to promote teaching and learning in traditional behaviourist classrooms with a number of advantages such as:

- the ability for manipulating quantifiable and ruled governed variables, as in simulations,
- the ability for presenting text-based information, and testing learners' knowledge, and for identifying areas where further instruction is necessary
- allowing learners to work at their own pace and receive feedback on their progress

Although drill-and-practice software is an efficient way to achieve rote learning objectives, current educational trends question the value of the rote learning that this type of software promotes. It has been widely criticised for using poor pedagogical strategies that do not conform to the 21st century, as it is heavily influenced by behaviourism and cognitive science (Bates, 1995). In the 21st century knowledge economy, memorisation of facts and procedures is not enough for success. Students in the knowledge economy need a deep conceptual understanding of complex concepts, and ability to work with them creatively to generate new ideas, new products and new knowledge.

However, other researchers (e.g. Harasim, 2012) are of the view that even though constructivism is good for using ICT, basic knowledge of well-structured domains still needs

to be taught, because some individual pre-service teachers need knowledge from which to begin construction. Concurring with Harasim is earlier study by Jonassen who contended that pre-service teachers, at an introductory stage require knowledge about a technical skill and are better supported by more traditional behaviourist approaches such as direct instruction Jonassen (1994), while constructivist approaches, such as inquiry based learning, are not as effective until teachers have acquired a desired amount of knowledge and competence.

The researcher believes that behaviourism and constructivism offer different perspectives on the learning process from which we can make inferences about how we ought to engender learning. However, the present study takes the stance that ICT should not support learning by attempting to instruct the pre-service teachers, but rather should be used as knowledge construction tools that the pre-service teachers learn *with*, and not *from*. In this way, the pre-service teachers in Ghana should function as designers, and the ICT functions as Mind tools for interpreting and organising their personal knowledge. In this way, ICT is treated as a tool, which can help the Ghanaian pre-service teachers to accomplish complex tasks of educational improvement, rather than a subject of study for its own sake.

3.7.1b. CONSTRUCTIVIST THEORY

This section examines constructivist theory, the key learning theory underpinning this study. It has been organised into two main sections. The first section discusses the context and learning pedagogy of constructivist theory in the pre-service teacher education setting. Subsequently, the relationship between constructivism and ICT will be considered.

Tracing its roots from the pioneering work of the philosopher and developmental psychologist, Jean Piaget (see Piaget, 1952) constructivist theory remains the most popular orientation in modern educational systems world-wide (Harasim, 2012 Shunk, 2012). Constructivism is widely recognised as representing a paradigm shift for educators and designers with dramatic implications for the roles for modern technologies in supporting meaningful learning (Jonassen, Hernandez-Serrano & Choi 2000). According to Piaget (1952:15):

in a constructivist learning environment, knowledge is not information to be delivered at one end, and encoded, memorised, retrieved, and applied at the other end. Instead, knowledge is experience that is acquired through interaction with the world, people and things.

Providing the most powerful and clear explanation of the theory, Brook and Brooks (1993) noted that constructivism is not a theory about teaching but it is a theory about knowledge and learning. In this paradigm, unlike the behaviourist perspective where learning focuses on the outcomes, learning emphasises the process and not the outcome. Therefore, learning is a process of constructing meaningful representations by making sense of one's experiential world. Thus, in constructivist learning environments students learn by actively making sense of new knowledge, making meaning from it and mapping it into their existing knowledge map or schema.

Clarifying the basis of constructivism, Duffy and Cunningham (1996:177) observed that despite the diversity of views encompassed in the theory, there seems to be a general consensus of the view that "learning is an active process of constructing rather than acquiring knowledge" and that "instruction is a process of supporting that construction rather than communicating knowledge." This view, which underpins effective teaching and learning in constructivist environment, is inconsistent with the situation in the Ghanaian pre-service teacher education context. There is the need for a change in mindset towards the idea that the key to successful learning lies with the pre-service teachers themselves, rather than the teacher educators, and, as such, the pre-service teachers need to be trained in a constructivist environment to become active learners and develop knowledge for themselves (Chen, 2011), but not depending on the teacher educators, as it is happening currently. Thus, pre-service teachers should be given the responsibility of their own learning, while teacher educators as 'scaffolds' support them.

Constructivism is categorised broadly into cognitive constructivism and social constructivism which are usually tied to Jean Piaget and Lev Vygotsky respectively. Piaget's cognitive constructivism theory focuses on learning development, whereby learners build their own knowledge by constructing mental models, or schemas, based on their own experiences (Piaget 1952). These schemas are then developed, modified and made more sophisticated over time. This approach to learning focuses on the individual's mental construction of knowledge. Cognitive constructivist classroom activities are designed to help pre-service teachers become actively engaged in questioning their existing understandings and restructuring their cognitive maps with new understanding. This category of constructivism is often encouraged in Ghanaian pre-service teacher education, as students are given tasks to work on them independently. However, sharing and working collaboratively is seldomly encouraged, as it is branded as "stealing or copying."

Social constructivism, on the other hand, extends cognitive views by placing more emphasis on the social context of the learning environment. Propounded by Lev Vygotsky (1978), social constructivism emphasises learning as occurring within the context of dialogue and social interaction (Duffy & Cunningham, 1996). A critical component of this theory is the Zone of Proximal Development (ZPD) which is grounded on the premise that students can, with the help of adults or more advanced peers, master concepts and ideas that they cannot understand on their own (Lim & Hung, 2003). This theory sees language as the prime conduit for learning, saying that our most valuable learning is gained by talking about things. Knowledge making, Vygotsky noted, can occur as we reflect on issues as individuals, but discourse-discussion, questions, arguments and explanation are the most powerful method of refining our understanding. This perspective of learning gives a high priority to language in the process of intellectual development. However, Mayer (1998) makes a strong argument that acknowledging the validity of both individually mediated and socially mediated constructivism provides a wider version of constructivist learning. Based on Mayer's argument, adopting this broader approach to constructivism in the Ghanaian pre-service teacher educational context will assume that the process of constructivist learning occurs both within the pre-service teachers, and within the group of pre-service teachers, while retaining the straightforward idea that the outcomes of the constructivist learning outcomes are stored within the pre-service teachers (learners). Acknowledging the validity of both versions of constructivism will ultimately help to overcome the significant criticisms of cognitive constructivism, which is that it focuses narrowly on the individual learner (Mayer, 1998).

As observed by Duffy & Cunningham (1996) training pre-service teachers in such an environment would help them to learn better by observing and interacting with their skilled teacher educators, as well as their more knowledgeable peers. Today, in most pre-service institutions, especially in the developed world such as the United Kingdom, where education is now said to be focused on student-centeredness, desks are arranged in the classrooms to facilitate discussion and collaborative learning. However, in the Ghanaian pre-service teacher educational context the opposite is true, as desks are still arranged in the rows to encourage the students to work independently, but which discourages social discourse and interaction in the learning environment.

Having discussed the context and two main categories of the theory, attention will now be focused on pedagogies of the theory. According to Jonassen (1998) constructivist pedagogies are centred on the following four key constructs:

- Instructional relationship between teacher and the students;
- Opportunities for collaboration;
- Scaffolding to help learners perform just beyond the limits of their activity;
- Engagement in authentic tasks that encourage knowledge construction.

The four constructs above by Jonassen form the basis for discussing the pedagogies.

In a constructivist learning environment, the instructional relationship between the teacher and the students is quite different from that of behaviourist perspective. In this learning environment, the role of the teacher becomes more complex as it is involved the management of learning, providing instruction and scaffolding activities mentoring feedback and progress and assessing students' performance (Neo & Neo 2001). Students on the other hand, play an active part, assuming ownership of their own learning. In other words, the learning process is shifted towards the student-centred mode, where the students become more autonomous and independent seekers of information and knowledge. This learning environment is in sharp contrast to the situation in Ghanaian pre-service teacher institutions. In Ghana, pre-service teachers are not allowed to do the *heavy lifting* of their own learning, but rather the teacher educators do the talking, while the pre-service teachers listen. While this is commonly viewed as the quickest and easiest way to impart knowledge and skills, it has been realised that is not the most effective way of learning. Student-centred learning, where the students take active part of their own learning, has therefore been promoted in many countries as a key component for learning, and its relevance to pre-service teacher education is, for instance, a recurring theme in the contemporary guides for practitioners (e.g. Chen, 2011).

Collaboration is an important and integral component of this learning process, as students work collaboratively to solve problems. As posited by Jonassen (2000), the pre-service teachers working collaboratively will have the opportunity to view problems from multiple perspectives, which may be vastly different from their own individual perspectives. Additionally, collaborative learning can challenge the pre-service teachers to critically think through problems and present their ideas in a cogent manner to their peers or teacher educators (Harasim, 2012). As it is often said, there is a greater creativity in numbers; the product of pre-

service collaborative learning will be superior to what anyone of them could have created individually.

Working collaboratively, scaffolding then, becomes an important aspect to constructivist learning as older, more experienced peers, as well as teachers, become “scaffolds” who help and support the individual learners and guide them until they achieve competence (McLaughlin, 1999, Verenikina, 2008; Vygotsky, 1978). Due to the rapid advancement of technology in contemporary educational environments, the notion of scaffolding has now been extended from teacher-student interaction to computer-student interaction (Salmon & Perkins 1998, Guzdial, 1994). This has led to new questions about scaffolding, for example, the notion of fading in scaffolding in software is problematic, as the traditional view of scaffolding is that the scaffolding should fade as the learners grow (Vygotsky, 1978).

Comparing scaffolds in learning environment with those of construction of buildings, Harasim (2012) identified five significant characteristics of scaffolds in construction of buildings which needs a careful consideration. Harasim noted that a scaffold provides a support, functions as a tool, extends the range of the worker, allows the worker to accomplish a task not otherwise possible, and is used selectively to aid the worker where needed. Like scaffolds that support workers during building construction, instructional scaffolds assist pre-service teachers to extend their current skills and knowledge they bring, to a higher level of competence (Jonassen ,1990). With this, Lim (2004) argues that since scaffolding is a dynamic process reflecting adjustment based on students’ responses the most important source of scaffolding in any learning environment is arguably the teacher. The teacher, according to Lim, decides consciously or unconsciously, how and when to use scaffolding strategies (Flick, 1998).

Similarly, Jonassen (1998) posited that for meaningful learning to occur in constructivist environments, individual pre-service teachers must work with realistic problems in real-world contexts. The problem in this context should be ill-structured and must be personally relevant to the pre-service teachers. This does not mean that we should leave the environment in pre-service teacher education so unspecific that there is a sense of helplessness or wasted effort. It is the responsibility of the teacher educators to provide structure within which the pre-service teachers will be engaged in critical thinking and problem-solving relevant to the performance objectives. Although, there is an increasing need for a clear structures in the learning process, this should not negate the opportunities for critical thinking and problem solving (Duffy & Kirkley, 2004).

While there are suggestions that the curriculum needs to be changed in order to accommodate this type of learning (Papert, 1993), the present reality for the pre-service teacher education in particular, and the education system in general in Ghana is the need to meet the demands of the national curriculum guide-lines.

Closely related to constructivism is the idea of constructionism which, according to Papert (1991) provides a testing bed for engaging students in problem solving and learning to learn with technology. Largely influenced by the works of Seymour Papert, a faithful student of Piaget (Piaget, 1973), the constructionist paradigm describes an educational philosophy which posits that learning occurs most effectively when students are active in making tangible objects in the real world (Harel & Papert, 1991). It further postulates that students can excel by building and constructing for themselves the specific knowledge that they need, rather than having a teacher dictating numerous facts. Therefore, teachers' play a role as knowledge facilitators in this learning environment (Papert, 2003).

Papert (1980) pointed out that when technology (ICT) is integrated within a constructionist environment; students create for themselves new experiences and a way of thinking (Bers, 2008). In this vein, a computer becomes an object-to-think-with that helps students to reflect on their performance in ways similar to experienced learners. Hence, supporting them to learn about their own thinking and learning, known as meta-cognition. The philosophy behind this theory is consistent with Fox's notion of the *computer as tutee* where pre-service teachers control computers, instead of the computers controlling them (Jonassen et al., 2008). With this, the pre-service teachers have the opportunity to utilise the computers as mindtools, unlike in the traditional behaviourist environment where *computer is used as a tutor*. For example, Harel & Papert (1991) found that student learned geometry and measurement skills, in the context of creating a computer-based programme, more effectively than their peers, who learned the content in a more traditional manner. In the context of pre-service teacher learning, the teachers would be expected to gain a deeper understanding of content and pedagogies when they create or build artefacts related to their learning.

Next, the study considers ICT integration models.

3.8. ICT INTEGRATION MODELS

Over the last three decades, there have been various models developed for acceptance and integration of ICT into educational setting to help measure and guide educators in their use of the technology. A few of the most widely recognised ones include Technology Acceptance Model (TAM) (Davis, 1989), Technological, Pedagogical, and Content Knowledge (TPACK) (Mishra & Koehler, 2006), Apple Classrooms of Tomorrow (ACOT) (Sandholtz, et al., 1997), Diffusion of Innovation (Rogers, 2003). Among the theories mentioned above, the TAM is the most frequently used for acceptance and integration of ICT in pre-service teacher education context (Sanchez, 2015; Teo, 2014).

Previous work by Adu Gyamfi (2011) adopted ACOT as the main theoretical framework. However, for this more in-depth larger scope analysis, the Technology Acceptance Model was used as the main theoretical lens for the study. The TAM has the following advantages over the ACOT due to the following reasons: First, the model has been adopted and tested in many empirical studies and the tools used with the model have proven to be of higher quality and yield statistically reliable results (Al-Azawei, Parslow, Lundaqvist, 2017; Dontoe, 2018; Sivo et al., 2018; Shroff, Deneen & Ng, 2011; Teo, & Milutonic, 2015; Wong, 2015). Additionally, the model has been an attractive instrument in many empirical studies because of its ease of use and implementation (Fathali & Okada, 2018; Huang, 2015; Teo & Milutonic, 2014). The number of researches and academics that still use the model testifies its general acceptance. As of 2009, Chuttur (2009) documented that more than 700 authors quoted the original TAM (Davis, 1989) in their studies. Equally important, compare with other ICT integration models such as TPACK, the TAM is more flexible, easy to adopt model and can be extended by adding a number of exogenous variables to influence its main variables to make the model strong. Recognising the crucial role external variables play in strengthening the TAM (Legris, Ingham & Collette, 2003; Venkatesh and Davis, 2000), many researchers have extended the model by adding exogenous variables such as self-efficacy, job relevance, technical support, prior ICT knowledge and others, to make it stronger (Venkatesh and Davis 2000).

Furthermore, the TAM has been widely recognised as a highly reliable, valid and robust predictable model that can be adapted in various contexts and fields including higher education (Afari-Kuma & Achampong, 2013), pre-service teacher education (Aypay et al. 2012; Sherer, Siddiq & Tondeur, 2018), and several others fields. The TAM is versatile and can therefore,

be adopted in many different educational contexts, including pre-service teacher education in Ghana, without much problems. Finally, the TAM has been found to possess predictive validity in studies whose participants are pre-service teachers (Al-Azawei, Parslow & Lundaqvist, 2017; Aypay, et al., 2012; Dintoe, 2018; Teo, & Milutonic, 2015). The next section discusses the origin and evolution of the model.

3.8.1. TECHNOLOGY ACCEPTANCE MODEL - ORIGIN AND EVOLUTION

Propounded by Davis (1989), the TAM provides an extremely useful theoretical tool in understanding how pre-service teachers' technology acceptance levels impacts technology integration (Aypay et al., 2012; Eteokleous-Grigoriou et al., 2012). Originated from the Theory of Reason Action (TRA) (Ajzen & Fishbein, 1980), the TAM was introduced and popularised by Davis F. in his doctoral dissertation "A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory Results" at the Sloan School of Management at Massachusetts Institute of Technology (Chuttur, 2009). Since its origin in 1989, the TAM has followed intense evolutionary process over the years, until it became the reference model it is today (Sanchez-Prieto et al., 2015; Tang and Chen, 2011).

This section traces the origin and evolution of the TAM, its application in pre-service teacher educational contexts in both developed and developing world with particular reference to Africa and Ghana.

3.8.2. THEORY OF REASONED ACTION (TRA)

Theory of Reasoned Action (TRA) posits that an individual's performance of specified behaviour is determined by his or her behavioural intention to perform the behaviour, and behavioural intention is jointly determined by the individual's attitude and subjective norm concerning the behaviour in question (Ajzen & Fishbein, 1980). According to TRA, the intention to perform has direct influence on the actual behaviour because people usually behave according to their intention to do it in an appropriate context and time. Therefore, TRA is regarded as an intention model per se, which views the intention as the immediate determinant of the action. Additionally, the individual's perceptions and beliefs, social influence may affect behaviour. In TRA, social influence is named "subjective norm," defined as a "person's perception that most people who are important to him think he should or should not perform

the behaviour in question” (Fishbein & Ajzen, 1975). It is identified as a direct determinant of behavioural intention in this theory.. From this perspective, students may choose to use ICT systems not only because that they perceive learning via ICT-based environment would be useful or enjoyable, but also for the essential reason that they perceive the pressure from the people who are important to them such as principals, teacher educators and parents.

Davis (1986) put forward the idea that as technology use is behaviour, then the TRA model would be a suitable way of predicting technology use and acceptance. However, in order to adapt this model for technology acceptance, Davis (1986) made a number of changes. First, subjective norm (SN) was not included as a determinant of Behavioural Intention (BI) in the TAM. Davis et al., (1986:986) considered SN to be the least understood aspect of TRA and of “uncertain theoretical and psychometric status.” They postulate that this is because SN can both directly affect BI as users comply with directives to use the technology and indirectly affect it, via attitude through internalization and identification processes. Therefore, only a person’s attitude to technology is considered in the TAM. The second adaptation made by Davis (1989) was the reduction of the number of salient beliefs of an individual to two distinct beliefs. Unlike in TRA where salient beliefs are elicited anew for each new context, in the TAM these two beliefs are established beforehand and are generalizable across different contexts and types of technology.

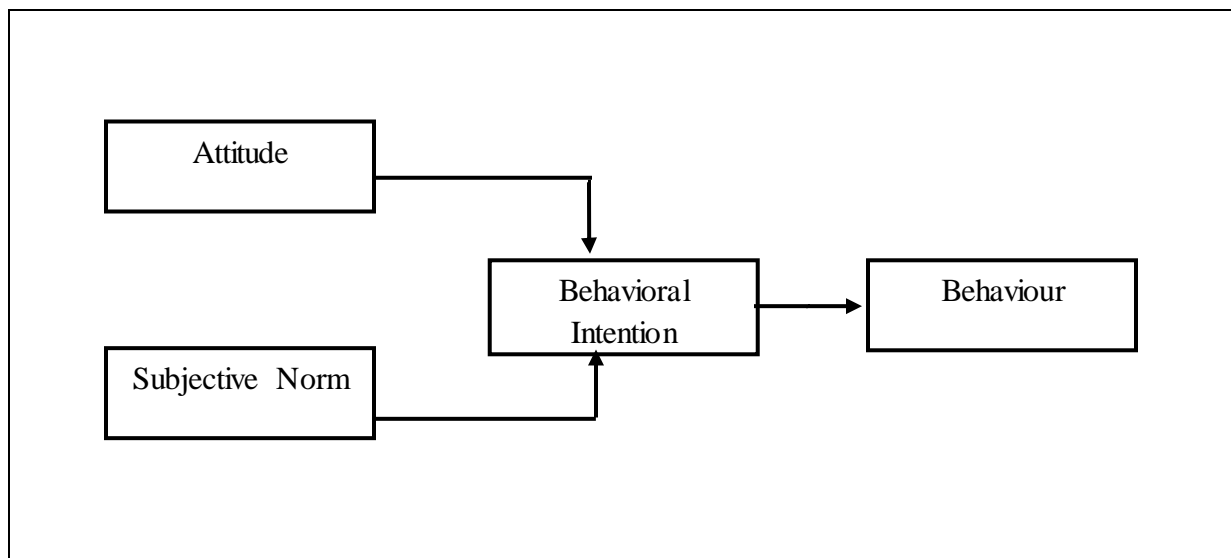


Figure 3.5. Theory of Reasoned Action (Fishbein & Ajzen, 1975:216).

The Theory of Reasoned Action (TRA), which is shown in Figure 3.5. above, postulates that beliefs influence attitude and social norms, which in turn shape the behavioural intention guiding an individual’s behaviour. This theory is based on the assumption that individuals are

rational decision makers and constantly evaluate their behavioural beliefs during the process of attitude formation towards behaviour. The TAM used TRA as the theoretical base for specifying the causal linkages between two key beliefs: perceived usefulness and perceived ease of use and user's attitudes, intentions and actual computer usage behaviour. The TAM replaced the determinants of attitude of TRA by perceived ease of use and perceived usefulness. Davis, et al., (1989) found that perceived usefulness is the strongest predictor of individual's intention to use Information and Communication Technology.

2.8.3 THE TECHNOLOGY ACCEPTANCE MODEL (TAM)

The Technology Acceptance Model (TAM) represents how users come to accept and use a given technology (Aypay et al., 2012; Teo, Fan & Du 2015; Wong et al. 2013). The model postulates that, when users are presented with a new technology, many factors influence their initial acceptance but two fundamental determinants, perceived usefulness (PU) and perceived ease of use (PEU) play a significant role in their continued acceptance and adoption (Davis, 1989; Hu et al., 1999). Davis (1989) was of the view that when technology is perceived to be useful (enhancing job performance) and easy to use (requiring least amount of effort), these perceptions results in positive attitude towards the acceptance and use of the technology. This means that, the adoption and integration of ICT by the pre-service teachers in the two case study colleges in this study will be determined by the joint influence of the perceived benefits of the technology (PU) and perceived efforts required by them to use the technology (PEU). Davis (1989:320) defined perceived usefulness (PU) as "the degree to which a person believes that using a particular system will enhance his or her performance." Whilst he referred perceived ease of use (PEU) to "the degree to which a person believes that using a system would be free of effort". Davis (1993) found perceived usefulness to be the strongest factor influencing adoption, whilst he found perceived ease of use to be a direct determinant of perceived usefulness (Davis et al., 1989). Thus, all else being equal, the less effort a system requires, then the more that using it can increase job performance. On the other hand, perceived usefulness has been found to have a significant influence on attitude towards usage (ATU) and intention to use (Teo, 2009). Attitude towards usage (ATU) refers to as the evaluative effect of negative or positive feeling of the individual in performing a particular behaviour (Ajzen & Fishbein, 2000; Davis, 1993) and has been identified as a factor that guides future behaviour. Together, PU and ATU constitute a significant influence on Behavioural Intention to Use (BIU), which in turn affects the Actual System Use (see, Figure, 2.6). The causal relationships between perceived ease of use (PEU), perceived usefulness (PU), attitude towards usage

(ATU), behavioural intention to use technology (BIU) and actual system use (ASU) are specified in the TAM to reflect the new environment of ICT integration in a system (see, Figure, 2.6). Causal relationships among the variables are shown by arrows (see, Figure, 2.6). The source of the arrows indicate the “causes” in the model, while the variables to which the arrows point are the “effects.”

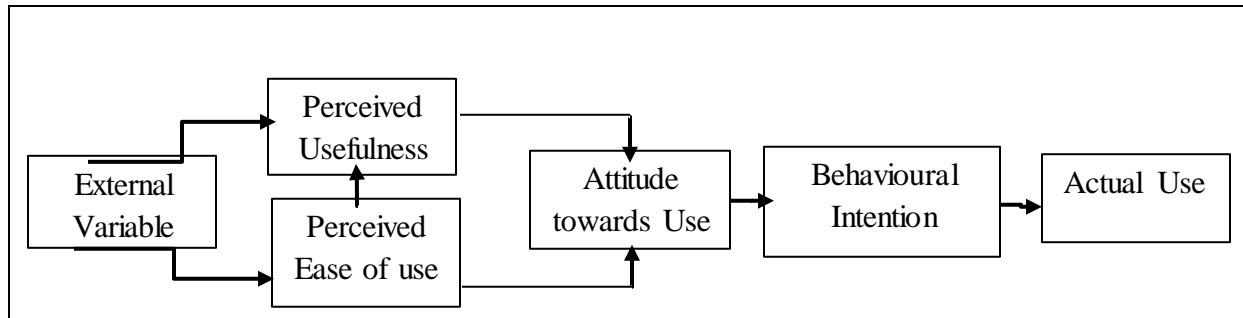


Figure 3:6. Technology Acceptance Model (Davis, 1989).

In this current study, PEU is defined as the degree to which an individual pre-service teacher believes that using ICT would be free of cognitive efforts, whereas PU refers to the degree to which an individual pre-service teacher believes that using ICT will enhance his or her performance while teaching and learning. Therefore, based on the model, actual usage of ICT in the two case-study colleges in Ghana will be determined by the pre-service teachers’ ease of the use of the technology, their perceived usefulness and attitude towards using the technology (Davis, et al., 1989), as well as the external factors added to the model. Causal relationships among the variables are shown by arrows (see, Figure, 2.6). The source of the arrows indicate the “causes” in the model, while the variables to which the arrows point are the “effects.”

While the TAM is considered by many as a robust and parsimonious theory of technology acceptance and usage (Al-Somali et al., 2009; Teo, 2014), the theory also presents a series of limitations, among which the following stand out (Chuttur 2009; Sanchez-Prieto et al., 2015):

- *Dependence on self-reports:* According to Sanchez-Prieto (2015) this dependence occurs when measuring the use of the system, which limits the reliability of the model and it hinders the study of the relationship between the BI and AU of the system. Additionally, some studies use student participants in controlled environments and these results cannot necessarily be generalised to organisations (Lee, 2008).

- *Lack of consideration of external variables:* Including factors such as computer self-efficacy, technical support, leadership support, technological complexity or gender.
- *Low level of variance in exploratory studies:* In this kind of research, the explanation of behavioural intention adoption can, on occasion, be relatively low.

Since its origin, and aiming to overcome these limitations, the model has evolved, sometimes including new constructs. Generally, the modification of the TAM can be grouped in the following categories (Sanchez-Prieto et al., 2015):

- *Inclusion of exogenous precursors:* such as self-efficacy, leadership support and others.
- *Incorporation of factors suggested by other theories* aiming to increase the model's predictive ability. For example, Social influence, Technological knowledge and others.
- *Inclusion of contextual factors:* Factors from the environment from the organisation or institution, the individual or the information system, such as: gender, culture, or the characteristics of the technology
- *Measurement of final element:* This group refers to the measurement of attitude, perceived ease of use, perceived use.

Aiming to incorporate new findings derived from the extended version of the TAM, a number of new versions of the model namely TAM2 (Venkatesh and Davis, 2000), TAM3 (Venkatesh & Bala, 2008) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis & Davis, 2003) and Venkatesh et al., (2012) have been proposed.

3.8.4. THE EXTENDED TECHNOLOGY ACCEPTANCE MODEL 2 (TAM 2)

Venkatesh and Davis (2000) extended the original TAM by incorporating additional constructs such as social influence process (Subjective norm, voluntariness and image) and cognitive instrumental process (Job Relevance, output quality, results demonstrability, perceived ease of use) which were considered to influence perceived usefulness. Their main objective was to include additional key determinants of the TAM's perceived usefulness and usage intention constraints, and to understand how the effects of these determinants change with increasing user experience over time with the target system (Venkatesh and Davis, 2000). Subjective norm is defined as a "person's perception that most people who are important to him think he should or should not perform the behaviour in question" (Fishbein & Ajzen, 1975:302). In the TAM2, it was hypothesised that the subjective norm would have a positive direct effect on intention to use when the system use is mandatory, but not when it is voluntary.

Adopting the TAM2 as the theoretical foundation to study 145 teachers in a university in Equador in South America to predict their level of acceptance of e-learning system, Ramirez, Sabate and Llanas-Audet (2016) found that perceived enjoyment and computer self-efficacy have a direct significant effect on perceived ease of use of e-learning systems. In the same vein, the study showed the predictive relevance and validity of the model to evaluate the acceptance of e-learning among these professionals. In another study in Kuwait, Rouibah (2009) utilised the TAM2 as theoretical framework to assess the applicability of students intention to use camera-mobilephone before retail shopping . Based on a sample of 151 users, the study revealed that the TAM2 was partially validated. Rouibah’s model tested in Kuwait explained 33.4 percent of variance in intention to use as against 44 percent in intention in the original Venkatesh and Davis’ (2000) model. The inconsistencies between Rouibah’s model in Kuwait and the original TAM (Vanketesh and Davis, 2000) could be interpreted due to the types of respondents (students versus employees), type of technology (camera-moble phone versus automated system) and the setting (university versus profit-making organisation) respectively. In terms of the explanatory power, Wu, Chou, Weng and Huang (2011) documented that while the TAM explains between 40 and 50 percent of technology acceptance, the TAM2, as pointed out by Venkatesh and Davis (2000) reaches 60 percent, sugesting that the TAM2 has a stronger explanatory power than the original TAM. The TAM2 theoretical model is shown in Figure 3. 7 below:

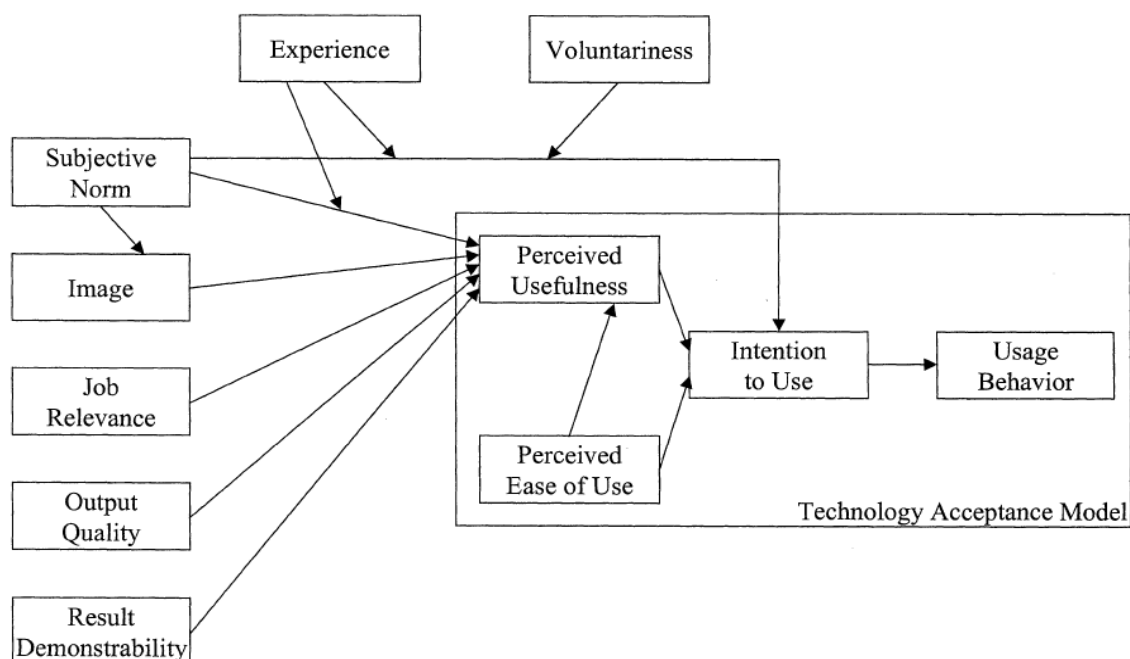


Figure 3.7. The TAM2(Venkateshand Davis, 200:188

Although the TAM2 substituted the attitude towards use and incorporated additional variables such as experience and subjective norm, the core ideology of the model remained unchanged.

Further extension of the model (TAM3) was formulated by Venkatesh and Bala (2008), where constructs based on 'anchor' and 'adjustment' were added to elaborate perceived ease of use.

Following on from these additions and extensions to the TAM, Venkatesh, Morris & Davis (2003) and Venkatesh et al., (2012) attempted to unify the technology acceptance literature in a Unified Theory of Acceptance and Use of Technology (UTAUT). The UTAUT is the extension of the original TAM by Davis (1989) which explains the differences in how people accept and use technology in the workplace. In the UTAUT, the PU is incorporated into effort expectancy and the Subjective Norm into Social Influence. The moderators, namely gender, age, experience and voluntariness of use, are also included in the model. The inclusion of the moderators addresses one of the criticism levelled against the TAM, in that it overlooks the role of moderators (Morris, et al., 2005). Tests of the UTAUT have shown that this model can explain about 70 per cent of the variance in behavioural intention to use a technology and about 50 per cent of the variance in technology use (Venkatesh, et al., 2012).

Although the UTAUT model outperformed all the previous models on which it was based, Venkatesh et al. (2012) further defined and extended their model to create the UTAUT2 model by adding three key constructs (hedonic motivation, price value, and habit) into the UTAUT, and dropping one of the moderators (voluntariness) in order to tailor it into a consumer use context, as most consumer behaviours are voluntary, resulting in no variance in the voluntariness construct. The study by Venkatesh et al. (2012) confirmed the important roles hedonic motivation, price value, and habit in influencing technology use in the UTAUT2 model, which is tailored to the context of consumer acceptance and use technology. Hence the UTAUT2 model (Venkatesh et al., 2012) is the most recent model to measure the acceptance and intention to use IT, in which the authors consolidated most of their previous work on technology acceptance that had resulted in a powerful framework. Some researchers have tried to apply the UTAUT model in educational contexts, such as an in adaptation of e-learning systems or web-based learning environments (Attiquayefio & Addo, 2014; Yueh, Huang & Chang, 2015).

Based on survey of 103 students in a university in Northern Taiwan; Yueh, Huang & Chang (2015) successfully applied the extended UTAUT model and tested the predictive power in

determining students' acceptance of a Wiki system in terms of their actual use and their behavioural intentions of future use. In a study in Ghana, Attiquayefio & Addo (2014) employed UTAUT to examine issues surrounding acceptance of ICT by students of tertiary institutions. Their findings were consistent with the original postulation by Venkatesh et al., (2003).

From the above analysis it could be concluded that the original TAM has undergone a number of changes and extensions to make it a powerful framework. However, the complexity of the resulting models conflict with the simplicity of the original technology acceptance model, which is the reason why the resultant models are rarely used, in favour of the extended versions of the TAM, adapted to the context and the kind of technology in which they are intended to be applied (Sanchez-Prieto et al., 2015).

Again, while the TAM2, TAM3 and UTAUT are helpful in understanding certain technology adoptions, they are too broad and rather complex to address the concerns of the current study. In light of these broad and complex theories, the TAM appeared to be a simple yet reasonable and robust model (Venkatesh and Davis, 2000) with which to study Ghanaian pre-service teachers' adoption and integration of ICT in teaching and learning. Moreover, the study on the TAM has been receiving continual interest from policy and decision makers, education practitioners and researchers, because the model is parsimonious, in the sense that it is based simply on three antecedent constructs namely Perceived Usefulness, Perceived Ease of Use and Behavioural Intention to adopt ICT in educational context (Al-Somali, et al., 2009; Teo, 2011). More importantly, the TAM has been found to possess a predictive validity in studies whose participants are pre-service teachers (Teo, Fan & Du 2015; Wong et al. 2013). The aforementioned reasons motivated the researcher to employ the extended original TAM over the equally important models discussed in the thesis. Following the reasons for adopting the TAM, the next section discusses empirical studies of technology acceptance of pre-service teachers, followed by the application of Technology Acceptance Model in the various contexts in the world.

3.8.5.EMPIRICAL STUDIES OF TECHNOLOGY ACCEPTANCE OF PRE-SERVICE TEACHERS

Technology Acceptance Model has been intensively used across many fields and contexts across the globe. One of the fields that need most attention in this study is pre-service teacher education context. As far as pre-service teachers are concerned, Teo and colleagues are among

the few researchers who have studied technology acceptance among pre-service teachers. For example, with data gathered from 313 participants, Teo & Milutinovic (2015) adopted the TAM as framework to examine variables that influence intention to use technology in teaching mathematics among pre-service teachers in Serbia. The study found attitude towards use to be the only construct that had significant influence on behavioural intention to use technology. This finding is inconsistent with the prior TAM studies (Davis, 1989; Teo, 2014; Wong, 2015). All the other factors were found to have indirect influence on behavioural intention to use technology. This finding is inconsistent with the prior prominent studies which indicated that attitude towards use has low mediating role. For example, Venkatesh and Davis (1996) dropped attitudes towards use construct from the original model. They concluded that attitude towards use construct does not fully mediate the relationships between both perceived ease of use and perceived usefulness. teachers Surveying 475 pre-service teachers from the National Institute of Education in Singapore that included complexity, facilitating conditions and computer self-efficacy as exogenous variables, Teo (2009) found consistent result for PU-ATT, PU-BI, PEU-PU. These results are consistent with the original TAM (Davis, 1989). Attitude and computer self-efficacy were also found to have direct effect on Behavioral Intention. However, computer self-efficacy and attitude had the strongest effect.

Based on a sample of 339 pre-service teachers enrolled at a teacher training institute in Thailand, Teo, Fan & Du (2015) found that the gender groups showed no statistical difference on perceived usefulness, perceived ease of use attitude towards use and intention to use technology. Again, female pre-service teachers had lower scores on perceived ease of use, suggesting that technology use was more challenging for the females than the males. This finding is inconsistent with prior studies that had yielded a conflicting results and challenged the popular traditional stereotyping view that males are more digitally competent than females (Tomte & Hatlevik, 2011).

In another study in Hong Kong, Wong (2015) drawing on technology acceptance survey of 234 pre-service primary mathematics teachers to study the factors influencing their technology acceptance overall results of the study showed an overall positive attitude of the pre-service teachers towards the technology.

3.8.6. THE TAM IN THE DEVELOPING WORLD CONTEXT

The TAM has had a significant research history, with the vast majority of the research being conducted in developed world (Acarli & Salam, 2015; Persico, Manca & Pozzi, 2014;

Teerovangadum, Heeraman & Jugumath, 2017) but with the current proliferation of ICT in education globally, the need to carry out research studies based on the TAM in the developing world has received maximum attention (Aypay, et al., 2012). In the last two decades, there have been an accumulating body of research studies based on the TAM, particularly in the Middle East and Asian countries (Aypay et al., 2012; Solangi, Al-Shahrani, & Pandhani, 2018; Teo, 2009; Teo, Wong et al., 2013, Teczi, 2011). For example in the Middle East, Al-Azawei, Paslow & Lunqvist (2017), adopted the TAM framework to assess 120 undergraduate students' perception of blended e-learning (BELS) at the University of Babylon. The model achieved acceptable fit and successfully integrated intention to use (ITU) and perceived satisfaction. However, psychological differences did not indicate positive impact on the learners satisfaction and e-learning adoption. In another study, Teczi (2011) adopted the TAM as framework to study of pre-service teachers adoption of technology in Turkish educational context. Teczi (2011) concluded in his study that pre-service teachers' attitude had positive influence on the pre-service teachers' intention to use the technology for pedagogical purposes.

In Asia, particularly in Singapore and Malaysia, there have been myriads of TAM studies (Teo, 2014; Teo 2012; Wong et al., 2013). For example, in Singapore, a survey of 139 pre-service teachers from the Institute of Education, conducted by Teo in 2008, found that pre-service teachers' attitudes and intentions to use computers were more positive than their perceived ease of use and usefulness. Teo's survey finding was inconsistent with the original TAM, which found perceived usefulness to be the strongest factor influencing adoption (Davis, 1989). However, in their comparative study, assessing the intention to use technology among pre-service teachers in Singapore and Malaysia, Teo, Lee, Chai & Wong (2009) concluded that the TAM serves as a valid model to predict technology acceptance among student teachers in both countries. A similar study by Wong et al. (2013) supported the above findings by validating the TAM in the Malaysian pre-service teacher education context. These studies refute earlier assertions that TAM model belongs to only the advanced countries (Teo, 2014).

Unfortunately, the model has not been extensively tested in Africa, particularly within the pre-service teacher educational context (Adjabeng 2011; Mtebe & Rasimo, 2014).

3.8.7. THE TAM IN AFRICAN CONTEXT

While studies based on the TAM abound in regions such as Middle East and Asian-Pacific regions. Unfortunately, the model has not been used extensively tested in Africa, particularly within the pre-service teacher educational context (Adjabeng 2011; Mtebe & Rasimo, 2014). However, most of the few studies conducted in Africa concentrated in the Northern and the Southern parts of the continent, particularly in countries such as Egypt, Libya and South Africa (Averweg, 2008; Farahet, 2012; Al-Ghatani, 2014), with few studies scattered over other parts of the continent. Unfortunately, most of the TAM validations have been carried out in non-educational settings, and focus most on business and Information Systems (Dare & Rambe 2013; Gyaase, Anokye-Sarfo, & Bediako, 2013). This limits its application in educational settings. However, this does not suggest that there are no TAM based studies in the African educational context. Although, not much research has been done based on the TAM, compared to the other regions in the world, there are evidence of some studies (Buabeng-Andoh, 2015; Averweg, 2008; Cassim & Obono, 2011; Gyaase, Anokye-Sarfo & Bediako, 2013; Oye, Iahad & Rabia, 2011). For example, in their study based on an on-line questionnaire administered to 196 respondents at the University of Technology in South Africa, Dare & Rambe (2013) found that perceived convenience, perceived ease of use, perceived usefulness and attitude towards use, all impacted on the students' desire to use mobile technology for educational purposes. Similarly, applying the TAM to online learning in the Egyptian Universities, Farahat (2012) found that students' perception of ease of use, usefulness and attitudes towards online learning were significant determinants for their intention to practice online learning.

Apart from the two dominant regions (Northern and Southern African countries), some few other studies have also been done in countries such as Nigeria, Tanzania, Gambia, Ghana and others. For example, in Nigeria, Oye, Noominshah & NooZariah (2011) adopted the model to study Nigerian higher education students' acceptance of computer technology. They found that perceived usefulness, attitude towards computer use, and computer self-efficacy have a direct effect on pre-service teachers' technology acceptance. Apart from business, information systems and education arenas, the model has also been adopted to study e-government in Gambia (Lin et al., 2011). Since the focus of this study is on the Ghanaian pre-service educational context much detailed discussion will be on application of the TAM in Ghana.

3.8.7. THE TAM IN GHANAIAI CONTEXT

Interestingly, a search for the literature relating to the adoption of the TAM in the Ghanaian context revealed that there have been a significant number of studies grounded in the TAM (Anamoah-Mensah, 2011; Gyaase, Anokye-Sarfo, & Bediako, 2013; Larbi-Appau, et al., 2018; Asabere & Enguah, 2012; Gyaase, Buabeng-Andoh, 2015; Iddris, 2012). However, like other parts of the African continent, more TAM research have focused more on non-educational settings, particularly in the business context. Although, there have been some few studies in the Ghanaian higher educational context (Larbi-Appau et al., 2018; Afari-Kumah & Achampong 2010), sadly enough, most of the TAM validations in Ghanaian educational context and mostly educational context have been carried out in the universities and mostly focused on students who are not pre-service teachers and the results are mixed. For example, Larbi-Appau et al., (2018) adopted the TAM as a framework to study computer attitude and self-efficacy of undergraduate students. This limits its application in the Ghanaian pre-service teacher educational context, particularly in Colleges of Education which is the focus of this current study.

