

UNIVERSITY FOR DEVELOPMENT STUDIES

**TEACHERS' TRAINING AND COMPETENCE IN TECHNOLOGY
APPROPRIATION: THE CASE OF TEACHERS IN SVELUGU.**

FUSEINI ABDUL-SOMED

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APPROPRIATION: THE CASE OF TEACHERS IN SABELUGU.**

BY

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(UDS/MTD/0016/22)

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JULY, 2024



DECLARATION

Candidate's Declaration

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

Candidate Signature.....

Date 13-02-2025

Candidate name: Fuseini Abdul-Somed

Supervisor's Declaration

I hereby declare that the preparation and presentation of this thesis was supervised following the guidelines on supervision of thesis laid down by the University for

Development Studies.

Supervisor's Signature

Date

Name of Supervisor: Dr. Alhassan Wuripe



ABSTRACT

The purpose of this study was to examine teachers' training and competence in appropriating technology as a methodological tool in teaching at Savelugu Experimental Cluster of Schools, in the Savelugu Municipality of Northern region, Ghana. This topic is chosen because, out of the several studies that have been conducted on the prospects of technology in education (for example, Aduwa-Ogiegbaen & Iyamu, 2005; Matthew, Joro, and Manasseh, 2015; Buabeng-Andoh, 2012), few of them has focus on the level of training and competence in-service teachers have or need to have, to effectively appropriate technology in their pedagogy. The topic is also chosen because the schools under study are technology enabled and there is the need understand how these technologies are appropriated and with what technology training and competence. The qualitative research method was followed to address the study's research questions. The case study design was adopted to guide the conduct of the study. Data was collected through observation, document review and administration of semi-structured interviews to Sixteen (16) respondents, who were purposively selected to participate in this study. Thematic analysis of the study's results revealed that, teachers in the schools under study perceived technology as an important tool in their work but had basic knowledge about its integration due to inadequate competence-based technology training programmes, which affected technology appropriation in the schools. The study concluded that teachers lacked the requisite technological competence to appropriate technology in the schools under study. It was recommended that; the Ministry of Education through Ghana Education Service should provide comprehensive and ongoing competence-based training for teachers, and make participation a requirement for point building for licence renewal. The Savelugu Municipal Directorate should also provide consistent monitoring and technical support on ICT and its usage to teachers.



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DEDICATION

I dedicate this work to my late mother, Hajia Bintu CB.



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LIST OF ABBREVIATIONS

ICT	Information and Communication Technology
IT	Information Technology
HEIs	Higher Education Institutions
COVID-19	Corona Virus 2019
LMSs	Learning Management Systems
ASPID	Adoption, Substitution, Progress, Innovation, Deterioration.
TPACK	Technological Pedagogical Content Knowledge
Becta	British Educational Communications and Technology Agency
GES	Ghana Education Service
ICT4AD	Information and Communication Technology for Accelerated Development
MOE	Ministry of Education
OFJT	Off-the-job training
OJT	On-the-job training
UNESCO	United Nations Educational, Scientific and Cultural Organization
CBT	Competence-Based Training
TK	Technological Knowledge
CK	Content Knowledge
PK	Pedagogical Knowledge
MMDAs	Metropolitan, Municipal and District Assemblies
PLC	Professional Learning Community
SSI	Semi-Structured Interview



EMIS	Education Management Information System
Msrc	Mobile School Report Card
NGO	Non-Governmental Organization
DLA	Discovery Learning Alliance
TLM	Teaching and Learning Materials
SMC	School Management Committee
PA	Parents Association
CPD	Continuous Professional Development



CHAPTER ONE

1.0 Background of the study

In a rapidly changing world driven largely by technology, it takes more than just traditional Know-how to perform effectively in an organization (Adam, 2022). Technology permeates every aspect of our existence and as such, its evolution has occurred in ways that were once unimaginable (Roth, 2020). Technology has the ability to change the way teaching and learning is done in contemporary times, it can solve the time and distance-related issues with education (Roger, n.d.). Several studies (Dourish, 2003; Eguchi, 2012; Elayyan, 2021; Young, 2008) has been conducted on the use of technology in education and what role actors in the field play in the context of education in the 21st Century. For example, in a study conducted on classroom use of technology tools in the Kaiserslautern School District in Germany, Young, (2008, citing Elayyan, 2021 & Kleyn-Kenny, 2001) stated that, the world as we know it has been irrevocably altered by the unprecedented, phenomenal advancement of technology, and the impact on every facet of society appears if not difficult but immeasurable.