For example, in their study of the adoption of ICT in two tertiary institutions in Ghana, Afari-Kumah & Achampong (2010) concluded that the TAM could not directly be implemented in a developing country such as Ghana to assess the intention of students to use ICT. However, a study by Anamoah-Mensah (2011) on 350 students' self-reported intention to use ICT in a Ghanaian higher education institutions found that perceived usefulness, perceived ease of use and attitude towards use were significant determinants of the students intention to use ICT. In another study, Gyaase, Anokye-Sarfo, & Bediako, (2013) assessing the level of ICT usage for financial management by the Ghana Education Service (GES) using the TAM as the research framework, concluded that although the TAM provided an effective framework for studying ICT adoption at the individual levels, but recommended further extension of the model by adding institutional interventions such as users' training, government support, quality and accessible ICT infrastructure and support from top management. Their findings were consistent with the earlier studies such as Teo, et al., 2009, which advocated an extension of the TAM model.

Being the first empirical study on adoption and integration of ICT in the Colleges of Education in Ghana grounded in the TAM, the findings of this research would fill the gap in the literature at this level, and also add to the existing empirical knowledge of the Technology Acceptance Model.

3.9. SUMMARY OF THE CHAPTER

This chapter was broadly organised into two parts. The first part outlined the five distinct scholarly literature identified as the most essential strategies for integrating ICT as a teaching and learning tool in pre-service educational institutions, while the second part focused on the theoretical foundations of the study. The chapter began with the discussion of four key rationales postulated by Hawkridge (1990) for investing in ICT in education in a global context. Having established the rationale for investing in ICT in education, the study then tackled the central issue of teacher change, which has been described as critical to any discussion on ICT integration in any educational context. This section of the literature review focused on changing the beliefs and attitudes of the teachers which have been described as the main precursors to ICT acceptance and its subsequent integration. The chapter further outlined the need for high quality infrastructure by focusing on four pillars (hardware, software, connectivity and technical support) which were articulated by UNESCO (2011) and linked it to the situation in the Ghanaian teacher education context.

Additionally, the chapter established that, while ICT professional development is well understood as an inherent component of contemporary pre-service teacher education reforms, what constitutes an effective model of ICT professional development is highly contested (Karlin et al., 2018). For example, Lieberman & Mace (2008) in their review on education reform research concluded that new models of teacher professional development are needed to establish and support communities of teachers engaged in educational reform. Lieberman et al., (2008) observed that having a professional community differentiated those who worked together for a systematic reform compared with those who tried new ideas in fragmented ways.

However, this study highlighted three key areas for ICT professional development for effective and meaningful ICT integration in pre-service teacher educational context. Key features that constitute effective ICT-PD were identified. Some of the key features identified were sustained and continuous, designed to meet the specific needs of the teacher educators. The Chapter found that for a professional development to be effective it should be sustained and continuous, and be designed by taken the individual teachers specific needs into consideration. Additionally, it should be hands-on, situated in the context, be pedagogically-focused and more importantly, , it must be evaluated at the end. ICT –PD for teacher educators in Ghana was also considered. Ghanaian pre-service teachers the professional development needs of the teacher

educators, given that they play a critical role in equipping the pre-service teachers. Research evidence suggests that teacher educators who role model the use of ICT in their practice help pre-service teachers build confidence and competence as effective ICT users (Karlin, et al., 2018). The role of the principals' leadership was also explored. It was found that all the other factors discussed in the literature depend on the effective leadership of the principal, since the principal was found to be the key facilitator in the effort to integrate ICT into pre-service teacher education. Moreover, a shared leadership model, which sees a paradigm shift from the focus on the leader as an individual, to a distributive leadership that promote successful leadership in other members of staff, was much favoured.

Although, reviewing the related literature was necessary, it was found to be insufficient, therefore, there was the need to look for a theory or a model to guide the study. In cognisance of the notion that ICT acceptance and integration in pre-service teacher education needed to be guided by a theory, the Technology Acceptance Model was chosen as the main theoretical framework of the study.

The next Chapter presents the design and methodology of the study.

CHAPTER FOUR: RESEARCH DESIGN AND METHODOLOGY

4.1.INTRODUCTION

This chapter presents the methodological premises underpinning the study. Given that research is an accepted investigation to find answers to a problem, deciding on the appropriate research methodology is an essential part in defining the steps to be taken toward the completion of the research (Schumacher, 2014). In line with this, the research methodology outlines all the essential steps to be followed in gathering and analysing the data for this research.

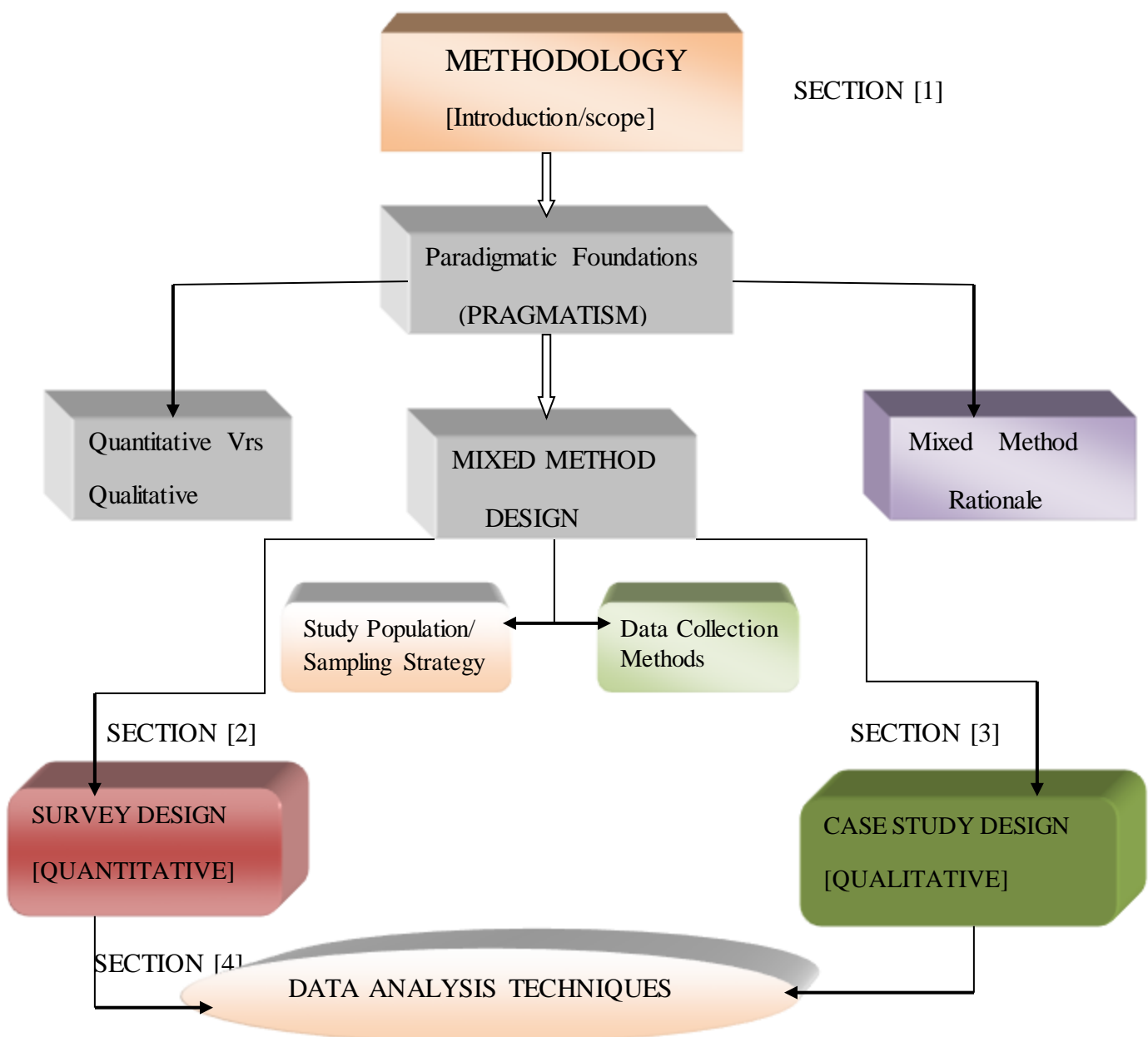


Figure 4.1 Scope of the Chapter

The chapter is organised into four major sections. It begins with a discussion on general methodological issues of the study, comprising a discussion of the paradigmatic foundations of the study, mixed method approach and the rationale for its adoption. Next, the data collection techniques adopted are considered, and concludes with an examination of the study population and the sampling strategy which was employed during data gathering. The second section focuses on the survey design [as part of the quantitative approach], whilst the third section considers the case study design [as part of the qualitative approach]. The fourth section considers issues such as trustworthiness of the qualitative data, and ethical considerations. The chapter concludes with an appraisal of the data analysis techniques employed for the study (See Figure 4.1).

Based on quantitative and qualitative methodologies, and exploratory in nature, the overarching purpose of this study is to explore factors influencing pre-service teachers' adoption and integration of ICT as a tool for teaching and learning in pre-service teacher education in Ghana. The key guiding research question of the study is: "How can pre-service teacher institutions in Ghana equip prospective teachers with the ICT skills and knowledge needed to teach in the 21st century?" Having established the scope, the research question, and purpose of the study, the researcher moved on to discuss the paradigmatic foundations of the study.

4.1. 1. PARADIGMATIC FOUNDATIONS OF THE STUDY

When a researcher undertakes research, he or she is often said to do it from within a particular paradigm of inquiry. The term "paradigm" in modern research is often associated with Thomas Kuhn. In his book, *The Structure of Scientific Revolutions* (1966), Kuhn saw paradigms "as accepted examples of actual scientific practice – examples which include law theory, application and instrumentations together- [that] provide models from which springs particular coherent traditions of scientific research" (Kuhn, 1996:10). Broadly, a paradigm provides a framework within which a researcher works. It is a basic belief system or worldview that guides the researcher (Guba & Lincoln 1998). As Lutrell (2010) posited, there is a need to ensure that the paradigm of inquiry adopted is appropriate to the purpose of the research being conducted. This thesis was grounded in the pragmatist paradigm, as the researcher aimed to prioritise the research question and relegated epistemological and ontological debate to the background (Teddlé & Tashakkori, 2003).

4.1.2. THE PRAGMATIC PARADIGM

Pragmatists believe that the research question is more important than either the methodology or the paradigmatic assumptions that underlie the research method (Tashakkori & Teddlie, 1998). Creswell (2003) argued that the use of the pragmatic philosophy results in what is referred to as pragmatic claims to knowledge, which underpin mixed-methodology and methods, where both qualitative and quantitative methods can be used because they provide the best understanding of the research problem. In this sense, pragmatism is essentially about answering the research question in the best way possible, where any approach can be used to understand the research problem (Creswell, 2012).

The philosophical assumptions that underpinned the current study were based on the search for the truth, without conforming to a particular ideology. What was important to the researcher was that the research questions were answered, without conforming to a specific ideology. Therefore, the decision was taken to mix both quantitative and qualitative methods within this study, in order to understand the research question more completely (Creswell, 2003).

Although some proponents (e.g. Leask, 2011) are not in favour when a researcher adopts pragmatism as a guiding approach to his/her research studies, the position taken by the researcher, in this current study, is that a researcher has to make choices, predominantly on the basis of research questions, to select approaches and methods that are most likely to provide insight and explanations into matters of concern (Onwuegbuzie & Leech, 2005). As a consequence, the researcher took a pragmatic stance to combine both quantitative and qualitative methods, because such a combination generates reliable results that either method, standing alone, would not give to the researcher.

The approach was suitable because, by using different theoretical and empirical approaches in the same research project, the results are enhanced, since often these methods complement each other (Creswell, 2003). In doing so, results from one method are clarified by results of another, thus providing a means of triangulation. Additionally, the results from one method can help develop or inform the other method. This is what pragmatism is essentially about, where the emphasis is on answering the research questions in the best way possible, where any approach can be used to understand the thesis problem (Creswell, 2012).

4.1.3. PARADIGM WARS

The question of whether qualitative and quantitative methods can be used for data collection and analysis in the same piece of research remains a debate. While some researchers see the two as different, with the quantitative viewing it from a narrow lens, and qualitative viewing the world through a wider lens, the argument for studying the same phenomenon by combining both quantitative and qualitative methods (triangulation) are much stronger nowadays (Tashakkori & Teddlie, 2010). However, despite the strong arguments in favour of mixing quantitative and qualitative paradigms, other researchers (e.g. Johnson & Christensen, 2012; Johnson & Onwuegbuzie, 2004), are of the view that these two paradigms cannot be integrated within a single study, since the epistemological and ontological assumptions underpinning them differ. They advocate that both paradigms are incompatible. For example, Bryman (2006) contested that mixed-methods research should not be seen as a universally superior or appropriate strategy.

Bryman was of the view that mixed-methods research has become a fad, as there is a perception that it is more likely to be favoured by the funding bodies (e.g. Economic and Social Research Council [ESRC]) who themselves are implicated in that fad, because it offers the best of all worlds. He was of the view that mixed-methods research is not intrinsically superior in terms of quality to mono-method research; and suggested that its quality may even be endangered, as a result of a slavish devotion to the belief that it is favoured by research funding bodies. However, addressing the need and desire to combine positivist and interpretivist paradigms, Kaplan & Duchon (1998) concluded that no one approach to research can prove to be reliable, valid and meaningful by itself. This debate between the paradigms with respect to the social reality has led to the middle ground that takes the best of both perspectives, one that is not committed to any one social reality. This has given rise to the adoption of mixed method approach in many studies nowadays.

4.1.4. MIXED METHOD APPROACH

The rise of mixed methods research is a signal feature of the academic debate in recent years, as several new names have been assigned to this approach, including: *third methodological movement* (Teddlie & Tashakkori, 2009), *the third research paradigm* (Denscombe, 2008) and *third path* (Teddlie & Tashakkori, 2009). The rise and popularity of this approach is also

evidenced in a number of recent papers and ‘special issues’ of journals. For example, an entirely new journal of mixed methods research, entitled *the Handbook of Mixed Methods Research* was published in 2003 (Tashakkori & Teddlie, 2003) and subsequently *Foundations of Mixed Methods Research* was also published in 2009 (Teddlie & Tashakkori, 2009). This shows the magnitude of the popularity of mixed methods as a research design in the recent decades. The mixed methods approach has also been adopted by several researchers in the field of education and technology (e.g. Divaharan & Lim, 2010; Wong 2015). The advocates of mixed methods research hail it as an important approach that is driven by pragmatism, that yields real answers to real questions, that is useful in the real world that avoids mistaken allegiance to either quantitative or qualitative approaches on their own (Brannen, 2005, Creswell, 2003; Greene & Hall, 2010).

Mixed methods research was defined by Tashakkori & Creswell (2007:4) as:

a type of research in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both quantitative and qualitative approaches or methods in a single study.

The above definition is more than simply using some quantitative and qualitative methods of gathering and analysing, reporting data separately in the same study. Rather, the definition indicates that mixed methods' studies combine qualitative and quantitative paradigms in meaningful ways. This means it is a convergence of philosophy, viewpoints, traditions, methods and conclusions. The researcher adopted the mixed-methods approach in this study, with the view that, by using both quantitative and qualitative approaches, the strengths of one approach offset the weaknesses of the other, which allows for a much stronger overall design and thus more credible conclusions (Schumacher, 2014). The purpose of gathering different types of data in this study was to understand more fully, to generate deeper and broader insights, to develop important knowledge claims that respect a wider range of interests and perspectives (Greene & Hall, 2010). In this way, the researcher can study the phenomenon from different perspectives and collect a variety of information which can facilitate the investigation (Creswell, 2003).

Bryman, Becker & Sempik (2008) recommend that a researcher, willing to engage in mixed methods inquiry, needs to determine whether a strong rationale exists for choosing the approach. With this in mind, the next section discusses the rationale for mixed methods adoption in this study.

4.1.5. RATIONALE FOR MIXED METHODS APPROACH

The aims and objectives of this research were both deductive and inductive (Bryman, 2007). The epistemological orientation of the study consisted of both a positivist and an interpretive stance, since the study was not only meant to test and confirm theory (Creswell, 2003), but also sought to produce new knowledge by viewing it objectively, as well as a construction of the individual participants' knowledge. The literature relating to the research in this area, as discussed in Chapter Two, was instrumental in the decision relating to the methodology adopted. The majority of the studies were based on the quantitative methods and their ontological positions were set by hypotheses to establish relationships between exogenous variables and the original TAM variables.

Many of the studies adopted statistical techniques such as correlation, multiple regression and mostly structural equation modelling (SEM) to test hypotheses based on different respondents in different contexts. Notable among them are a study by Aypay et al., (2012) in Turkey, Irvine & Birch (2009) in Canada, Ma, Anderson & Streith, (2005) in Sweden, Mtebe & Raisamo (2014), and Teo (2009) in Singapore, Yuen and Ma (2008) in Hong Kong and Wong, Teo & Russo (2012) in Malaysia. The adoption of a quantitative methodology in the prior studies placed them within the positivist paradigm which included elements of a deductive strategy (Bryman, 2007). In its pure form, Bryman (2007:28) posited that positivism "is an epistemological position that advocates the application of the methods of the natural sciences to establish knowledge by testing theories".

Positivists employ experimental and quantitative methods to test and verify hypotheses (Guba & Lincoln, 2000). However, positivists do not involve or interact with respondents and treat them independently. This notion ignores the importance and significance of the respondents to reflect deeply the problem under investigation more freely (Easterby-Smith et al., 2002). Most importantly, while the TAM is considered by many researchers to be a robust and parsimonious theory of technology adoption (Aypay et al. 2012; Teo, 2009), it has been strongly criticised because it relies on self-reported quantitative data (Chattur, 2009). While helpful, self-report data can be problematic as the participants may misreport their attitudes, their beliefs and the scope of their technology use.

Considering both the aims and objectives of this thesis and also some of the methodological limitations of the TAM studies reported in the literature, which for example, relied on self-

reported data, a quantitative approach alone would not have been completely answered the research questions in this study. Consequently, the decision was taken to substantiate this approach with an additional method. While qualitative methods appeared to be less predominant in the related literature reviewed, the adoption of such an approach was an appropriate attempt to get more inductive knowledge from the participants (Chigona & Dayeda, 2011; Dikbas, Ilgaz & Usluel, 2006). There are few research studies in this research area that have adopted mixed method (both quantitative and qualitative) approach in their study (Al-Azawei, Parslow and Lunqvist, 2017; Chen, Lin, Yeh & Lou, 2013; Sanchez et al., 2012; Wong, 2015). For example, Wong (2015) in his study of 234 mathematics pre-service teachers' technology acceptance in Hong Kong adopted a mixed method design in which follow-up interviews of 14 pre-service teachers were used to collect additional qualitative data to triangulate with the quantitative results. Sanchez et al., (2012) also considered mixed-method in their study on pre-service teachers' attitudes towards the use of ICT in the classrooms in Spain.

Moreover, in their study to explore factors influencing college students' behavioural intention to use Web-based systems in Taiwan, Chen, Lin, Yeh & Lou (2013) adopted a mixed method approach. The empirical results of the study showed that the students showed positive intentions towards the system for web-based learning activities. Additionally, Al-Azawei, Parslow and Lunqvist (2017), in their study "investigating the effect of learning styles in a blended e-learning systems (BELS) at the university of Babylon, Iraq adopted a mixed method approach. Based on a sample of 120 undergraduate students the model achieved an acceptable fit and successfully investigated intervention to use (ITU) and perceived satisfaction.

This suggests that using a mixed method in this study is line with the thinking of other influential researchers. Hence, the findings of this thesis would build directly on previous TAM studies in this area. More importantly, the aims and objectives of the studies discussed above were both deductive and inductive (Bryman, 2007). In the same vein, the data collection involved gathering both numeric information as well as text information, so that the final database represented both quantitative and qualitative information (Creswell, 2003).

Likewise, the aims and objectives of this study were both deductive and inductive, since it was not meant to test and confirm only theories but also to produce new knowledge by relying as much as possible on the participants' views of the phenomenon being discussed. Therefore, in this study, whereas the quantitative data analysis provided a general picture of the research problem, the qualitative analysis would go beyond the statistical results. The combination of

the methods, therefore complemented each other, and allowed for a more complete analysis (Tashakkori & Teddlie, 2010). This approach therefore, allowed the researcher to question the results from the quantitative data (Greene, Caracelli & Graham, 1998). In essence, by combining both methods in this study, each method complemented the other and allowed for a more robust analysis, taking the strength of of each approach (Greene, Caracelli &Graham, 1989).

4.1.6. THE MIXED METHODS DESIGN

Creswell (2012) defined a mixed methods design as a procedure for collecting, analysing, and “mixing” both quantitative and qualitative in a single study to understand a research problem. The basic assumption is that the adoption of both quantitative and qualitative methods, in combination, provide a better understanding of the research problem and the research question than either of the methods by itself (Creswell, 2003). The research design stage of this thesis adopted Creswell (2003) recommendations of using mixed methods. Within this design, three issues needed consideration: implementation, priority and integration.

Implementation

According to Creswell (2003) implementation refers to the sequence of the research process. Thus, whether the quantitative and qualitative data collection and analysis are conducted in phases (sequentially) or at the same time (concurrently). This thesis adopted a sequential explanatory design, with the quantitative method preceding the qualitative data collection and analysis, with the former informing the latter (Creswell, 2003).

The sequence of the two main phases are graphically shown Figure 4.2 below:

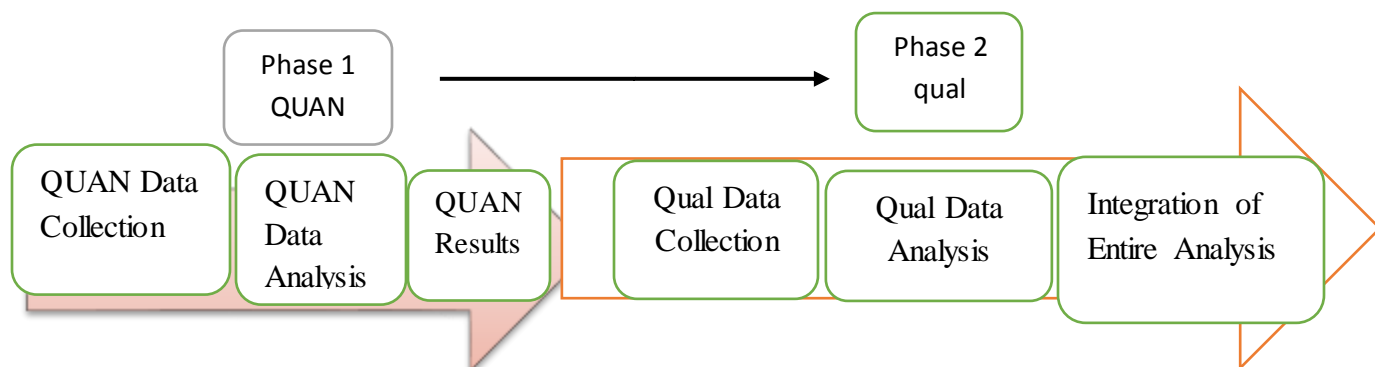


Figure 4.2. *Sequential Explanatory Design Stages* (Source: Creswell, 2003:213).

The rationale for choosing sequential explanatory design was to use qualitative results to assist in explaining and interpreting the findings of a primarily quantitative study. The second reason

was the straightforward nature of the design. It was easy to implement because the steps fall into clear separate stages (Creswell, 2012). However, the design was not without weaknesses. The main weaknesses of the design were the length of time required, and feasibility of resources to collect and analyse both quantitative and qualitative data.

Priority

Ivankova, Creswell & Stick (2006) posited that establishing the priority of the quantitative or qualitative approach within a sequential explanatory study depends on the particular design a researcher chooses for each phase of the study, the volume of the data collected during each phase, and the rigour and scope of the data analysis within each phase. In this study the sequence of the quantitative and qualitative data collection was determined by the study's purpose and the volume of the data collected in each phase. A quantitative phase came first in the sequence because the aim of the study was to seek an in-depth explanation of the results from the quantitative measures. Therefore, the notation of the study was QUAN + qual. The capitalization means that the quantitative method has a priority over the qualitative approach. The arrow signifies that the quantitative phase occurs before the qualitative approach (see Figure 3.2). The quantitative method in the research project adopted a survey which was sent to the 2nd and 3rd year students in two pre-service teacher institutions being researched (n=400) whereas the qualitative method located and examined cases from the quantitative phase to confirm or disapprove some tentative explanations. This meant that the sample in the qualitative phase was small and purposive. The data collection was done by means of semi-structured interviews (n=8) and classroom observations (n=6).

Integration

Lastly, the integration of the two data sources (QUAN + qual) occurred at the discussion section.

Given that a multi stage format of mixed methods design which typically includes two or more stages is difficult to comprehend without graphically representing the procedures (Ivankova, Creswell & Stick, 2006), a detailed graphical representation of the mixed method procedures used in this study is presented below.

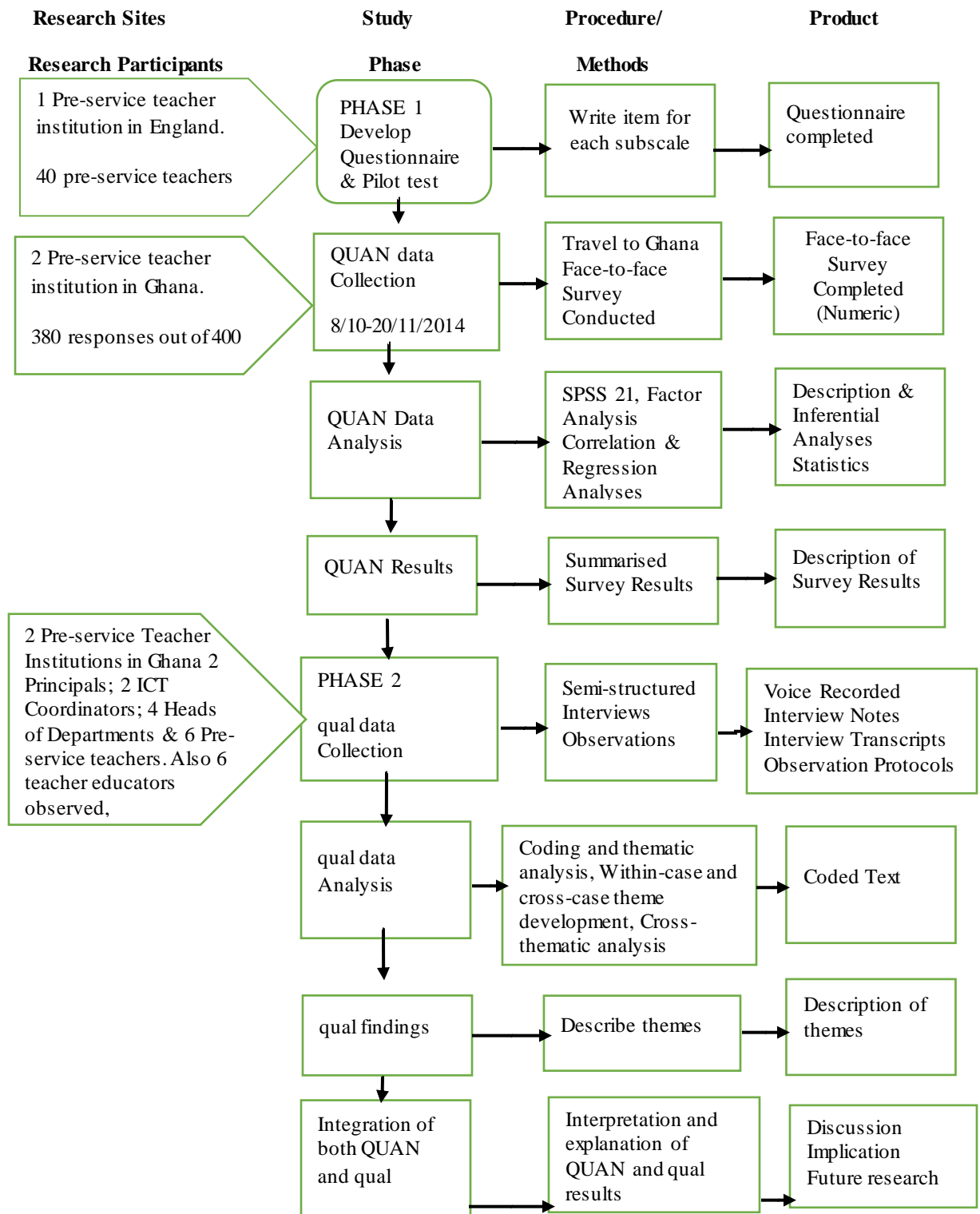


Figure 4.3. Research procedure using Sequential Explanatory instrument design mixed method study. Modified Creswell (2003:213).

4.1.7. THE CONTEXT OF THE STUDY

Delamont (2012) advises that before a researcher commences data collection, the researcher needs to identify site(s) that would provide rich sources of data. An important element of this thesis was to make clear the context within which the thesis was conducted. Two pre-service teacher education institutions in Ghana were purposively chosen as the context of this study. Placing emphasis on the potential of ICT to provide the foundation for transforming the nation's educational system, the Government of Ghana, as part of the 2007 Educational Reform, selected 15 "Discovery Colleges" to steer ICT adoption in the Ghanaian Education system (Government of Ghana, 2007). These Colleges are at the fore-front of technology adoption, as they are meant to show-case best practices in the use of ICT in teaching and learning.

Consequently, they receive extra attention from the education ministry, through infrastructure and professional support. Hence, they are classified as "Innovative Colleges". The two case study colleges in this study were selected from these 15 "Innovative Colleges." As these colleges represent the "state of the art" in the use of new technologies in teacher training in Ghana, they constitute a national benchmark which all similar teacher training institutions should attempt to achieve in the future. Clearly, if these Innovative Colleges fail to integrate ICT wisely into their teacher training provision, the chances of such integration occurring in other, less well equipped and resourced colleges, will be very limited. Given that there are 15 "Innovative Colleges" out of the 38 Colleges of Education in Ghana, the question that came to the fore was, how does the researcher select just 2 Colleges as the most "Innovative", and what criteria was used to make the selection? The researcher recognised that this was a critical issue to the integrity and validity of the research. The selection process was undertaken based on the following criteria, which were assessed in respect to each college.

- Is the college relatively rich in ICT resources and perceived to be using these resources effectively?
- Does the College administration provide active support for ICT implementation, as is shown in their ICT implementation strategy and plan?
- Do teacher educators in the college demonstrate a higher utilisation of ICT in teaching, compared to the remaining colleges
- Does the college have a website and at least a computer laboratory

- Are there positive attitudes towards ICT on the part of the teaching staff and principals? and
- Will the College be willing to participate in the study?

The two Colleges (hereafter referred to as College A and College B) were selected, as they were found to have optimal conditions for ICT integration, compare with other Colleges of Education in Ghana. This allowed them to serve as “critical cases” within the pre-service teacher educational system.

4.1.8. STUDY POPULATION AND SAMPLING STRATEGY

The study population can be defined as the entire group under the study, as specified by the aims and objectives of the research (Delamont, 2012). Since the objective of this study is to explore strategies for integrating ICT in the pre-service teacher education in Ghana, it is important to identify the target population. The target population in this research included Principals, Heads of Departments, ICT Coordinators, teacher educators and pre-service teachers, in two pre-service teacher education institutions in Ghana, who have the appropriate attributes for the phenomenon being researched. Having identified the target population, it became necessary to identify sampling strategy that will help select the desired participants.

As Cohen, Manion, & Morrison (2003:39) states:

the quality of a piece of research not only stands or falls by the appropriateness of methodology and instrumentation but also by the suitability of the sampling strategy that has been accepted.

Consistent with the above quotation is Yin (1989), who posited that the most crucial aspect in understanding a desired phenomenon revolves around accurately choosing the desired participants, suggesting that the quality of this thesis would be dependent upon the suitability of the sampling strategy. Sampling is a procedure that entails utilizing a small number of units in a given population, as a basis for drawing conclusions regarding the whole population (Creswell, 2012). The researcher aimed to be able to draw generalized conclusions about the population based on the sample under study. Cohen, Manion & Morrison (2011) identified probability (e.g. random, cluster etc.) and non-probability (purposeful, convenience, quota etc.) sampling as the two main types of sampling. Among the two key sampling types, Schumacher (2014) identified non-probability sampling as the most common type in educational research. However, in this current study, purposive sampling (a type of non-probability sampling) was

adopted as the main sampling strategy, in order to access “knowledgeable participants who have in-depth knowledge about the phenomenon under discussion” (Cohen, Manion & Morrison, 2011:28). Additionally, little is known about the phenomenon being under studied in the Ghanaian pre-service teacher institutions. Consequently, the researcher was of the view that there would be a little or no benefit to adopting random sampling, since most of the participants selected by random sampling (especially first year students as they may not have the opportunity to use ICT for teaching purpose) may be largely ignorant of the phenomenon under discussion, and may not be able to comment on the matters of interest to the researcher.

With regard to the pre-service teacher respondents in the survey, purposive-random sampling [a type of purposive sampling] was employed (Mertens, 1998). According to Mertens (1998), with purposive-random sampling, a purposeful sampling procedure is adopted first, followed by a randomization procedure. In this study purposive sampling procedure was first adopted to select the 2nd and 3rd year students, since the survey questionnaires required them to give their experiences on the use of ICT in their teaching practice schools. Therefore, to qualify to participate in this study the pre-service teacher must have experience in practicum schools and also be taught with ICT, and this is achievable only by being a 2nd or 3rd year student.

The first year students were unlikely to have been exposed to the demands and challenges of teaching in a real school setting equipped with computer technologies, and therefore, they were not eligible for inclusion. Hence, the two cohorts of students [2nd and 3rd years] were purposefully selected, and then, within each cohort, the sample of participants were chosen using the principle of random sampling. This was achieved by allocating the students with numbers and then picking the students with odd numbers. This exercise was repeated on several times until the required number (400) was achieved in both case study colleges. The adoption of purposeful random sampling could be defended on the grounds that the respondents selected were not based on the recommendations of the principals in the case-study colleges, who might handpicked a group of students who would put their institutions in a “good light” (Mertens, 1998:264). However, the purposive-random sampling was not without disadvantage. A significant disadvantage observed during the random sampling stemmed from the fact that, since the researcher had no control over the choice of the respondents, it was found that quiet uncooperative individuals were selected and this affected the response rate.

In the case of the teacher educators’ interviews, the 2 Principals, 2 ICT coordinators and 4 Heads of departments were interviewed in both case study colleges. These teachers in the

senior management team were chosen as they were more likely to be knowledgeable and could articulate their experience on the various issues regarding ICT implementation in their respective colleges. Six pre-service teachers were also interviewed, based on their responses to the questionnaire. At the end of the questionnaire, the pre-service teachers were asked to tick a box and leave their mobile phone numbers if they were interested in a follow-up semi-structured interview. In all, 82 and 98 students ticked the box and also left their mobile numbers from Colleges A and B respectively. Out of these figures, 3 pre-service teachers were randomly selected from each college and were contacted through their mobile phones. Lastly, 6 teacher educators (3 from each college) were observed. They were selected randomly by the Principals just as they were about to go to the classroom to teach. In all 420 participants participated in the study.

4.1.9. DATA COLLECTION METHODS

A critical component of any research study is choosing the appropriate data-collection techniques. The importance of multiple sources of data to the reliability of the study is well established (Yin, 2014; Schumacher, 2014; Stake, 1995). For instance, Newman & Benz (1998) contended that a good researcher must be familiar with a variety of methods, since employing multiple methods may enhance the quality of research. For this reason, both previous work by Adu Gyamfi (2011) and the current study employed multiple data collection methods including questionnaires, semi-structured interviews and observations as depicted in Figure 4.4 below:

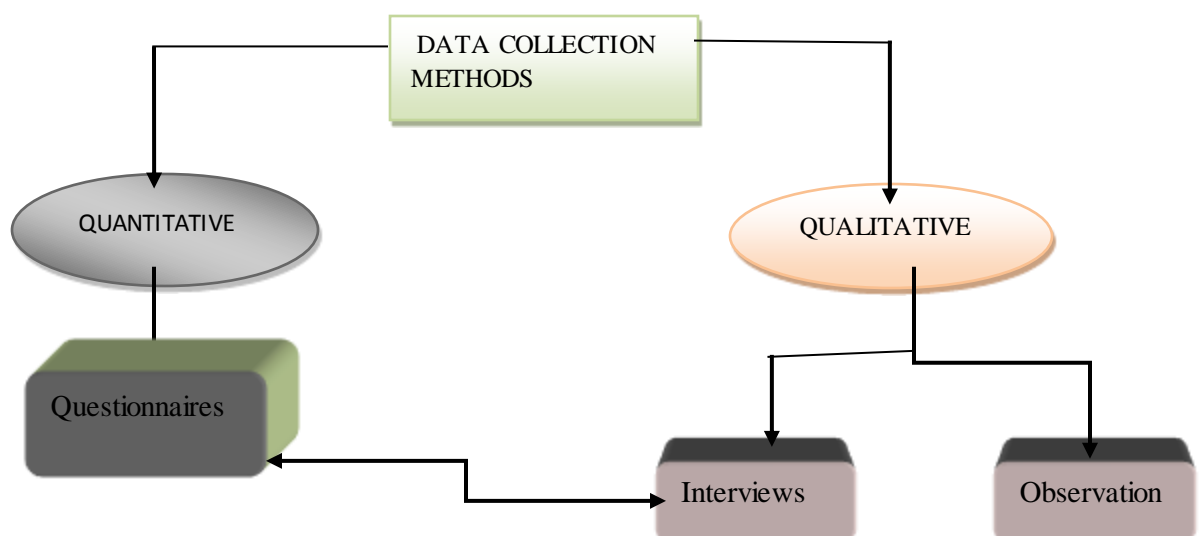


Figure 4. 4. Data Collection Methods Adopted in this study.

By putting the three methods together [via triangulation], it was believed that each method's weakness will be offset by the strengths of others.

4.2. SURVEY RESEARCH METHOD

This section describes the survey research method and procedures used in collecting the data in this thesis. The section commences with the introduction of the survey method and outlines the survey design. The final section discusses the construction, measurement and testing of the theoretical TAM.

With its many applications, survey research is the most widely used research design to study innovation in education (Creswell, 2012, Teo, 2011), especially the integration of ICT in the pre-service teacher context (Hammond, 2011; Luan & Teo, 2009; Tibenderana, et al., 2010). Kothari (2004) defined a survey as a quantitative method that is utilised to examine widespread social issues, whereby the results of a sample can be generalised upon to reflect society as a whole. The use of survey in the quantitative phase is justified for the following reasons: First, this methodology is typically used when objectivity, replicability and causality are required by means of research questions which gather data required for the measurement and hypotheses testing of the variables which enabled the acceptance or rejection of the hypotheses. Measurement of such variables was done through a survey, which was the best way to obtain the data and be able to analyse it and “develop claims for new knowledge” (Creswell, 2003:21). Again, social reality was being viewed from an external perspective, where the researcher was isolated from the respondents and could not influence their reality. Second, surveys enable a researcher to obtain credible information from a large population at a relatively low cost. Most importantly, the use of a survey allowed for generalisability across the population, in which different contexts can be compared.

When considering the type of survey design to adopt, Creswell (2012) opines that there are two basic types: cross-sectional and longitudinal survey research. According to Creswell (2012), with the cross-sectional survey design, the researcher collects data about current attitudes, opinions or beliefs regarding the phenomenon under study, at one specific point in time, and by means of a large sample. By contrast, a longitudinal survey is designed to collect data at many points in time within the same sample or cohort groups. For example, drawing on responses from 8000 teachers, Graham (2005) conducted a survey repeated over four years (1999-2003) in New Zealand classrooms. The study found that ICT usage by the teachers had

changed during the four-year period. Although, there are few studies that had adopted longitudinal survey to study ICT adoption by teachers, a cross-sectional survey was found to be suitable for this thesis, for the following three reasons: First, studying an observable facts for a long period of time is not a typical strategy for studying technology acceptance and usage in pre-service teacher education. Secondly, the researcher had a limited time to complete this thesis which makes it difficult to use a longitudinal survey. Lastly, most of the leading research in educational technology has adopted a cross-sectional survey, rather than a longitudinal survey (Aypay et al., 2012; Teo, 2009; Teo, Fan & Du, 2015).

However, cross-sectional survey research has not been without criticisms. With respect to this thesis, the administration of cross-sectional survey research required organisation and accurate record keeping (Backstrom & Hush-Cesar 1983) which made the approach quite laborious. Again the researcher had to review responses on questionnaires individually, and transfer the information from the questionnaires to a format for statistical analysis. These problems were mitigated through a meticulous bookkeeping and labelling (Denscombe, 2008). Again, as Farran argued (1990:101), surveys are “divorced from the context of their construction and thus lose the meanings they had for the participants involved.” Adoption of a triangulation strategy by combining the survey design with a case study design, also required the researcher to be at the natural setting (in this case the two case study colleges) to co-construct the reality with participants.

4.2.1. SURVEY QUESTIONNAIRE

The data collection method at the quantitative phase of the study was a self-administered paper-based questionnaire. A self-administered questionnaire is a self-report data collection instrument that each research participant fills out as part of a research study (Johnson & Christensen, 2012). Questionnaires are used to obtain information about the thoughts, feeling, attitudes, beliefs, values, perceptions, personality, and behavioural intentions of research participants. Although, survey questionnaires can be administered in several ways (e.g. self-administration, post and on-line), this study adopted self-administered paper-based questionnaire for the following reasons:

First, despite the fact that, on-line and e-mail survey questionnaires have received maximum attention by most researchers nowadays, that they have comprehensive geographical coverage and are less expensive (e.g. survey monkey), they were found not to be appropriate for this study. This was due to the fact that, not all the expected respondents would have e-mail

addresses and even if they had, Internet accessibility would have been a problem for some of them. This is due to the unreliability and expensive nature of the Internet facility in Ghana and for that matter Africa. Second, a printed self-reported questionnaire was employed to maximise the response rate and reduce sample bias in comparison to online methods, such as web-based surveys, which tend to involve low response rates and are biased towards more technologically literate and enthusiastic respondents (Schumacher, 2014). Again, it was economical and easy to arrange. It proffered anonymity and avoidance of bias as the respondents were asked not to write their names on the questionnaires. Most importantly, the method made it possible to reach a large number of respondents. Being a common research tool, the pre-service teachers were familiar with it and were able to fill it without much problems (Fowler, 2009). Hence, impressive response rate recorded in the study.

However, self-administered questionnaire was not without disadvantages. First, as Bryman (2004) posited, the responses rates could be low as they can be ignored by the respondents. In this study, pre-notification and follow-up on the questionnaires were adopted to increase the return rates. After stipulated two weeks period for the collection of the questionnaires, additional one week was given to the respondents who had not returned the questionnaires, and those who had lost their questionnaires were replaced and given enough time complete. The designated person who was himself a pre-service teacher was tasked to remind the respondents about the submission. E-mail reminders were also sent from time to time to the designated person and also directly to some of the respondents who provided their e-mail addresses.