In the Oman Sultanate, Elayyan, (2021), conducted a study to find out how the 4th Industrial Revolution IR 4.0 products like the internet of things, cloud computing, big data, cybersecurity, artificial intelligence, Blockchain, and robots affect educational variables like control learning, learning opportunities, instructional activities, and social implications. Ellyan found out that machines and robots will take up the jobs of humans in the education sector in the future. Chen, Lin, and Chung, (2023) and Eguchi (2012) confirmed Elayyan's findings by stating that "educational robots have shown the potential



to support the development of students' understanding of abstract concepts and motivate students and enhance their interest in STEM fields”.

That notwithstanding, humans still stand as the central control component of technology use in every sector of society, of which education is no exception. The use of technology by actors in the education sector to perform their job-related task constitutes its appropriation in education. In the words of Dourish, (2003), appropriation is the process by which individuals adopt and modify technologies to suit their working methods, it is similar to customization, but with a greater focus on the adoption patterns of technology and the transformation of practice. In the education sector, technology appropriation is therefore the process through which technological resources are appropriated for use in a certain educational setting. In the context of education, technology use and mastery are just the beginning of the appropriation process, while understanding the potential of technology to improve education is essential (Toure, 2009). In the technology appropriation process, teachers need the requisite technological competence to improve the quality of their teaching activities and develop students' IT competence through training programmes (Phan, Ngo & Phan, 2019). In defining competence, Phan et al, (2019, p.125) categorize competence into two:

“Activity category (competence is the mobilization of knowledge, skills and other personal attributes excitement, belief, will ... to perform a certain type of work in a given context (Education and Training Ministry, 2015); Category of individual attributes (Competence is the characteristic of an individual who demonstrates the



level of proficiency – i. e., can be practiced successfully and certainly - one or several types of activity (Institute of Linguistics, 2010)”

Considering the fast evolution of technology in education, teachers are under duress as they are required to implement technology in the classroom; they encounter numerous obstacles as they attempt to weigh the benefits and drawbacks of utilizing technology as their platform for educating students (Mijares, 2022). This cannot happen without teachers being equipped with contemporary pedagogical and digital competencies in order to conform to the standards of rapidly evolving educational trends. Instefjord (2015, p. 315) defined digital competence as:

“The set of knowledge, skills, attitudes (thus including abilities, strategies, values and awareness) that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, socialising, consuming, and empowerment”.

Instefjord argued further that digital competence for teachers also involved teachers’ ability to use technology to influence learning outcomes in the knowledge building process, through the dimensions captured in the definition above. Teachers would be able to optimize the appropriate use of technology in the classroom as a result of the training they receive in the competence areas of the technology pedagogy (Mijares, 2022). Toure (2009, p. 103) observed that, “There is little concern for training teachers, while teachers need opportunities to learn to use these technologies and make them meaningful for their





teaching and their own professional development and lifelong learning”. Training refers to any action that teaches people how to act in a skilled way. Training is about getting people to learn new skills, and teaching is definitely a skill. In these ways, "training" means learning to the point where it becomes natural, so that the student can show the skill even when things are hard (Guzdial, 2010).

Several studies(Bevort & Breda, 2008; Instefjord, 2015; Phan et al., 2019) have been conducted on technology appropriation in education by different scholars around the world. For example, in Europe and Bevort and Breda, (2008) conducted research on young people’s digital media appropriation in an education perspective and found out that there is a significant gap between home and school appropriation in both countries. They (Bevort and Breda) opine further that, Information technology is not just an "object" of knowledge; it also requires familiarity and a certain level of competence. In addition, the use of technology whether as a project or a process, necessitates the observation of how they are appropriated, taking into consideration their particularities and undetermined factors.

In Vietnam, Phan et al. (2019) conducted a study to analyse the information technology application competence of teachers in online teaching. The study concluded that, the best way to develop IT application competence of teachers in online instruction is by identifying criteria for using technology, constructing content instruction, selecting appropriate teaching methods, and encouraging student participation and evaluation for optimal results. 95% of the 110 teachers in the study agreed that there should be a standard IT competence framework, guiding the use of technology in teaching. On the other hand,

62% of the study participants agreed that, it was very necessary to integrate technology with pedagogical methods.

In an article to explore opportunities for appropriation of digital competence in teacher education in two teacher training institutions in Norway, Instefjord, (2015, p. 2) found out that similar challenges were found in both teacher education institutions under study. The findings indicated that there is “conflict between mastery and appropriation, and between personal and educational use of technology, and the resistance towards technology among some teacher educators”. Instefjord believes that technology use as pedagogical tools for teaching and learning in all subjects in the teacher education programmes, forms part of the foundation for building digital competence in pre-service teachers.

Within the African context, several studies (Bozalek, Ng, & Gachago, 2013; Abdelwahed, 2014; Nafukho & Muyia, 2013) have been done on the use of technology in education. For example, in South Africa, Bozalek, Ng, and Gachago (2013) in a study, which is focused on the use of emerging technologies for teaching and learning in South African Higher Education Institutions (HEIs). The study concluded that, by recognizing and communicating with change agents, as well as developing policies to encourage institutional-wide engagement with emerging technologies, opinion leaders can foster a more receptive environment for the adoption and diffusion of these technologies-

In Tunisia, Abdelwahed, (2014), wrote an article which draw up an inventory of the process of the integration of ICT in teaching practices in the Tunisian school context. The purpose of the study is to comprehend why and how a select group of instructors were





able to successfully integrate ICT into their classroom practices. The article highlighted and appreciated innovative and creative teachers who have successfully integrated ICT and overcome a number of "obstacles" in integrating technology in their classroom instruction. A study conducted by Nafukho and Muyia, (2013) in Kenya, examined the World Bank's education policies in Africa with special focus on AVU Kenyatta University Project. The study critically examined the use of information technology (IT) in distance learning project initiated by the World Bank in Kenya and found out that Higher education institutions on the continent have become more digital, and self-paced learning and internet classes are becoming very popular.

According to Abukari (2018), some universities and institutions in Ghana provide pre-service teacher preparation programmes that give pre-service teachers both material and pedagogical training. Abukari emphasized emphatically that "even the best of pre-service teacher training cannot equip one for a lifetime of teaching," (p.1). Teachers' professional and personal development depends on their access to ongoing professional development and on-the-job training. In order to ensure that working educators have the knowledge, dispositions, and abilities to do their jobs well in the 21st century, it is essential that they receive ongoing training and professional development to enhance their competence to deliver. The provision of access to technological tools as stated earlier does not work in isolation, but in conjunction with good teacher training and mastery of competence to operate them (p.16).

Ibrahim, Ibrahim, and Fuseini, (2022) in their study conducted in the Sagnarigu district of Ghana, argue that, one of the main modern technologies in industries is ICT which has



a great influence on every aspect of our society but its usage in the Ghanaian education sector service delivery is limited especial at the pre-tertiary school's level (cited in Hammond, 2014; Wang, Chen and Liang, 2011). Ibrahim et al opined further that, one of the fundamental strategies in the delivery of a 21st Century education which can maintain service standards in emergency situation is the use of ICT. This was manifest in some Ghanaian pre-tertiary schools, most of which relied heavily on delivering their contents online during the outbreak of the COVID-19 pandemic, which almost distracted the academic calendar of Ghanaian pre-tertiary schools. The experience of the pandemic period in Ghana drives home the need for Ghanaian teachers to prepare themselves appropriately in order to maximize technology use in their pedagogy, which will inversely translate into maintaining standards while enhancing the efficiency of students to utilize these technology tools to their benefit, as students in the 21st century (Ibrahim et al., 2022).