Finally, as Swan and Hofer (2008:320) state: “survey questionnaires alone cannot explain exactly what respondents’ mean by their responses or what they thought particular questions meant.” Hence, through the use of mixed methods the participants’ responses to the survey questionnaires were verified and challenged through the use of qualitative methods such as semi-structured interviews and observations.

4.2.2. PILOT SURVEY

A good method of guaranteeing that the chosen instrument would address its intended purpose was to conduct a pilot survey in a realistic situations to ensure that everything would work (Schumacher, 2014). When the survey instrument was put together, it became necessary to submit it to a review by experts and to administer it to a group of pre-service teachers in the United Kingdom who were similar to the main respondents (pre-service teachers) in Ghana.

The pilot survey was conducted among 40 Postgraduate Certificate in Education (PGCE) students in a university in South-East England in order (a) to check the clarity of the questions, the statements, as well as the sufficiency of the possible answers (b) evaluate the appropriateness of the scales, (c) check completion time of the questionnaire, (d) discard all unnecessary, difficult and ambiguous questions (Schumacher, 2014). Of the total of 40 questionnaires that were distributed, 35 of them were returned, for which all of them were suitable for data analysis, The response rate was 88%.

The pilot study served as a useful training experience for administering the questionnaires. Results and feedback from the pilot study were helpful in revising the questionnaires and changes were made accordingly. Changes made included:

- Reducing the number of the questions:

Question 12 and 13 were found to be much the same. Therefore, one of them was deleted

The question was: Did you have any opportunity to use ICT during your teaching practice?

- Deleting questions that caused ambiguity

In question 3, answers options 2 [once each day] and 4 [once each day] were found to be repeated. The 4th one was deleted.

Having discussed the survey method and data collection methods, attention was then focused on the quantitative data collection process.

4.2.3. QUANTITATIVE DATA COLLECTION PROCESS

In this section, the study adopts the five steps data collection process in quantitative research suggested by Creswell (see Creswell, 2012). According to Creswell (2014) the process of quantitative data collection involves more than simply gathering information; and includes five interrelated steps. These steps are depicted in the flow diagram below:

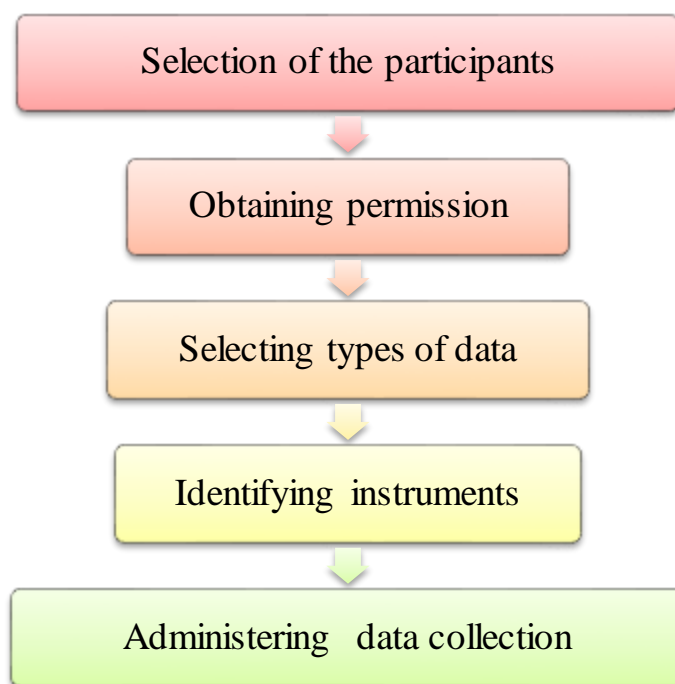


Figure 4.5. Five Steps in Quantitative Data Collection Process (Creswell, 2012:158-191).

4.2.4. SELECTION OF THE PARTICIPANTS

The first step proposed by Creswell involves specifying the target population and sample, and deciding on appropriate sample size for the study. Many research methodologists (e.g. Cohen, Manion & Johnson, 2011; Schumacher, 2014) have documented that the most rigorous sampling in quantitative research is simple random sampling, since it gives all the participants an equal probability of being selected from the given population. However, they indicated that the research circumstances may dictate that another form of sampling needs to be adopted. Indeed, the questions posed in this thesis are such that it is appropriate to adopt purposeful random sampling (Schumacher, 2014) to select the 2nd and 3rd year pre-service teachers (target population) in the two case study colleges (see section 2.7.1a for the reasons).

After knowing the target population and sampling strategy, it was important to determine the sample size for the study. Patton (1990:184) asserted that there are no specific rules for deciding the sample size in a survey research but the sample size depends on “what you want to find out, why you want to find it out, how the findings will be used and what resources including time you have for the study.” However, as Creswell (2012) suggests, one useful way to determine the sample size is to select a sufficient number of participants for the statistical tests the researcher plan to use. In order to use parametric statistical tests a researcher needs a sample of not less than about 60-70. However, the researcher also needs to consider how large the

sample is, in relation to the population, in order to be able to generalise from it. Creswell (2012) posited that a sample of 10% is usually enough for 100 and a 5% sample of 200 is more than adequate. In this current study, there were 955 students in both colleges, 485 students in College A and 470 in College B. Out of these, 400 pre-service teachers were selected for the purpose of this research. Thus, 200 pre-service teachers per site were selected (see section 3.1.7 for how they were selected).

4.2.5. PERMISSION TO UNDERTAKE THE STUDY

Following ethical approval from the University of Lincoln Ethics Committee, letters seeking permission to undertake the research were sent to the two Principals of both case study colleges in Ghana (Appendix E). In order to ensure the participants' cooperation in the study and provide data, permission was sought from the participants and the institutional heads. The letter contains information on the purpose of the study, the amount of time to be spent at each site collecting data, the time required of participants and how the data will be used. Moreover, the specific activities to be conducted, and the benefits of the study to the case study colleges were mentioned in the letter and, finally, being sensitive to the potential harm that the participants may experience because of the research, the letter indicated the provisions that were made to protect their anonymity (see section 3.3.9). Having outlined the processes by which the participants were identified, and explained the procedure for gaining permission, the next section considers the specific forms of data that will help the researcher address the hypotheses and the research questions of the study.

4.3. CONCEPTUAL FRAMEWORK FOR THE STUDY

In spite of its popularity and considerable empirical support, the Technology Acceptance Model (TAM) has been criticised by many researchers for its parsimony. The critics are of the view that the interaction between technology and its acceptance for use is multifaceted (Thong & Xu, 2012; Edmunds, Thorpe & Conole, 2010) and therefore, the simplistic TAM, with just its two constructs of ease of use and usefulness, may not capture all the components necessary to adopt and integrate ICT, into the current study. Drawing from the previous literature, the researcher is of the view that the original TAM has a weakness in its lack of explicit inclusion of external variables. This is more especially important given that the socio-economic circumstances and cultural norms operating in Ghana are very different from those operating in those Western nations in which the majority of TAM exercises have been undertaken.

Hence, in order to address these specific national characteristics, the current study builds on, and extends the original TAM.

4.3.1. RESEARCH MODEL AND HYPOTHESES

Given that many prior studies have extended and validated the TAM to suit their contexts (e.g, Teo, & Milutinovic, 2015) the current study extended the TAM by incorporating eight exogenous variables which is presented in Figure3.6 below:

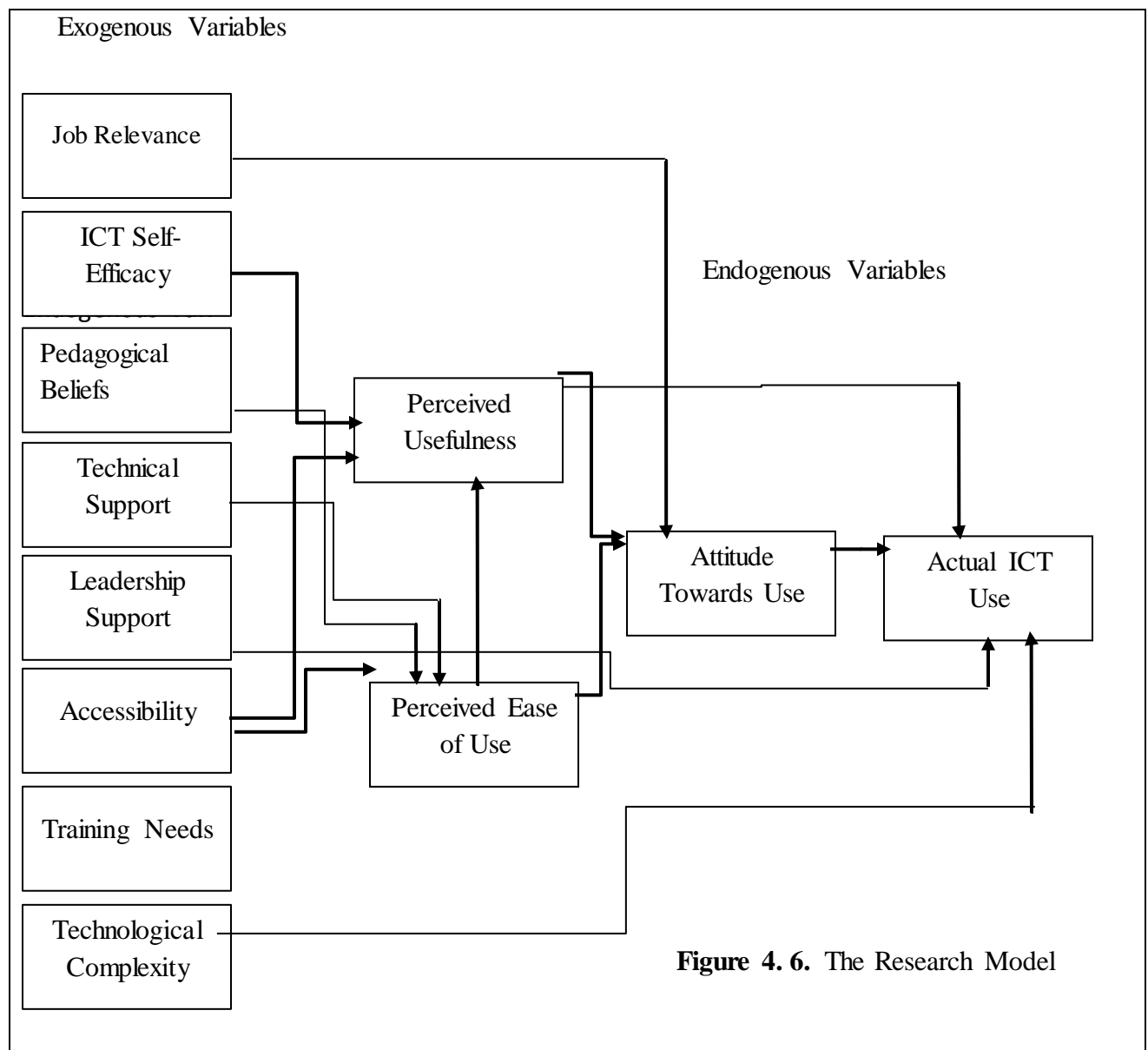


Figure 4. 6. The Research Model

It is important to note that this study did not consider the behavioural intention to use element, as the study focuses on the actual ICT usage behaviour. Having extended the TAM, the next section focuses on the hypothesis development in the thesis.

4.3.2. HYPOTHESES DEVELOPMENT

This section presents the research hypotheses, based on the extended theoretical TAM (Davis, 1989). As the TAM keeps being popular and parsimonious across a wide spectrum of technologies and users, it was chosen as the model of this study to achieve two main goals

- to test the applicability of the TAM in the Ghanaian pre-service teacher education context,
- to extend the TAM to reflect the Ghanaian situation, with two core determinants of socio-cultural factors and institutional factors as shown in Figure 3.4.

Although the original TAM model has been tested and validated in many educational contexts (e.g. Mtebe Raisano, 2014; Gyaase, Anokye-Sarfo & Bediako, 2013; Iddriss, 2012; Oye et al., 2011; Teo, 2009), a search of databases such as the Education Resources Information Center's online library of education research publications (ERIC), Proquest Education Journal, the *African Journal of Information and Communication Technology*, *Science Direct*, the British Journal of Educational Technology, the Australian Journal of Educational Technology and others have revealed that currently, the TAM has not yet been tested and validated in the Ghanaian pre-service educational context. As a consequence, this study appears to be the first attempt to test for the applicability of TAM in the Ghanaian pre-service teacher education setting. Based on the literature review and theoretical components of the TAM, the study proposes the following hypotheses:

Job Relevance

In the context of pre-service teachers' ICT use, job relevance refers to the extent to which a pre-service teacher considers ICT to be applicable to his or her job. It is widely recognised that when an individual perceives a new technology as being relevant to his job, the individual is inclined to accept it. On the contrary, when an individual perceives new technology as irrelevant to his or her job, the individual is less likely to accept it. Consistent research studies have found that job relevance positively affects users' attitude and hence its actual usage (Al-Gahtani, 2014; Perez, Sanchez, Canicer & Jimenez, 2004). In this study the following hypothesis will be tested:

Hypothesis: 1. the degree to which ICT is perceived to be relevant to a pre-service teacher's future job has a positive effect on his or her attitude towards technology.

ICT Self-Efficacy

Drawing from Bandura's social cognitive theory (Bandura, 1977), in the context of using technology, ICT self-efficacy refers to the perception an individual pre-service teacher has of his or her capacities and abilities to use ICT to accomplish a task (Compeau & Haggis, 1995). Bandura's theory postulates that people will be motivated to perform an action if they are confident that they can perform that action successfully, and believe that the action will have a favourable result. There is a growing corpus of studies which suggest that a causal link exists between self-efficacy and perceived usefulness (Ahmad et al., 2010; Hayes, 2007; Wong et al., 2010; Wozney, Venkatesh and Abrami, 2006).

For example, Teo (2009) posits that a pre-service teacher with a weak sense of ICT self-efficacy, will be frustrated more easily by obstacles to his or her performance, and will respond by lowering his or her propensity to use ICT. This suggests that an individual pre-service teacher will feel that he or she may meet a lot of problems in using ICT in the future. By contrast, an individual pre-service teacher with a strong sense of ICT self-efficacy will not be deterred easily by a difficult problem, and will persist with his or her efforts. Such an individual is more likely to overcome whatever obstacle is present. Accordingly, the following hypothesis will be tested:

Hypothesis 2. A pre-service teacher's ICT self-efficacy will significantly and positively have an influence on his or her perceived usefulness of ICT.

Pedagogical Beliefs

Pre-service teachers' pedagogical beliefs have been viewed as a key area that needs to be addressed in the context of ICT integration into classroom (Hayes, 2007; Sipilä, 2010). Where pre-service teachers favour constructivist-oriented beliefs, student-centred approaches are more likely to integrate ICT in their classrooms in a substantial and intellectually fruitful way (Ertmer, 2005; Jimoyiannis, et al., 2007). Many researchers are of the view that teachers' pedagogical beliefs and teaching philosophies influence the way in which technology is adopted, and the degree of technology integration within classroom practices (Chai, Wong & Teo, 2011; Teo, Chai, Hung & Lee, 2008), suggesting that the extent to which ICT will be effectively integrated into pre-service teacher education instruction depends on the type of pedagogical perspective adopted by teachers. In this study it is hypothesised that:

Hypothesis: 3. A pre-service teacher whose pedagogical beliefs favour constructivist-oriented beliefs and student-centred approaches is more likely to use ICT with ease.

Technical Support

The importance of high-quality technical support to the success of ICT integration has been highlighted in many studies (Rogers, 2005; UNESCO, 2011). According to Burnip (2006) and Rogers (2005) the availability of high-quality technical support is crucial in determining the successful adoption of ICT by pre-service teachers (Burnip, 2006; Rogers, 2005). In the context of this study, technical support is defined as the assistance provided to the teacher educators and pre-service teachers of computer hardware and software products by knowledgeable people (Wilson, 1991).

Research studies have shown that the greater the technical support provided, the greater the likelihood of the successful adoption of ICT, as high levels of technical support are thought to promote more favourable beliefs about the ICT usage among individual pre-service teachers (Son, Choi, Lim, & Xiong, 2012; Yueh, Huang & Chang, 2015). For example, in their study of the adoption of WebCT from 836 university students, Ngai, Poon & Chan (2007) extended the TAM to include technical support as a precursor. They found that technical support had a significant direct effect on perceived ease of use and usefulness.

Hypothesis: 4. Technical support has a significant effect on perceived ease of use by the pre-service teachers.

Leadership support

In the context of this study, leadership support is defined as the pre-service teachers' perception of the degree to which leadership understands the importance of ICT and the extent to which the top management is involved in the implementation of ICT. Leadership support is a key factor in ICT acceptance. Strong commitment from leadership (Principals, ICT coordinators, Heads of department etc.) is critical to ensuring ICT adoption, by creating a supportive context for ICT within the institution.

Hypothesis: 5. Leadership support has a significant effect on the actual use of ICT by the pre-service teachers.

Accessibility

Accessibility is defined as the degree of convenience with which an individual pre-service teacher can access ICT in his or her institution. Greater accessibility leads to more frequent use of ICT, whereas low accessibility works as a barrier in using ICT. In this current study it is hypothesised that:

Hypothesis: 6. An individual pre-service teacher's ease of access to ICT will have a positive effect on perceived usefulness.

ICT Training Needs

Training needs have been identified as an important factor affecting ICT acceptance and its subsequent integration in educational institutions (Rodriguez and Monge-Lozano 2012). Appropriate training increases the likelihood that ICT will be accepted, since training tends to bring about better understanding and more favourable attitudes toward the technology and to result in more frequent use of it (Venkatesh and Davis, 2000). Prior studies have suggested that valuable training programmes have a positive impact on PEU (Son, Choi, Lim, & Xiong, 2012). For example, Escobar-Rodriguez and Monge-Lozano (2012) showed that training in how to use a new technology can enhance students' productivity, as they do not need to waste much time learning how to do so on their own. On this basis, it is hypothesised that:

Hypothesis: 7. Appropriate and valuable training provided to the pre-service teachers will have a significant and positive effect on perceived ICT ease of use.

Technological Complexity

Technological complexity refers to the degree to which technology is perceived as relatively difficult to understand and use (Thompson, Higgins, & Howell, 1999). It is believed that when a technological product gets simpler to operate, pre-service teachers tend to develop positive perceptions towards the usage of it, which in turn increases the likelihood of the usage behaviour or acceptance (Aypay et al., 2012). However, when technology is perceived to be complex, this perception may hinder technological adoption and its subsequent integration, especially to the pre-service teachers in the developing world context. In this current study, it is hypothesised that:

Hypothesis: 8. Technology complexity has a significant influence on actual use of ICT.

Perceived Ease of Use (PEU)

Perceived ease of use has been operationalised to mean that the degree to which a pre-service teacher believes that adopting ICT would require a little effort. It is considered the primary factor shaping pre-service teachers' attitude towards ICT acceptance, because pre-service teachers tend to explore the technical and practical characteristics of ICT products at first hand and tend to look for ICT products that are easy to operate. All other factors being equal, a pre-service teacher is likely to consider ICT to be useful when it is easy to use. Hence, the following hypotheses will be tested:

Hypothesis: 9. The degree to which a pre-service teacher considers ICT to be easy to use has a positive influence on his or her perception of the usefulness of ICT.

Hypothesis: 10. Perceived ease of use will significantly and positively influence a pre-service teacher's attitude towards ICT use in the classroom.

Perceived Usefulness (PU)

Perceived usefulness is operationalised in this study to mean the degree to which a pre-service teacher believes that adopting ICT would promote his or her work performance. This is grounded on the proposition that a pre-service teacher would tend to utilize ICT when it is perceived to be useful in performing his/her tasks. In other words, ICT use in classroom settings would be perceived as useful, when a pre-service teacher develops a belief that this usage of ICT will help him/her teaching and having more control over knowledge transaction (Teo, 2009).

Hypothesis: 11. Perceived usefulness will significantly and positively influence pre-service teachers' attitude towards ICT use.

Hypothesis: 12. Perceived usefulness will significantly and positively influence pre-service teachers' actual use of ICT.

Attitude towards use

A number of studies have indicated that the successful pedagogical use of ICT depends on pre-service teachers' attitude and acceptance towards technology (Teo, Fan, & Du, 2015; Yuen & Ma, 2008). Ajzen & Fishbein (2000) described attitude as a predisposition to respond favourably or unfavourably to an object, person or event. In this study it is about responding favourably or unfavourably to ICT integration in pre-service teacher education. Kersaint et al.,

(2003) found that teachers who have positive attitudes towards ICT feel more comfortable with using the technology, and usually incorporate it into their teaching.

By contrast, those who have negative attitudes, resist using it (Yang, et. al, 2017). In the same vein, in his survey of 139 pre-service teachers from the Institute of Education in Singapore, Teo (2008) found that pre-service teachers' attitudes and intentions to use computers were more positive than their perceived ease of use and usefulness. Consequently, attitude has been hypothesised as a direct determinant of actual use of ICT.

Hypothesis: 13. A pre-service teacher's perceived attitude towards ICT use will significantly and positively influence his or her actual use of ICT.

Actual System (ICT) Use

In the TAM, the actual system use is the end result of all of the interactions of all the other constructs. In this study, Actual System Use or Usage Behaviour is the degree to which the pre-service teachers plan to use ICT after they have ascertained the extent of its usefulness. The successful use of any form of technology provided by an educational institution depends on the willingness of the users to use it in performing their tasks. For this study, actual use was measured on a weekly usage scale, as well as by means of a pre-service teachers determined frequency of use range.

After developing the hypotheses and defining the variables within them, the next major step was to develop instruments for data collection.

4.4. INSTRUMENTATION

The original TAM constructs have been adopted and operationalised in this research by using measurements validated by previous research, with wording carefully modified to suit the context of the current study (Aypay, et al., 2012; Hossain & de Silva, 2009; Park, Roman, Lee & Cheung, 2009). Comprising three sections, the first section of the survey requires the respondents to give their opinions on 38 statements on the 12 TAM constructs in the study. They are job relevance (JR) (2 items), ICT self-efficacy (ICTSE) (3 items), technological complexity (TC) (2 items) technical support (TS) (4 items), leadership support (LS) (2 items) ICT training needs (ICTTR) (4 items), pedagogical beliefs (PB) (3 items), perceive ease of use

(PEU) (4 items), perceived usefulness (PU) (4 items), Attitude towards ICT use (ATICTU) (4 items) and Actual ICT use (AICTU) (4 items).

These items were adapted from various published sources that are found to be reliable and valid (Compeau & Higgins, 1995; Davis, 1989; Perez, Sanchez, Canicer & Jimenez, 2004; Teo, 2014; Teo, 2009; Venkatesh et al., 2003; Wozney, Venkatesh and Abrami, 2006). Each statement, with the exception of *actual ICT use* was measured on a five-point Likert scale with the following responses: *strongly agree, agree, neutral, disagree, and strongly disagree* (Schumacher, 2014).

Schumacher (2014) recommended the use of Likert type of scale in educational research, due to its high validity (convergent and discriminant). The scale is popular because it is simple to administer (Delamont, 2012), has a high degree of validity and reliability, provides single scores from set of items, allows ranking of the respondents, and is relatively easy to construct.

The second section of the research instrument focuses on pre-service teachers' ICT usage in practicum schools, while the final section requires the respondents to provide their demographic information which comprises the gender, age and ICT accessibility of the respondents.

The questionnaire was designed to be completed within a maximum of 20 - 25 minutes to maximise the completed response rate and minimize impact on the time of the respondents. The respondents were given the questionnaires, and asked to fill them out in their own time and return them by mail, e-mail or for collection by the researcher (Schumacher, 2014) (see Appendix A).

4.5. RELIABILITY AND VALIDITY

Pallant (2013) described reliability and validity strategies as very important in quantitative research because they have an influence on the quality of the data the researcher obtains. Given that they can have influence on the quality of the data obtained, this section evaluates the reliability and validity of the quantitative instruments in this study.

4.5.1. RELIABILITY

A reliability test was carried out immediately after the data of the 380 questionnaires had been keyed into the IBM SPSS Statistics 21 package to assess how free the scale is from the random error (Pallant 2013). In the context of this study, the reliability of the questionnaire is the extent

to which the questionnaire provides the same results with repeated measurements. As posited by Field (2013) evidence of an instrument's reliability is normally demonstrated by one or more of several generally accepted procedures.

However, Pallant (2013) postulates two key indicators – test-retest reliability (temporal stability) and internal consistency. With test-retest reliability the researcher administers the questionnaires on two occasions on the same respondents. In contrast, with an internal consistency estimate of reliability, respondents are administered a measure with multiple parts on a single occasion (Field, 2013). Due to the limited timeframe of this study and other constraints (e.g. finance, distance etc.), administering the survey questionnaire twice to the same respondents on two different occasions was not possible. The procedure adopted in this study was the internal consistency reliability test.

According to Pallant (2013) internal consistency reliability estimates how consistently individuals respond to the items within a scale. One of the widely used internal consistency reliability indicator, the Cronbach's alpha coefficient was utilised. Setting a recommended threshold, DeVellis (2012) postulates that, ideally, the Cronbach alpha coefficient of a scale should be .07 and above.

As exhibited in 4.5.2, nearly all the constructs exhibited Cronbach's alpha value greater than .07, a commonly recommended threshold for exploratory research (Nunnally, 1978). Analysis of data from three constructs Accessibility (ACC (.059); Pedagogical Beliefs PB (.068); ICT Training (ICTTR) (.059) showed x-values lower but close to 0.7.

Therefore, ACC and ICTTR were discarded, but PB was maintained for the analysis, since its Cronbach's alpha value was closer to the recommended threshold of 0.7. This means 11 out of the 13 variables remained for the analysis. This might suggest potential limitations of these measures in the pre-service teacher education context in Ghana.

Table 4.1 below exhibited the results of the Cronbach's alpha.

Table 4.1. Cronbach's alpha

Scale		Cronbach's alpha (α)	No of items
Perceived Ease of Use	[PEU]	.085	4
Perceived Usefulness	[PU]	.085	4
Attitude Towards ICT Use	[ATICTU]	.088	4
Accessibility	[ACC]	.059	2
Job Relevance	[JR]	.089	2
Self-Efficacy	[SE]	.089	3
Pedagogical Beliefs	[PB]	.068	3
Leadership Support	[LS]	.084	2
ICT Training	[ICTTR]	.059	4
Technical Support	[TS]	.091	4
Technological Complexity	[TC]	.071	2
ICT Usage	[ICTU]	.086	4

Based on the factor analysis and reliability results, 11 out of the original 13 hypotheses were considered to be tested as follows:

H:1. The degree to which ICT is perceived to be relevant to a pre-service teacher's future job has a positive effect on his or her attitude towards technology

H:2. A pre-service teacher's self-efficacy significantly and positively influences his or her Perceived usefulness of ICT.

H:3. A pre-service teacher whose pedagogical beliefs favour constructivist-oriented beliefs and student-centred approaches is more likely to use ICT with ease.

H:4. Technical support has a significant effect on perceived ease of use by the pre-service Teacher.

H: 5. Leadership support has a significant effect on the actual use of ICT by the pre-service teacher.

H:6. Technological complexity has a significant influence on actual use of ICT.

H:7. The degree to which a pre-service teacher's considers ICT to be easy to use has a Positive influence on his or her perception on the usefulness of ICT.

H:8. Perceived ease of use will significantly and positively influence a pre-service teacher's attitude towards ICT use in the classroom.

H:9. Perceived usefulness will significantly and positively influence pre-service teachers' attitude towards ICT use.

H:10. Perceived usefulness will significantly and positively influence pre-service teachers' actual use of ICT.

H:11. A pre-service teacher perceived attitude towards ICT use will significantly and positively influence his or her actual use of ICT.

4.5.2. VALIDITY

Validity refers to whether the results of the study could be generalised to the whole population. In this study, validity of the instrument was achieved through the following strategies:

Prior to dissemination, the questionnaire was piloted to forty Postgraduate Certificate of Education students from a university in South East England who have similar characteristics to the pre-service teachers in the colleges of education in Ghana to check for appropriateness, readability and comprehensiveness of the survey instrument. As posited by Bryman (2007:263) *“piloting also has a role in ensuring that the research instrument as a whole functions well”*. (See Pilot Survey for details). Again, two doctoral students with expertise in research on ICT in education from the University of Lincoln in the United Kingdom and the thesis supervisor examined the instrument and made suggestions about the comprehensiveness and the clarity of the instrument (Rossi et al., 1993). The fact that the questionnaire was constructed using variables already tested in surveys by Compeau & Higgins, 1995; Davis, 1989; Perez, Sanchez, Canicer & Jimenez, 2004; Teo, 2014; Teo, 2009; Venkatesh et al., 2003; Wozney, Venkatesh and Abrami, 2006 researching this same field, ensured that there was *content validity*. This kind of validity makes use of recognised subject matter that has already been evaluated to assess a given phenomenon (Bryman, 2007).

Lastly, the qualitative phase provided an additional validity check and gave more information and credence as to what might have influenced the responses given in the survey.

Following the modifications derived from the feedback of the pilot test, outside expert and the supervisor's advice the questionnaire was then disseminated.

4.6. QUESTIONNAIRE ADMINISTRATION

Data was gathered by means of a survey questionnaire containing questions focusing on Technology Acceptance Model (TAM). The survey questionnaires were administered to 400 pre-service teachers in two Colleges of Education. The questionnaires, with covering letters, were sent to the principals in the two pre-service teacher institutions in Ghana. The letters outlined the purposes and scope of the study, and sought support for the conduct of the study. The principals, in turn, looked for designated persons who distributed the questionnaires to the respondents, prior to the researcher's arrival. This strategy relieved the researcher from the burden of distributing the questionnaires himself, and therefore had enough time to concentrate on the interviews and observations.

4.7. CASE STUDY METHOD

This section discusses the methodology and the research design appropriate for the qualitative part of the study. The overarching objective of the qualitative study was to examine issues related to the research topic, but which had not been covered in the survey. The qualitative study complements the quantitative component in the previous section. It aids the interpretation and confirms the results of the survey findings. This section is organised into four key subsections: It begins by focusing an overview of the qualitative research study, followed by discussion of case study design and the sampling strategy for the qualitative research. Data collection techniques and process are also considered. Thematic analysis of the interviews and observations are discussed. The section concluded with summary of the chapter.

4.7.1. CASE STUDY

In this section, the case study method is examined in more detail and the underlying reasons leading to its choice, its' strengths and weaknesses are highlighted.

Case study, as a research method, has been growing in the instructional technology discipline for the last three decades (Gillham, 2004; Bryman, 2004; Lim, 2007; Yin, 2014) and its use by the researchers in this field is increasing. Although there is no specific definition of the case study, many researchers have advanced definitions according to their disciplines and field of interests (Bassey, 1999; Cohen, Manion & Morrison, 2011; Nind, 2008). For example, Stake (1995) best described case study as creating a "picture" for others to see and experience phenomenon being studied. However, the most well-known definition was advanced by Yin (2003).

Yin (2003: 13) defines a case study as an empirical inquiry that:

*investigates a contemporary phenomenon within its real-life context, especially
when the boundaries between phenomenon and context are not clearly evident.*

The current study falls within Yin's (2003) definition, as it investigates a contemporary phenomenon (integration of ICT) in a real-life situation (two pre-service teacher institutions in Ghana). Although, there are four key qualitative traditions such as ethnography, phenomenology, biography, grounded theory and case studies, case studies have been widely recognised as a commonly used research method in ICT integration in pre-service education (Creswell, 1998; Yin, 2003). In this study, the case study was chosen as the preferred method, based on following key characteristics:

First, it is the preferred method for investigating the impact of technological innovations and changes in education in these contemporary times (Cohen, Manion & Morrison, 2011; Lim, 2010; Yin, 2003). This is consistent with the current study, which focuses on technology adoption, and its subsequent integration in the pre-service teacher education context.

Secondly, case study design allowed the researcher to develop an in-depth understanding of teachers' experiences with the use of ICT and to observe a phenomenon (ICT integration) that would be difficult to measure without observations and interviews (Creswell, 2012).

Again, case study was a preferred method, as the research questions posed were of the "how" and "what" types and the focus was on contemporary phenomenon (technology acceptance and adoption in pre-service teacher education in Ghana) where the researcher had little control over the event (Bogdan & Biklen, 2012; Yin, 2014).

Furthermore, unlike its rivals such as experiment or histories, case study research provided the opportunity for the researcher to use an impressive array of sources of evidence (Yin, 2003) in order to build an in-depth picture of the case. The adoption of semi-structured interviews and observations for the qualitative data collection analysis allowed the researcher to be on the field to capture the phenomenon under discussion (in this case, ICT integration).

In addition, the case study approach allowed the researcher to develop an in-depth understanding of teachers' experiences with ICT and observe the phenomenon (ICT integration) that would have been difficult to measure without the observations and interviews (Creswell, 2003). Recording actual words and expressions of the interviewees and the observed

participants was a reliable way of gathering data as the study related to human attitudes and behaviour towards the adoption of technology in the classroom context. This gave the participants the opportunity to express their feelings freely.

Moreover, the adoption of case study approach helped the researcher to capture the issues that were not covered by the quantitative survey research that might have had influence on the research results. As posited by Yin (2014), there is the need for a decision to be taken by a researcher prior to any data collection: namely, whether a single case study or multiple cases are going to be used to address the research question. Consequently, the study moved to discuss the suitable type of case study approach to be utilised.

4.7.2. SINGLE VERSUS MULTIPLE-CASE METHOD

According to Yin (2003) a case study can be designed as either single or multiple case studies. In addition, Creswell (2014) recommended that, in conducting a case study research, the researcher must first, consider the type of case study that is most promising and useful. However, there is a great deal of dispute between researchers about using single or multiple case studies (Nind, 2008; Yin, 2009). While some proponents claim that single case study is sufficient for research study (Eisenhardt, 1989), others advocate a multiple-case approach (Creswell, 2012; Yin, 2014).

Disputing the case for a single case study approach to innovation in education, Yin (2003) advised that although all designs can lead to successful case studies, but when a researcher has the choice and resources, he or she should give a priority to multi-case over single case design. Yin strongly stressed that, even if the researcher can only do a two case-study, his chances of doing a good case study research will be better than using a single case design. In the same vein, Herriot and Firestone 1983 considered that the evidence gained from a multiple case study approach is more rigorous and complete than a single case study, because of the ability to triangulate evidence. Other proponents, such as Zigler & Muenchow (1992), argue that findings in a multiple case-study are likely to be much more convincing and accurate, especially if they are based on several different sources of information. In this study the multiple case study was chosen as more appropriate to answer the research questions based on the following reasons:

Generally, the evidence from a multiple-case study is more conclusive than that from a single case study given that the researcher has been able to gather and compare evidence from but

related sites bounded by the common topic. Besides, the use of replication procedure for each separate “case-study” is usual means by which multiple case studies can be effectively linked and given unity (Yin, 1994:45-47).

Although case study design has been found to be distinctive form of empirical inquiry, many scholars and researchers (e.g. Nind, 2008) nevertheless criticise case studies due to the weaknesses outlined below:

Perhaps, case study may be criticised for its lack of reliable and generalisable findings, especially due to the fact that only two pre-service teacher institutions out of thirty-eight in Ghana were adopted for investigation. Although the research findings may not be generalizable, they enabled a better understanding of the phenomenon. In the same vein, as posited by Stonehouse (1979) that case study can lead to generalisations when they are cumulative, therefore, the adoption of multiple case study approach was a suitable strategy for enhancing the generalisability of the findings of this study. Again, answering the research questions posed in this study required not only analytical statistics, but the narratives from rich personal experiences of the participants experiencing the phenomenon. This was achieved through face-to-face semi-structured interviews and observations in two case study colleges. It also placed the study within the interpretive paradigm where the researcher attempted to create a plausible interpretation of what is discovered.

Moreover, the collection of multiple sources of data via a multiple case study approach imposed a burden on the researcher, as it was more time-consuming than if the data were only collected from a single study. This implies that the researcher needs to know how to carry out the full variety of data collection techniques (Denzin & Lincoln, 2011). This required the researcher to master multiple data collection techniques, which raised the crucial questions regarding the training and expertise of the researcher. In this study, the solution to this problem was achieved through the researchers constant meeting with the supervisor, discussing issues relating the research method skills and researchers practical research skills training at both University of Southampton and University of Lincoln as part of the researchers’ MPhil and PhD programmes respectively.

For the purpose of this current study, the researcher used case study method purposely as a follow-up for further clarification of the results of the survey and also a tool for data triangulation purposes.

4.8. QUALITATIVE DATA COLLECTION TECHNIQUES

Yin (2003) pointed out that no matter how much research experience a social researcher may possess, every case study investigator should be well versed in a variety of data collection techniques, so that a case study can use multiple sources of evidence. He further argued that without such multiple sources, an invaluable advantage of case study design will be lost. With this in mind, a multiple sources approach, comprising observation and interview will be considered. This section examines and discusses why these two techniques are considered most appropriate for this study, and the potential merits and limitations of each.

4.8.1. OBSERVATIONS (*No Substitute for Being there*)

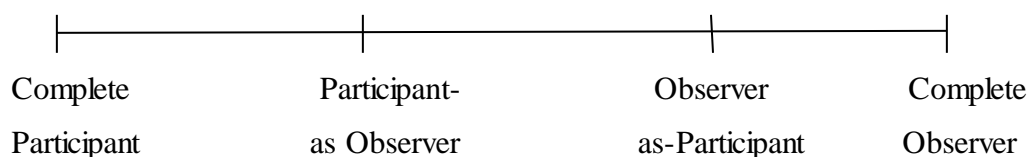
Observation has been considered by many researchers, as the most frequent data-collection method used in qualitative research (McMillan & James, 1992; Lofland, 1971). Comparing its validity with other qualitative research methods, Bailey (1978:242) asserts that “all other things being equal,” observation has greater face validity than “a second-hand account gathered either through interviewing or document study.” On this basis, observation has been adopted as the first method of the qualitative phase of this study. According to Delamont (2012), a researcher’s key job in observation is to find out what the participants think is going on, what they do, why they do it, how they do it, and what is ‘normal’ and ‘odd’ for them. Within this context the observations allow the gathering of rich data in natural settings. Silverman (2005) indicated that richer data means a better description and understanding of what goes on in a particular context, and improves the provision of clues and pointers to other layers of reality.

As Flick (2009) posited, observation in this study involved the researcher going to the site, and observing the phenomenon that was of interest to him. In a sense, the idea was to be in the social setting, to make a careful record of what the pre-service teachers and teacher educators say and do, and to make sense of it. The main purpose for conducting observations in this study was to establish current classroom practices with regard to the integration of ICT. Observation of lessons took place in both computer laboratories and normal classrooms, with two goals in mind:

- Capturing teachers’ utilization of ICT in teaching and learning;
- Documenting ICT infrastructure.

The researcher aimed to be as unobtrusive as possible so that the behaviour of the participants involved could be observed as objectively as possible. Discussing the level of detachment and

involvement of the observer in conducting observations in educational environment, Gold (1958) noted four modes through which observer may gather data. This has been depicted along the following continuum:



Based on Gold's typology, the principal role of the researcher was that of a complete observer. As a complete observer, even though acknowledged by the participants, the researcher performed his role as an outsider, and not directly engaged in central behaviours and activities within the situation under study (Hatch, 2002). Identifying the major strengths of observational data for qualitative programme the following were noted:

First, unlike interviews and questionnaires, as a technique for gathering information, the observational method relies on a researcher's seeing and hearing things and recording these observations, rather than relying on the respondents' self-reported responses to questions. Secondly, direct observation of social phenomena permits a better understanding of the contexts in which the phenomena occur. This represents a first-hand encounter with the phenomenon of interest (Kinchen, 2011) and stimulates questions to be posed to participants, for example, during the interviews.

Again, direct observation of the phenomenon gave the researcher the opportunity to see things that were taken for granted by participants, and would be less likely to come to the surface using interview or questionnaire techniques. The researcher was able to understand the context, recorded and described behaviours of the participants as they occurred.

Additionally, observations allowed the researcher to observe the events and actions that the interviews and questionnaires could not reveal. For example, the observations helped the researcher to see the teacher educators and pre-service teachers using the ICT in the actual classroom. It also allowed the researcher to learn some sensitive information that participants felt reluctant to discuss in interview. For example, in College A when one teacher educator was asked whether they had ICT with Internet access in all the classrooms, he decided not to answer but asked the researcher to go to the classrooms to verify himself. Observation is an important way of collecting information about the participants, as it is known that teachers do not always do what they say they do, for example, during interviewing (Johnson & Christenson 2012). Unlike interviews and questionnaires, as a technique for gathering information, the

observational method relies on a researcher seeing and hearing things and recording these observations, rather than relying on the respondents' self-report responses to questions. Most importantly, observation enabled triangulation with the data gathered by means of semi-structured interviews and survey questionnaires in this study.

However, the use of the observation as a research method was not without limitations. Observation was time consuming, strenuous, and the selective perception of the observer may distort the data (Taylor & Bogdan, 1998). Another major weakness is that the observed participants may not behave naturally, when they become aware that they are being observed. Furthermore, classroom observation can be considered an intrusive procedure, and can generate anxiety and uneasiness (Taylor & Bogdan, 1998). However, the process of informant feedback, where the teachers were able to read what the researcher had recorded, with the opportunity to amend or add information, helped to alleviate these stressful feelings and confirmed the professionalism of the researcher, in this study, as an observer and not a judge. Additionally, the observers are sometimes found to be obstructive, and their presence may affect the phenomenon being observed. To address this problem, the researcher performed his role as an outsider and did not directly engage in central behaviours and activities within the classrooms observed. The researcher sat quietly at the back of the classrooms during the observations.

In order to enter into the inner world of the participants, to gain an understanding of their perspectives (Gubrium et al., 2012), semi-structured interviews were conducted, in addition to the observations.

4.8.2. SEMI-STRUCTURED INTERVIEWS

Bogdan & Biklen (2012:135) describe interviewing as a "purposeful conversation in which the participants use natural language to express themselves so that in-depth information can be gathered directly from the participants own words." Creswell (2014) documented that, in conducting interviews, the researcher needs to determine the type of interview that is practical, and will net the most useful information to answer the research questions. With this in mind, and after assessing the types of interviews available [Structured interview, Semi-structured interview and unstructured interview], face-to-face semi structured interview was adopted.

According to Basit (2010), the semi-structured interview is the most favoured type of interview in educational research. Against this background, semi-structured interviews was utilised to obtain in-depth information about the participants' thoughts, beliefs, knowledge, reasoning,

motivations, and feelings about ICT integration within their respective institutions (Johnson & Christensen 2012). Mears (2009) posited that semi-structured interviewing requires that the researcher should be interested in meaning making with another person, bridging borders of experience that brings “insider” information to the outside, so that those who have lived (or not lived) the experience can better understand. Conducting semi-structured interviews in educational setting has a number of advantages that need to be recognised.