From the foregoing, it is clear that the way we teach and learn could be impacted by technology, when it is accepted and appropriated by teachers as a methodological tool. Several studies have been conducted on the prospects of technology in education (for example, Aduwa-Ogiegbaen & Iyamu, 2005; Matthew, Joro, and Manasseh, 2015; Buabeng-Andoh, 2012), but few of them has focus on the level of training and competence in-service teachers have or need to have, to effectively appropriate technology in their pedagogy, especially within the Savelugu Municipality. Without teachers having the requisite training and competence, technology will only remain at the design stage without being implemented. It is only when teachers have the requisite training and competence that they are better placed to appropriate technology, anxiety in

technology use sets in, when teachers lack the requisite training and competence. In this regard, this study aimed to get an understanding of teachers' perspectives and experiences with the integration of technology into teaching practices in Savelugu Experimental Cluster of Schools.

1.1 Problem statement

Even though the use of technology in education has gained prominence among educators in the 21st century, much work still needs to be done to understand how teachers use technology as part of their pedagogical practices in the classroom, especially in countries that are still growing in the field of technology. However, the effectiveness of this integration depends on the competence of teachers in using these technologies. As regards the use of technology in education in Ghana, governments have paid much attention to curriculum design and provision of technology infrastructure to schools with little efforts being directed to why technology is working or not working in the education sector (Natia & Al-hassan, 2015; Antwi, Bansah & Franklin, 2018). A classic example of this government of Ghana support to schools is the cluster of schools under study; where computing is taught as a subject and the government of Ghana in collaboration with Non-Governmental Organisations, have provided the schools with the requisite technology infrastructure needed to integrate technology into pedagogy, but technology seem not to be working for the schools. This has shelved issues pertaining to the teachers' perspectives and experience with technology training programmes challenges teachers face, and teachers' overall competence in using technology in classroom teaching practices (Ryan, McGarr, & McCormack, 2020; Davidson, 2012; Oyunge, 2021). This



led the researcher to look at the concept of technology appropriation in education relative to teacher training and competence in implementing it in their pedagogy.

It is imperative to look at the level of training and competence teachers have in technology use, how they appropriate technology in the classroom and the challenges teachers face while adopting technology in their teaching practices. In keeping with Voogt, Fisser, Roblin, Tondeur and Braak (2013), Mncube, Tanner and Chigona (2021) assert that, by using information and communication technologies (ICTs) in a method known as technology appropriation, both developed and developing countries have experienced technological empowerment as a result of globalization and digital progress. In Lin, Liu, Hwang, Gwo-Jen, Chen and Yin (2022), technology appropriation is viewed as the practice of using a device, artifact, or program for the purpose of enhancing one's own learning and professional growth (p.2). This intricate process is affected by several variables, including the surrounding environment, personal perception and experience with technology training programmes, acquired competence, and innovative thinking of teachers in the technology integration process.

From the previous studies above, it is clear that technology and its appropriation have been studied previously by different researchers in developed countries (Lin et al. (2022); Mncube et al., 2021 and Voogt et al. 2013); however, teachers' level of training and competence in appropriating these technologies have received very little attention in developing and emerging economies like Ghana, since it is still a developing concept. Most of these studies employed quantitative approach than qualitative. There is therefore the need to assess teachers' level of training and competence in technology appropriation,



using qualitative approaches like interviews, observation, and document review in the Ghanaian context, specifically in the Savelugu Municipality. This study therefore aims to assess teachers' training and competence in technology appropriation among teachers teaching in Savelugu Experimental Cluster of Schools (Savelugu Experimental Primary "A", Savelugu Experimental Primary "B" and Savelugu Experimental Junior High School), within the Savelugu East Circuit of Savelugu Municipality in the northern region of Ghana, with the goal of understanding teachers' perspectives and experiences with the integration of technology into teaching and learning.