First, the semi-structured interview approach allowed the researcher to seek understanding by exploring and probing participants’ viewpoints in an open, but structured, environment (Mears, 2009). Secondly, semi-structured interviews are flexible and adaptable as the responses can be probed, followed-up, clarified and elaborated to achieve accurate responses. Non-verbal as well as verbal behaviour can be noted in face-to-face interview and the interviewer has the opportunity to motivate the participants (Schumacher, 2014).

Again, it helped the researcher to discover the participants’ perceptions, opinions, beliefs and attitudes and illuminate some unfamiliar aspects of the research (Lee, 1999). Involving open-ended questions, semi-structured interviews allowed the respondents to answer the questions in their own words. Moreover, as posited by Greene et al., (2006), the face-to-face semi-structured interview gave the researcher the opportunity to clarify confusing questions and gather additional elaborations from respondents, to help clarify answers.

Despite the fact that face-to-face semi-structured interviews have many advantages for gathering high-quality information, they are not without disadvantages. The primary disadvantages of the semi-structured interview are its potential for subjectivity and bias, its higher cost and time-consuming nature, and its lack of anonymity (Drew, Hardman & Hart, 1996). Depending on the training and expertise of the interviewer, the respondents may be uncomfortable in the interview and unwilling to report true feelings; the interviewer may ask leading questions to support a particular point of view.

The significant weakness, which is mostly underestimated, is that after the interview was completed the laborious and time-consuming task of transcription began. Some researchers hire professional transcribers to transfer the audio-recordings to text, but that is an expensive endeavour. In addition, much can be lost by the researcher in not transcribing the interviews himself or herself. Moreover, if the researcher decided to hire a transcriber, he/she needs to check for the accuracy and completeness by listening to the tape while he/she reviews the transcript. This implies the researcher needs to plan to invest time, money, and energy in the

transcription. In order not to lose much of the data and to maintain the accuracy of the transcript, the data was analysed manually by the researcher.

Once the interview questions had been completed, they were reviewed together with the supervisor. The pilot study was carried out in July 2014 with two teacher educators and three pre-service teachers in a university in the South-east England, to test the validity of the interview schedule. Feedback from the pilot studies led to some minor changes and additions to the questions (See Appendix B1).

4.8.3. PARTICIPANTS' SELECTION, INTERVIEW AND OBSERVATION PROCESSES

Initial contact was made by phone to the principals of the two colleges. A summary of the outline of the research project [Appendix E] was sent to the principals after they had agreed to take part in the research. Each was assured that the college, and information pertaining to the college, would be kept confidential. Colleges were assigned a letter code to ensure confidentiality, but to enable the information to be traced by the researcher. To select the most productive sample in order to answer the research question effectively, teacher educators who demonstrated great interest and least interest in the implementation of ICT were selected for the interview in order to obtain a balanced view. Based on the above-mentioned criteria, 2 Principals, 2 ICT coordinators, 4 heads of department and 6 pre-service teacher students were interviewed at both colleges, making a total of seven interviews per site.

Tables 4:1 and 4:2 summarise the type of college and interviewees in each of the two case study colleges. Each interviewee was categorised according to gender, age and position held. The ages of the teacher educators' were between 25 and 60 years, whilst that of the pre-service were between 18 and 30 years (see Table 4.4.2).

questions prior to the interview, enabled the interviewee to be prepared and confident, supporting the development of a comfortable collegial atmosphere during the interview. It was not intended to “put the respondents on the spot.” Allowing the interviewees to view the questions prior to the interview reduced this problem.

The face-to-face semi-structured interviews were conducted with all participants at both case study colleges at a location that was convenient, available, physically comfortable and private, and at a time convenient to the interviewees, so that they would not be under pressure (Glesne & Peshkin, 1992). A semi-structured interview with a maximum of ten open-ended questions was proposed (see Appendix B). Accordingly, the interviews were conducted over a four week period with each session lasting between 30 and 45 minutes. Once the interview questions had been completed, they were reviewed together with the supervisor. The pilot study of the semi-structured interview was carried out in July 2014 with two teacher educators and three pre-service teachers in a university in the South-east England, to test the validity of the interview schedule (see Appendix 1). Apart from piloting the interview protocol, member checking was employed to ensure the credibility of the data. All interviews were audio-taped, subject to agreement of the participants, transcribed and analysed.

The advantage of using a semi-structured interview approach was that some comparable data was gathered between the participants who were interviewed. During these interviews the researcher was seeking to understand, in considerable detail, how participants think and how they came to develop a particular perspective they hold (Bogdan & Biklen, 2012). The disadvantage, as Bogdan & Biklen (2012:35) put it, is that “you lose the opportunity to understand how the subjects structure the topic at hand.” In this case both participants and researcher are active, in that both help create meaning. To counter this, the researcher attempted to give the participants latitude to take the questions in whichever direction they pleased, without a rigid process to follow. At the end of the interview, the researcher thanked the interviewees for their time and contributions to the study, and reminded them of their rights to amend or withdraw their information from the research.

4.8.4.THE OBSERVATIONAL PROCESS

Classroom observations and interviews occurred simultaneously in both colleges. The main purpose of the classroom observations was to establish current classroom practices in regard to the integration of ICT. Observations of ICT-mediated lessons were often arranged for the researcher on the day of visit, with principals requesting permission of the teacher educators as the researcher was being introduced to them. As a result of the spontaneity of these arrangements, the researcher was given the opportunity to observe the different types of classes, which were typical of the two case study colleges, and not rehearsed or specially prepared lessons.

The checklist for the observations was inextricably tied to the theoretical framework and some of the pertinent issues raised in the literature review. Four ICT-mediated lessons were observed in each college. The ICT-mediated lessons were in different subject areas: Mathematics, Science, Social Studies, Education and ICT. Out of the 8 lessons observed, 5 were conducted in the computer laboratories, mediated by ICT tools that included Internet, CDROMs and open tools (word processing and presentation applications). The remaining three were conducted in the classroom where two of them were without a data projector and a teacher's computer. The third lesson was mediated by a presentation application (PowerPoint). During the observations, a record of events was kept to provide a relatively incontestable description for further analysis and reporting. However, making field notes while the activities under investigation were taking place was not always possible. It was then necessary to write up the observations as soon as possible, while memories of them were still fresh immediately after the observations.

An observational protocol was followed and the responses were later transcribed from handwritten notes into electronic format (see Appendix C). In order to establish credibility of the data After the observation, each teacher observed was sent the report of the observation shortly after the observation. The report included a detailed description of what was observed, including evidence of constructivist approaches to teaching and learning, ICT infrastructure, layout of the classrooms, seating arrangements and a reflection by the researcher. A letter accompanied this report asking teachers for validation by adding further information or amending sections they disputed. None of the observed participants raised any issue or objection about the reports sent to them. To preserve anonymity in the writing of the report, the teacher educators observed were given pseudonyms (see Appendix C).

4.8.5. QUALITATIVE DATA ANALYSIS PROCESS

Bogdan and Biklen (2003:147) defined qualitative data analysis as “working with the data, organising them, breaking them into manageable units, coding them, synthesising them, and searching for patterns.” Strauss and Corbin (1990), on the other hand, identified qualitative analysis as an “iterative process” and not a linear activity, in that analysis involves an iterative search through the data to develop meaningful categories. The study employed an emergent thematic analysis approach, involving searching for patterns within the data to analyse the findings (Braun & Clarke 2006; Boyatzis, 1998; Denzin & Lincoln, 2008). These patterns were identified via an intensive, manual coding process that involved systematically listing individuals themes within, and then across, each of the individual audio transcripts.

In line with thematic analysis process, analysis of the data was conducted repeatedly in three stages: (1) coding process (Rossman & Rallis, 1998; Strauss & Corbin, 1990); (2) categorisation of data (Denzin & Lincoln, 2008; de Laine, 1997) and (3) identification of themes (DeSantis & Urgarriza, 2000; Patton, 2002). The researcher oscillated between these three processes. Consistent with the qualitative, interpretative methodology used in the second phase of the study, the data analysis was conducted as follows:

The interviews and observations were transcribed as soon as possible, while still fresh in the researcher’s mind (de Laine, 1997). Having this in mind, the audio-recorded interviews and hand written observation data were transcribed verbatim into an electronic format. This was the first stage of the data analysis. Each interview and observation was numbered, the date, time and the location recorded. Careful and repeated readings were made of all the transcribed interviews and observations, to gain familiarisation with the data. This was achieved by initially reading through the transcripts without considering an interpretation. Then, upon repeated readings, major ideas that surfaced were chronicled (Merriam, 2014). In order not to lose contact with the data and the perspectives and interpretations of those being studied, virtually every paragraph of the transcript was examined in the initial stage of the coding (Charmaz, 2004). This resulted in a proliferation of codes. Codes were reviewed and those found to be connected to the concepts and categories in the existing literature were used. This process was repeated for accuracy and explanation, until no new codes were found.

In developing codes, memos were also written that linked the proposed codes to some pieces of the data (Barbour, 2008; de Laine, 1997). Bryman (2004) asserted that memos are one of

the basic aids to the generation of concepts and categories in helping researchers to crystallize ideas and not to lose track of their thinking on various topics. During the fieldwork and post-fieldwork phases, memos assisted the researcher to conceptualise the relationships between various codes and processes. In order to reduce the codes into a manageable size, codes found to be in common were combined into higher-order codes or categories (Bryman, 2004). It was important to ensure that the data grouped into emerging categories and could be “dovetailed” into these specific categories in a meaningful way (Patton, 2002).

Originally, it was decided to use qualitative software (Nvivo08) to analyse the data (Lewins & Silver, 2008) but following the transcriptions, it was preferred to analyse the data manually in order to provide the maximum scope to work closely with the data. Moreover, the researcher wanted to capture the richness of the experience of the interviewees and the observed, which would not have been possible via the use of software to produce further statistical data.

The coding was used to generate a small number of themes and categories. The emergent categories were re-examined for regularities that seemed to capture the essence of meanings and behaviours across multiple situations reflecting abstractions that symbolised higher order concepts or themes. In this way, through iteration and reiteration in the analysis, the six themes reported in the findings chapters emerged (see chapter 4). According to Gomm (2008) themes, in some way stand for the way ideas are organised in the minds of the people studied. The data was then interpreted, with reference to the research questions posed, and the related literature review (see figure 2.1). Although, this process was time-intensive, it ensured that the researcher did not miss the nuances within the data, and that the researcher obtained a particularly intimate understanding of the data.

Regular meetings were held with the researcher’s supervisor acting as a co-researcher to discuss and reconsider the emerging themes and categories. Inconsistencies were dealt with by re-evaluating the initial transcripts and observational data, and, following discussion, decisions were made by consensus (DeSantis & Ugarriza, 2000).

4.9. ETHICAL CONSIDERATION

Regardless of the tradition of inquiry, a researcher faces many ethical issues that surface during data collection in the field, and in analysis and dissemination of research reports (Creswell, 2014). Ethical clearance was obtained from the University of Lincoln Ethical Committee, prior to proceeding with the data collection. Following ethical approval, letters seeking permission to undertake the research were sent to the Principals of both of the case study colleges in Ghana (Appendix E). In line with Fontana & Frey (2002) and Hamnett, Porter, Singh & Kumar, (1984) assertion that, ethical concerns have traditionally been centred on topics of informed consent, right to privacy and protection from harm, this study adopted ethical conditions related to informed consent, the right to privacy and protection from harm.

a. INFORMED CONSENT:

Diener & Crandall (1978) identified four main components of informed consent as follows: voluntarism, full information, competence and comprehension. In this current study, Voluntarism meant that participants were free to choose whether or not take part in the research, and were undertaking any risks knowingly and voluntarily. Full information implied that participants were fully informed about the purposes and methods of the research. Competence referred to the ability of mature and responsible individuals to make correct decisions, if they are given relevant information and finally, Comprehension referred to as participants' understanding of all aspects of the research.

Informed consent of the participants in this study was accomplished through the following process: Before the study began, the participants were informed about the purpose and scope of the research study and invited to ask any questions needed for clarification (see Appendix G). An informational letter outlined that the research study, undertaken as part of the PhD study of the researcher. The aim of the study was to explore strategies for integrating ICT as a tool for teaching and learning in Initial Teacher Training Institutions in Ghana (see appendix E). The informational letter made clear what participation in the study would require, and outlined what data would be collected from the sites. The informational letter also explained that some of the participants would be asked to take part in an interview; while others would be subjected to classroom observation, as well as completing the survey questionnaires (only pre-service teachers) (see Appendix E).

It was clarified that participants' privacy would be protected, because all participants' data would be anonymised, and no information would be given to any other researcher or agency without their consent. Participants were informed that participation in this research project was voluntary, and that they could withdraw at any time without penalty. Possible dissemination of the research, through means such as conference presentations and proceedings and journal articles, were made clear to the participants. Assurances were made to each of the participants that all data collected from them would be treated in a confidential manner, and that their anonymity would be assured throughout the process of the research, and within its documentation (Bogdan & Biklen, 2012). All participants were also informed of the opportunity to have access to the final report if desired. Consent forms were sent to all participants (see appendix D).

b. RIGHT TO PRIVACY:

The essence of the right to privacy was taken into cognisance from three perspectives: the sensitivity of the information, the setting being observed and the dissemination of the material. Cohen, Manion and Morrison (2003) point out that the greater the sensitivity of the information collected and the more private the setting, the more safeguards are called for, to protect the privacy of the research participants. This was particularly important in terms of dissemination of the material. The researcher made sure that information provided by the participants could reveal their identities and that their confidentiality would be preserved.

The participants' privacy was protected in the current study by the following means. The two sites for the study were coded College A & B instead of their real names. Anonymity of the participants was assured by giving each participant a code name used to organise, store and report on the data and removing any identifying information such as headings and subject lines from the original text. The same code name was used to store and report on any information gained from interviews, observations and questionnaires.

c. PROTECTION FROM HARM:

Bailey (1978) offers several aspects for protection from harm such as: avoiding the use of deception if at all possible; ensuring that promises of confidentiality can be kept; and avoiding projects that place either participants and/or researchers in unethical situations. Although it was not possible to foresee all possible ethical situations, the researcher took all precautions to

protect the participants from mental or physical stress, harm or danger, as the research study was planned and implemented (Best & Kahn, 1998; Neuman, 2003).

In writing the final report, the researcher protected the confidentiality and anonymity of the participants by using coded references and pseudonyms carefully, and presented the data ethically and honestly (Crow & Wiles, 2008; Bailey, 1978). Neuman (2003) notes that other types of harm such as stress, anxiety or discomfort may be caused within the bounds of data collection, such as interviews or observations, and stresses that researcher must be sensitive to these issues, by considering possible precautions and weighing potential harm against potential benefits. An assessment of possible harm was made in conjunction with the planning of this research study, and the possibility of harm through the implementation of the study was considered to be low. The data, collected from, and about, the participants, were generated within the course of normal involvement and participation in the study. The results were only used for their stated purposes and were not utilised in a manner to which the respondents would object (Sekaran, 2000).

4.10. TRUSTWORTHINESS OF QUALITATIVE DATA

This section considered strategies adopted in ensuring and documenting the quality in the qualitative process in this study. Because of its unusual axioms and the apparent “softness” of its postures, naturalistic enquiry is often attacked as untrustworthy, in contrast to the rationalist enquiry which has well-developed standards of trustworthiness (Creswell, 2014). Recently, serious efforts have been undertaken to develop standards, which are parallels of those commonly used by positivists (See: Creswell, 2014; Flick, 2009; Savin-Baden & Major 2013).

Creswell (1998:201-202) identified eight strategies such as prolong engagement, triangulation, peer debriefing, negative case analysis, clarifying researcher’s bias, member checks, rich, thick description and external audit. However, Creswell (2014) recommends that a qualitative researcher should engage in at least two of them in a given study. Given that member checks, triangulation and external audit are the most cost-effective procedures to achieve trustworthiness of qualitative data (Creswell, 2014), the trustworthiness of the qualitative data was achieved using the the aforementioned three criteria (See Table 3.3 below).

TABLE. 4.4. HOW TRUSTWORTHINESS WAS ACHIEVED

COMPONENT OF TRUSTWORTHINESS	HOW THIS WAS ACHIEVED
MEMBER CHECKS	According to Creswell (2014) Member checks occur when the researcher solicits participants' views of the credibility of the findings and interpretations of a qualitative study. Lincoln & Guba (1985) asserted that, it is the most critical technique for establishing credibility in qualitative study. In the qualitative phase of this study data obtained through the semi-structured interviews and classroom observations were validated through the process of member checking. Interviews participants were sent verbatim transcripts and teachers observed were sent observation reports. A letter accompanied reports asking teachers for validation by adding further information or amending sections. A reply paid envelope was included to enable them to send back the interview transcripts and observation reports easily (see sections 3.8.3/3.8.4).
TRIANGULATION	Application of multiple data sources to gain understanding of a phenomenon was achieved through triangulation. Triangulation was accomplished through the use of multiple data sources (survey questionnaires, semi-structured interviews and observations), double checking the findings, and checking for the relationships that converged. (See sections 322; 381;382).
EXTERNAL AUDIT	The thesis was given to two PhD students who had no knowledge about the topic, to examine both the process and the product of the account, assessing their accuracy. assessing the product, the two students examined whether or not the findings, interpretations, and conclusions were supported by the data.

4.11. METHODOLOGICAL ISSUES

Analysing data in mixed methods research was found to be one of the most difficult steps in this study, if not the most difficult step, of the mixed methods research process. The difficulty stemmed from the fact that the single researcher was involved in the study. The researcher had to be competent in conducting quantitative and qualitative data analysis. Besides, the researcher

had to be adept at integrating the findings from both strands. Such effective integration was a necessity for coherent and meaningful inferences from both quantitative and qualitative findings, being integrated into a coherent whole, such that increased understanding can be achieved (Tashakkori & Teddlie, 1998). Again, it was more expensive and time consuming, as it took more time than conducting qualitative or quantitative data collection and analysis alone.

4.12. SUMMARY OF THE CHAPTER

In this chapter, the appropriateness of the underlying paradigm to the research and the research methodology have been discussed. The methodology adopted had a pragmatic underpinning (Creswell, 2003) and utilized a mixed methods approach. In line with this methodology, data was collected from a number of sources, in order to understand the research question from the perspectives of different stakeholders. The research design has been described, with particular attention paid to the mixed method design that structures the study. A discussion of the nature and benefits of both quantitative and qualitative approaches was offered, followed by an appraisal as to how these informed the research design for each phase of the research.

In order to promote validity and trustworthiness, multiple sources of evidence were adopted (quantitative and multiple qualitative data sources) to establish a chain of evidence (Yin, 2003) and ascertain whether the results were consistent between data collected from the multiple sources (Merriam, 2009). The main purpose was to ascertain whether the qualitative data corroborated the quantitative findings, whether the qualitative data illuminated aspects that the quantitative data did not, and/or whether the qualitative data suggested new insights (Flick, 2007). A multiple case study strategy was also adopted to enhance the external validity and generalisability of the findings of the study. The literature suggests that it is appropriate to use a survey in conjunction with case studies, as case studies allow the researcher to get close to the phenomenon, gather insights, ascertain why things happen and provide deeper explanations of observations. Although, Patton (1990:115) criticised purposive sampling “as deliberately and unashamedly selective and biased”, it was found to be a suitable sampling strategy used to access knowledgeable people who have in-depth knowledge regarding ICT usage and integration by virtue of their experience.

Chronologically the questionnaires were the first to be distributed in each case study college. Subsequently, semi-structured interviews were also utilised, because they “result in a true and

accurate picture of the respondents' selves and lives" (Fontana & Frey, 2005:698) and provide in-depth, detailed data collection, and allow researchers "enter into the other person's perspective" (Patton, 2002:341). To ensure accuracy of the conclusions drawn, classroom observations were also conducted to allow the gathering of rich data in a natural setting. Ethical considerations and the actions taken to protect the participants as well as measures for establishing the trustworthiness of study were discussed.

In the next chapter, the collected data would be analysed and interpreted, quantitatively and qualitatively, in relation to the research question.

CHAPTER FIVE: DATA ANALYSIS AND RESULTS

5.1. INTRODUCTION

The methodology employed to collect data for the thesis was discussed in the previous chapter. The focus of this chapter was to analyse the results gathered from the data collection procedures described in the previous chapter. Based on the mixed methods approach, the chapter has been organised into two main phases. Phase one focuses on quantitative data analysis, whilst phase two focuses on qualitative analysis.

5.2. QUANTITATIVE DATA ANALYSIS

This phase of the study sets out to validate and test the Technology Acceptance Model (Davis, 1989) in the context of Ghanaian pre-service teachers' integration of their technology in teaching and learning. The statistical analysis of the thesis comprised three stages. The first stage considered process of coding and screening of the data, followed by the assessment of the reliability and validity of the data. The third stage focused on the descriptive analysis of the data. The final stage considered inferential statistics comprising the appropriateness of factor analysis for the study, and utilisation of multiple stepwise regression analysis to test the hypotheses of the proposed model. IBM SPSS Statistics version 21 was adopted to analyse the data.

5.3. DATA CODING AND SCREENING

As recommended by Pallant (2013) four key steps in data screening prior to the analysis process was conducted. First, the data files were screened for accuracy by proof reading the original data against the computerised data file in the data window. Secondly, random cases were checked for accuracy using the descriptive statistics mode of the SPSS frequencies as missing data has been found to be one of the most significant problems in data analysis (Tabachnick & Fidell, 2013). Thirdly, the data was checked for outliers (cases with value very atypical of the other numbers in a distribution) Lastly, normality and linearity were assessed, and corrected for, in order to fulfil the requirements of conducting quantitative data analysis. Once the researcher was sure there were no errors in the data file, the descriptive phase of the data analysis began.

5.4. DESCRIPTIVE STATISTICS

In this section descriptive statistics of the respondents are presented to indicate the general responses to the constructs measured. The section has been grouped into three parts: first, demographic profile of the respondents, followed by respondents prior ICT experience and current ICT usage in the Colleges.

5.4.1. SURVEY RESPONSE RATE

A response rate is the percentage of questionnaires that respondents return to the researcher (Creswell, 2012). According to Creswell (2012) many survey research studies in leading educational research journals report a response rate of 50 percent or better. The researcher sought to achieve high response rate from the respondents in order to have confidence in generalising the results to the population under this study (Creswell, 2012). In this thesis, the total number of valid surveys was 380 out of 400, giving a response rate of 95% as shown in Table 5.4.1 below:

Table 5. 4. 1 Survey Response Rate

Institution	Surveys Handed Out (n)	Responses (n)	Response Rate (%)
College A	200	180	90
College B	200	200	100
Total	400	380	95

Source: Pre-service Teachers' Survey 2014

This impressive response rate was achieved due to the pre-notification, adequate follow-up procedures, incentive used (winning an iPad) (Babbie, 2009), respondents interest in the study and the limited time required to complete the questionnaire (20-25 minutes). This is an impressive response rate when compared to similar TAM studies such as Al-Azawei, Parslow & Lundqvist (2017) in Iraq (42.25%), Attiquayefio & Addo (2014) in Ghana (86%) and Mtebe & Raisamo (2014) in Tanzania (20.3%) which reported significant findings.

5.4.2. AGE AND SEX DISTRIBUTION OF THE RESPONDENTS

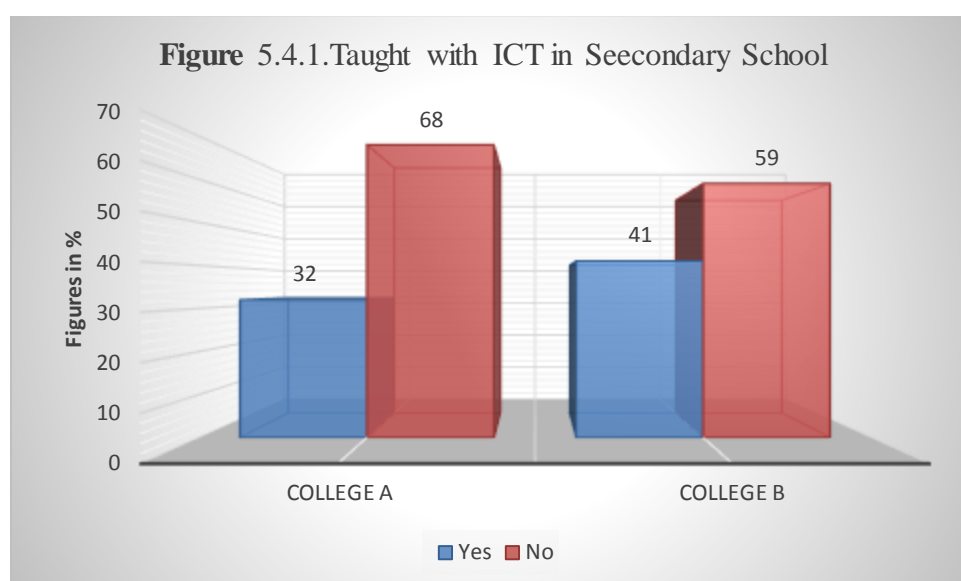
Table 5.4.2 Age and Sex Distribution of the Respondents

Age (in years)	COLLEGE A			COLLEGE B		
	Male	Female	Total	Male	Female	Total
18 & below	10	8	18	9	10	19
19 -24	37	39	76	38	37	75
25 -30	3	3	6	2	4	6
31-35	-	-	-	-	-	-
Total	91	89	180	97	103	200
	N=					
	%					
	51	49	100	49	51	100

Source: Pre-service Teachers' Survey 2014

Data from Table 5.4.2 indicated that an overwhelming majority of the pre-service teachers were aged between 19 -24, as 76% in College A and 75% in College B fell within this age bracket. Again, whilst only 6% fell within the ages of 25-30, none was above 30 years. The participants' population thus mostly fell within the age range about which claims are being made in educational debates concerning the 'digital natives' and 'net generations' (Presky, 2001). This suggests that the majority of the current cohorts of the pre-service teachers were born within the digital era. Therefore, if necessary training and ICT facilities are made available they are more likely to use ICT for teaching and learning purposes. In general 188 (49%) of the respondents were males whilst 192 (51%) were females, as indicated in the above table.

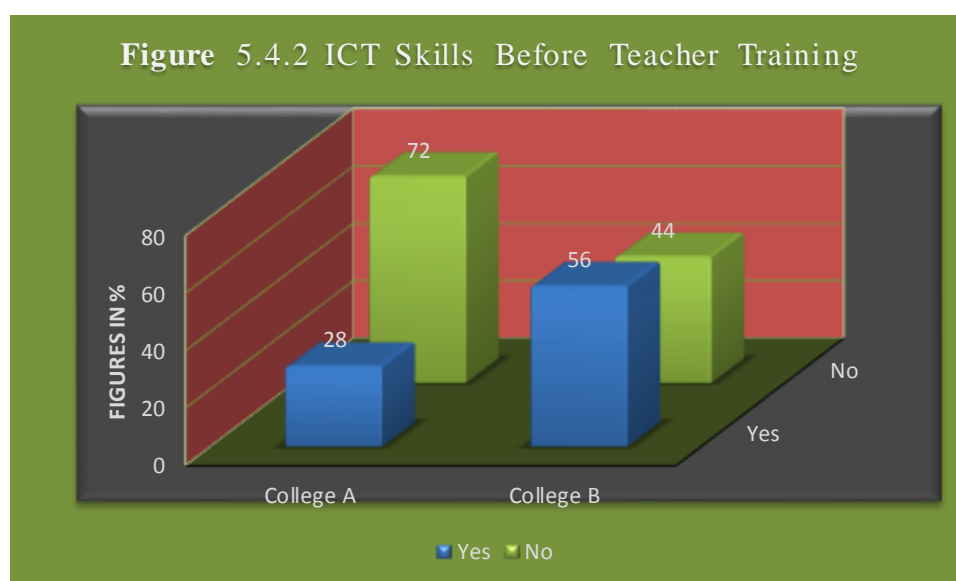
5.4.3. TAUGHT WITH ICT IN SECONDARY SCHOOL



Source: Pre-service Teachers' Survey 2014

Data from figure 5.4.1 revealed that a substantial 68 % of the students from College A as against 59% from College B reported that they did not have any opportunity to be taught with ICT in their secondary education. Conversely, 41% of the respondents from College B, as against 32% from College A reported having the opportunity. A cursory glance at the data from Figure 4.4.1 indicated that College B has a higher percentage of students taught with ICT in their secondary education. Given the geographical location and higher socio-economic status of the people in the city where College B is located, the difference is not surprising. Being the second largest city in Ghana, the city boasts of a good number of infrastructural facilities such as telephones, electricity, good secondary schools and universities. And since the city is the main “watershed” for College B (even though some come from other parts of the country) there is a likelihood that more students from that college would be taught with ICT in their secondary education than in College A, which is located in a mere district capital with predominantly farming population.

5.4.4. ICT SKILLS BEFORE TEACHER TRAINING



Source: Pre-service Teachers' Survey 2014

Research studies suggested that the extent to which pre-service teachers are exposed to ICT prior to their teacher training programme is an important factor for their acceptance and subsequent integration of the technology (Teo, 2009). Data from figure 4.4.2 shows that an overwhelming 72% of the respondent from College A, as against 44% from College B, indicated that they did not receive any ICT skills prior to their teacher training programmes. This seemed to paint a gloomy picture of successful integration of ICT in both colleges. Conversely, a substantial 56% compared with only 28% of the students said they had ICT skills prior to their teacher training programme from College B and College A respectively. These differences could be attributed to the geographical location and probably the higher socio-economic backgrounds of the students. College B is in the second largest city in Ghana where majority of the people have a higher socio-economic status when compared with those in College A, which is in a district capital where the people are predominantly farmers.

5.4.5. ACCESS TO ICT RESOURCES IN COLLEGE

Table 5.4.3. Access to ICT Resources in College.

Construct	Frequency	Percent
Yes	380	100
No	-	-

Source: Pre-service Teachers' Survey 2014

A long standing focus on research on instructional technology has been the extent to which pre-service teachers' have access to ICT, because it has been recognised as an obvious precursor to the ICT use. Data from table 4.4.3 depicted that all the respondents (100%) from both Colleges reported having access to ICT resources in their Colleges. This finding supports Enochsson and Rizza's (2009) research review on the use of ICT in teacher education in 11 countries, in which they found that access to ICT was generally not a problem. Surprisingly, they concluded that the pre-service teachers did not integrate ICT into their teaching.

5.4.6. LOCATION OF ICT RESOURCE

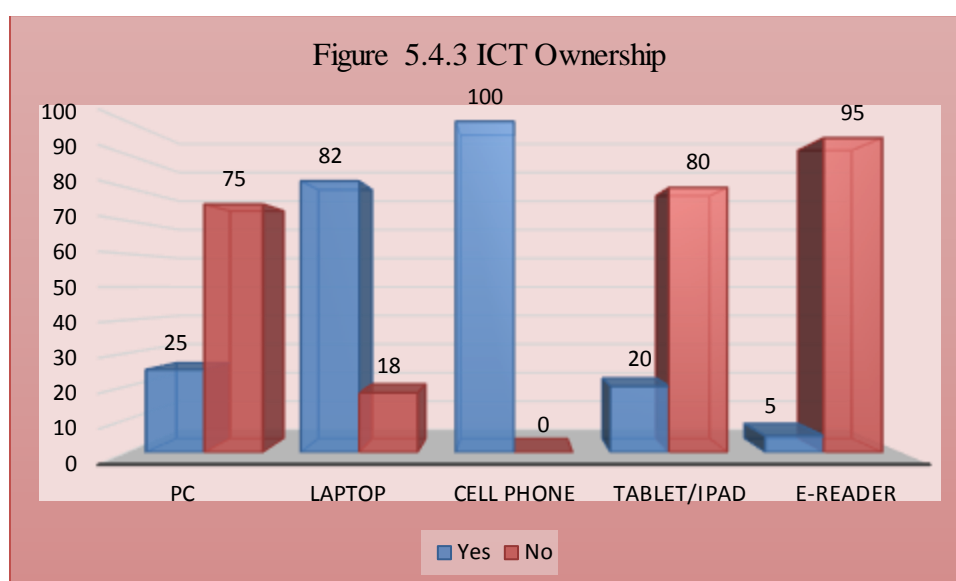
Table 5.4.4. Location of ICT Resource

Construct (100%)	Computer Lab.		Classroom		Library		Others	
	Col A	Col B	Col A	Col B	Col A	Col B	Col A	Col B
Yes	100	100	5	84	-	89	-	-
No	-	-	95	16	100	11	-	-
Total %	100	100	100	100	100	100	-	-

Source: Pre-service Teachers' Survey 2014

When the respondents were asked to indicate where their ICT resources were located in their Colleges, all the respondents (100) from both colleges reported having access to ICT in computer labs. However, while 84% from College B indicated that apart from the computer lab, they had access to ICT in the classroom, only 5% said so in College A. Again, while 89% of the respondents from College B reported that they have access to ICT in the library, none of the respondents in College A reported that. Although analysis from the above data indicated that College B stands out as a college where computers seemed to be available nearly throughout the college, in general, ICT is predominantly located in ICT labs in both Colleges.

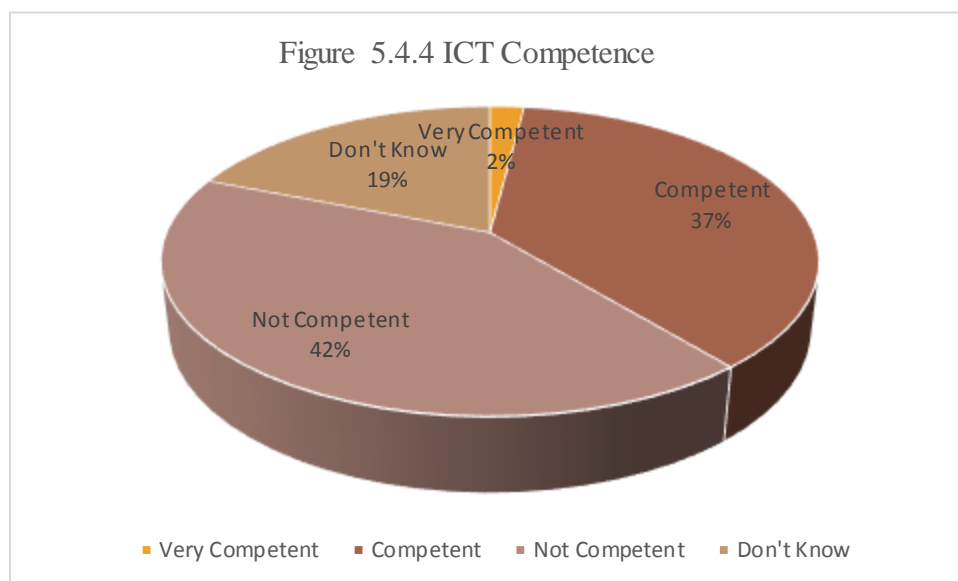
5.4.7. ICT OWNERSHIP



Source: Pre-service Teachers Survey 2014

The data from figure 5.4.3 depicted that a substantial majority of the respondents possess laptops and cell phones. The data revealed that an overwhelming 100% and 82% of the respondents possess cell phones and laptops respectively. However, only 25%, 20% and 5% of them reported possessing personal computers (PC), tablets/iPad and e-reader respectively. The higher proportion of the respondents possessing cell phones and laptops could be attributed to two main factors. First, both of the case study colleges under discussion are ‘privilege’ members of the 15 selected “Discovery Colleges.” Secondly, they could be beneficiaries of Better Ghana ICT Initiative (Government of Ghana, 2010) where government gives free laptops to students. The fact that most of the pre-service teachers have their own computers provides a good basis for developing their expertise in ICT for pedagogical purposes. Compare to the earlier study (see Adu Gyamfi, 2011) the current finding reveals a trend in increased ICT ownership among the pre-service teachers over the last 3 years, despite the low percentage of ownership of PC, e-reader and tablets/iPad.

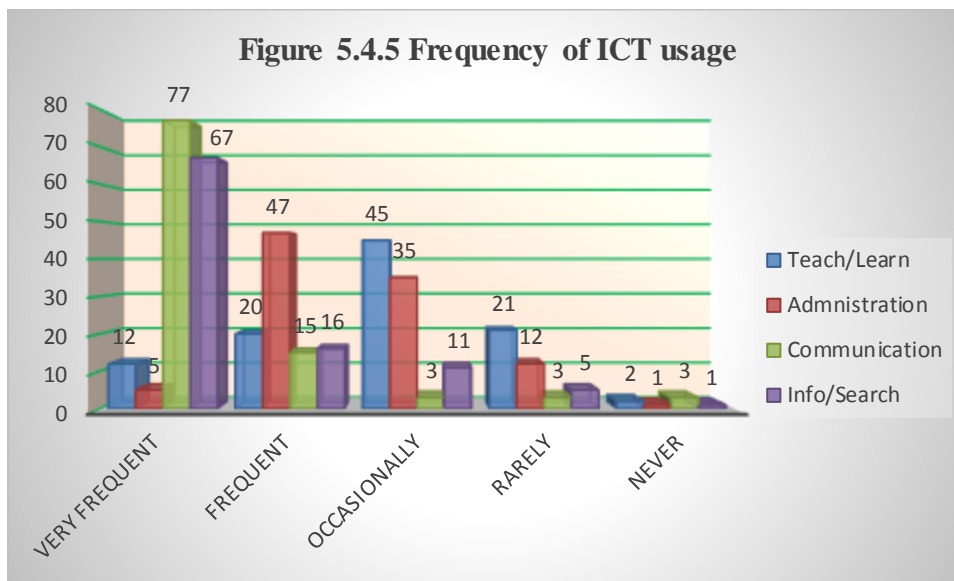
5. 4.8. LEVEL OF ICT COMPETENCE IN CLASSROOM PRACTICE



Source: Pre-service Teachers' Survey 2014

Figure 4.4.4 describes the respondents' level of ICT competence in classroom practice. Despite the evidence from Table 4.4.3, that access to ICT is not an issue in both colleges, when the students were asked to self-evaluate their level of competence of ICT use, a significant proportion (42%) of them identified themselves as not competent in using ICT for pedagogical purposes. However, 37% of them identified themselves as competent and 2% as very competent. This supports the view that having access to ICT is not a guarantee of competency. This foregrounds the need for support and training for the pre-service teachers.

5.4.9. FREQUENCY OF ICT USAGE



Source: Pre-service Teachers' Survey 2014

Although all the respondents in both colleges indicated that they use ICT, however, the data from figure 4.4.5 revealed that majority of them do not use it for teaching and learning purposes. The data indicated that a substantial 77% of them purposely use it for communication followed by source for information search (67%). On the contrary, only 20% and 12% of them indicated that they use it frequently and very frequently for teaching and learning respectively. Whilst 45% said they occasionally use it for teaching and learning.

5.4.10. QUALITY OF ICT RESOURCE

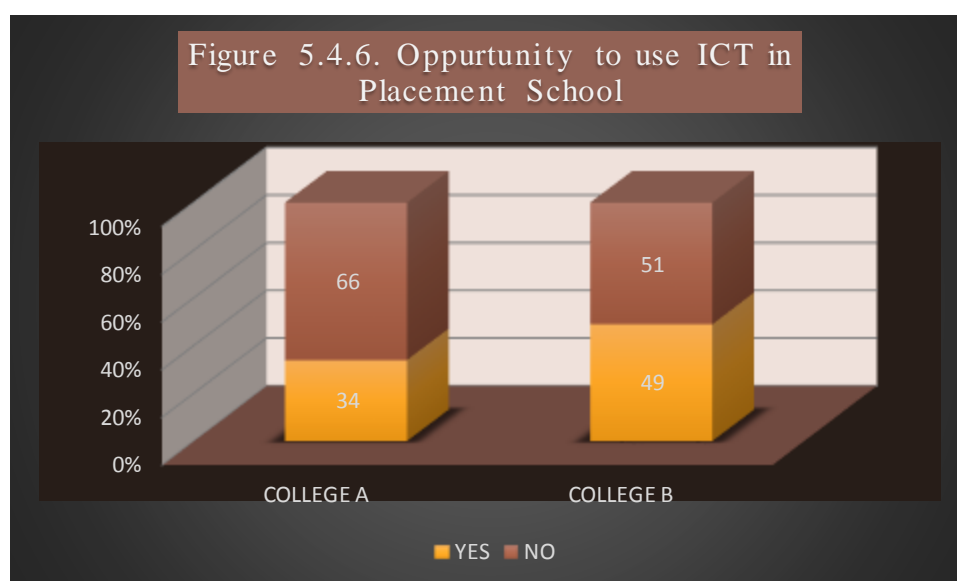
Table 5.4.5. Quality of ICT Resource

Construct	Computer Lab		Col Website		Internet Access		Data Projector	
	Freq	%	Freq.	%	Freq	%	Freq	%
Very Good	21	5.5	6	1.6	-	-	117	30.8
Good	276	71.3	171	45	56	14.6	83	21.8
Average	62	16.3	23	6.1	32	8.4	-	-
Poor	20	5.3	-	-	269	70.8	-	-
Very Poor	6	1.6	-	-	23	6.1	-	-
Does not exist	-	-	180	47.4	-	-	180	47.4
Total	380	100	380	100	380	100	380	100

Source: Pre-service Teacher Survey 2014

When the students were asked to rate the quality of ICT infrastructure in their respective colleges, an overwhelming 71% and 6% of the respondents from both case study colleges rated the quality of their computer labs as good and very good respectively. Conversely, a significant proportion of them (71%) rated computers with Internet access as poor, while only 15% rated them as good. Most importantly nearly half of the respondents (47%) in College B rated their College website as good or very good whilst all respondents from College A (100%) indicated had no website at the time of the research. Whilst all the respondents (100%) in College A indicated that there is no data projector in their college, 53% of them from College B rated the quality of their data projector as very good. This seemed to suggest that, relatively, College B has better ICT facilities, compared with College A.

5.4.11. OPPORTUNITY TO USE ICT IN PLACEMENT SCHOOL



Source: Pre-service Teacher Survey, 2014

As indicated in Figure 5.4.6, the opportunity to use ICT in the placement schools differed between the two colleges. Whilst nearly half of the respondents (49%) in College B reported having the opportunity for using ICT in their practicum schools only 34 % in College A reported having the same opportunity. On the contrary, an overwhelming 66% of the respondents reported not having the opportunity in College A, as against 51% in College B. Some of the reasons assigned by the respondents for not using the ICT were that they were not encouraged by their colleges to use the technology; most of the schools they were placed in did not have ICT facilities and if they had, they were locked in the offices. Others also indicated that their mentors were not technologically competent enough to teach with ICT.

5.4.12. SUBJECT AREA

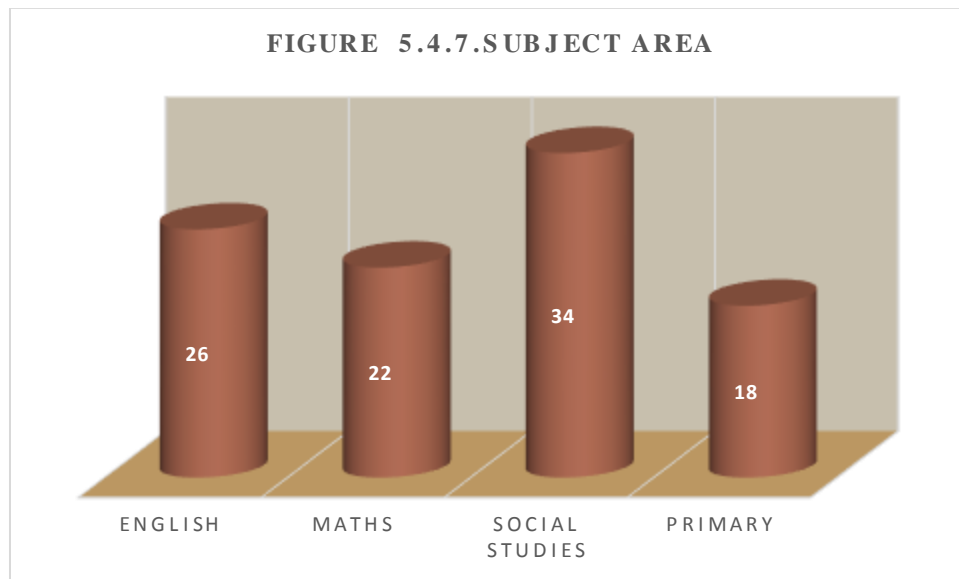


Figure 5.4.7 showed the subject areas of the participants were trained to teach. In all, Social Studies recorded the the highest number of participants (34%) in the study. While the participants offering primary education recorded only 18 percent, those offering Social Studies recorded the highest percentage (34%) . In addition, 26 percent of them were English while and 22 percent of them were Mathathematics students . In all majority of the participants were being trained to become Social Studies teachers, followed by English.This is not surprising since Social Studies is now a core subject in both Junior High and Senior High Schools. This might be the reason why the subject now attracts higher number of students to offer the course.

SECTION B

5.5. INFERENTIAL STATISTICS AND HYPOTHESES TESTING

The previous section examined descriptive analysis of the study. The aim of this section was to use the survey data to test the hypotheses formulated in Chapter 4. This section has been organised into 3 major parts. First, it considered the appropriateness of factor analysis for the study, followed by the assessment of the reliability and validity of the measurement items and concluded by testing of the hypothesis of the proposed model.

5.5.1 FACTOR ANALYSIS [*Simplifying complex data*]

Quantitative education research is characterised by multivariate studies (Punch, 2009). Having many variables often makes it difficult to understand the data. This difficulty has led to the development of a statistical technique, factor analysis, to reduce the number of variables, but without losing the information the original variables provide (Muijs, 2011). Factor analysis has been included in the IBM SPSS primarily as a “data reduction technique (Pallant, 2013). It allows the researcher to condense and reduce information to a manageable number of related variables, prior to using them in other analyses, such as multiple regression or multivariate analyses of variance. Moreover, it helps the researcher to determine how many latent constructs underlie a set of survey items. From this perspective, factor analysis has been employed by many researchers as a data-reduction technique to reduce a large number of overlapping measured variables to a much smaller set of factors in their studies (Al-Adwan & Smeldley, 2013; Afari-Kumah & Acheampong, 2010; Teo, 2009).

In order to scale down the large set of items the variables to a smaller but more manageable size, while retaining as much of the original information as possible (Field, 2013), Factor analysis was used in this study. Factor analysis has been categorised as exploratory or confirmatory, based on what the researcher wants to achieve with his or her analysis (Field, 2013; Pallant, 2013). With exploratory factor analysis (EFA), data are searched for the underlying structures to explore the interrelationships among a set of variables whereas, with confirmatory factor analysis (CFA) the researcher seeks to structure that has been identified by previous research, aiming to confirm a hypothesis or theory concerning the structure of variables. However, the aim of this study was not to identify previous research to confirm a hypothesis or theory concerning the selected variables. The aim was to adopt the factor analysis

for data reduction purposes. Hence, Principal components factor analysis was adopted to reduce the number of items in the variables

According to Field (2013) in assessing the suitability of data for factor analysis, there are a number of considerations to bear in mind before carrying out factor analysis. Adopting Field's (2013) procedure, the suitability of the factor analysis in this study was assessed through the following processes as depicted in Figure 5.5.1

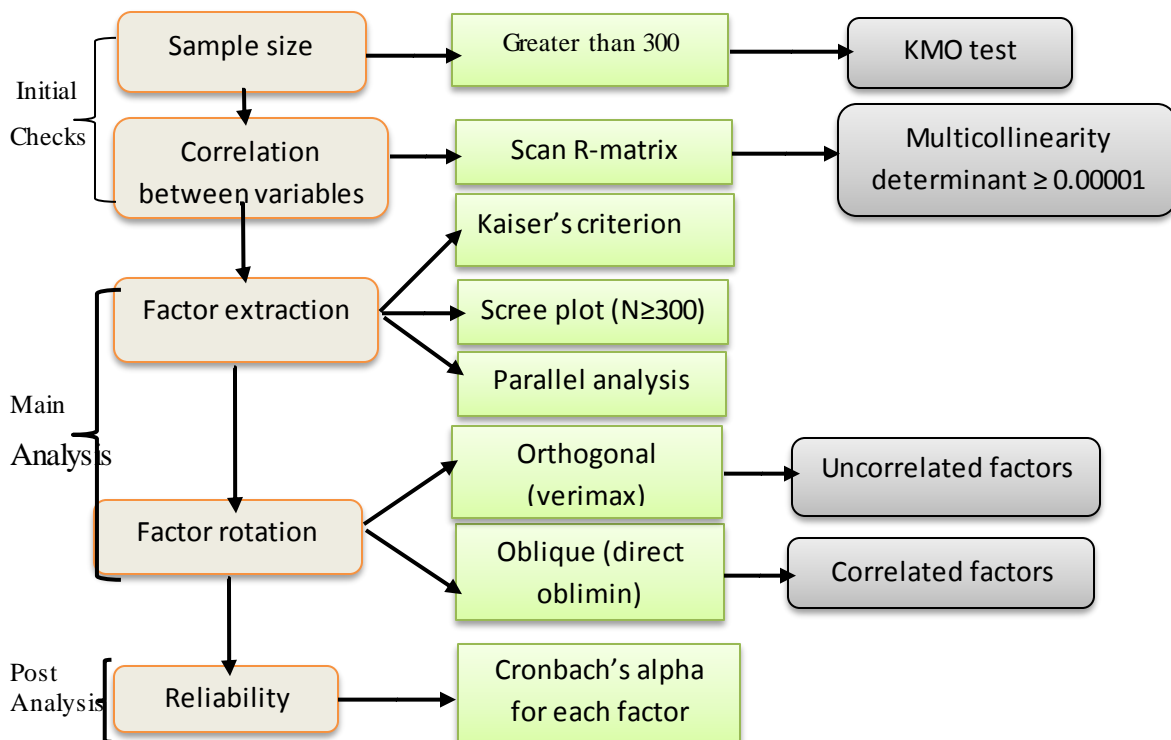


Figure 5.5.1. Procedure for Factor Analysis (Field, 2013:684)

Based on Field's procedure, the sample size and the relationship among the variables were first two main issues to be considered. While there is a little agreement among researchers concerning how large a sample size should be, the general consensus is that the larger the better (Pallant, 2013). However, Tabachnick & Fidell (2013:613) recommended that "it is comforting to have at least 300 cases for factor analysis". In the same vein, Commrey & Lee (1992) class 300 as a good sample size, 100 as poor and 1000 as excellent. However, they later conceded that any study with at least a sample size of 150 and above should be sufficient enough if the constructs have several high loading marker variables (above .08). Conversely, some authors (e.g. Nunnally, 1978) are of the view that it is not the overall sample size that is of concern, but rather the ratio of participants to items, thus, a number of cases for each item. For example,

whilst Nunnally (1978) recommends ten cases for each item to be factor analysed, most current researchers recommend that ideally, four or more cases in each item are adequate in most cases (Tabachnick & Fidell, 2013). On this basis the sample size of this study (N=380) fulfilled the above conditions and it was adequate enough to proceed with checking other procedures.

The suitability of factor analysis was further tested by two important factors Kaiser-Mayer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity. Field (2013) recommended that KMO value of .6 or above and Bartlett's Test of Sphericity value of .5 or smaller are appropriate for factor analysis (see Table 5.5.1)

Table 5.5.1 KMO and Bartlett's Test

Kaiser-Mayer-Olkin Measure of Sampling Adequacy		.635
Approx. Chi-Square		868.196
Bartlett's Test of Sphericity	df	435
	Sig.	.000

In this thesis, the KMO value was .635 and Bartlett's Test of Sphericity is significant exceeding the recommended threshold value of .6 (Kaiser, 1974) and Bartlett's Test of Sphericity (Bartlett, 1950) reached statistical significance ($P = .000$), supporting the factorability of the correlation matrix. Once KMO and Bartlett's Test of Sphericity had proved to be appropriate, it was possible to determine how many factors to extract.

To determine how many factors to extract, an initial analysis was run to obtain eigenvalues for each factor in the data. The Principal Component Analysis revealed the presence of 13 components with eigenvalues exceeding 1, and in combination explaining 59% of the variance. Although Kaiser (1974) recommended retaining all factors with eigenvalues greater than 1, many contemporary researchers (e.g. Tabachnick & Field 2013) have criticised the technique as resulting in the retention of too many factors and recommended utilisation of Cattell's (1996) scree test as alternative. Employing Cattell's (1996) scree test, the screeplot was inspected to look for the change (or elbow) in the shape of the plot. The scree plot was ambiguous and showed inflexions that would justify retaining either 2 or 4 factors. Subsequently, 4 factors were retained because of the large sample size and the convergence of the scree plot and Kaiser's criterion on this value.

Knowing that the interpretation of factor analysis is greatly helped by a technique known as rotation, the final stage centred on the rotation and interpretation. According to Pallant (2013) there are two main approaches to rotation resulting in either orthogonal (uncorrelated) or oblique (correlated) factor solutions. However, Tabachnick & Fidell (2013) postulates that orthogonal rotation produces results that are easier to interpret and report. In this study both techniques were conducted before concluding that the orthogonal approach produces better and clearer results. Within orthogonal approach with principal component analysis, a number of different techniques such as varimax, quartimax & equamax are provided in IBM SPSS 21. Among these techniques, Field (2013) recommended varimax method, as it attempts to minimise the number of variables that have high loadings on each factor. As a rule of thumb, only variables with loading of .3 and above are interpreted (Tabachnick & Fidell, 2013) and this is reflected in the loadings in Table 4.5.2. Accordingly, the greater the loading, the more the variable is a pure measure of the factor.

5.5.2. RESULTS FROM EXPLORATORY FACTOR ANALYSIS

The 25 items of the TAM were subjected to principal components analysis (PCA) using SPSS version 21. Principal components analysis revealed the presence of 19 components with eigenvalues exceeding 1, and in combination explaining 59% of the variance respectively. An inspection of the screeplot revealed ambiguous inflexions that justified 2 or 4 factors. Using Cattell's (1966) scree test, it was decided to retain four components for further investigation. The four-component solution explained a total of 48.2% of the variance, with component 1 contributing 31.25% and Component 2 contributing 17.0%. To aid in the interpretation of these four components, varimax rotation was performed (see Table 5.5.3.).

Knowing that the interpretation of factor analysis is greatly helped by a technique known as rotation the final stage centred on the rotation and interpretation. According to Pallant (2013) there are two main approaches to rotation resulting in either orthogonal (uncorrelated) or oblique (correlated) factor solutions. However, Tabachnick & Fidell (2013) postulates that orthogonal rotation produces results that are easier to interpret and report. In this study both techniques were conducted before concluding that the orthogonal approach produces better and clearer results. Within orthogonal approach with principal component a number of different techniques such as varimax, quartimax & equamax are provided in IBM SPSS 21. Among these techniques, Field (2013) recommends varimax method as its attempts to minimise the number of variables that have high loadings on each factor. As a rule of thumb, only variables with

loading of .3 and above are interpreted (Tabachnick & Fidell, 2013) and this is reflected in the loadings in Table 5.5.2 in this study. Accordingly, the greater the loading, the more the variable is a pure measure of the factor.

Table 5.5.2. Principal Component Analysis with Varimax

Component	1	2	3	4
Perceived Ease of Use				
POEU1	.653			
POEU2	.606			
POEU3	.835			
POEU4	.742			
Perceived Usefulness				
PU1	.746			
PU2	.674			
PU3	.443			
PU4	.412			
Attitude Towards ICT				
ATICT1		.720		
ATICT2		.665		
ATICT3		Discarded		
ATICT4		.739		
Job Relevance				
JR1		Discarded		
JR2		.699		
Self-Efficacy				
SE1			.756	
SE2			Discarded	
SE3			.596	
Leadership Support				
LS1			.712	
LS2			.506	
Technical Support				
TS1				.835
TS2				.697
TS3				.457
TS4				.715
Technology Complexity				
TC1				.654
TC2				.770
ICT Usage				
FreqTeachLe				.795
FreqAdmn				.614
FreqComm				Discarded
FreqSInfo				Discarded
Ict use				.609

Extraction Method: Principal Component Analysis. Rotation Method: Varimaxwith Kaiser Normalization converged in 4 iterations. The exploratory factor analysis was conducted primarily to identify any item with low factor loadings. As a result of the factor analysis the following questionnaire items relating to the following were discarded:

1. AT ICT3 (.351) 2. JR1(.369) 3. SE2(-.363) 4. FreqComm (.367) 5. FreqInfo.(.383)

Thess items were removed from further analysis. The data were then analysed using both correlation and stepwise regression analysis.

5.5.3. PEARSON CORRELATION ANALYSIS

The idea of correlation is one of the most important and basic in the elaboration of bivariate relationships. According to Pallant (2013) unlike chi-square, measures of correlation indicate both the strength and the direction of the relationship between a pair variables. Pearson correlation coefficient is used when two variables are correlated linearly (Field, 2013). In an efforts to determine the strength and directions of the relationships among the various TAM constructs in the study, a correlation technique was adopted to find the relationships among the TAM variables. The following variables, as depicted in table 5.5.3, were used in the correlation analysis. Table 5.5.3. Pearson's Correlation Coefficients among the TAM variables.

PATH	VALUE	SIGNIFICANCE
JR ↔ ATU	-.189*	.000
SE ↔ PU	.114*	.027
TC ↔ AUSE	.247**	.000
TS ↔ PEOU	.326**	.000
LS ↔ AUSE	.147*	.004
PB ↔ PEU	.111*	.031
PEU ↔ PU	.098	.056
PEU ↔ ATU	.106*	.039
PU ↔ ATU	.104*	.042
PU ↔ AUSE	.118*	.021
ATU ↔ AUSE	.206**	.000

*Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at the 0.01 level (2-tailed)

Table 5.5.2 showed Pearson correlation coefficients among dependent and independent variables within the TAM framework in this study. 10 out of the 11 correlations were significant at the 5% level, and mostly positive correlations existed among the study variables except JR – ATU ($r = -.189$, $P < .05$), which recorded a negative correlation. Statistically significant and strong positive correlations were found among TS and PEU ($r = .326$, $P < .00$); TC and ICT Usage ($r = .247$, $P < .000$) and ATU and AUSE ($r = .206$, $P < .000$). Other statistically significant but moderate correlations were found among six important pairings: SE and PU ($r = .114$, $P < .027$); LS and ICT Usage ($r = .147$, $P < .004$); PB and PEU ($r = .111$, $P < .031$); PU and ATU ($r = .104$, $P < .042$); PEU and ATU ($r = .106$, $P < .039$) and PU and AUSE ($r = .118$, $P < .021$). Perhaps, the most interesting results from the correlation analyses were the relationships that were not significant. Contrary to the expectations, a weak correlation was present between PEU and PU ($r = .098$, $P > .056$) but was statistically insignificant. This is inconsistent with major TAM studies (e.g. Davis, 1989; Teo, 2014) findings that found a strong link between PEU and PU.

After having delineated the relationships among the TAM variables, through Pearson correlation analysis, the results showed that, in general there were strong and positive relationships between the independent variables and dependent variables (Table 4.5.3). Next, the researcher turned to the regression analysis to test the hypotheses in the study.

5.5.4. REGRESSION ANALYSIS

Regression analysis is widely recognised as one of the rigorous statistical techniques for constructing measurement models designed to confirm or disprove hypothesised underlying latent variable structures (Law, Pelgrum & Promp, 2008). Regression analysis has also been adopted extensively in studies across different fields such as psychology, education, information systems, marketing and career counselling (Sharma, & Chandel, 2013; Bryman & Cramer, 2011). Regression analysis could be single or multiple. Delineating the difference between single and multiple regression analysis, Hinton (2014) noted that the difference between single regression and multiple regression is that, in single regression, a single dependent variable is related to a single independent variable (or predictor variable). However, in multiple regression, the criterion is regressed against several potential predictors. Given that we cannot understand very much of the social world if we confine our attention only to relationship between single independent and dependent variables, one at a time, a more

complex statistical analysis that allows us to assess the joint effect of two or more variables on a single dependent variable was employed.

Multiple regression has been defined variously by differently by several authors. Whilst Forster (1998) defined multiple regression as a procedure in which a researcher predicts the score of a dependent variable from the scores of a number of independent variables, Hinton & Cramer (2014) simply defined multiple regression as an extension of simple (or bivariate) regression. According to Howitt & Cramer (2014) multiple regression quite simply helps us choose empirically the most effective set of predictors for any criterion.

On deciding a suitable regression method to test the hypotheses, the most common procedures (Enter, Forward, Backward and Stepwise) were all tried first to check if they resulted in different conclusions. After conducted a series of analyses, a stepwise multiple regression procedure was found to be most suitable procedure for this study based on the following reasons, First, the procedure combines both forward and backward procedures for analysis (Norusis 2012). Second, it adds predictor variables to the regression that best correlate with the dependent variable, and subtracts predictor variables that least correlate. This helps the researcher to generate a regression equation using only the predictor variables that make a significant contribution to the dependent variable. The F-ratio test statistic was adopted as a means to predict the dependent variable. The independent variables that did not provide a statistically significant contributions to the model were removed (Hinton, McMurray & Brownlow, 2014). Lastly, it allowed for theory testing and examination of correlation among two or more variables that are related (Field, 2013).

5.5.5. THE TESTING OF THE HYPOTHESES.

Previous work by Adu Gyamfi (2011) employed Chi-Square test, however, the causal path properties of the TAM required that a multiple regression be employed. In addition, much larger sample size of the study (400 as opposed to 120) meant that stronger parametric test like regression, could be run on the data. For the previous smaller data set (Adu Gyamfi, 2011) a non-parametric test like Chi-Square was appropriate. The Chi-Square test allowed the researcher to establish how confident he or she can be that there is a relationship between two variables. However, Chi-Square value means nothing on its own and can meaningfully be interpreted only in relation to its associated level of statistical significance (Bryman, 2004).

A series of stepwise multiple regression analysis was conducted to test the hypotheses. Each multiple regression analysis was between a set of independent variables and a single dependent

variable. For each construct, a factor loading's average of its related items was used. Predictor variables items that best correlated with the independent variable item were used, whilst the items that least correlated were subtracted automatically from the regression equation by the stepwise regression method. Following a standard practice in the Social Sciences research (Creswell, 2012) a statistical significant level of 0.05 (5%) was adopted as a benchmark to accept or reject a null hypothesis. According to Creswell (2012) the hypothesis is said to be statistically significant when the *p-value* (probability value) is less than the predetermined significant levels set by the researcher ($p < 0.05$). On the other hand, *p-values* exceeding 0.05 (5%) value meant that there was no significant to the results obtained and the null hypothesis was rejected. A lower result than 0.05 was accepted as significant. This implied that there was only 5% probability that the result was obtained purely by chance. This meant that the same difference would occur 95% of the time should the test be repeated.

To begin with, it is important to note that all the independent variables with the same dependent variables were grouped together in the same tables to save time and space. For example, in table 1, JR and PEU have the same dependent variable (PU), and therefore, their hypotheses were tested in the same table, even though JR→PU is hypothesis 1 (H:1) whilst PU→ATU is hypothesis 9 (H:9). In order to compare the contribution of each independent variable to the prediction of the dependent variable, Beta weights (Standardized Coefficients) were utilised to assess the importance of the predictors and compare them in respect to their effect on the dependent variable (Pallant, 2013) (see Table 5.5.3).

As posited by Norusis (2012:249) “standardized coefficients are the coefficients you get if you standardize both the dependent variable and each of the independent variables to have a mean of 0 and a standard deviation of 1”. The regression tables also report a *B* value (an unstandardized coefficient), but these values, while useful in a prediction formula, they do not allow researchers to compare the relative strength of each independent variable as a predictor because the value may be scored in different units. However, in terms of the *p* values (levels of significance for each beta weight), it is evident that all of the independent variables (JR, PEU and PU) in Table 5.5.3 have a statistically significant impact on the dependent variable (ATU). More importantly, the explanatory power of the TAM for individual constructs was examined using the resulting R square values for the dependent variable. The R^2 values were used to assess the ability of the model to explain the variance in the dependent variable (Kline, 1998). It is evident from the Table below that JR, PEU and PU contributed significantly 34%, 12% and 23% towards the pre-service teachers' attitudes towards use respectively (see Notes).

Table 5.5.3. Influence of JR, PEU and PU on ATU

Model	Unstandardized Coefficients		Standardised Coefficients	t	Sig
	B	Std. Error	Beta		
JR	.202	.054	.189	3.738	.000
PEU	.047	.024	.101	1.993	.047
PU	.083	.041	.104	2.036	.042

a. Dependent Variables: Attitude towards Use (ATU)

b. Independent Variables (Constant): Job Relevance (JR); Perceived Ease of Use (PEU); Perceived Usefulness (PU)

Note: R^2 (JR = 34%, PEU = 12%, and PU = 23%).

β denotes regression coefficient showing the average in dependent variables the correspondent independent is increased by 1.

Results from Table 5.5.3 further revealed that Job Relevance (JR) has a significant influence on attitude towards ICT use (ATU) ($\beta = .189$, $P < 0.00$). Therefore, JR impacts on pre-service teachers' attitude towards use (Al-Gahtani, 2014). Consequently, hypothesis H1 is supported. Consistent with the prior TAM studies (Hu et al., 1999; Davis, 1989), Perceive Ease of Use (PEU) ($\beta = .101$, $P < .047$) and Perceived Usefulness (PU) ($\beta = .104$, $P < .042$) have significant impacts on Attitude towards ICT use (ATU). As a result, hypotheses 8 and 9 were supported. An explanation was that when pre-service teachers perceived ICT as easy to use, and useful, they will develop favourable attitudes towards the use of the technology.

Table 5.5.4. Influence of SE and PEU on PU

Model	Unstandardized Coefficients		Standardised Coefficients	t	Sig
	B	Std. Error	Beta		
SE	.095	.043	.114	2.226	.027
PEU	.075	.034	.101	1.922	.056

a. Dependent Variable: Perceived Usefulness (PU)

b. Independent Variables (constant) Self-efficacy (SE), Perceived Ease of Use (PEU)

The above table (5.5.4) gives a surprising result. Whilst Self-efficacy (SE) was found to influence Perceive Usefulness (PU) ($\beta = .114$, $P < .027$). Contrary to the expectations, the stepwise regression analysis showed that the relationship between Perceived Ease of Use (PEU) and Perceived Usefulness (PU) ($\beta = .101$, $P < .056$) was insignificant. Consequently,

whilst hypothesis two (H:2) is statistically supported, hypothesis seven (H: 7) was not supported. This result contradicts the original TAM that PEU has positive influence on PU (Davis, 1989).

Table 5.5.5. Influence of PB and TS on PEU

Model	Unstandardized Coefficients		Standardised Coefficients	t	Sig
	B	Std. Error	Beta		
PB	.133	.052	.111	2.165	.031
TS	-.214	.104	-.106	-2.069	.039

a. Dependent Variable: Perceived Ease of Use

b. Independent Variable: (Constant), Pedagogical Beliefs (PB), Technical Support (TS).

Table 4.5.5 shows the multiple regression analysis for the influence of Pedagogical Beliefs (PB) and Technical Support (TS) on Perceived Ease of Use (PEU). Results from the Table show that pre-service teachers' Pedagogical Beliefs (PB) has a positive influence on their Perceived Ease of Use (PEOU) ($\beta = .111$; $P < .031$). Hence, hypothesis 3 (H3) is supported. The table also shows that Technical Support (TS) has negative influence on Perceived Ease of Use (PEU) ($\beta = -.106$, $P < .039$) hence, hypothesis 4 (H4) supported.

The final aspect of the stepwise multiple regression analysis was to verify the influence of LS, TC, PU and ATU on pre-service actual use of ICT.

Table 5.5.6. Influence of LS, TC, PU and ATU on pre-service teachers' ICT Usage

MODEL	Unstandardized Coefficient		Standardised	t	sig
	B	Standard error	Beta		
LS	.057	.020	.132	2.822	.005
TC	.088	.018	.247	4.951	.000
PU	.072	.031	.118	2.318	.025
ATU	.101	.027	.173	3.674	.000

a. Dependent Variable: Actual ICT Usage (AUSE)

b. Independent Variables (Constant): Attitude towards Use (ATU), Leadership Support (LS), Technological Complexity (TC), Perceived Usefulness (PU), Perceived Ease of Use (PU).

$R^2 = 58\%$ (LS, TC, PU and ATU).

Table 4.5.6 depicted multiple regression results for the influence of LS, TC, PEU, PU and ATU on pre-service teachers' Actual ICT Usage (AUSE). The results from the Table showed that Leadership Support (LS) ($\beta = 132$, $P < .005$) and Technological Complexity (TC) ($\beta = .247$, $P < .000$) had direct impact on pre-service teachers' actual ICT Use (AUSE) of ICT, supporting hypotheses 5 and 6. More importantly, consistent with the findings of major TAM studies (Teo, 2009; Hu, et al., 1999), the proposed model of this study demonstrated that the actual usage of technology (AUSE) was significantly influenced by Perceived Usefulness (PU) ($\beta = 118$, $P < .025$) and Attitude Towards Use (ATU) ($\beta = .173$, $P < .000$).

Consequently, Hypotheses 10 and 11 were supported. However, the findings from Table 4.5.7 revealed that Technological Complexity (TC) has the strongest influence on pre-service teachers' actual ICT usage than the three main TAM constructs such as PU and ATU. Overall, the original TAM constructs such as PU and ATU were found to have a significant positive impact on the actual ICT usage. However, ATU is the dominant factor in explaining actual ICT use.

More significantly, the explanatory power of the model for individual constructs was examined using R square value for the actual ICT usage. Together, leadership support, technological complexity, perceived usefulness and attitude towards use were able to explain 58 percent of the variances observed in pre-service teachers' intention to adopt ICT for pedagogical purposes leaving 42 percent unexplained. Although, this finding exceeded Venkatesh and Davis (2000) who found that the TAM typically accounts 40 percent of the variance, there is possibility that other dimensions may increase the explanatory ability of the research model of this study.

5.5.6. SUMMARY OF HYPOTHESES TESTING RESULTS

In summary, Table 5.5.7 below showed the 11 hypotheses tested in the thesis based on the multiple step-wise regression analyses.

Table 5. 5.7. A summary of the hypotheses testing results.

HYPOTHESES	PATH	HYPOTHESIS	RESULTS
H1	JR \longrightarrow ATU	$P < 0.00$	Supported
H2	SE \longrightarrow PU	$P < 0.027$	Supported
H3	PB \longrightarrow PEU	$P < .031$	Supported
H4	TS \longrightarrow PEU	$P < .039$	Supported
H5	LS \longrightarrow AUSE	$P < .005$	Supported
H6	TC \longrightarrow AUSE	$P < .000$	Supported
H7	PEU \longrightarrow PU	$P < .056$	Not Supported
H8	PEU \longrightarrow ATU	$P < .047$	Supported
H9	PU \longrightarrow ATU	$P < .042$	Supported
H10	PU \longrightarrow AUSE	$P < .025$	Supported
H11	ATU \longrightarrow AUSE	$P < .000$	Supported

N=380, Significance level at 0.05 (5%) confidence level

In sum, Table 5.5.7 showed that all the 11 hypotheses with the exception of hypothesis 7 were supported. Significantly, three major conclusions could be drawn from the above analysis:

First, all the three major TAM constructs PEU, PU and ATU were found to have a significant positive direct and indirect influence on the pre-service teachers' actual use of ICT for teaching and learning. Second, there was a weak relationship between PEU and PU which sounds unusual compared to the original TAM (Davis, 1989). Third, technological complexity, which is an exogenous construct, had the strongest impact on actual ICT usage. Together, leadership support, technological complexity, perceived usefulness and attitude towards use were able to explain 58 percent of the variances observed in pre-service teachers' intention to adopt ICT for pedagogical purposes leaving 42 percent unexplained.

Figure 5.5.2 below also shows the summary of the hypotheses (see next page)

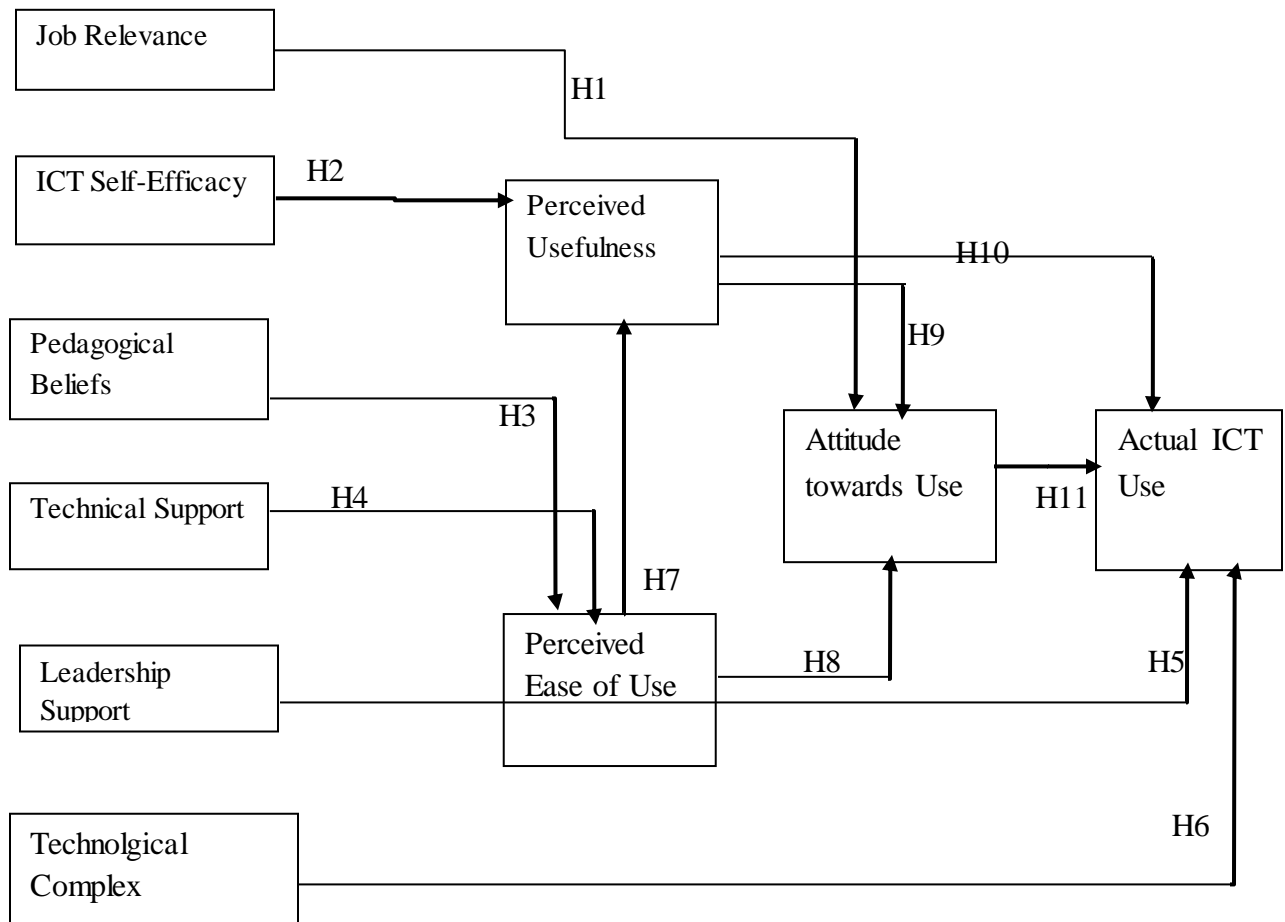


Figure 5.5.2: Summary of the Hypotheses .

The next phase of the Chapter covers the qualitative phase of the study. The aim is to confirm, disconfirm and expand the quantitative results to achieve the aims and objectives of the study.

5.6. QUALITATIVE DATA ANALYSIS

The previous phase of this chapter considered the quantitative data analysis. This phase focused on the qualitative data analysis of the study. The objective of this phase was to confirm, disconfirm and expand the quantitative results in order to achieve the objectives of the study. According to Cohen, Manion & Morrison (2011) there is no one correct way to analyse and present qualitative data; how one does it should abide by issue of *fitness for purpose*.

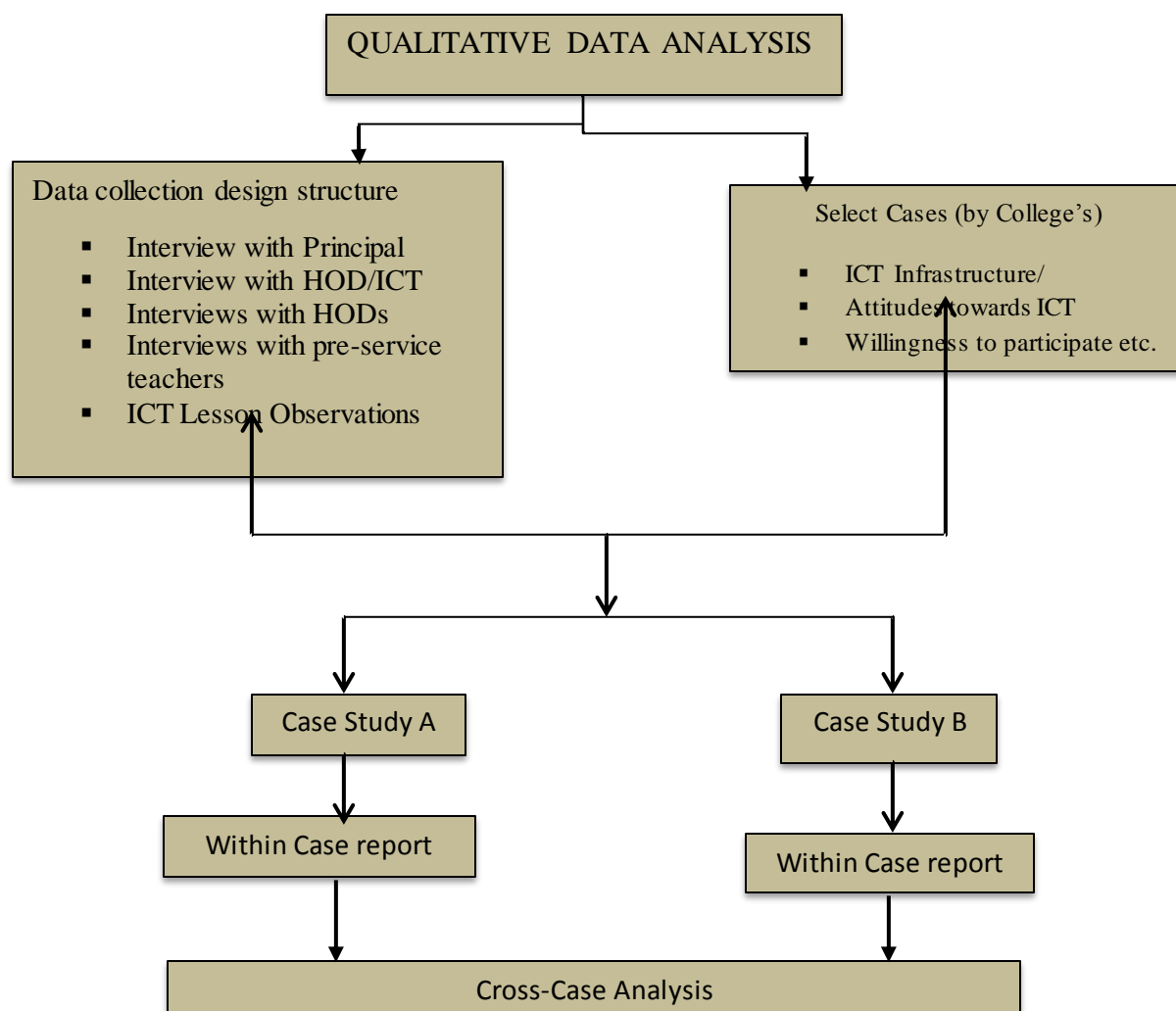


Figure 5.6. Representation of qualitative data collection and analysis process for the study.

Tashakorri & Teddlie (2010) posited that specifically, once qualitative data is available, depending on the research question(s), the researcher should decide whether a within-case analysis or a cross-case analysis is appropriate, or both. In this study both within-case and cross-case analyses were adopted, having in mind that although a single case (within-case) may provide a detailed understanding of the phenomenon under discussion, cross-case analysis

allowed for a greater opportunity to generalise across the several representation of the phenomenon. Against this background the qualitative phase of the study was organised into two main sections. The first section focused on within-case analysis while the second considered cross-case analysis.

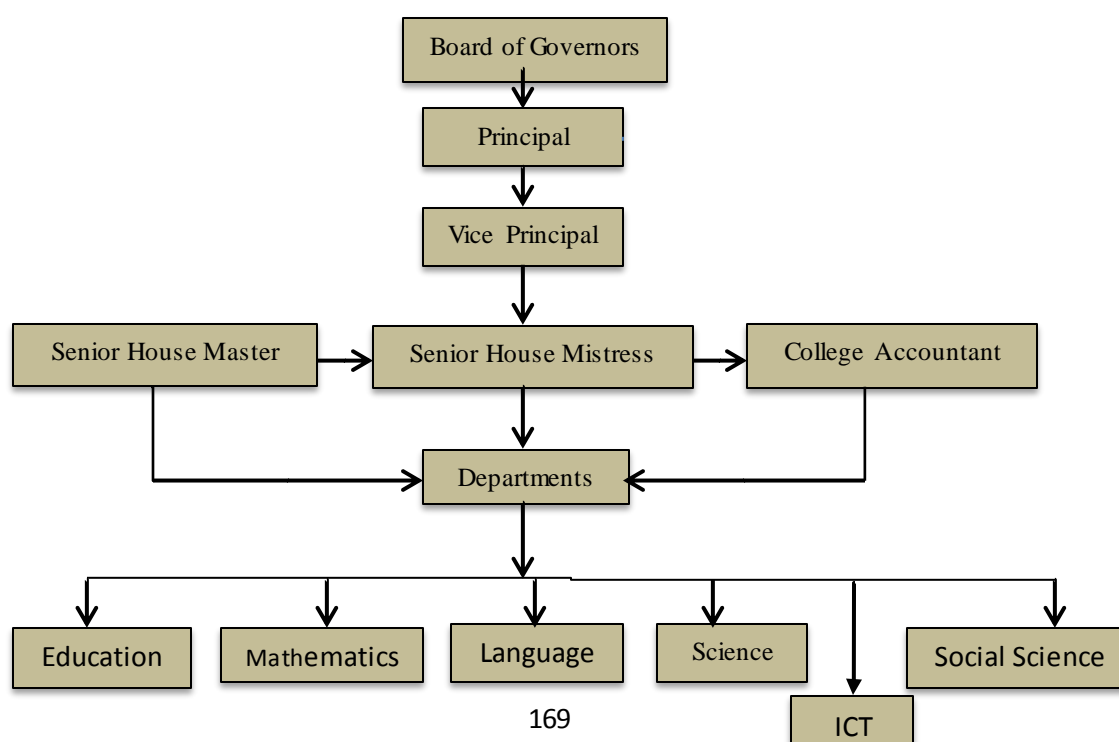
5.7. WITHIN CASE ANALYSIS

According to Miles & Huberman (1994) within-case analyses are qualitative analyses that are bounded within a single case. Creswell (2014) posited that when multiple cases are chosen by a researcher, a typical format is to first provide a detailed description of each case and themes within the case. This is what Creswell referred to as withi-case analysis. Data is gathered so that the researcher can learn as much about the contextual variables as possible, that might have a bearing on the case. Once the analysis of each case is completed, cross-case analysis begins.

COLLEGE A

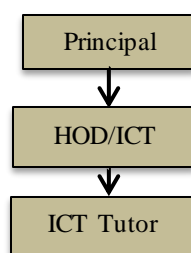
College A is a government co-educational pre-service teacher institution. Situated in a predominantly agricultural town surrounded by many smaller rural towns, most graduates from this institution generally find employment in the surrounding schools and remain in the municipality. At the time of the study, there were 485 students with ages ranging between 18 and 30. With average class size of 42, the College had staff strength of 48 teaching staff and 51 supporting staff. The College's Board of Governors determined the organisational structure of the college as depicted by Figure 4.8.6 below:

Figure 4.7.1. Organisation Structure of College A



At the operational level, the Principal headed the college, assisted by the Vice Principal, Senior House Master, Senior House Mistress and the College Accountant. The administration of the college rests on these five senior staff members.

Figure 5.7.2. ICT Department Organisation Structure



From figure 5.7.2 it can be seen that the ICT Department was made up of only three people in the college. They included the Principal, the Head of ICT Department (HOD/ICT) and the ICT tutor of the College. The HOD/ICT planned the ICT implementation approach for the college and discussed the plans with the principal. While the HOD/ICT looked into the hardware provisions for the college and the infrastructure set-up, there was no Technical Assistant to ensure that the computers were maintained in the college. The Subject Leaders (SLs) and the Head of Departments (HODs) were not formally involved in the ICT implementation process. The college did not have any distinct written ICT goals to drive the ICT implementation process. As a consequence, there was no central thrust for them to get together to contribute. The effort to implement ICT in their subject areas came from individual teacher educators within the department based on what they felt best suited the needs for the department. The norm for acquiring ICT resources was through an ad hoc process and based on the needs of the subject leaders in the various departments.

There were two computer laboratories with 40 computers in each laboratory. Altogether there were 45 computers with Internet facilities, of which two were linked with a printer. Considering the whole school's ratio to the Internet connected machines, averagely, there were over ten students for each machine (10:1). However, considering the average class size of forty-two students, a computer mediated lesson observed, there were two students to a machine (2:1) as only 45 computers at the time (20 in lab A and 25 in lab B) connected to the Internet were functioning. Interestingly, at the time of the interview, the Principal and the ICT coordinator made it known that they had just received 30 brand new Triton PCs and 12 laptops from the Government. The Principal clearly pointed out that the new laptops would be

distributed among the departments to install them in the classrooms for teaching and learning purposes. This suggests that even though the Principal was not competent in using the technology, he had in mind using the technology for pedagogical purposes.

Leadership

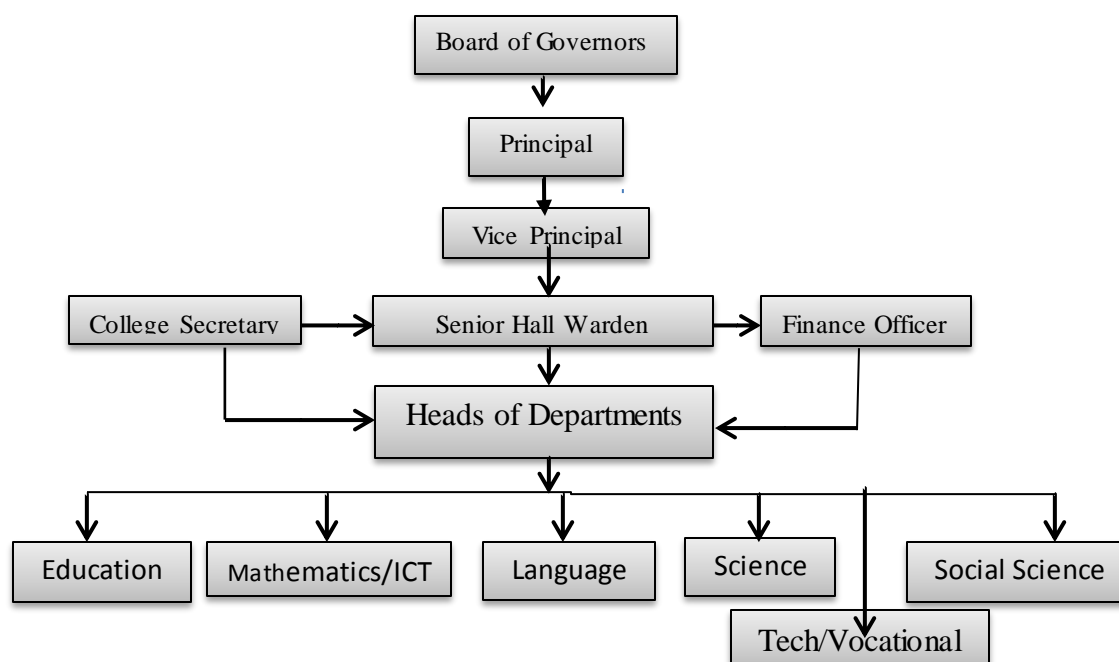
The current leadership had been with the college for four years. The principal was the 8th Principal of the college. He did not receive any formal training in ICT skills and has no prior experience in implementing ICT or integrating ICT in a subject. Hence, he worked 'closely' with the ICT department for advice and support in making decisions for the college. Due to his lack of ICT skills, and experience in the area of integrating ICT, he preferred the ICT Coordinator initiated programmes for his perusal and monitored the implementation of ICT in the college. The principal's style of introducing ICT to his teacher educators was by encouraging the teacher educators to use ICT for both instructional and administrative purposes.

COLLEGE B

College B is also a government co-educational pre-service teacher institution. There were about 470 students in the college with the average class size of 42. The college had staff strength of 45 teacher educators and 38 supporting staff. The College also had two computer laboratories, one fully-air-conditioned computer room with about 40 computers, data projector screen, white board, and two printers and 45 computers in the second one. However, out 85 computers, it was observed that 47 of them were connected to the Internet. Besides, the Social Science department had a special computer lab with about 15 computers all connected to the Internet and an overhead projector.

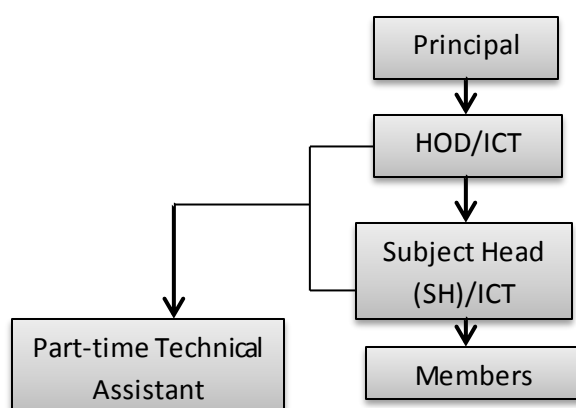
Out of 100 computers in the College, 62 were connected to the Internet. Whole school student-computer ratio was about eight students to one machine (8:1) (comparatively better than College A), while it was one student to a machine (1:1) in a typical ICT-mediated lesson. A part-time technical assistant was available in the college to provide technical support and resolve technical problems that might arise during the ICT-mediated lessons. Figure 5.7.5 depicted that at the helm of the college organisation are the Board of Governors. The Principal and the rest.

Figure5.7.5 Organisation Structure of College B



The ICT Department Organisational Structure of College B is presented in Figure 5.7.6. The principal was directly involved in the running of the department and was involved in discussion with regard to the strategies for implementing ICT in the college. The HOD/ICT reported directly to the Principal. The implementation of ICT in the college and monitoring the progress of ICT implementation and receiving feedback from the teacher educators were the department's responsibility.

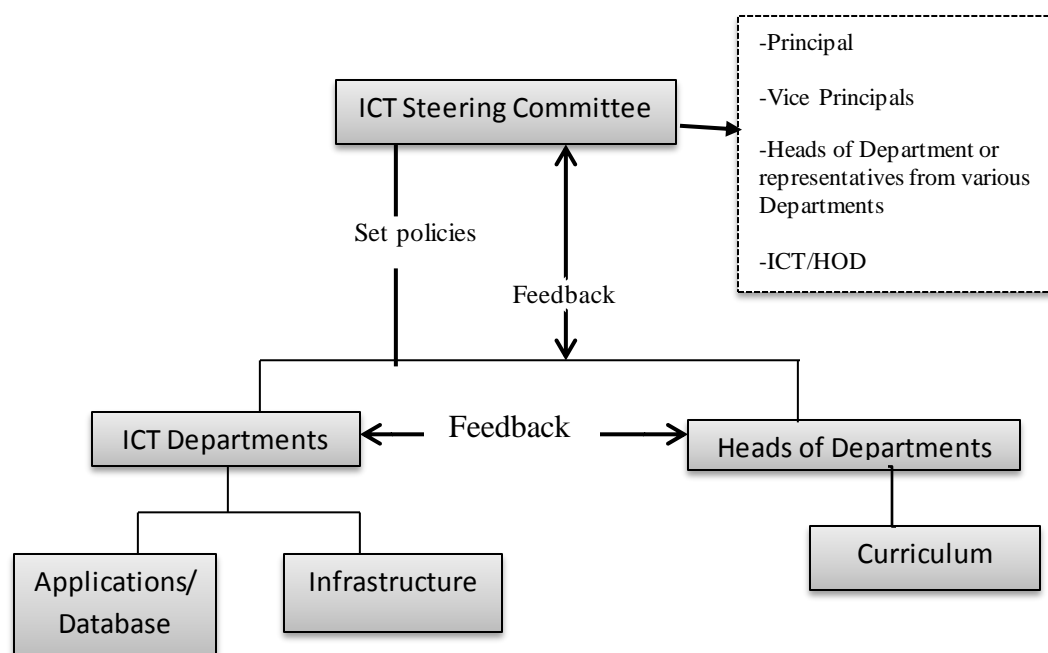
Figure 5.7.6. ICT Department Organisation Structure



HOD/ICT worked together with the HODs and the Subject Leaders (SLs) in various departments of the College. The members also included teacher educators who were keen in the area of ICT and worked with the committee to formulate directions and policies for the

college. The department did not operate independently. They received information and decisions regarding policies from the ICT Steering Committee (see Figure 4.7.7).

Figure 5:7.7. *The ICT Steering Committee of College B.*



The composition of members for this committee consisted of representatives from all the Subject Areas (SA) in the departments. The members were usually the HODs/SLs, but in some situations, a teacher who had knowledge and experience in ICT represented the department instead of the HODs/SLs, especially if the HOD/SL was not very competent or confident in the use of ICT. This enabled the department's representative to assist the ICT department to make informed decisions. These SL representatives were responsible for ensuring a two-feedback took place. The principal's approach was to involve the SL, thereby, making them responsible for ICT integration in their subject areas. This modus operandi empowers them to make sure their departmental teacher educators are progressing from one level of ICT integration to the next, through a constant mentoring processes.

Leadership

The Principal was the 7th principal of the college. She has Masters in Information Technology from the University of North Carolina in the United States and has been in the college for four years. The principal had good knowledge of ICT integration skills, which was built up through her involvement with the Instructional Technology Division (ITD) in the Ministry of Education

(MOE), Ghana. She has personal experience and knowledge of how to integrate ICT in the subject areas, as well as the skills of training teachers, since she had personally conducted training during her stint with ITD.

Her leadership style in the area of ICT implementation was direct involvement with the teacher educators and the pre-service teachers. She clearly communicated the importance of ICT integration in subject areas and demonstrated it by taking an interest in the type of ICT lessons that the teacher educators conducted. She monitored the teachers by observing the types of lessons that they conducted, and reviewed the lessons together with the teachers and also personally praised them for their efforts. The researcher had the opportunity to observe the principal teaching with ICT in an English class. The principal sources for training and guidance for her teachers because she feels the teacher educators needed exposure to various ICT integration approaches, to achieve the goal of the college – that is to enable their students to become independent learners.

The principal models ICT integration in the area of English which is her forte, thereby, leading by example. The principal monitored the ICT Department and in the process she planned the finance together with the HOD/ICT to ensure that they managed the college's finances to maximise the use of the funds for the benefit of the teachers in the area of ICT. In order to ensure that the college produced qualified and competent teachers with ICT for the basic schools, the college has established a demonstration school where most of the pre-service teachers have their practicum. In her words, the Principal commented:

A demonstration school is a basic need for any good college of education.

It is evident from the within-case case analysis that there existed an environment conducive for ICT integration to take place in College B than College A. While this section has reported a within-case analysis, the next section discusses cross-case analysis.

5. 8. CROSS-CASE ANALYSIS

This section lifted the level of discussion from a descriptive account (within-case analysis) into a cross-case analysis of the two case-study colleges. As posited by Boonstra (2003) the purpose of cross-case analysis is to compare the variations between the cases, and identify their common patterns and to categorise them into groups. Through this “pattern matching” process (Yin, 2003:31), the emergent findings are likely to be more robust than that of a single case. In

this study six key themes emerged as crucial components for effective adoption and integration of ICT into teaching and learning environment in Ghanaian pre-service teacher educational context. The themes were:

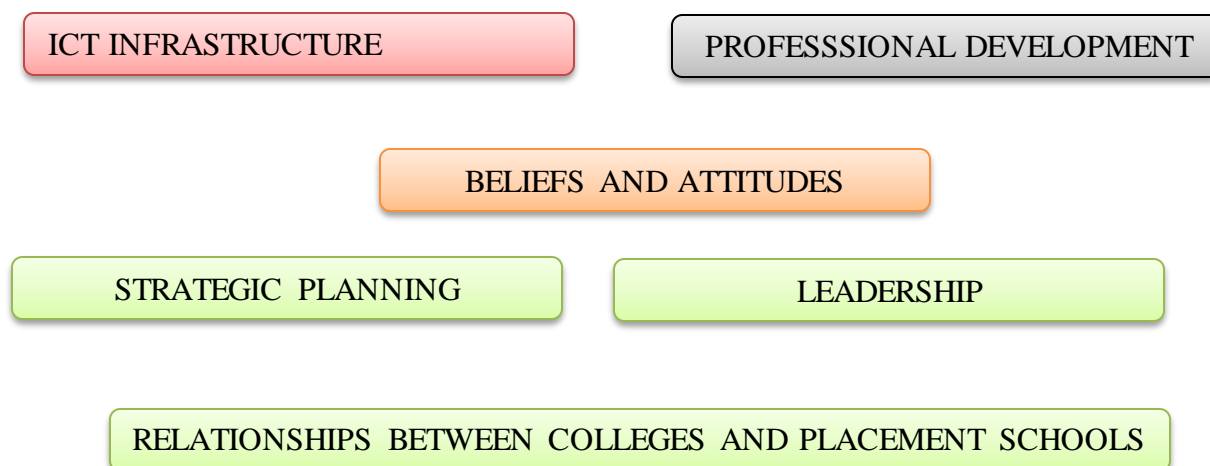


Figure: 5.8.1 Components of Effective ICT Integration Processes

Considering the above sequence ICT infrastructure will be first discussed.

5.8.1. ICT INFRASTRUCTURE

In the process of ICT integration, the need for a reliable and quality ICT infrastructure is undeniable (Rudra et al., 2018). However, in line with ICT infrastructure in this study, two main issues appeared to have a significant impact on ICT integration: quantity and quality of ICT infrastructure.

College A with a student population of 485 at the time of the study had 112 Pentium 4 and Triton computers with 45 of them connected to the Internet. The college has two computer labs for both students and staff. In a normal class in the computer lab, the student-computer ratio was approximately 2:1 since a normal class in the college consists of 42 students and only 45 computers at the time of this research (20 in lab A and 25 in lab B) connected to the Internet are functioning. In general, the ratio looks good compared with international standards, for example, Singapore which is one of the most networked countries in the world has 5:1 (UNESCO, 2011). However, with regard to the ratio for the whole college, considering computers with the Internet, there were discrepancies in the figures given by the Principal and ICT Coordinator. Whereas the Principal estimated it at 8:1 the ICT coordinator put it at 9:1. The Principal estimated:

At the moment , I think the computer ratio is 8:1 or I had to check from

The HOD/ICT who is the right person....

Conversely, the ICT Coordinator who was emphatic noted:

The ratio currently stands at 9.1 for the college.

It seemed the Principal is not directly responsible for the issues relating to ICT integration and therefore, could not give accurate information relating to it. It seemed the ICT Coordinator is directly responsible for issues relating to ICT integration in the College. This suggests that the Principal in the College is not showing leadership in the implementation of ICT integration in the College. The low student-computer ratio (9:1) means College A students do not have adequate access to computers, especially computers connected to the Internet. This situation can affect the integration of ICT in the college adversely, as effective integration of ICT requires sufficient numbers of computers connected to the Internet for the students and teachers' use (Maor, 2017).

Knowing that limited access to computers connected to the Internet creates an impediment to ICT integration, the college, in partnership with a private organisation, had established a well-resourced private Internet café on campus where the students and staff use the facility by paying a subsidised fee. Although, the facility is a useful addition to that provided by the college, it may cause a financial burden on the students therefore, only a few were able to benefit from the resource.

College B on the other hand, with 470 students with access to about 100 computers, has two 'modern' computer labs. Unlike the Principal in College A, the Principal in College B and her ICT coordinator seemed to agree on almost all the issues regarding the ICT infrastructure. For instance, when the Principal was asked about the number of computers and student-computer ratio, she gave the exact figures as the ICT coordinator. She noted:

We have 2 modern computer labs which is furnished with about 100 computers....

Majority of them connected to the Internet even though sometimes slow.

The ICT Coordinator similarly quoted:

In all we have about 100 computers across campus excluding staff and students'

personal laptops. The modern computer suite has about 60 new computers.

The similarities in figures meant that the Principal was well-informed and also monitors ICT infrastructure in the college. On average, the college had 42 students per class and therefore, when using the modern computer lab, the ratio was 1:1. However, the student-computer ratio for the whole college was approximately 7:1. This indicated that comparatively College B is well-resourced with ICT infrastructure than College A. More importantly, in College B the computers are not limited to the computer labs. The college has a small number of computers located outside the computer labs such as the library, the Principal's office and ICT coordinator's office and some of the classrooms. The Social Science lab is also well-resourced for teaching and learning with ICT. However, it was time tabled and priority given to ICT and Social Science students and staff. Confirming this, the ICT coordinator indicated:

There is also one purpose-built ICT/ social science classroom for teaching and learning This classroom had to be pre-booked....

However, priority is given to the Social Science and ICT subjects.

Despite these limitations, it was observed that College B students had more access to ICT than those in College A. Given that the quantity issues go side by side with quality, attention would now be turned to the quality of ICT infrastructure.

One major issue emerged regarding the quality of ICT was the ease of Internet use. All the teacher educators and students interviewed in both colleges complained about unreliable and slow connections and they urged the management to do something to improve it. As ICT coordinator from College B commented:

*Unreliable and slow internet is a major source of worry,
sometimes it takes about 10 minutes to connect*

Similarly, the Head of Science in college A also commented:

*The Internet is very slow, it makes it difficult for staff and
students to work. Hope management do something about it*

The opinions shared by the above participants were in consonant with the quantitative findings, where 71% of the respondents from both Colleges rated their Internet facility as poor as against only 15% as good (see Figure 4.4.7). This indicated that both the students and the teacher educators see the weak Internet facility as inimical to effective use of ICT.

Another quality issue emerged was the access and the availability of functionable computers. As posited by Lim, Chai & Churchill (2011) that providing ICT access that is meaningful, computers should preferably be located in classrooms, instead of computer laboratories, so that users can have access to them at all times. This was not the case in either college, although there was a variation between the two colleges. In College A, the only access to the computers with the Internet was the computer labs. The normal classrooms were so crowded, to the extent that it would be impossible to locate computers in them. This was confirmed by the ICT coordinator:

Our classrooms are so congested and it would be physically impossible to locate computers in classrooms considering students' large numbers. These classrooms were originally built to accommodate about 22 students but are now taking 40 and over.

College B seemed to have relatively better access than College A. They have at least one well-resourced classroom with modern ICT facilities for teaching and learning, apart from their two ICT labs. Having in mind that a booked room of computers does not enable easy integration of ICT into the curriculum, the Principal of College B commented:

Locating computers in labs alone restricts using them by our tutors and students hence the extension to the classroom.

The indication is that College B was better placed than College A in terms of ICT infrastructural provision since they have ICT facilities outside computer labs whilst College A has its facilities restricted to the computer labs.

Another issue that came to the fore regarding the quality of infrastructure which all the participants interviewed in both colleges saw it as critical to ICT integration was technical support and maintenance. According to Ofsted (2004) the reliability of resources and the confidence of staff and students in using ICT are dependent on good-in-house technical support and maintenance. In both case study colleges the participants were concerned about the issue of technical support. The Principal in College A expressing his concern noted:

*There is no technical person on-site. And when we needed one we have to book earlier and sometimes it takes months for us to get our turn.
The recognised persons are about 75km away in our regional capital.*

On the same issue, the ICT coordinator in College B commented:

...major problem is the frequent breakdown of computers and difficulty in getting them repaired since we do not have a resident technical person to attend to them.

The comments by the participants indicated that technical support was a major problem in both colleges. Acknowledging the crucial role of Technology Assistants in freeing them from attending to technical problems and enabling them to focus their attention on teaching with the technology, the leadership in both colleges indicated they were making efforts to get these important personnel on-site. However, they indicated that their efforts are being hampered due to financial constraints. For example, the Principal in College B noted:

We managed to employ one part-time technical assistant who comes here every fortnight but this is not adequate, we need an onsite full-time...but we cannot afford to employ him full-time since we had to pay him ourselves.

Similarly, the Principal in College A commented:

We used to have one National Service Person here as a technical assistant when his service ended, I decided to employ him but unfortunately, there is government embargo on employment which is very sad... We had to let him go.

Given that the existence of an adequate technical support structure is a necessary condition for sustainable adoption of ICT (Law, Pelgrum & Plomp, 2008), and the leadership in both colleges were making every efforts to solve the problem, they were beset with financial problems due to harsh government policies, particularly an embargo on employment. The above excerpts gave clear evidence that currently, the colleges are responsible for finding financial resources to maintain their ICT resources from their own scarce resources.

Voicing out their sentiments, the pre-service teachers in both colleges indicated that although they had well-furnished ICT labs in their colleges, they felt that they had limited access to the equipment, since their access is restricted by the colleges' authorities. College authorities restricted ICT use to when a supervisor or tutor is available. As one pre-service teacher retorted:

The computers are just corralled in the ICT labs. Access is restricted which has forced us into buying our own laptops.

Responding to the students' assertion, the Principal in College A noted:

We used to have about 120 computers in our two labs but now only about sixty

are functioning due to damage caused by unidentified students. They are now restricted to use the facility. They can only use it when there is a supervision.

From the above excerpts, it seemed that the management in both colleges are being over-protective, probably due to the lack of funding. This does not augur well to promote effective use of ICT for pedagogical purposes.

As indicated in the literature review that, when infrastructure is provided, the next major aspect in the ICT integration process is building the capacity of the pre-service teachers and teacher educators to use the facilities to achieve its maximum benefits.

5.8.2. ICT PROFESSIONAL DEVELOPMENT

Given that the extent to which teacher educators have the knowledge and skills for modelling the use of ICT in their own teaching process is a critical factor in the successful integration of ICT into pre-service teacher education (Karlin & Ottenbreit-Leftwich, 2018), the interviews and the observations considered whether opportunities existed for these professionals to develop their ICT skills and knowledge, appropriate for ICT integration process.

Making sense of the need for consistent and effective professional development for the meaningful ICT integration, the Head of Education Department in College A, figuratively remarked:

*No matter the weapon in your hand, if you
are not trained to use it, you can't use it.*

This suggests that ICT professional development is at the heart of effective ICT integration process and should be taken seriously. The participants in both case study colleges indicated that professional development was available in college-based and external form. Confirming this, the Principals in both colleges reported that, whilst their ICT coordinators occasionally organise ICT professional development for the staff internally, they also arranged for them to attend government mandated ICT professional development and other workshops externally. For example, the Principal in College A, who indicated that he regarded ICT professional

development as important for both teacher educators and pre-service teachers to be technologically competent to teach with ICT, reported:

*Last year, May, we had one week ICT training for all the staff
I brought in an expert who took them through.. Besides, I arranged for them
to attend training and workshops organised by our universities as well.*

The Principal in College B on the other hand indicated:

*My staff have ICT professional development day every last Friday
of the month at the City Educational Centre. The ICT coordinator
also occasionally organises ICT training programmes for the staff.*

Even though the leadership in both colleges indicated that they were making efforts to provide ICT professional development for their staff and the students to supplement the government mandated one; the staff were of a different opinion, as they questioned the consistency and the quality of the training they received. Summarising the awful situation in the training rooms, one tutor from College A noted:

*The computers are not enough; the room is always crowded,
you find about five tutors clustered on one table and the worst
of all if you don't go early you won't get a comfortable place to sit.
We also had to travel 75 km to attend this training.*

Agreeing with the above quotation, most of the teachers interviewed [especially those in College A] felt that although they had access to the technology, and even had their own lap tops, they did not believe that they were being supported to use ICT for teaching. As one teacher educator from College A indicated:

*Although we have two computer labs with well-equipped ICT resources
We have not been encouraged to use them. It was only last year May
That I had a week ICT training at the University of Cape Coast.....
Since then I had to struggle myself.*

Another teacher educator commented:

*Because I have not received any training I don't
See the value of using the technology. I have my
own laptop but cannot use it due to inadequate training*

The views raised above supported the supposition that the integration of ICT into teaching and learning process is not guaranteed by just providing the technology. Thus, having access to computers without appropriate accompanying training to use them as a tool for teaching and learning is not a sufficient condition for the integration of ICT. Another teacher educator from College A indicated:

*Often we are taught how to use a programme, not shown how
to integrate it to the curriculum. The knowledge gained in training
quickly fades because it is not put to use in the classroom*

In support, all the participants in both colleges confirmed that even though their leadership values professional development, the colleges do not provide adequate resources to support the staff's professional development. Participants who were not experienced users of ICT reported that there was not enough professional development available to meet their specific needs, while those with much more experience and who were regular ICT users were frustrated with the simplicity of the professional development offered. This revelation came to light when a tutor in College A queried:

*The course does not consider our individual differences. We, the
old ones, Born Before Computers (BBC's), do not even know how
to turn the computers on, but we attend the same training, with the
same pace with the young tutors who have had more exposure to the ICT.*

The above excerpt seemed to suggest that the professional development received by the participants is not designed to meet the individual teachers' training needs. This finding is inconsistent with the approaches to the effective ICT professional development outlined in the literature.

When the participants were asked to what extent they were perceived to be proficient in using the ICT for the pedagogical purposes, it was observed that even though few tutors, particularly those from College B, demonstrated the ability to select and use appropriate tools and resources for teaching and learning purposes in general, the teacher educators have not gone beyond the basic ICT competencies (Word processing Excel, PowerPoints and Internet Explorer). In College A, apart from the two ICT tutors and the Head of Education who uses her own laptop and projector to teach students in the classroom, none of the teacher educators were seen using ICT for teaching and learning. In essence ICT was still left in the domain of the two ICT tutors. Confirming the above assertion, the Principal in College A indicated:

It is important for staff to manage basic ICT skills before adopting the technology in classroom teaching and learning practices.

Therefore, our focus now is to equip them with the basic ICT skills.

However, the ICT coordinator in College B said:

Although majority of our tutors still demonstrate basic ICT skills, a few of them have gone beyond the basics and are able to use ICT for pedagogical purposes.

Overall, all the teacher educators in both colleges recognised the importance of providing high quality ICT professional development as beneficial to transform their own teaching and students learning. However, in general, the ICT professional development in both colleges seemed to be driven by what Watson & Prestridge (2003) describe as ‘retooling’ intentions. This is because it was observed that the approach to professional development in both colleges aimed to augment the existing curriculum as they basically provide specific skills and competencies focus on specific types of ICT application. Although considered an integral part of the ICT integration process, the teacher educators required more than knowledge on technical skills, but also knowledge which is subject specific (Mishra & Koehler 2006; Steketee, 2005). For example, in College A, nearly all the ICT-mediated lessons observed were based on teaching ICT skills and taught by ICT teachers.

Given that successful adoption of ICT in pre-service teacher education depends largely on the beliefs and attitudes of teacher educators who eventually determine how they are used in the classroom the participants made many comments that need to be discussed.

5.8.3. BELIEFS AND ATTITUDES

Pre-service teachers’ attitude towards technology usage are an essential factor in assisting successful classroom use of technology (Al-Azawei, Parslow & Lundqvist, 2017; Larbi-Appau, 2018; Teo & Milutonic, 2015). However, it is unlikely for teacher educators with negative attitudes towards ICT use to be able to transfer their ICT skills to their students, let alone encourage them to use the technology. On the positive note, teacher educators with positive attitudes towards ICT are more likely to accept and use ICT, hence transferring their skills or encouraging their students to use the technology for teaching and learning purposes. Although, some researchers (Larbi-Appau, 2018; Tezci, 2011) have also argued that having a positive attitude towards ICT alone is not sufficient by itself to achieve effective ways of using ICT, it has been found to be a major predictor of ICT acceptance and its subsequent use (Bitner & Bitner, 2002; Teo, 2014).

Interestingly, all the participants interviewed in both colleges acknowledged that ICT is a pre-requisite in 21st century education and made a number of positive comments to substantiate their interest. The Principal of College B being enthusiastic about ICT commented:

....cannot survive without it. I think ICT can improve our education system to prepare our young ones to face future challenges..... Technology is really a necessity; it's no longer an option. It gives students a lot of illustrative materials, enhances their understanding.

The participants also highlighted the importance of ICT as the tool for teaching and learning in the 21st Century. They linked it to promoting some of the basic elements of constructivist teaching and learning, such as independent learning, making students authentic learners and the changing role of teachers. As ICT Coordinator in College B put it:

ICT promotes independent learning. It changes the teachers' roles from lecturers to facilitators and makes students authentic learners.

A similar idea was shared by the ICT Coordinator in College A when he said:

ICT is the main tool for teaching and learning in the 21st century. It supports students to learn both independently and collaboratively, hence taking ownership of their own learning.

Even though the participants linked the use of ICT to constructivism; in reality it was observed that they mainly subscribe to the behaviourist approach of teaching. Pre-service teachers also showed enthusiasm for using ICT and highlighted the positive link between ICT and constructivism.

A student from College B noted:

I feel it's good to use, it makes teaching easy, you have a lot of stuff for teaching.....It can transform our teaching and learning. It helps students take responsibility of their own learning thereby thinking creatively.

Furthermore, when the pre-service teachers were asked whether they had considered using ICT in their teaching, all answered in the affirmative. One of the students from College B, expressing his view that ICT promotes the concept of self-reliance and collaborative learning indicated that:

When you use ICT, you are able to find out new things. You have the capacity to do things on your own. Also it also helps to bring a real-world situation in the

classroom, making learning authentic, most importantly it helps us to work collaboratively to share ideas creatively.

Similarly, a student from College A remarked:

Appropriate use of ICT in our schools will foster pupil-centred learning which supports greater critical and analytical thinking skills. It also provides access to information that would not be available otherwise, expands learning experiences in the classroom setting.

The positive comments made by the participants were indications that the two colleges seemed to be ready and willing to adopt ICT for pedagogical purposes. As Yuen & Ma (2008) posited, the success of any initiatives to implement ICT into any educational programme depends strongly upon the support and attitude of the teachers involved. Based on Yuen & Ma's assertion, it could be concluded that, since the participants' attitude towards ICT is positive, with the necessary help and provision of adequate resources they would adopt ICT for teaching and learning.

As an extension to the attitudes, Pajaras (1992) asserted that an understanding of the current beliefs and perspectives that teachers hold serve as a good starting point for discussion of effective integration in pre-service teacher education. Consequently, the participants expressed their beliefs towards ICT during the interviews.

The teacher educators who were averse to the use of ICT for pedagogical purposes expressed their hesitancy regarding the use of this modern technology. One teacher educator, with over 20 years' teaching experience, said that up to now he has been regarded as a successful and efficient Mathematics tutor, and he did not see any point in given up his own way of teaching and trying to adopt a 'completely' a novel system. He noted:

*As a tutor my major role is to transmit knowledge I have to my students
I am sick of the word computer. We've been spending too much time and energy
on over the last couple of years.*

Another tutor from College B, who had 16 years' teaching experience, stated that she is not good at using computers, and even thought of using computers for teaching purposes made her feel uneasy. She noted:

*I feel uneasy to use ICT for teaching as I am not comfortable with it. To me
using ICT for teaching and learning is 'waste of time' and time-consuming.*

Similarly, one young teacher saw the use of ICT for teaching as a trial. However, his student-centred philosophy was in keeping with the purpose of using ICT as a teaching tool. He noted:

It is frustrating to teach with computer but I can see the potential.

The above excerpts obviously indicated that teacher educators with higher levels of teaching experience were more averse and concerned about the fact that the new system which they were supposed to adopt was something with which they were not familiar, and they thought that their objections were valid. The old and experienced teacher educators resistant to ICT could be attributed to two reasons. First, it could be due to the fact that the colleges still do not have clear written vision or goals for pedagogical use of ICT. Secondly, their pedagogical beliefs might have been shaped by the socio-cultural context that they had been in for nearly two decades.

As Dawes (2001) pointed out, teachers are not deliberately negative, but they need to clearly see the value and benefits of new initiatives. Until these teachers see the benefits of using ICT for pedagogical purposes, they would rather stick to their existing teacher-centred beliefs than change to a more constructivist student-centred model. In order to help these teachers see the potential benefits of ICT, the leadership needs to convince them to realise the potential benefits of using ICT for pedagogical purposes. However, convincing these teachers is not just about telling them about the potential of ICT use in the learning process, but to show them a visible leadership by acting as a role model in using the technology for pedagogical purpose.

On the contrary, in the technology-supporter teachers' point of view, this 'waste of time', as indicated by the technology-aversed teacher educators, is an advantage because they believe that a teacher educator should give his or her students' the chance to search, investigate, select, decide, and choose. Going through this process, pre-service teachers would develop higher-order skills and specifically critical thinking skills which is relevant in 21st century education. However, they indicated that more time is needed in using the ICT tools within the teaching and learning process.

The pre-service teachers also found that high-stake in public examinations and object of 'improving examination results' was found to negate the opportunities offered by ICT by opting for the straight 'grade one's' (*grade 1's*) student over one that is more creative, and more open in their perspectives. These came to light through the following comments.

A pre-service teacher from College B commented:

Teaching JHS students with my own laptop the head teacher said to me

Concentrate on the syllabus for the students to get better grades

Confirming this assertion, a student from College A also remarked:

Using computers is a waste of time. We want to maintain our records in 100%

with six ones. Head teacher in my placement school retorted!!

The question that needs to be asked and answered is, how can the high-stake public examinations be embedded into authentic contexts, making the best use of ICT for teaching and learning purposes? With this question in mind, the next important factor that needs to be discussed is the role of leadership in leading the effective integration of ICT into teaching and learning in the two colleges.

5.8.4. LEADERSHIP

The role of leadership has been described as the single most important factor affecting the successful integration of ICT in pre-service teacher education (Dewitt, 2013; Fullan, 2012). No matter how much training the teacher educators and pre-service teachers receive to prepare them for ICT integration, they will not successfully use the technology without the support of the leadership of their Principals.

Hooper and Potter (2000) identified setting a good personal example by a leader as one key factor for introducing innovation. Like every innovation, the Principals are expected to lead the change efforts acting as “change agents” and thereby ensuring the successful adoption of ICT across the curriculum (Mouza, 2017).

In College B, the Principal was observed to be teaching with ICT in her subject area, thereby leading by example. This empowered the staff to use ICT for teaching and learning purposes. As one teacher educator noted:

With her strong background in Information Technology, the Principal teaches with ICT which stimulates (we) the staff to do likewise.

She communicates with us electronically and expects us to do the same.

Conversely, the Principal in College A did not use ICT for teaching and learning purposes and therefore majority of the staff, apart from the ICT Coordinator and the ICT teacher did not teach with ICT, simply because there was no perceptible efforts from the leadership to empower them to use the technology. This was consistent with the study by Wilder (2012) in four pre-service teacher institutions in Namibia. In the study, Wilder found that lack of good exemplars and role modelling of the principals dissipated the interest and enthusiasm of the teachers, hence causing the failure of the initiative.

In another study, Bush (2012) contended that to achieve effective ICT integration for pedagogical purposes, the principals should be able to monitor the teacher educators, as well as the students in the process of ICT integration. With effective monitoring, the principal will be able to gather evidence of the impact of ICT use in the classroom, and data about areas where modifications of the initiative may be needed. In College B, it was found that the principal was directly involved in monitoring the ICT integration process, despite her multiple responsibilities. Accordingly, there was some positive evidence in College B as the principal indicated:

Although, I do monitor the staff myself and also sometimes delegate some powers to the HODs' and SLs' to do the work on my behalf and report back to me. However, occasionally I go to classrooms to observe ICT lessons myself.

Whilst the principal in College B was found to lead by example and occasionally, monitor the usage of ICT in the classroom, conversely, her counterpart in College A indicated that he did not do any monitoring, for the reason that he had busy schedules and, moreover, was not competent in the use of ICT, particularly for pedagogical purposes. He remarked:

Sorry, I do not do much direct monitoring; I have a lot of responsibilities. Monitoring is the job of my ICT Coordinator. He is capable and I trust him.

Given that it is difficult to support an innovation about which one has a little knowledge, it is of vital importance that, the principals receive appropriate training on ICT in order to increase their own skills and knowledge so as to effectively inspire the staff in integrating ICT across the curriculum (Flanagan & Jacobson, 2003).

The two Principals in both colleges indicated that, even though they are supposed to lead the ICT initiatives in their colleges, there was no specific provision made to equip them to build

their capacities in using ICT. Recognising the need for them to be trained in ICT in order to lead the change, the Principal in College A noted:

Receiving effective professional development will have helped, we, the principals to use the ICT to inspire our staffbut the government has not provided us with adequate training since the inception of the initiative, it's sad!!

Adding her voice, the Principal in College B bemoaned:

Given that knowledgeable and effective leaders are extremely important to lead and inspire the staff in this initiative, I believe that the integration of ICT in our colleges should begin from us (the Principals) and that we should be acquainted with the issues of ICT integration and create a conducive environment to support teacher educators in the use of ICT in their teaching and learning.

From the above excerpts one could assume that one underlying reason for the lack of ICT adoption and integration in the two colleges is the lack of participation in staff development by the principals, as well as the teacher educators.

As Fullan (2011) contended that no single individual possesses the capacity to effectively play all possible leadership roles in the introduction of innovation, it was discovered that whilst the principal in College B was found to exhibit shared leadership style (Mynard, 2009), her counterpart in College A did not but instead delegated almost all the powers to the ICT coordinator.

In College B, it was revealed through the interviews and observations that the principal sets the tone for the overall ICT integration and adopted a visible role in ICT integration within the curriculum through modelling expectations. While the HOD/ICT was in-charge of providing the relevant infrastructural support, the HODs/SLs' were empowered to lead their department using the ICT 'goals' as a guiding principle to achieve ICT integration within the curriculum. The HODs/SL's thus took a lead in charting the direction for their departments to achieve the colleges' ICT targets. Down the hierarchy, the SL/HODs worked closely with the teacher educators to ensure relevant professional development was provided to meet their needs.

The Principal in College B reported:

Being a Principal does not mean I know everything. I directly involve

My staff and even students in the implementation process. We have an ICT Steering Committee involving all HOD's/SL's. These Heads are responsible for ICT implementations in their departments as well as subject areas.....

In this perspective, all staff have a vested interest in ensuring the initiative succeeds and that the development is sustained beyond the involvement of any one individual. This finding is in consonant with the quantitative results that leadership support and involvement in the ICT implementation process has a direct positive effect on pre-service teachers' actual use of ICT for teaching and learning purposes (see H:5).

On the contrary, the teacher educators in College A perceived the lack of visible involvement by the principal to lead the change, as a key barrier to the integration of ICT. It was observed that there was a lack of visible leadership of the principal in the ICT integration process. Moreover, the teacher educators indicated in their interview that they did not see the importance of ICT integration in the curriculum, nor were they aware of the expectations of the college since there was no modelling for them to follow. Whilst the HOD/ICT and the ICT teacher in the college functioned as the sole members of the 'ICT Department', the HOD/SLs were not formally involved in the ICT integration process. This lack of involvement of the senior staff seemed to create the impression that ICT integration was not a priority. As the Head of Education Department puts it:

*I don't recall the last time we met to discuss about ICT...
If there is, then it might be between the Principal and the HOD/ICT.
I want the Principal to involve all heads and even students in ICT decisions.....*

While the Principal in College B involved all the staff in the ICT integration process, her counterpart in College A has formally shifted the leadership to someone else in the College, so that there is no direction or focus that has been established to enable a coordinated approach to ICT integration. Since the ICT Coordinator and the ICT teacher functioned as sole members of the ICT implementation process in the college, it seemed to suggest that the integration process was more technology driven, rather than curriculum focused. Interestingly, the Principal in College A, although he could be classified as not an 'advocate' for ICT integration, however, he had in mind to distribute computers and laptops donated by the government in the classrooms. As he indicated during the interview:

All the new PC's and the laptops will be distributed among the departments

The ICT department has been enjoying the privilege for quite a long time

This happened right at the time of the interview when the principal had received received 30 brand new Triton PCs and 12 laptops from the Government of Ghana and was about to distribute them.

Although, it was observed that there were myriad problems, however, when asked about the barriers to ICT integration, the leadership (the Principals, ICT coordinators, HOD's and SL's) in both Colleges identified erratic power supply, lack of technical support, poor Internet access, lack of funding and the nature of the classrooms as the significant ones. For example, the Principal in College A noted:

Poor electricity supply and lack of technical support to maintain our computers and also help our students in the class are my headache.

We've bought a plant but cannot power the two computer labs at a time.

Agreeing with the Principal in College A, the ICT coordinator in College B remarked:

The Internet is too slow and worse, we do not have constant flow of electricity and had to depend on our plant which is expensive to run.

While the leadership mentioned the above listed problems as the major barriers to ICT integration, the students were of different view, as they mentioned overprotection of the ICT facilities, erratic power supply, negative ICT culture and mentors' incompetency in using ICT in the placement schools, as major barriers to them. The aforementioned barriers give us enough evidence that although College B is ahead of College A in terms of quality of infrastructure and effective leadership, in general, the two colleges do not have adequate capabilities and expertise to implement ICT integration on their own. Therefore, there is a need for a government support for effective implementation of ICT in both colleges. With the government support and effective monitoring system, the leadership in the colleges could put effective measures in place to remove the roadblocks, in order to achieve effective ICT integration in the colleges.

Another important theme that emerged in the qualitative data was the strategic plans put in place in the colleges.

5.8.5. STRATEGIC PLANNING

For a successful integration of ICT to occur in pre-service teacher institution, it is the duty of the leadership to have a strategic plan in place (Fullan, 2001). In the course of the interviews, it emerged that the two colleges had some form of strategic plan for integrating ICT in teaching and learning. The plans in both colleges outline a number of approaches to achieve integration.

In College B, the management, and the alumni in collaboration with the Ministry of Education, have initiated a major project called “Rebuilding and Improving Existing Classrooms”. The aim was to redevelop the college by building modern classrooms and computer labs to bring the college up to the contemporary 21st century standards. As quoted by the Principal in college B:

Most of our classrooms today were built half a century ago (Circa,1967).

To ensure that our students have access to facilities that can support them to become innovative, the alumni in collaboration with MOE have initiated a major project called “Rebuilding and Improving Existing Classrooms.”

The aim is to re-design our college to the modern standards.

This project aimed to rehabilitate the old-fashioned classrooms, and also build new ones fit for the purpose of the 21st Century. It was observed that colleges were not designed with ICT classroom plans in mind when they were built. Almost all the ICT labs in the two colleges are placed in existing older classrooms, that were not designed according to the needs of the ICT labs. Both Colleges have created dedicated computer rooms, but found this was not ideal for several reasons. For example, some of the rooms do not offer the necessary electrical outlets and telephone lines, and worst of all do not have available network connections for Internet access.

One major theme that needs not to be overemphasised was that the use of the expertise of the experienced pre-service teachers featured prominently in colleges A’s strategic planning. The principal of the college quoted by saying:

We planned to use the expertise of our students from the ‘privilege secondary

Schools’ who are well-versed in ICT skills to help the less-privileged ones.

The college tackled this strategy by forming ICT clubs headed by some of the students who attended the “privilege secondary schools,” i.e. well-endowed schools with modern facilities. These students assist their less fortunate colleagues by the teaching them the basic ICT skills. Similarly, the ICT coordinator in College B also indicated that, occasionally, some of their

students who have the expertise in using ICT help the less privileged ones, and even some of their tutors.

In another vein, as part of speeding up their integration process, College B has made ICT a compulsory subject and it is graded as a core subject. A student failing in ICT, according to the management, cannot graduate. According to the Principal, this has motivated the students to take ICT seriously. The Principal noted:

We have made ICT a compulsory subject and its graded as a core subject. A student failing ICT cannot graduate.

Conversely, ICT is not compulsory in College A and sadly students do not do ICT until they reach second year. Confirming this the Principal said:

ICT is not taught in Year 1. We teach them from Year 2.

This suggests that ICT is not featured prominently in College A's curriculum and therefore, not much attention is given to it.

Highlighting the issue of Internet accessibility, the principal in College A reported that accessibility to the Internet has been a major component of the strategic planning in the college. In order to increase accessibility and improve students' skills, plans are well advanced for the college to partner with Vodafone Ghana, to provide broadband Internet access to the college. This was also confirmed by the ICT Coordinator in the college when he reported:

plans are well-advanced to partner with Vodafone Ghana to provide fast Internet access for our college to become a fully Wi-Fi campus by 2018. With this our students and tutors will have full broadband Internet access anywhere on campus. At the moment we use modems in our computer labs which is very slow.

Even though the colleges are making efforts to improve their ICT infrastructure for effective ICT integration the principals from both colleges were of the view that funding was woefully inadequate, and therefore they were looking for alternative sources of funding. As principal of College A puts it:

We depend on a Government grant which is not consistent, therefore, we mainly depend on our meagre Internally Generated Fund, alumni and sometimes Member of Parliament [M.P.] Common Fund etc.

In addition, the Principal bemoaned the annulment of the Parent-Teacher Association (PTA), which had been instrumental in contributing financially to improve the ICT infrastructure. According to the Principal, PTAs ceased to be part of teacher training colleges when the institutions upgraded to Diploma Awarding Institutions. This has been a very big blow to them, in terms of financing their ICT projects. This suggests that the college is not financially capable to implement ICT on their own and therefore, government or private organisations' support is needed.

Although, the colleges had enumerated various approaches to achieve ICT integration within their strategic plans, there were no clear goals established which looked at the specific ways of integrating ICT into teaching and learning in the college. This evidence was unearthed when the principals and the ICT Coordinators were asked whether their colleges had curriculum goals for ICT integration.

In response, the principal of College A commented:

To be frank with you, we do not have curriculum goals as a college but we follow the Government's general plan: we prepare our teachers for future jobs.

Similarly, the principal in College B remarked:

At the moment no ICT plan exists. Our college is currently working under a government's plan, we plan to have one on our own....

The last two comments by the principals revealed a negative development in both colleges, since specific goals for implementing ICT in any institution, according to Fullan (2012) should be given pre-eminence even before the programme takes off. Since they do not have a specific plan to follow, it will be difficult for them to make effective progress unless they break the status quo (that always follows governments plans) and follow their own line of action, in order to become innovative and address their own issues. Having clear goals and a vision shared by all the staff and students will guide them to know exactly how the technology will be used as a tool in the teaching and learning context.

Besides the five major themes discussed above, another significant recurring theme in course of the analysis that needs to be considered was the relationships between the pre-service teacher institutions and the practicum schools, regarding ICT usage.

The last theme that emerged, centred on the relationship between the colleges and their placement schools.

5.8.6. RELATIONSHIP BETWEEN COLLEGES AND PLACEMENT SCHOOLS

In Ghana practicum is viewed as an important component of pre-service teacher education, as it provides an authentic learning environment for the pre-service teachers to make sense of theoretical knowledge and practice the skills they acquire (Bullock, 2004). When pre-service teachers have experience in using ICT during their practicum, they become more confident in applying the technology in their teaching when they become full-fledged teachers (Steketee, 2005). As a consequence, fostering the connection between the pre-service teacher institutions and the placement schools is necessary to support the linking of theory to practice in relation to ICT integration (Callahan & Martin, 2007; Calvo de Mora & Wood, 2012; Levine, 2007).

In this study it was found that the relationship between the case study colleges and the practicum schools was mixed. Whilst few practicum schools created conducive environments for the pre-service teachers to use ICT in their teaching practice, others created impediments, even where ICT facilities were found to be available. One student from College A reported overprotection by her placement school head teacher of the ICT resources in the school. The student quoted the head teachers' own comments during the interview as:

*All these expensive materials are the responsibility of me, the head teacher
If they are stolen or broken. I will be responsible for them and therefore,
I have to keep them safe by locking them up.*

This is a common phenomenon in the developing world where the head teachers revere computers as "untouchables" because they are precious and use them as exhibits to attract students.

The Principal in College A noted that the relationship between the Colleges and the practicum schools is one of the critical barriers to ICT integration. He remarked:

*We train them [students], they acquire the skills/knowledge
But are not able to use them in schools. Most schools in our
Jurisdiction have woefully inadequate ICT infrastructures.*

The principal further indicated that even though "Baah Wieredu One laptop Per Child Initiative" by the previous government to give every child in Basic Schools access to computers was laudable, he did not think the local schools under their jurisdiction benefitted from the

initiative, because the initiative came to an abrupt end when we changed government. He therefore, suggested that, if government make ICT accessible to the local schools in their area, then effective ICT integration will be possible. However, if the situation is left to remain as it is now, then the whole ICT implementation programme will be a mirage.

Consistent with the above quotation from the principal, a student from College A noted:

*Things that we do spend a lot of time on, are not
necessarily used in the [field experience] classroom.
I'm afraid of the future of ICT in our Basic Schools.*

Additionally, the demanding official curriculum in the practicum schools was identified as one of the significant barriers. As one tutor mentor from College B remarked:

The demanding official curriculum puts significant stress on the mentor in the placement schools, as they need to cover voluminous syllabi to prepare students for exams.

This finding is consistent with what Eteokleous-Grigoriou et al (2012:117) referred to as “the tyranny of the National Curriculum” in their study in Greece. They found that the high volume of educational material to be covered, demanded by education officials on a nationwide basis, was inimical to ICT integration. This suggests that this problem is global, and not only limited to Ghana. However, it worth noting that since the mentors feel stressed with the national curriculum, it is doubtful they will try to integrate ICT into their classroom practice, since they will find it a time-consuming process which will delay them from covering the syllabus of the official curriculum.

Additionally, some pre-service teachers reported in their field experience that: “they don’t really have the [desirable] access” to ICT; had ill-maintained equipment; and their mentor teachers were not too interested in teaching with ICT. They also indicated that, in some of their teaching practice experiences, they were not afforded adequate access to ICT tools and wireless Internet Connections and experienced the effects of a negative ICT culture. Expressing his shock and dismay after receiving ICT training, with the hope of passing it on to his pupils but did not have the opportunity, a student from College B noted:

*The school had no computers, electricity not to mention telephones.
My God the government needs to help this school.*

Another student from College A added his experience:

*They had computers, about ten of them in their ICT suite;
But, excuse me, they are now white elephant because there
is no electricity to power them, let alone the Internet.*

Having mentor teachers who are competent in using ICT for pedagogical purposes in practicum schools is important, since their technology level, ability to model integrated lessons, and support for pre-service teachers' lessons with ICT, are salient factors that can enable or disable pre-service teachers' use of technology (Grove, 2008; Bullock, 2004). Expressing their concerns about the competence and confidence of their mentors in their respective practicum schools, a student from college A noted:

*Although, the school has about 14 computers, I never saw
My mentor using a computer. He told me that he has no
No idea about using computers but he thinks its good....*

Adding her voice, a student from College B also remarked:

*Don't know because I haven't seen him using computers before
And he has never discussed anything relating to ICT with me.
All the computers are coated with thick dust meaning they don't use them*

Conversely, a student from College B reported that her practicum site was adequately resourced with computers with the Internet and also her mentor was an ICT coach. This student indicated that her vision for ICT integration was greatly expanded. She reported:

*My mentor's classroom was nearly 75% paperless. It's been really interesting
to see how he uses it throughout the day... Pretty amazing stuff."*

Similarly, another student from college A indicated:

*My mentor is highly competent. He is the Head of Science and deputy
ICT coordinator of the school and uses ICT in almost every aspect of
his work. He is my role model as he helps me*

From the above analysis it seemed that there is a gap between the colleges of education and their practicum schools on how ICT is used. Overcoming the barriers to genuine partnership demands steadfast commitment from both the Colleges of Education and the Practicum schools, and most importantly, the Ministry responsible for education, the MOE, should be best placed to advance this partnership initiative. The three partners should perceive themselves as partners in a common endeavour in teacher preparation, and not fragmented and disjointed

(Wong & Goh, 2010). ICT integration should be seen as part of cohesive programme and not as a disjointed stand-alone course as happening in the colleges currently.

5.9. METHODOLOGICAL LIMITATIONS

Stake (2006:17) states “Mature is the researcher who rejoices in finding a big mistake”.

Despite the careful attention given to the design of the questionnaire, it was not without limitations.

One major methodological limitation discovered was the pre-service teachers’ inability to complete the questionnaires. Questionnaire was used as the main source of quantitative data collection in the study. Consisted of 20 questions, the questionnaire was designed to cover both close-ended and open-ended questions. Questions 1-18 consisted of close-ended questions and 19-20 consisted of open-ended questions. Thus, in all, the questionnaire consisted of 18 closed-ended questions and 2 open ended questions. The pre-service teachers answered all the 18 closed-ended questions on the questionnaire but left the only two open-ended questions at the end of the questionnaire. This limitation may be due to the following:

1. The type of questionnaire adopted. The researcher adopted self-administered questionnaire filled in the absence of the researcher instead of the one filled in the presence of the researcher. Adoption of questionnaire in the absence of the researcher could be one of the reasons why the respondents could not complete the questionnaire. Filling in the questionnaire without the presence of the researcher, although helpful in that it enabled the respondents to complete the questionnaire in private, and also devoted as much time as to its completion, the downside was that unlike the self-administered questionnaire filled in the presence of the researcher, the researcher was not available to address any queries or problems the respondents encountered hence, their inability to complete the open-ended questions. However, self-administered questionnaire in the presence of the researcher, although enables the researcher to address problems the respondents may encounter immediately, it also has its downsides in that the presence of the researcher may be threatening and can exert a sense of compulsion. All in all, adoption of self-administered questionnaire in the presence of the researcher could have prevented this problem from occurring since the researcher could have checked the respondents to ensure that all questions were completed and where they had difficulties,

helped them to address them ensuring all questions were answered thereby ensuring a good response rate.

2. The arrangement of questions on the questionnaire from easy to more difficult questions.

3. Participants level of understanding of the questions: It seemed the participants found the open-ended questions difficult to understand after answering the easy close ended questions and therefore, ignored them.

4. Limitations of the pilot survey due to the differences in educational contexts and academic levels between the pilot survey participants and actual participants, It is well recognised that for a pilot survey to be effective, the participants in the pilot survey and actual participants should have the similar characteristics. Even though the pilot survey participants and actual survey participants had the same characteristics as pre-service teachers. Interestingly, while the pilot survey participants in England were able to complete the questionnaire, it was surprising to find that the actual participants in Ghana could not complete it. The respondents answered all the 18 close-ended questions but left questions 19 and 20 which were the only two open-ended questions. As already indicated, it could be due to the differences in educational contexts and academic levels. The pre-service teachers in England were graduates while those in Ghana were non-degree holders. In Ghana, students enter pre-service teacher course in Colleges of Education after their Senior High School education. However, in the United Kingdom to pursue PGCE, one must be a graduate before he or she enters into the PGCE course. This suggests that the academic levels of the pilot survey participants were higher than the actual participants in the study.

Through triangulation strategy adopted in the study, additional data were obtained from semi-structured interviews and observations for validation of the data. This strategy was explained vividly by adopting Cohen, Manion & Morrison's analogy.

Cohen, Manion & Morrison (2011:205) indicated:

mixing methods of data collection is like putting together
several flawed fishing nets, each of which have a hole, a torn part
to construct a "new" stronger net that works well
despite the problem with each individual net.

The above excerpt is consistent with Brannen (2005) who posited that all research methods have limitations, and that no one approach to research can prove to be reliable, valid and meaningful by itself. Recognising that all research methods have limitations, the researcher employed multiple sources of data so that the strengths of one approach offset the weaknesses of the other to allow for a much stronger overall design. In this study the strengths of semi-structured interviews were used to cancel the weaknesses of the questionnaire to allow for a much stronger overall design. However, this limitation warrants further research to find out why this limitation occurred and how to prevent it from reoccurring in the future.

5.10. SUMMARY OF THE CHAPTER

The mixed methods design adopted in this study initially appeared messy and laborious, with information from various data sources confirming and contradicting each other. However, there were considerable advantages in the use of the multiple data sources. First, unlike case study design which focused on few participants, survey design helped the researcher to reach large sample of 380 pre-service teachers from the two case study colleges. Again, quantitative data helped the researcher to gather data required for measurement and testing of hypotheses as required by the research questions.

However, as Swan & Hofer (2008:320) stated:

*surveys alone cannot explain exactly what respondents means
by their process or what they thought particular question meant.*

Hence, through the use of mixed methods, the participants' responses to the survey were verified, challenged and extended through the use of the qualitative semi-structure interviews and observational methods. These processes uncovered conflicting and clarifying data. For example, nearly 50% of the pre-service teachers indicated in the questionnaire that they were competent in the use of ICT for teaching and learning purposes. However, the observations of lessons in the classrooms revealed conflicting results that the pre-service teachers were not using ICT in the classroom but predominantly in the ICT laboratories. Again, in contrast to quantitative method, qualitative aspect of the study allowed for in-depth study of the participants and also ensured the use of multiple sources of data such as semi-structured interviews and observation to triangulate the quantitative data sources. For example, the semi-structured interviews with open-ended questions allowed the participant to expressed their

perspectives freely in their own words. One aspect of qualitative method that deserves attention is the use of quotations from the participants. When reporting research, as a researcher, you want to remind your audience that what you say is based on evidence and that the connections and conclusions you make stem from significant patterns of the data. In this study extensive quotes from the participants used for the analyses ensured trustworthiness and validity of the data as it brought the voices of the participants directly into the analysis of the study (Merriam, 2014). Quoting verbatim from interview for analysis remind readers of direct evidence which strengthens the validity and reliability of the research. However, Cohen, Manion and Morrison (2011) warned that we should not over do it but should be carefully chosen. Although expensive and time consuming, the observation also allowed the participants to be studied in their natural setting and enabled the researcher to understand how the participants socially construct their realities. Additionally, it allowed the gathering of rich data in the natural setting (Lim, 2016). More importantly, trustworthiness procedures such as member checking, triangulation and external audit used in the qualitative study reinforced validity and reliability procedures used in the quantitative to strengthen the validity and reliability of the entire study. In summary, the combination of three data sources used for gathering and analysing data in this single study served as cross-data validity checks (Yin, 2014).

CHAPTER SIX

DISCUSSION, RECOMMENATIONS AND CONCLUSIONS

6.1. INTRODUCTION

Chapter Five described the data analysis of the study. This final chapter presents the summary and discussion of the results. the recommendations of the study, limitations and suggestions for future research work. Futhermore, the research contribution will be presented. Finally, some recommendations would be provided for the Ghanaian Ministry of Education, policy-makers and pre-service teacher educational practitioners to take into account when considering the implementation of ICT to improve Ghanaian pre-service teacher education in the future.

6.2. DISCUSSION OF KEY FINDINGS.

Taken together, there were several noteworthy findings based on both quantitative and qualitative data. The findings of the thesis in relation to each research question are summarised below:

Research question 1:

Question: What are the relationships among variables associated with ICT acceptance among the pre-service teachers?

Based on multiple stepwise regression analyses, all the eleven hypotheses tested were statistically significant, with the exception of hypothesis seven. According to Venkatesh and Davis (2000), the TAM typically accounts 40 percent of the variance. The results from this thesis exceeded the typical results of the TAM to explain 58 percent of variance by assuming a direct effect between LS, TC, PU and ATU and actual ICT usage. Such findings support appropriateness of the TAM across-cultural differences (Tarhini, Teo & Tarhini, 2016). The comparable and strong R square value of this study suggested a good strength of the model under investigation. Hence, the model is acceptable in the Ghanaian pre-service teacher educational context.

Another noteworthy finding in the study was that attitude towards ICT use, perceived usefulness, perceived ease of use, technological complexity and leadership support had a significant positive direct and indirect influence on the pre-service teachers' actual use of ICT

for teaching and learning. However, from the effect sizes, the most dominant determinant of the pre-service teachers' actual use of ICT in the two colleges was technological complexity ($\beta = .247$, $P < .000$) which is an exogenous variable compared with the two original TAM variables PU ($\beta = .118$, $P < .025$) and ATU ($\beta = .173$, $P < .000$). This suggests that TC, which is an exogenous variable, plays a more significant role on the pre-service teachers' actual use of ICT than the two primary original TAM variables. Consistent with this current study is a study by Aypay and colleagues (2012) in Turkey, which found that when a technological product gets simpler to operate, pre-service teachers tend to develop positive attitude towards the usage of it, which in turn increases the likelihood of the actual usage behaviour. The plausible reason for this finding might be that the use of ICT might no more be perceived as complex by the Ghanaian pre-service teachers and, therefore, their adoption are not hindered. This finding is in line with the data from Table 5.4.2 which indicated that the pre-service teacher participant population overwhelmingly fitted within the age range focused on by the 'digital natives' debate in education (Prensky, 2009; Tapscott, 1998), as an overwhelming 76% in College A as against 75% in College B were aged between 18-24 years. This qualified them to be identified as the digital natives, having been born in the digital era (Prensky, 2001). Although Prensky's work generated a substantial criticisms by some researchers (Kennedy, Judd, Dalgarno & Waycott, 2010; Mishra & Koehler, 2006; Oblinger & Oblinger, 2005), it has been understood as an important to the 21st century reality. However, the contrary happened in this study, as 42 percent of the pre-service teachers who claimed to be 'digital natives' reported to be incompetent in using ICT for pedagogical purpose (see Figure 5.4.4). Since the emphasis was on using ICT for teaching and learning purposes, the problem might be lack of pedagogical training in their teacher training institutions. This finding could be linked to BECTA (2008) study in the United Kingdom which found that although the pre-service teachers were found to have good ICT skills in terms of personal use, they were unable to transfer these skills and use ICT in the classroom.

Contrary to other prominent TAM research studies (e.g. Afari-Kuma & Achampong, 2010; Davis, Bagozzi & Warshaw, 1989; Davis and Venkatesh, 1996; Teo & Schalk, 2009) which found that attitude towards ICT use had no significant influence on actual use of ICT, the findings of this research indicated that among the original TAM key constructs, attitude towards use has the strongest positive statistical significant influence on the preservice teachers' actual ICT usage ($\beta = .173$, $P < .000$) followed by perceived usefulness ($\beta = .118$, $P < .025$). This finding is inconsistent with other studies such as Shroff, Deenen & Ng (2011) which

suggested that the role of attitude towards usage (ATU) in the TAM is inconclusive. For example, Davis and Venkatesh (1996) dropped the “attitude towards use” construct from the original model, as they concluded that it did not fully mediate the relationship between both perceived ease of use and perceived usefulness and behavioural intention to use.

Interestingly, concurring with the above researchers (Shroff, Deenen & Ng, 2011; Teo and Schalk, 2009; Davis & Venkatesh, 1996), based on a local research study in one Ghanaian tertiary educational institution, Afari-Kuma and Achampong (2010) also concluded that attitude had no influence on students’ intention to use ICT. The divergence of these findings could be attributed to the different profiles of the students, and the contexts under which the studies were conducted. Afari-Kuma et al., (2010)’s study in Ghana was conducted in a single university where the students were not being trained to become teachers to teach with ICT, while the current study was conducted in two pre-service teacher educational institutions where the students were being trained to become teachers, who would be teaching with ICT in their future classrooms.

Consistent with Anderson & Maninger (2007), who postulated that when new technology is presented to teachers, they make a value judgement as to whether the new technology will be beneficial and enable them to perform their job better than they used to. This study showed that perceived usefulness has a significant positive influence on the pre-service teachers actual use of ICT ($\beta = .118, P < .025$). This implies that the more useful they judge ICT to be, the more likely they will use it (Al- Azawei et al., 2017), suggesting that the pre-service teachers in both colleges have identified adoption of ICT in teaching and learning as better solution to their identifiable problems. This result is congruent with the qualitative results where the participants made positive comments that ICT is an important tool for teaching and learning in the 21st century and therefore, it is no longer an option as they cannot survive without it. However, this finding is inconsistent with Venkatesh (1999) who found that perceived ease of use is a stronger catalyst (over perceived usefulness) in fostering ICT adoption.

Closely related to the above findings was the positive relationship between job relevance and the pre-service teachers’ attitude towards use. Consistent with the literature (Acarli & Saglam, 2015; Al-Gahtani, 2014; Perez, Sanchez, Canicer & Jimenez 2004), the results from Table 5.5.5 showed that job relevance has a significant influence on the pre-service teachers’ attitude towards ICT use ($\beta = .189, P < 0.00$). This implies that since the pre-service teachers’ perceived ICT has relevance to their future job they develop positive attitudes towards its usage.

Therefore, they will be inclined to accept it, and use it in their future classrooms to enhance teaching and learning.

However, contrary to the major TAM research studies (Shroff et al. 2011, Davis, 1989 Teo, Fan, & Du, 2015) while perceived ease of use has a significant positive effect on attitudes towards use, surprisingly, it was found not to have significant influence on perceived usefulness. While this finding concurred with Hu et al., (1999) who found that perceived ease of use was not a significant determinant of perceived usefulness, it contradicted the major TAM research studies (Sherer, et al., 2018; Solangi, et al., 2018; Teo & Milutonic, 2015) which indicated that perceived ease of use is a dominant factor in explaining perceived usefulness and system use. A plausible reason for the lack of support for hypothesis 7 could be that the pre-service teachers in both colleges may not see ease of use as a significant determinant of ICT use, and, therefore, adopt the technology primarily because of the functionality offered TEO, (2014). This suggests that the pre-service teachers gave a priority to usefulness over ease of use of ICT despite the fact that the literature showed that ease of use is a pre-requisite for ICT to be useful (Davis, 1993), otherwise users might not use it appropriately. It is important to establish that ICTs have been in the Ghanaian education system for over a decade (MOEG, 2007), and as a result, the pre-service teachers might have been relatively conversant with some of the advanced and complex information and communication technologies for personal and for learning purposes, and preferred to be challenged when using computers for teaching and learning purposes. Nevertheless, this disparity warrants further investigation to validate it.

With regards to ICT self-efficacy, it was noted conclusively that the pre-service teachers' ICT teaching efficacy has a significant positive effect on perceived usefulness. This finding was coherent with Wozney, Venkatesh and Abrami's (2006) survey of 764 teachers which concluded that one of the two greatest predictors of teachers' technology use is their confidence that they could achieve instructional goals by using technology. This implies that time and effort should be devoted to increasing the pre-service teachers' confidence for using the technology, but not for personal tasks, but to achieve their future students' learning objectives. Ertmer, Ottenbreit-Leftwich & York (2006) and Ertmer (2005) posited that ICT self-efficacy can be achieved by the pre-service teachers working with knowledgeable peers and having access to suitable role models. However, access to suitable role models will be difficult to achieve since most of the teacher educators and the teacher mentors in their placement schools, who are supposed to be their role models, are themselves not competent. It is important to

recognise that although knowledge of ICT is necessary, it is not enough if the pre-service teachers do not feel confident using that knowledge to facilitate their students learning.

Whilst, it is well established in the literature that continuous access to pedagogical and technical support have significant positive effects on perceived ease of use (Ngai, Poon & Chan, 2007), the findings of this study showed that technical support has a negative effect on perceived ease of use ($\beta = -.106$; $P < .039$). This inconsistency could be attributed to the lack of technical support in both colleges as reported in the qualitative study. However, there is a need for conducting further studies to explore what lies behind this divergence.

Significantly, whilst technical support was found to have a negative effect on perceived ease of use ($\beta = -.106$, $P < .039$), the study confirmed that the pedagogical beliefs of the pre-service teachers have a significant positive influence on perceived ease of use ($\beta = .111$, $P < .031$). This implies that the pre-service teachers' personal philosophies directly influence their beliefs towards the ease of using ICT as an educational tool. The confirmation of hypothesis three (H3) is in line with the widely held belief that, where pre-service teachers are in favour of constructivist beliefs and student-centred approach to teaching and learning, they are more likely to use ICT in their future classrooms in a sustainable and intellectually fruitful way (Jimoyiannis et al., 2007; Judson, 2006; Ertmer, 2005). However, this quantitative result is inconsistent with the qualitative findings, which indicated that ICT use in both colleges was predominantly teacher-centred.

From the above discussion, the TAM has proven to be a useful theoretical model in helping to understand and explain pre-service teachers' acceptance and adoption of ICT in the Ghanaian pre-service teacher education context. However, critical analyses of the model pointed out that the original TAM needed to be improved, and that the current model in this study goes a long way in that direction. Over the years the research results with TAM have been generally consistent (e.g. Aypay et al, 2012; Teo, Fan, & Du, 2015). However, in this current study the relationships among the different components of the TAM in this study, it was observed that, in the two case study colleges, the research findings were inconsistent with the original TAM. First, the relationship between PEU and PU, contrary to the major TAM findings, was found to be insignificant. Whilst contrary to other prominent studies (Davis, et al, 1989), that attitude has a negligible influence on actual ICT usage, attitude towards use was found to be the

strongest determinant of the pre-service teachers actual ICT usage among the original TAM components.

Although the study found high technology acceptance among the pre-service teachers and showed that understanding factors affecting pre-service teachers intention to use ICT is a vital issue because they can be used as important precursors to successfully integrate ICT into teaching and learning. The same study also supports Hu, Chau, Liu and Tam's (1999) view that mere acceptance of ICT is not necessarily equivalent to a commitment to use the technology for pedagogical purposes.

Having examined the relationships among variables associated with the ICT acceptance among the pre-service teachers, the next focus was to consider the discussion on research question 2

Research question 2:

Question: What factors promote or inhibit successful integration of ICT in these institutions?

Consistent with Enochsson & Rizza (2009), the quantitative results indicated that access to ICT was not much a problem in both colleges, as an overwhelming 100% of the respondents in both colleges reported having access to ICT (see Table 5.4.3). However, a significant proportion of them (42%) identified themselves as not competent in using ICT for pedagogical purposes (Figure 5.4.4), whilst 19% reported that they were not sure whether they were competent or not. Conversely, the qualitative results indicated that their access to ICT laboratories were restricted, due to over protection of the facility by the colleges' authorities which has forced most of them to buy their own laptops. It further indicated that, although the ICT resources were available, they were time-tabled and had to be pre-booked to regulate access.

Moreover, priority was given to 'special' subjects and departments. Confirming this fact, the ICT coordinator in College B indicated that even though they had two ICT labs in addition to a purpose-built ICT suite at their Social Science department, access to them are time-tabled and priority is given to ICT and Social Science students and staff. This discriminatory nature of access to the ICT facility in the colleges does not augur well for effective integration of ICT in subject pedagogy, as it restricts access. As one student put it: "the computers are just corralled in the ICT labs. Access is restricted which has forced us into buying our own laptops". Improvements in the levels of pre-service teachers' access to computers should be

included as a core element of an ICT in education policy, and all subject areas be given equal access, as inadequate access adversely affects ICT-use, even when all other conditions are favourable. Similarly, a subsidized laptop policy could be adopted for the pre-service teachers to purchase them and pay them in instalments.

Although, it was observed in College B that there were few computers outside the computer labs (e.g. few classrooms, principal's office and the library), in general, the location of ICT resources in both colleges was predominantly the computer labs. This was confirmed in both quantitative and qualitative data in the study (see Table 5.4.4). This barrier was partly attributed to the nature of the classroom buildings and lack of funding. The qualitative study found that most of the classrooms were built nearly half a century ago, and therefore were not built with the installation of modern technologies in mind. In addition, the classrooms were found to be overcrowded, with limited spaces for computers. This points to the reasons why College B was undertaking a project dubbed "Rebuilding and Improving Existing Classrooms", aimed at rehabilitating the old-fashioned classrooms and building new ones fit for the purpose of the 21st classroom environment. This small scale initiative could be similar to a large scale school rebuilding programme dubbed Building Schools for the Future (BSF) in the United Kingdom (BETT, 2010). Dubbed the biggest rebuilding programme since Victorian times, the BSF aimed to provide pupils with inspirational buildings that would make them feel valued and worthwhile, and give them access to new ways of learning fit for the 21st Century (BBC News, 14 June 2011). Successful completion of the initiative will allow the pre-service teachers and teacher educators to have access to modern technology in a classroom environment fit for 21st century.

However in the short term, an introduction of a "laptop trolley" could be adopted as a practical way of moving the technological equipment around the classrooms. As Harrison (2002) documented, that ICT can be used far more effectively for teaching and learning when even a smaller number of computers is placed within the teacher educators' classroom and is integrated into the existing curriculum.

Another significant result from both quantitative and qualitative data revealed that computer ownership by students is a norm in both colleges. An overwhelming 100% and 82% of the respondents possessed cell phones and laptops respectively (see Figure 5.4.3). This phenomenon of high computer ownership could be attributable to the two colleges' "privilege" status for being among the 15 "Discovery Colleges" which receive extra attention from the

government through ICT infrastructure and professional support and secondly, the introduction of Better Ghana Laptop Project (MOEG, 2013). This finding concurs with EkinSmyth's (1998) study of Australian pre-service teacher educational context which found that pre-service teachers' access to their own laptops had been a pivotal agent of change. This was because having access to their own laptops, the pre-service teachers felt they had been treated as professionals, learnt technical skills from the people they were comfortable with, when and where it suited them. The fact that most of the pre-service teachers have their own laptop/computers provides a good basis for developing their expertise in the use of ICT for pedagogical purposes. Additionally, this finding could be a major factor for the strong positive relationship between TC and actual ICT usage. Since the pre-service teachers, and even the teacher educators, possessed their own laptops, they could overcome the difficulties in using the technology, since they can practice how to use the technology at their own time.

Teo (2009) found that the extent to which pre-service teachers are exposed to ICT prior to their teacher training programme is a crucial factor for their adoption and ultimately its integration to pedagogy. However, the quantitative data analysis revealed that an overwhelming 72% of the pre-service teachers from College A as against 44% from College B did not receive any ICT skills prior to their teacher training programmes (see Figure 5.4.2). Similarly, a substantial 68% compared with 59% of the students from Colleges A and B respectively indicated that they did not have any opportunity to be taught with the ICT in their secondary education.

Conversely, 41% of the respondents from College B, as against 32% from College A, reported having the opportunity of being taught with ICT in secondary school(see Figure 5.4.1). These findings indicated that there are different levels of ICT skills and knowledge among the pre-service teachers in both case study colleges. This can cause impediment to teaching the pre-service teachers with ICT, since they do not have the same ICT competence levels. Additionally, College B students seemed to be relatively well-equipped with ICT compared to College A. These differences could be attributed to the geographical location and probably the higher socio-economic backgrounds of the students in College B as against College A. These findings seemed to suggest that the rural-urban digital divide mentioned earlier in the study still exists (see p.8), as College B is located in one of the largest cities in the country, whilst College A is located in a rural area.

The participants seemed to have totally accepted the rationale (even though there were few exceptions) for introducing ICT into education, and were able to base their judgments on understandable reasons. These findings were manifested when the participants were asked to express their beliefs and attitudes towards the use of ICT in their profession. Nearly all the participants expressed positive attitudes towards ICT and acknowledged it as a pre-requisite in the 21st century education, and made a number of positive statements to support their interest. For example, the principal of College B noted that effective use of ICT can improve the educational system in order to prepare the young students to face the challenges of the 21st century (see p.199) and therefore, needed to be given a priority in any educational system.

Similarly, highlighting the importance of ICT as a viable educational tool for teaching and learning, the ICT coordinators in both colleges attributed it to making students take responsibility of their own learning, and also playing a pivotal role in changing teachers' as well as students' roles (Neo & Neo, 2001; Jonassen, 1998) to make them self-reliant and authentic learners. In the same vein, a student in College A enthusiastically reported that effective ICT use supports critical and analytical thinking and, more importantly, provides access to information that could not be otherwise available. The above findings, are consistent with pedagogical (Means, 2006, Partnership for the 21st century, 2010; Ghana ICT Policy, 2015; Hawkrige, 1990; MOEG, 2008) and economic rationales for investing in ICT in education (Education Queensland, Queensland State Education, 2010; African Union, 2004), but in reality, the pedagogical rationale does not reflect the practical use of the technology in both case study colleges as ICT is mainly taught as a stand-alone subject. Consistent with this finding is a study by Buabeng-Andoh (2015) in Ghanaian pre-service teacher education which found that ICT is merely taught as a stand-alone subject and the institutions regards its use to be in the domain of the ICT teachers. This suggests that the focus of teaching ICT in these institutions is equipping the students with ICT skills. It is important to recognise that although equipping the pre-service teachers with ICT skills is regarded as a pre-requisite for ICT integration. However, it is now generally recognised that such stand alone courses are not sufficient to prepare effective ICT-using teachers (U.S. DOE, 2017). Therefore, there is the need for the leadership in these institutions to consider about redesigning their curricula by integrating as integral part of teaching and learning and just regard them merely as a stand-alone course taught by technical experts (Koehler and Mishra, 2009).

Again, not all the participants were in the favour of the change. There were few individual teacher educators who were averse to the use of ICT for pedagogical purposes, and believed

that the status quo must be maintained. Opposing the change, these technology averse staff were of the view that, with their long term experience in teaching, they had been comfortable with the status quo and saw no point in giving it up and adopting a 'novel' system. These teacher educators might be in what Hooper & Potter (2000) described as the "denial phase" of change. According to them, the individual at these phase of change, refuses to accept that change is appropriate, and they produce a wide range of arguments as to why the change does not affect them, and why they need not to take any action. This is akin to the findings of this study. For example, two of the technology averse teachers believed that, as teachers, their duty was to transmit their knowledge to their students, and they found the use of ICT both time consuming and 'time wasting' and therefore, would not waste their time on them. The challenge is how to remove this barrier to win the minds and hearts of those who resist the change. Persuading these teacher educators to use the technology would not be easy. However, there is a way out. The first step is to convince them of the educational value of using ICT; second, to instil within them a belief that they can overcome the challenges to ICT; and finally, by providing them facts and information, together with examples of what other "exemplary" pre-service institutions have achieved.

Despite the positive statements made by the participants for the rationale for integrating ICT in education (see pp. 199-202), the study found that, in general, ICT was used to support traditional modes of teaching in both colleges (Shunk, 2012; Skinner, 1968). This was confirmed by the observations conducted in both colleges. As documented in Chapter Three, the observation of lessons in this study took place in both computer laboratories and normal classrooms with two goals in mind:

- Capturing teachers' utilization of ICT in teaching and learning;
- Documenting ICT infrastructure and its capacity to uptake ICT.

The study revealed that where lessons were observed in the normal classrooms, even if there were computers, traditional 'chalk and talk' behaviourist teaching, which has been criticised by a number of modern researchers such as Mayer (1998) and Jonassen (1994), was prevalent. This was evident in nearly all the lessons observed in the normal classrooms in both colleges. In College A, the normal classrooms where the observations took place had no computers, and as result the lessons were taught in the traditional behaviourist way (Skinner, 1938). In College B, however, even though one tutor used a colourful PowerPoint to deliver his lesson, it was predominantly traditional didactic approach. The teacher educators' role was dispensing

knowledge, whilst students passively received the knowledge. Bates (1995) heavily criticised this pedagogical strategy as poor, as it does not conform to the 21st century learning where students need deep conceptual understanding of complex concepts to generate new ideas.

However, where lessons were observed in the computer labs, there were some elements of a constructivist approach to teaching and learning. For example, in a ‘project work’ lesson observed in College A, the students were found to be working in teams collaboratively and sharing their ideas; hence taking ownership of their learning. The teacher educators’ were also found to be guiding and supporting the pre-service teachers. A similar constructivist element was found in a Science lesson observed in College B, where the students were found to take ownership of their own learning by working in groups collaboratively, whilst the tutor provided scaffolding for them (Tang and Chen, 2011). It was observed that the collaborative group work would not have been possible without using the ICT facilities. The implication is that where students have access to ICT, learning is seen as an active process of constructing, rather than acquiring knowledge (Duffy & Cunningham, 1996), as the students take ownership of their learning and work both independently and collaboratively, while the teacher educators serve as scaffolders, guiding and supporting them in constructing, rather than communicating, knowledge (Harasim, 2012). These are the kind of pedagogical strategies needed in the 21st century knowledge economy to promote higher-order thinking skills and metacognition among students (University World News, 2013).

Conversely, where the students do not have access, even if the teacher educators use ICT as observed in College B’s normal classroom, students were not actively involved in the learning process. The teaching was seen as “a talk show” and the students’ learning was to absorb the teacher educators’ lectures (Shunk, 2012). This kind of pedagogical perspective seemed to be more about helping students absorb facts, and less about helping them to develop as critical thinkers. This finding concurs with the research studies that postulate that teachers and students who have access to ICT are more likely to adopt more constructivist instructional models more frequently, and in a more advanced capacity, than those who have not (Jimoyiannis, 2012; Meyers, et al., 2016). Even though this view has been challenged, However, some researchers still support it (Mereku, et al., 2010).

With 74% of people enjoying access to electricity currently, Ghana’s access to electricity remains one of the highest in Sub-Saharan Africa. Being second only to South Africa, in terms of access to electricity (Volta River Authority [VRA], 2013), it would have been expected that

there should have been a constant flow of electricity. However, all the participants in both colleges, especially the leadership, mentioned erratic power supply as the major barrier to ICT integration. This is not surprising, as the study was conducted in the period where Ghanaians were going through power crisis which resulted in massive load shedding and power disruptions. This is a common phenomenon in most African countries as their power supply mostly depends on hydro-electric power.

To overcome the power crisis, there is the need for government of Ghana to take urgent measures to boost the power supply by diversifying the sources of power, either through wind, solar or thermal plants. Ghana has a huge energy potential for tapping wind and solar energy but currently does not utilise any of them. Currently, Ghana has only built a 2 megawatt Solar Farm in Navrongo. The plans by the government to establish a wind farm that will add between 50 to 80 megawatts of electricity to the national grid and 10 megawatts of solar plants currently under construction at Lawra and Kaleo, even though not enough, it is a good step in the right direction to solve Ghana's periodic power problems (VRA, 2013). Equally important, Ghana could emulate the good examples of the three North African Countries (Tunisia, Morocco and Egypt) who are now using wind power to supplement their existing hydro-electric power supply.

The importance of technical support and maintenance to the successful integration of ICT into pedagogy in pre-service teacher educational context is well established in the literature (ISTE, 2018; UNESCO, 2011). However, the results from both the quantitative and qualitative data of the study showed that the lack of technical support and maintenance was one of the most critical issues reported in both colleges, as a reason for the low level of ICT usage for teaching and learning. Evidence from the qualitative data indicated that both colleges had no full time technical support on-site. As a result, obtaining support was lengthy, time consuming and sometimes did not reach the colleges when it was required.

Strikingly, one estimate of technical support responsiveness by the regional technology coordinators in College A revealed that on average it takes 7 days, and sometimes months, to fix a technology problem that arises in the college. The principal of College A illustrated his frustration on this issue by indicating that currently they had no technical person on-site and therefore when they needed one, they had to pre-book as it takes weeks before they had their turn as the recognised technical staff live far away from the College. Sharing the same sentiments, the Principal in College B also indicated that frequent breakdown of computers,

and difficulty in getting them repaired, was a major barrier. This indicates that the immediacy of response to breakdowns was a key issue and limited both the teacher educators' and pre-service teachers' enthusiasm to try out the new technology. This finding supported the quantitative results, which showed that technical support had a negative influence on perceived ease of use ($\beta = -106, P < .039$).

The above findings concurred with other studies conducted in other African countries such as Nigeria and Tanzania (Evoh 2009; Okebukola, 2012). For instance, Okebukola (2012) found technical support and maintenance as a critical barrier to ICT integration in pre-service teacher education in Nigeria, as they were non-existent, or left in the hands of the casual "amateurs." The above problems are prevalent in African pre-service teacher educational contexts, where often times policymakers fail to recognise technical support and maintenance as an integral part of their ICT initiatives. However, this finding is inconsistent with ISTE (2018) study which indicated that As recommended by two studies in the United Kingdom (Healy, 1998; Ofsted, 2004), in order to ensure reliability of ICT resources and build confidence of the teacher educators and pre-service teachers, there should be a good in-house support by assigning a responsibility to a full time technical support advisor. The challenge is, how are these colleges going to achieve this, given that the Ghanaian government has placed embargo on employment? (see p. 193). Until the government lift the embargo, the problem will continue to persist. Alternatively, if the colleges place more priority on the use of ICT, they could use Internally Generated Fund (IGF) to employ these technical persons, as College B has employed their own part time technical person. Another major approach, that has been adopted by a number of colleges which cannot solve the technical and pedagogical problems individually, is the formation of a partnership with other colleges to share resources and expertise (Dewitt, 2013).

Interviews and survey results from most of the pre-service teachers' lead us to believe that some of the teacher mentors, and even the head teachers in the practicum schools, feel pressured by the structure of current national examinations, the Basic Education Certificate in Education (BECE), to cover the curriculum in conventional ways. Moves to increasingly utilise a constructivist way of teaching (Jonassen, 1998), or efforts to persevere with learning with modern technologies, are undermined by the perceived impossibility of reconciling standard examination and curriculum coverage pressures with ICT integration. For example, while a pre-service teacher from College A indicated that, he was discouraged from using his own laptop for teaching, and concentrate on the syllabus for the pupils to get better grades, a student

from College B also noted that her head teacher wanted to maintain their 100% record passes and therefore, should not waste time using computers. In this context, the prevailing understanding is that what gets tested gets priority and, therefore, teaching with ICT to produce creative pupils with higher thinking skill is relegated to the background. Despite the incessant calls by the Government, and most of the employers in Ghana for rapid change in the education system through the use of ICT, it is more likely that the integration of ICT into teaching and learning will happen soon, and even if it will happen, it will take time. The current assessment system in the basic schools, and the ubiquitous public requirement for examination success constrains the integration of ICT. This suggests that there are many profound difficulties to overcome. One key suggested solution is that the policy-makers need to find ways to increase the presence.

To achieve a successful ICT integration, this study advocates a strong government policy that will adopt a balanced, holistic approach catering for leadership development, relevant professional development for the teacher educators, pedagogical and technical support for ICT-use, as well as improved ICT infrastructure in the pre-service teacher educational sector. This policy should be backed by longitudinal mixed methods studies that will provide regular monitoring of ICT-use in different subject areas, within the pre-service teacher institutions, to provide a basis for informed policy decisions. More importantly, the study proposes that the Ghanaian pre-service teachers' mind-sets must change to include the idea that their future classroom teaching will not be effective without the appropriate utilisation of ICT resources to facilitate their pupils' learning (Ertmer & Ottenbreith-Left, 2010).

Additionally, the study found that there was no adequate provision for ICT professional development for the Principals. Since the success or the failure of ICT integration in pre-service teacher institutions depends on the Principals, several actions have been proposed in this study to equip their capacities to develop positive attitudes to model ICT in their colleges. These include participating in professional training, attending technology conferences, joining technology organisations (example, Association for the Advancement of Computing in Education [AACE]), reading books and journals about ICT, visiting innovative pre-service teacher institutions in the use of technology, finding "experts" to help them, writing technology plans to guide ICT integration. Although, it will not be easy for the principals to fulfil all actions enumerated above, given their busy administrative schedules and other important commitments. However, adhering to them would help them to become knowledgeable and

competent to act as role models by providing visible leadership in the use of the technology and encouragement to their staff for the use of the technology for effective teaching and learning (Liao, et al., 2017).

Research question 3:

Question: What strategies could be adopted to facilitate effective ICT integration in these institutions? This leads us to explore the recommendations of the study.

6.3. RECOMMENDATIONS

The recommendations offered here have been developed based on the findings of the study.

▪ TEACHER EDUCATORS' PROFESSIONAL DEVELOPMENT

In order to achieve a pedagogically effective and sustainable use of ICT in the pre-service institutions in Ghana, the professional development of the teacher educators should be given a priority. The literature review elaborated on a number of approaches to effective professional Continuous Professional Development. However, based on the findings of this study, the study recommends the cascading model to train the teacher educators, who will in turn pass their expertise to the pre-service teachers when they become proficient in the use of ICT for teaching and learning. Adopting this model a number of master trainers should be selected, from each of the selected pre-service teacher institutions, to undergo ICT training (preferably in a country that has successfully implemented ICT in teacher education). The master trainers should be expected to be technology mentors and also with the ability to champion in the use of ICT in teaching and learning in innovative ways. On their return these master trainers will in turn, train their colleagues at their institutions, district or regional levels. Once sufficient people have participated in such workshops, some of them can themselves become trainers, thereby enabling the process by cascading expertise downwards through the education system (Chan, 2002). This approach has been found to be suitable for the initial phase of ICT implementation, where expertise within the education community is limited as revealed in this study. This model has been successfully adopted by a number of South-East Asian countries such as Malaysia, Indonesia, Philippines, Thailand and Vietnam. For example, when Malaysia started its ambitious Smart State ICT initiative in 1997, its Ministry of Education adopted this model to disseminate ICT training in the country. For the Cascading Model to be effective in disseminating effective ICT use in the Ghanaian pre-service teacher education context, it must be hand-on, sustained and continuous, personalised to individual teacher educators needs,

pedagogically-focused and most importantly, should be evaluated at the end using multiple evaluation measures to determine its effectiveness.

▪ RESEARCH AND INNOVATION

There is a need for innovative research in the area of ICT integration to improve these colleges. There should be government intervention to sponsor some of the teacher educators, especially those in leadership positions in the colleges, to go and conduct research in some of the renowned universities in countries such as the United Kingdom, Finland, the United States, or Singapore which are well advanced in the use of the technology in education. The Enlaces initiative in Chile presents a compelling evidence of such strategy. The government of Chile at the threshold of their ICT initiatives (Enlaces) formed a partnership with the Institute of Education, at the University of London for the Chilean academics to conduct ICT research in the areas concerning their reforms. Similarly, Bhutan, in the 3rd face of their ICT implementation, sent 7 lecturers from Paro and Samtse College to Singapore for three months for professional development training at the National Institute of Education (NIE) in Singapore. While in Singapore, the lecturers also visited educational institutions and interacted with staff from e-learning companies (UNESCO, 2008; Wong, 2008). Malaysia, also at the threshold of their Smart State ICT Initiative, sent experts to NIE in Singapore to study their system. The government of Ghana can also take the same steps by partnering with some of the universities in the countries mentioned above, to conduct research in the areas concerning ICT adoption and integration in pre-service teacher education.

▪ FINANCING ICT INNOVATION WITH A PUBLIC-PRIVATE PARTNERSHIP

Public-Private Partnership as possible mechanism for developing sustaining infrastructure and services have created growing interest from governments around the world, Such partnerships were identified at the Rio 1992 United Nations Conference on Environment and Development (Lim, 2016). The Rio Earth Summit as central to achieving global sustainable development. PPP then focuses on the shared responsibility of both public and private sectors towards the provision and maintenance of infrastructure and services for the general population (Lim, 2006). One of the key findings of this study was the lack of funding from the government. For example, the Principal in College A indicated in his interview that their main source of funding for their ICT project was their meagre Internally-Generated Fund which was woefully

inadequate. This suggests that the Colleges are not receiving adequate funding from the government to support their ICT implementation projects. Given that government of Ghana has a lot of responsibilities cannot finance ICT initiatives in all the 38 Colleges of Education in the country alone, this study recommends that for the government to secure sustainable funding to implement successful ICT integration in pre-service teacher educational institutions in Ghana, the government should sign a Memorandum of Understanding (MOU) with local private corporations that have the resources and the desire to undertake social responsibility. In this regard, this study recommend that government should sign MOU with RLG, a local computer manufacturing company which have expertise and resources to partner government to finance ICT initiatives in the pre-service teacher educational institutions. Again, the government could partner with the private Internet providers such as MTN or Vodafone-Ghana to provide cheaper mobile broadband for reliable Internet connections in the Colleges. This will relieve the government the burden of financing ICT facilities in the Colleges alone.

▪ LEADERSHIP DEVELOPMENT

Pre-service teacher institutional leaders play one of the most important roles in initiating and supporting the use of ICT in pre-service teacher education (Yu, et al.,2016). To equip the pre-service teacher educational institution leaders to proficient to successfully lead ICT integration process in their institutions the strategies have been organised into three strands: 1. Meeting the training needs of the current Principals. 2. Need for new generation of leadership, 3. Need for visionary political leadership.

Under this first strand, a set of leadership modules (e.g. Leadership in 21st Century and Leading a Change) should be designed. The modules should be taught through workshop and seminars and should be compulsory to all the pre-service teacher educational leaders. Again, Ministry of Education and the universities could co-create modules leading to Master's Degree for the pre-service teacher educational leaders(Principals) in the country.

The University of Cape Coast and University of Education, Winneba the two Higher Education Institution in Ghana that trains educational leaders should place strong emphasis on training of college leaders such as Principals, Vice Principals, Heads of departments and others. This is one area of teacher education and training that tends to elude the attention of educational policy makers in Africa. This weakness was shown in the study where the Principal in College A, for example, was found to be struggling with the ICT implementation process. There is the need for the universities to customise its leadership programme to match the changing demands for

college leaders especially the Principals to be innovative. As adopted in Philippines during the initial stages of their ICT initiatives, special Masters programme that would help the Principals to develop action research competencies and management of ICT in their institutions should be encouraged. This is to ensure that current and future pre-service teacher institutional leaders develop the skills, the capability and capacity to lead and transform the pre-service teacher education system to better train teachers to meet the needs of the global information and knowledge economy. As Fullan (1992) pointed out if there is no pressure to move then there is a tendency to stick to the status quo. It is therefore, important to have deadlines and clear targets, as well as support required to achieve the targets for the current Principals otherwise all efforts to equip them will come to nothing. The Principals should be made aware of the changing requirements of the 21st century Principal to be innovative to provide opportunities for the teacher educators to enhance the preparations of future teachers to use ICT in effective ways to teach students in the Ghanaian basic schools.

▪ MAKING TECHNICAL SUPPORT AND MAINTENANCE A PRIORITY

The availability of both pedagogical and technical support in the college is important to ensure that the teacher educators actually use ICT in their teaching with impediment (ISTE, 2018). However, inadequate technical and maintenance support was found to be one of the most significant barrier to ICT integration in both colleges. The leadership of the case study colleges should make technical support a high priority within their vision for teaching and learning in their colleges. One approach that has been adopted by a number of colleges, which cannot solve the technical problems individually, is the formation of a partnership with other pre-service teacher institutions to share their expertise (Dewitt, 2013; Liao et al., 2017). Alternatively, the government should invest in good-quality, warranted ICT equipment. The warranties provided by the leasing companies should include on-site technical support. Moreover, the colleges can also reduce pressure on their ICT support staff by training the teacher educators and students on how to use the ICT equipment to deal with minor problems. The formation of ICT Clubs in College A was a good step in a right direction, which should be encouraged in all the colleges. This recommendation is in consonance with Wong (2008), who advised that teacher training curriculum should include training in basic hardware maintenance, instruction in basic networking, and training in simple networks since ICT maintenance is usually an issue in sustaining ICT integration in learning environment.

▪ ENHANCED PARTNERSHIP MODEL ADOPTION

One of the key findings of the study was that the College of Education-Practicum school partnership was pivotal in the preparation of pre-service teachers to adopt ICT for teaching and learning purposes. However, it was found that the relationship was more of a barrier than a driver. Based on the assumption that a well-rounded preparation of teachers is a joint effort between pre-service teacher institutions and practicum schools, this study proposes an Enhanced Partnership Model approach as the most appropriate model to bridge the theory-practice gap to achieve effective integration of ICT to enhance teaching and learning in the Ghanaian pre-service teacher education. The National Institute of Education (NIE) in Singapore, at the initial stages of ICT implementation in 1997, formed a robust partnership with the Singaporean Ministry of Education and some selected practicum schools. To strengthen the relationship along the whole continuum and reinforce the theory-practice nexus, the NIE advocated an Enhanced Partnership Model to leverage on the proven strengths of the NIE's university-based approach, while emphasising a close collaboration with MOE and the schools. With this model, all the three institutions perceived themselves as partners in a common endeavour in teacher preparation, professional development and joint action research (Wong & Goh, 2010). NIE provides formal teacher education within an academic setting, and schools take on more active roles in practicum, and other collaborations that strengthen the link between university-based learning and real classroom setting. Most importantly, the joint efforts of the three partners is enhanced by research, which makes the model research-driven and evidenced-based. Recommending the adoption of this model to achieve meaningful ICT integration in pre-service teacher education in Ghana, the pre-service teacher institutions need to provide formal teacher education within the academic setting, while the primary and junior high schools take active role in the practicum. The Ministry of Education then needs to work in a close collaboration with these two partners.

Tightness between theory and practice practicum helps provide opportunities for pre-service teachers' to experience a greater measure of in-depth substantive learning and meaning in the journey of becoming full-fledged teachers. Although, adopting this model in Ghana will not be without a challenge. The buy-in from the multiple stakeholders in the model including the pre-service teacher education mentors, practicum school based mentors, principals and pre-service teachers may be affected by the time and resources available to them. Overcoming the barriers to a genuine partnership will demand steadfast commitment from both the pre-service teacher institutions and the practicum schools, and most importantly, the Ministry of Education to

advance this partnership initiative. These three partners should perceive themselves as partners in a common endeavour in teacher preparation and not fragmented and disjointed (Wong & Goh, 2010). The strong tripartite relationship has been the key driver of NIE's internationally recognised teacher preparation programmes and is "the envy of other nations".

▪ CHANGES TO ASSESSMENT IN PRE-SERVICE INSTITUTIONS

The current certification guidelines in the pre-service teacher institutions in Ghana should be revised in such a way to make more room for effective opportunities for the pre-service teachers to adopt ICT for their own learning and teaching in the practicum schools. To make this policy successful the standards for assessing the pre-service teachers' preparedness to teach with technology should be a performance based. For example, the assessment guidelines should include a digital portfolio, demonstrating the preparedness to teach with technology as an exit requirement for graduation. Revising the current certification guidelines by adopting ICT for pedagogical purposes, will increase the importance of the pre-service teacher education in providing innovative and effective opportunities for the pre-service teachers to integrate ICT effectively. With a set of ICT standards in the teacher training curriculum, the colleges will be better positioned to organise classroom and professional development activities to develop ICT competencies for pre-service teachers and teacher educators.

6.4. LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

There are some specific limitations that need to be acknowledged in this thesis. The limitations by themselves provide grounds for research opportunities for future investigation.

6.4.1. LIMITATIONS

Despite the positive findings that the TAM is a predictive and robust model, this thesis was not without limitations. Several limitations were identified: First, the thesis adopted a purposive sampling procedure to select second and third year pre-service teachers from only two out of 38 public colleges of education in Ghana. More specifically, this research represents the voices of second and third year pre-service teachers in two colleges of education in Ghana. Again, using pre-service teachers alone, the results may not accurately mirror the experiences of the in-service teachers. Many researchers have cautioned that pre-service teachers' view may differ from those of in-service teachers (Teo, 2014; Wong, 2015) mainly because in-service teachers'

ICT use is directly impacted by school environment. Pre-service teachers in this study may not have been exposed to demands and challenges of a real school setting equipped with ICT. Taken together, the above factors may limit the ability to generalise the findings of the thesis to a wider population of teachers in Ghana. These limitations were due to financial constraints and a limited timeframe for the study; therefore, a nationwide study was not feasible.

Another significant limitation was that this thesis included only eight external variables to the TAM (ICT self-efficacy, technological complexity, leadership support, pedagogical beliefs, technical support and leadership support, Accessibility and ICT Training needs). In pursuit of parsimony, it is possible that this thesis has excluded variables that may impact significantly on technology adoption by the pre-service teachers. This has raised the possibility that other variables not included in the TAM may have the potential to exert influence on the pre-service teachers' adoption in significant ways.

Closely related to the above limitation was that two out of the eight original exogenous variables, Access (.059) and ICT training needs (.059) fell below the recommended Cronbach's alpha threshold of 0.7 and were therefore discarded from the analysis. This may have weakened and contributed to the loss of the explanatory power of the model. Finally, a major part of the pre-service teacher training takes place in their partnership schools. However, this study did not gather data directly from these partnership schools.

6.5.FURTHER RESEARCH OPPORTUNITIES

As the population of this study was limited to pre-service teachers and teacher educators in only two colleges of education out of 38 in Ghana, a nation-wide study should be conducted to confirm the findings to a more general population encompassing the whole of the 38 pre-service teacher institutions in the country.

Further study could include in-service and pre-service teachers in order to establish the extent to which ICT acceptance of pre-service teachers is different from in-service teachers. The results of such study will inform teacher educators to devise a strategy to narrow the gap, if any by providing access to and teaching relevant ICT skills and knowledge at the pre-service teacher training level.

Future research could also focus on the capabilities of informal learning technologies, especially, less expensive Android mobile handsets from China which is ubiquitous in the Ghanaian society. On average, a Ghanaian pre-service teacher possesses at least two Smart phones with Internet access. In addition, mobile devices with Internet outnumber computers because of range of activities feasible when using mobile applications such as WhatsApps and other web 2.0 applications such as wikis, blogging, You tube and others. The impact of mobile technologies is immense in Africa. For example, in South Africa, mobile education known as m-literacy has been adopted to improve literacy using m-novels (Buabeng-Andoh, 2015). Despite the numerous advantages offered by informal learning technologies particularly mobile devices suffer several challenges such as having small screen, limited processing power, small keyboards

The proposed model for this research accounted for 58 percent in the actual use of ICT by the pre-service teachers in teaching and learning. Although this is an acceptable percentage in social science research (Venkatesh and Davis, 2000), 42 percent remained unexplained. Such results suggest that in addition to the six external constructs used in the thesis, efforts to search for other relevant external constructs should be encouraged to make the TAM more fruitful. For future research, additional constructs such as social influence (Wu Chu, Weng and Huang, 2011), facilitating factors (Ramirez, Sabate and Lina-Audet, 2016) perceived enjoyment (Rouibah, 2009) and personal innovativeness (Agarwal and Prasad 1998) are suggested additions to the model. The incorporation of these variables could improve the prediction capacity of the model.

6.6. CONCLUSIONS

Previous findings from the field of technology acceptance research documented that for the advantages of the new technologies to be attained, the technology must be accepted and used (Al-Alzawei, 2017; Teo & Milutinovic, 2015). Using the technology acceptance model as a theoretical framework, the aim of the thesis was to explore factors influencing acceptance and integration of ICT as a tool for teaching and learning in Ghanaian pre-service teacher education context. Again, all the 11 hypotheses tested were statistically significant with the exception of hypothesis 7

Contrary to the prominent prior findings (Aypay, et al., 2012; Teo & Milutonic, 2015; Teo, 2014), this study found that perceived ease of use had no significant influence on perceived usefulness, despite the fact that a large body of literature strongly supports the view that PEU is the strong determinant of PU (Aypay et al. 2012; Davis et al., 1989; Teo, 2014). There is a need for a further research to explore what lies behind this divergence.

Given the pertinence of ICT usefulness in relation to ICT acceptance and integration, pre-service teacher educational programmes in Ghana should enhance pre-service teachers' knowledge and beliefs about usefulness of ICT in teaching and learning. Achieving this, there should be a visible leadership (Principal, teacher educators and others) involvement in the use of ICT for teaching and learning purposes. Seeing leadership lead by example will encourage the pre-service teachers to see the importance of using ICT for teaching and learning purposes.

Similarly, the teacher educators can increase the pre-service teachers' level of ICT usefulness by demonstrating the value of ICT usage in their daily instructional process. This will motivate the pre-service teachers to accept and use ICT for teaching and learning purposes in their future classrooms. However, the problem is that, the teacher educators who are supposed to model the use of ICT for the pre-service teachers are themselves not competent to use ICT in teaching and learning purposes. Therefore, ICT-PD for the teacher educators should be given a priority as the literature indicated that, the extent to which the teacher educators have the knowledge and skills for modelling the use of ICT in their own teaching process (Karlin & Ottenbreit-Leftwich, 2018) is the most critical factor for the successful integration of ICT into pre-service teacher education (Karlin & Ottenbreit-Leftwich, 2018). There should be a sustained and continuous ICT-PD focus on PIE model (Meyers, et al., 2016) for them to enhance their competences in teaching with ICT.

Although it is widely established in the literature that no single leadership style can prove to be appropriate in integrating ICT into pre-service teacher education, the study found that the most effective leadership approach to achieve meaningful ICT integration in pre-service teacher education should be through a shared leadership. With this approach all parties have a vested interest in ensuring that the initiative succeeds.

6.7. CONTRIBUTIONS AND IMPLICATIONS

The study makes several contributions to the field of study: First, research in the field of technology acceptance model comes mainly from the developed world and reflects its distinctive educational culture. This study, with its focus on pre-service teacher education in Ghana, a non-Western cultural educational context, has introduced a fresh perspective to the literature on ICT adoption and integration in the pre-service teacher educational context. To this end, the findings will allow researchers to assess the validity and robustness of the model across cultures. This is in line with Teo (2010), who put forward the need for validating the TAM in different cultural contexts, so as to strengthen its cultural validity. The research has thus, contributed to the literature by validating the TAM in the Ghanaian pre-service teacher education context.

Second, the study has provided a new theoretical model which extended the original TAM by incorporating six exogenous variables (job relevance, ICT self-efficacy, leadership support, technological complexity, technical support) considered to be the most relevant to ICT adoption and integration processes in the Ghanaian pre-service teacher educational context. More importantly, the findings of the study are unique, as the model included pedagogical beliefs, a construct that has been relatively unexplored in the previous TAM studies, and which has shown interesting results in this study.

Another important implication is to develop the teacher educators competences in the use of ICT-enabled teaching and learning tools as a priority to enable them successfully integrate ICT in their daily professional duties.

In addition to the substantial implications discussed above, this study may be of general methodological interest to researchers. The study has shown some of the advantages of applying mixed methods approach to test technology acceptance model. Nearly all the prior studies referred to in the study adopted quantitative methods (e.g. Buabeng Andoh, 2015; Given the methodological superiority of this approach to the more traditional approaches-quantitative and qualitative .

Finally, the thesis serves as a practical guide to the policy-makers and the Principals in the Colleges of Education about how to increase the use of the new technologies in teaching and learning within the Ghanaian education system. In the medium term, it is envisaged that this thesis will lead to a more widespread use of ICT in pre-service teacher education. In the long

term, as teachers are better trained to teach with these new technologies, they will also make better and more widespread use of them in the classroom, which will help equip students in Ghana with the necessary skills to survive and thrive in the fast developing global economy and information society.

6.8. DISSEMINATION

The following publications were submitted during the period of this thesis:

1. Peer-Reviewed Journals

- Adu Gyamfi, S. (2017). Identifying pre-service teachers' readiness for computer use: *A Technology Acceptance Model Approach. International Journal of Education and Development (IJEDICT)*, 13(2), 105-122.
- Adu Gyamfi, S. (2017). Pre-service teachers' attitudes towards information and communication technology. *International Journal of Education and Development (IJEDICT)*, 13(1), 52-69.
- Adu Gyamfi, S. (2017). Informal tools in formal context: Adoption of web 2.0 technologies among geography student teachers in Ghana. *International of Education and Development using Information and Communication (IJEDICT)*, 13(3), 24-40.
- Adu Gyamfi, S. (2018). Investigating the Technology Acceptance of Ghanaian pre-service teachers: An Extension of Technology Acceptance Model, *Australian Journal of Educational Technology (AJET)*. Still under consideration.

2. Conferences/Posters Presentations

- Life Beyond PhD Conference, 26th-29th August 2014, Cumberland Lodge, Windsor, UK. “*Pre-service teacher education in Ghana. Developing ICT for the Global Economy*”

3. Postgraduate Research Presentations

- Postgraduate Methodology Research Conference 14 April, 2014, University of Lincoln, UK. “*What is Triangulation? How can it be used to design qualitative research*”
- Postgraduate Research Conference, 18th April, 2013, University of Lincoln, UK.

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APPENDICES

APPENDIX A– SURVEY QUESTIONNAIRE



For Office Use Only

Entry Number:

UNITED KINGDOM

Survey on the Use of
Information and Communication Technology (ICT) on Pre-service Teacher
Education in Ghana.

[Pre-service Teachers Survey]

PLEASE RETURN THIS QUESTIONNAIRE TO
YOUR PRINCIPAL/ASSIGNED PERSON
OF YOUR COLLEGE

You are invited to participate in this research about integration of Information and Communication Technology (ICT) within Pre-service Teacher Education in Ghana. You have been selected as you are a student teacher in College A, one of the two Case-study Colleges, where this research is taking place. This study is being conducted by Stephen Adu Gyamfi, a PhD student at the School of Education, University of Lincoln in the United Kingdom.

The purpose of this research is to explore strategies for integrating ICT as a tool for teaching and learning in Pre-service Teacher Education Institutions in Ghana. ICT simply means the use of computers, laptops, Internets and peripheries such as overhead projectors and printers for teaching and learning purposes.

Your contribution to this research is invaluable. The results of the study may be published but personal identifiable information is not going to be collected. Although there are some demographic (sex, age, area of specialisation) data, no one will be able to attach a particular set of responses to a particular person. There will be no risk attached, if you agree to participate in this research. You may not benefit personally from this study; however, your participation may provide a long-term benefit by identifying strategies for integrating ICT in pre-service teacher education in Ghana. The returned questionnaire will be kept confidential. The electronic data will be kept secure; no one will have access to it except the researcher himself. Once the research is submitted and approved, all questionnaires will be destroyed.

Your participation in this study is entirely voluntary and that you can choose to withdraw without any penalty. If you have concerns about the research that you think I or my supervisor can help you with, please, do not hesitate to contact me on 0044(0)7578498986 or e-mail: sadugyamfi@lincoln.ac.uk or my supervisor, Professor Terence Karran, School of Education, University of Lincoln, Brayford Pool, Lincoln LN6 7TS, The United Kingdom. E-mail: trencek@lincoln.ac.uk.

If you complete the questionnaire you could be eligible to win an e-reader (Amazon Kindle). If you want to enter into the prize draw, please, provide your details below: (This is optional. This part will be cut out and separated from the questionnaire for the purpose of the draw and to ensure that your answers remain anonymous).

Name.....

E-mail.....

Many thanks for your help in completing this survey,

Stephen Adu Gyamfi, PhD Student.

School of Education, University of Lincoln, United Kingdom.

SECTION A

1. Please indicate the extent to which you agree with the following statements regarding the use of ICT for teaching and learning by putting a tick [✓] in one of the boxes for each statement.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Perceived Ease of Use					
I find it easy to use ICT to do all that I want to do, with respect to teaching and learning					
It is easy for me to become skilful at using ICT for teaching					
Using ICT for teaching requires a lot of mental effort					
Overall I find ICT easy to use in my teaching					
2. Perceived Usefulness					
Using ICT is relevant to my future work as a teacher					
ICT is a useful tool for my teaching and learning.					
Using ICT will allow me to communicate and work with others during work					
Using ICT will improve my teaching performance					
3. Attitude Towards ICT Use					
Using ICT will make my teaching work more interesting					
I am positive towards using ICT as a learning tool.					
ICT can be a useful instructional tool in almost all subject areas.					
ICT is not a high priority in my subject area.					
4. ACCESSILITY					
I find it easy to get access to computers with Internet In my College.					
I am able to use ICT whenever I need it in College					
5. Job Relevance					
I consider ICT to be fundamental to my future job as a teacher					
I consider ICT to be needed by my job					
6. Self-Efficacy					
I feel confident using ICT for my college work					
I can teach with ICT if someone shows me how to do it first.					
I will find it difficult to explain to students how to use ICT.					

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
7. Pedagogical Beliefs					
Using ICT helps me focusing on constructivist practices and student-centred approaches.					
Using ICT provides opportunity for me to collaborate with my peers					
I can use ICT to encourage students take the responsibility of their own learning					
8. Leadership Support					
I am supported and encouraged by my college principal to use ICT in my teaching always.					
My principal provides useful training for using ICT for teaching within my institution.					
9. ICT training					
I receive ICT training from knowledgeable trainers on-site					
I receive ICT training from knowledgeable trainers off-site					
My level of understanding of using ICT improved after attending training					
I lack of training on how to use ICT for teaching and learning purpose					
10. Technical Support					
Availability of adequate technical support helps me use ICT innovatively					
It is easy to have ICT technical support anytime I face difficulty.					
I get technical support when I get stuck using ICT for teaching and learning purpose					
There is an adequate technical support on site					
11. Technological Complexity					
Learning to use ICT takes up too much of my time					
It takes too long a time for me to learn how to use ICT for teaching and learning					

2. Please indicate how frequently you use your ICT resources for the following:

ICT usage	Very Frequently	Frequently	Occasionally	Rarely	Never
Teaching & Learning					
Administration					
Communication					
Searching information					

3. On average, how often do you use ICT in your college? (Please tick one box).

- ☐ Several times a day ☐ Once each day ☐ Several times each week
☐ Once each day ☐ Don't use at all

SECTION B: ICT Experience

4. Did you have any ICT skills before entering your teacher training education?

- ☐ Yes (please go to question 5) ☐ No (please skip to Q 6)

5. Please indicate the kind of skills you had

- ☐ Word processing ☐ spread sheet ☐ Power point
☐ Internet ☐ other (please specify).

6. Did you have any opportunity to be taught with ICT in your Secondary School?

- ☐ Yes ☐ No

7. Do you have access to ICT resources in your College?

- ☐ Yes (Please go to Q8) ☐ No (Please skip to Q9)

8. Where do you generally use ICT resources in your college? (Please tick all that apply)

- ☐ Classroom ☐ Computer lab. ☐ Library ☐ Other (Please state).

9. Do you have any of the following ICT resources? (Please tick the relevant boxes)

- ☐ Laptop ☐ Personal Computer ☐ Cell phone
☐ Tablet/iPad ☐ e-reader (Kindle) ☐ Don't have any.

10. Please indicate the quality of the ICT infrastructure in your College by putting a tick in the boxes below:

Infrastructure	Very Good	Good	Average	Poor	Very Poor	Does not exist
Computer Laboratory						
School website						
Laptop/PC availability						
Educational software						
Internet Access						
Printers,						
Scanners						
Data projector						

11. If you use ICT, how would you describe your level of competence in classroom practice?

☐ Very Competent
 ☐ Competent
 ☐ Not Competent
 ☐ Don't Know

12. Did you have any opportunity to use ICT during your teaching practice?

☐ Yes
 ☐ No

13. If yes, what type of ICT tools did you use? (Tick as many boxes as you can)

☐ Word processing
 ☐ Spreadsheet
 ☐ PowerPoint
☐ Internet Explorer
 ☐ Multimedia
 ☐ Others (please specify)

14. If you did not have any opportunity to use ICT during your teaching practice, please advise as to the reasons why (in the boxes below).

1.	2.
3.	4.

Section 3: Background Information

Please tick (✓) the appropriate box

15. Your Gender? ☐ Male ☐ Female

16. Age Category: ☐ 18 & under ☐ 19-24 ☐ 25-30 ☐ 31-35 ☐ 36 & above

17. Which level are you trained to teach?

☐ Primary [Skip to Q 19] ☐ Junior High School [please go to Q 18]

18. Which subject area(s) are you training to teach?

☐ English Language ☐ Mathematics ☐ General Science
☐ Social Studies ☐ R M E ☐ Technical
☐ ICT ☐ Others (please specify)

19. Is there anything not mentioned in the questionnaire that would make you enthusiastic or reluctant to use ICT for teaching and learning purposes (Please, write below):

.....
.....

20. Would you like to mention anything else related to the use of ICT in your College? (Please write it below):

.....
.....

I will be following up this questionnaire with interviews looking further at how to effectively integrate ICT into teaching and learning in pre-service teacher education. If you are willing to be interviewed, please write your name and phone number below.

Name:..... **Phone number:**.....

Thank you for your valuable time in completing this questionnaire.

APPENDIX B – INTERVIEW PROTOCOLS

INTERVIEW SCHEDULE – PRINCIPAL

Time of interview: _____ Date: _____ Place: _____

Interviewer: _____ Interviewee: _____

Position of Interviewee: _____

Project Title: Pre-service Teacher education in Ghana: Developing ICT for the Global Economy.

This research project aims to investigate integration of ICT in Initial Teacher Training Education in Ghana. The purpose of the study is to explore strategies for integrating ICT as a tool for teaching and learning in Initial Teacher Training Education in Ghana. You have been chosen because you are knowledgeable and that you can provide the information needed to address the purpose of this research. Your participation is invaluable as you may provide a long-term benefit by identifying strategies for integrating ICT in pre-service teacher education in Ghana. Although the study is conducted for academic purpose, its findings may be available for the Ministry of Education so it will help in planning for ICT integration in the future and in implementing other educational reforms. This interview will take between 30 and 40 minutes.

1. Can you please give me a brief background of your college? (E.g. when it was founded, how many students does it have, etc.?)
2. To what extent does your college management offer supportive climate for the use of ICT by staff and students in your college?
 - b. For how long has your college been using ICT for teaching and learning?
3. What do you think are the key contribution and roles of ICT in education?
4. As a principal, to what extent and why, are you in favour of the use of ICT in your college?
5. What are your main curriculum goals for implementing ICT in your college?
6. What strategies or approaches are used in implementing ICT in teaching and learning?
7. What staff development and support services exist in your college with regard to ICT?

8. What ICT-infrastructure (equipment, software, access, to internet and the like) is available in your college? NB. (What's student-computer ratio across the college).

9. What are the sources of funding for supporting ICT development in your college, both equipment set-up and staffing?

10. What are the barriers or factors, if any, preventing your college from adopting ICT for teaching and learning?

Finally, I would like to ask if you have anything to add or any last comment.

THANK YOU VERY MUCH.

INTERVIEW SCHEDULE – ICT COORDINATOR

Time of interview: _____ Date: _____ Place: _____

Interviewer: _____ Interviewee: _____

Position of Interviewee: _____

Project Title: Pre-service Teacher education in Ghana: Developing ICT for the Global Economy.

This research project aims to investigate integration of ICT in Initial Teacher Training Education in Ghana. The purpose of the study is to explore strategies for integrating ICT as a tool for teaching and learning in Initial Teacher Training Education in Ghana. You have been chosen because you are knowledgeable and that you can provide the information needed to address the purpose of this research. Your participation is invaluable as you may provide a long-term benefit by identifying strategies for integrating ICT in pre-service teacher education in Ghana. Although the study is conducted for academic purpose, its findings may be available for the Ministry of Education so it will help in planning for ICT integration in the future and in implementing other educational reforms. This interview will take between 30 and 40 minutes.

1. As an ICT coordinator, what roles and functions are you required to serve in your current position at this college?

2. Can you tell me, how long has your college been using ICT for teaching and learning?
3. What do you think are the key contribution and roles of ICT in education?
4. As an ICT coordinator, to what extent are you in favour of the use of ICT in your college?
5. What are your main curriculum goals for implementing ICT in your college?
6. What strategies/ approaches are used in implementing ICT in teaching and learning?
7. How does your college management encourage the use of ICT among the staff and the students?
8. What ICT facilities are available in your college? To what extent do the teacher educators and the students have access to ICT resources?
9. What are the sources of funding for supporting ICT development in your college, both equipment set-up and staffing?
10. What major difficulties and challenges exist for the ICT team in implementing ICT for teaching and learning in your college?

Finally, I would like to ask if you have anything to add or any last comment.

INTERVIEW SCHEDULE – HEAD OF DEPARTMENT

Time of interview: _____ Date: _____ Place: _____

Interviewer: _____ Interviewee: _____

Position of Interviewee: _____

Project Title: Pre-service Teacher education in Ghana: Developing ICT for the Global Economy.

This research project aims to investigate integration of ICT in Initial Teacher Training Education in Ghana. The purpose of the study is to explore strategies for integrating ICT as a tool for teaching and learning in Initial Teacher Training Education in Ghana. You have been chosen because you are knowledgeable and that you can provide the information needed to address the purpose of this research. Your participation is invaluable as you may provide a

long-term benefit by identifying strategies for integrating ICT in pre-service teacher education in Ghana. Although the study is conducted for academic purpose, its findings may be available for the Ministry of Education so it will help in planning for ICT integration in the future and in implementing other educational reforms. This interview will take between 30 and 40 minutes.

1. Can you please give me a brief background of yourself as a Head of Department in this college?
2. For how long has your college/department been using ICT for teaching and learning?
3. What do you think are the key contribution and roles of ICT in education?
4. As a Head of Department, to what extent are you in favour of the use of ICT in your college?
5. What are the main curriculum goals for implementing ICT in your college?
6. How does the senior management of your college support the adoption and integration of ICT in the curriculum?
7. How does your college management encourage the use of ICT among the staff and the students?
8. What ICT facilities are available in your department/college? To what extent do the teacher educators and the students have access to ICT resources?
9. What are the sources of funding for supporting ICT development in your college, both equipment set-up and staffing?
10. What are the barriers or factors, if any, preventing your college from adopting ICT for teaching and learning?

Finally, I would like to ask if you have anything to add or any last comment.

THANK YOU VERY MUCH.

INTERVIEW SCHEDULE – STUDENT

Time of interview: _____ Date: _____ Place: _____

Interviewer: _____ Interviewee: _____

Position of Interviewee: _____

Project Title: Pre-service Teacher education in Ghana: Developing ICT for the Global Economy.

This research project aims to investigate integration of ICT in Initial Teacher Training Education in Ghana. The purpose of the study is to explore strategies for integrating ICT as a tool for teaching and learning in Initial Teacher Training Education in Ghana. You have been chosen because you are knowledgeable and that you can provide the information needed to address the purpose of this research. Your participation is invaluable as you may provide a long-term benefit by identifying strategies for integrating ICT in pre-service teacher education in Ghana. Although the study is conducted for academic purpose, its findings may be available for the Ministry of Education so it will help in planning for ICT integration in the future and in implementing other educational reforms. This interview will take between 30 and 40 minutes.

INTERVIEW QUESTIONS - PRE-SERVICE TEACHERS

RESEARCH THEMES	INTERVIEW QUESTIONS
Experience prior to teacher training with ICT's?	Taking your mind back to before you commence your study at this college, can you tell me what ICT's you may have used? For what purpose/s were these ICT's used? How familiar are you with Word processing, Excel PowerPoint, Internet, wiki's, Blogs, and Online Chat?
Experience as a student with ICT's?	Have you used any additional ICT's since coming to teacher training? What are the new ICT's that you are now using? How are these ICT's being used? How have you found using these ICT's?

ICT experience in placement school	<p>Do you have opportunity to use ICT in your placement school?</p> <p>How is the infrastructure like in your placement schools?</p> <p>How do you assess ICT culture in the school?</p> <p>How do you assess your mentor in your placement school competency in ICT usage?</p>
Attitude towards ICT's?	<p>How do you feel about using ICT's?</p> <p>From your perspective what are some of the positives of using ICT's?</p> <p>What do you believe are some of the negative aspects of using ICTs?</p> <p>What makes you enthusiastic or unwilling to use ICT for teaching and learning purposes?</p> <p>What motivates you to use ICT in the classroom?</p>
How much and how do you expect to use ICT's in the classroom?	<p>Have you considered using ICTs in your teaching?</p> <p>What are some of the ways that you might expect to use ICTs for learning and teaching in your classroom?</p> <p>What problems do you think you'll face in the use of ICT s in your classroom?</p>

THANK YOU VERY MUCH FOR YOUR COOPERATION

APPENDIX B1: PILOT TESTING AND VALIDATING THE INTERVIEW

Once the interview questions had been completed, they were reviewed together with the supervisor. The pilot study was carried out in July 2014 with two teacher educators and three pre-service teachers in a university in the South-east England, to test the validity of the interview schedule. The purpose was to ensure that the participants felt comfortable with the questions and understood them. This led to some minor changes additions to the questions. Piloting gave the researcher some experience in the use of interviewing and instilled a greater sense of confidence. It also identified questions that needed probing and those that required more clarity.

For example, the first teacher educator advised me to add the last question to ask my interviewees if they had contributions to make in addition to the questions I asked them. This led to the last statement in the interview questions for teacher educators.

Finally, I would like to ask if you have anything to add or any last comment.

Again, Q4 on ICT Coordinator's protocol was found to be repeated. One was deleted:

As an ICT coordinator, to what extent are you in favour of the use of ICT in your college?

APPENDIX C - OBSERVATIONAL PROTOCOLS

COLLEGE: A SUBJECT: PROJECT WORK

OBSERVED TUTOR: MR. HEBERT MENSAH

DATE: 15th October, 2014 TIME: 1400 – 15.00 pm.

PURPOSE: To establish current classroom practices in regard to the integration of ICT.

1. THE LESSON OBSERVED-SUMMARY

- Final year students as part of their diploma award have to write a project work as part of their programme.
- All students write Project work at the end of their course. It was one of the project work classes that I observed.
- Lesson observed at the main computer lab.
- Tutor guided them on how they can use the net for their research
- He worked with them through a number of useful websites for the projects. Majority of the students were more familiar with Google search.
- He later worked with them one on one basis to assist them.
- Majority of the students worked independently.

2. CLASSROOM SETTING

- Computers arranged in pairs on flat tables.
- Each computer host between 2-3 students.

- Classroom was crowded due to its small size.

3. TEACHER EDUCATORS AND STUDENTS UTILIZATION OF ICT

- Students use computers independently
- Though some students shared ideas but it was not effective since they were working on different topics as their project work
- Student-computer ratio 2:1

4. DOCUMENTATION OF ICT INFRASTRUCTURE

- The computer lab had about 20 new Pentium '4' computers and about 5 non-functional ones.
- All 20 functional computers were connected to the Internet
- However, Internet was found to be slow.

5. EVIDENCE OF EFFECTIVE USE OF ICT.

- Tutor guides students not teach them
- Students work both independently and collaboratively
- Students take ownership of their own learning and also
- ICT used creatively to promote active learning

THANK THE TEACHERS AND STUDENTS AFTER OBSERVATION.

APPENDIX D: CONSENT FORM



UNITED KINGDOM

INVESTIGATOR STEPHEN ADU GYAMFI

School of Education, University of Lincoln

Brayford Pool Lincoln, United Kingdom.

Phone 0044 07578498986

SUPERVISOR Professor Terrance Karran

School of Education, University of Lincoln

PROJECT TITLE: Pre-service Teacher Education in Ghana in Ghana: Developing ICT

for the Global Economy

CONSENT LETTER

My Name: _____

Position: _____

I agree to participate in the research project *Pre-service Teacher Education in Ghana: Developing ICT for the Global Economy* being conducted by Stephen Adu Gyamfi, from School of Education, University of Lincoln, United Kingdom. I have read and understood the information about the research, and any questions I had about the research have been answered clearly. I agree that the information gathered in this research may be published in a form that does not identify me in any way.

Signatures: _____ /_____/_____

Participant

Date

_____/_____/_____

Investigator

Date

APPENDIX E - PERMISSION LETTER



SCHOOL OF EDUCATION
BRAYFORD POOL, LINCOLN
UNITED KINGDOM, LN6 7TS
23RD SEPTEMBER, 2014

THE PRINCIPAL,
WESLEY COLLEGE OF EDUCATION
KUMASI-ASHANTI

Dear Sir/Madam,

PERMISSION TO USE YOUR COLLEGE FOR MY ACADEMIC RESEARCH.

My name is **STEPHEN ADU GYAMFI**. I am currently a final year Doctoral student at the University of Lincoln's School of Education. I am undertaking a research titled:

Pre-service Teacher Education in Ghana: Developing ICT for the Global Economy.

The purpose of my thesis is to explore strategies to integrate ICT as a tool for teaching and learning in initial teacher training education in Ghana. The study is designed to address this key question: *How can pre-service teacher institutions in Ghana equip the prospective teachers with the ICT skills and knowledge needed to teach in the 21st Century?*

Why did I choose Wesley College? I chose Wesley College over other Colleges of Education in Ghana based on the following reasons:

- Wesley College is one of the most reputable Colleges of Education in Ghana that has rich ICT resources and infrastructure for ICT integration

- You have knowledgeable teaching staff and students who can provide the information needed to achieve the purpose of this research.
- You have positive attitudes towards ICT for teaching and learning

Your participation in this study is invaluable as your contribution may provide a long-term benefit by identifying strategies for integrating ICT in pre-service teacher education in Ghana. As a Principal (gatekeeper) of the college, I hope you will help me to achieve my aims of the thesis by agreeing to:

1. permit me to undertake 7 semi-structured interviews with you, (the Principal), the ICT coordinator, 2 Heads of departments and 3 final year student teachers.
2. observe 3 teacher educators teaching with ICT in the classrooms or computer laboratories.
3. assign somebody to administer my 200 questionnaires to the pre-service teachers-purposely to those who have experience in teaching practice, thus 2nd and 3rd year students.

PARTICIPANTS SUMMARY

PARTICIPANTS	NUMBERS (N)
PRINCIPAL	1 (INTERVIEW)
ICT COORDINATOR	1 (INTERVIEW)
HEADS OF DEPARTMENTS	2 (INTERVIEWS)
PRE-SERVICE TEACHERS (STUDENTS)	3 (INTERVIEWS-TO BE SELECTED FROM THE 200 QUESTIONNAIRE RESPONDENTS)
TEACHER EDUCATORS	3 OBSERVATIONS
PRE-SERVICE TEACHERS (STUDENTS)	200 (QUESTIONNAIRES)
TOTAL	210

I should like to undertake a-four day field study in your college from **13th to 24th October 2014**. I hope you would grant me the permission to use your college for the field study of my research.

If you have concerns about the research please, do not hesitate to contact me on my mobile phone 0044(0)7578498986 or e-mail: sadugyamfi@lincoln.ac.uk./stevo12013@yahoo.com.

If you need further clarification from a person other than the researcher himself, you can please contact my supervisor, Professor Terence Karran, School of Education, University of Lincoln, Brayford Pool, Lincoln LN6 7TS, United Kingdom. E-mail: trencck@lincoln.ac.uk.

Thank you very much in anticipation. I sincerely apologise for the short notice.

Yours faithfully,

STEPHEN ADU GYAMFI (PhD. STUDENT)