1.2 Purpose of the Study

The purpose of this study is to examine teachers' training and competence in appropriating technology in pedagogy at Savelugu Experimental Cluster of Schools, in the Savelugu East Circuit of Savelugu Municipality of Northern region, Ghana.

1.3 Research objectives

The study addressed the following objectives:

1. To find out the perception of teachers in Savelugu Experimental Cluster of Schools, regarding the role of technology in their pedagogical practices.
2. To understand the nature of teachers' experiences with technology training programmes in Savelugu Experimental Cluster of Schools.
3. To determine how technology training programmes have contributed to teachers' pedagogical competence in integrating technology in classroom.
4. To identify challenges encountered by teachers in Savelugu Experimental Cluster of Schools, when incorporating technology into their instructional practices.



1.4 Research questions

This study considered the following research questions:

1. What is the perception of teachers in Savelugu Experimental Cluster of Schools, regarding the role of technology in their pedagogical practices?
2. What is the nature of teachers' experiences with technology training programmes in Savelugu Experimental Cluster of Schools?
3. How has technology training programmes contributed to teachers' pedagogical competence in integrating technology in classroom?
4. What are the challenges encountered by teachers in Savelugu Experimental Cluster of Schools, when incorporating technology into their instructional practices?

1.5 Significance of the study

This study holds significance as it will add to knowledge in the area of technology use in education relative teacher training and competence. It will also increase literature and serve as reference material to researchers on the mushrooming concept of technology appropriation in education within the Ghanaian and global context. The findings of this study will have practical implications for educational stakeholders, including policymakers, curriculum developers, and teacher trainers, and may contribute towards improving technology appropriation in schools and enhancing teaching and learning outcomes.



1.6 Limitations

The study had limitations in the following aspect of it:

1. Sample size: Because the study had a small sample size, the results may be limited in their applicability to a larger population.
2. Because Savelugu Experimental Cluster of Schools were the exclusive focus of the study, the findings may not be relevant to other contexts or settings.

1.7 Delimitations

The study was delimited to understanding teachers' perspectives and experience with technology appropriation in pedagogy, by looking at their technology training, the problems they face, and how competent they are in using technology in the classroom as a whole. Other variables such as technology infrastructure, availability of support system, availability of internet and impact on academic performance were not looked at. The study also covered teachers teaching in the Savelugu Experimental Cluster of Schools in the Savelugu East Circuit of Savelugu Municipality in the Northern Region, because technology appropriation will be possible in those schools, since they have the requisite technology infrastructure for that.

1.8 Organization of the Study

The study comprises five chapters. Chapter one looked at background of the study, problem statement, purpose of the study, research objectives, and research questions. Also in this chapter, significance of the study, limitation, and delimitations of the study were presented. In chapter two, related literature was reviewed on historical development



of technology in education, concept of technology appropriation, concept of training, concept of competence, and conceptual framework of the study. Chapter three presented the methodology, which embodied research design, population, sample and sampling technique, data collection procedure, data analysis procedure, and ethical issues. Chapter four was focused on results and results discussion. Finally, chapter five presented summary of findings, conclusions, and recommendations for further research.



CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

This chapter reviews relevant professional and academic literature related to the topic under study. A literature review is a summary of the literature relevant to a specific subject or sector. This aspect of the study will review literature related to technology appropriation in education, teacher training and competence, challenges teachers face in technology appropriation and how this can generate new framework and perspectives that will influence the pedagogical practices of teachers.

2.1 Conceptual Review

This section of the study was divided into six (6) sub-sections as follows:

1. The concept of Educational Technology
 - (a) What is Educational Technology?
 - (b) Historical Development of Educational Technology
2. The concept of Technology Appropriation
 - (a) What is Technology appropriation in Education?
 - (b) Components of Technology appropriation
 - (c) Technology and the Ghanaian Basic Schools Curriculum
 - (d) Challenges teachers face in appropriating technology
3. The concept of Training
 - (a) What is Training?
 - (b) Types of Training
 - (c) What is Teacher Training?



(d) Types of teacher training

(e) Role of Teacher training in promoting Technology appropriation in pedagogy

(4) The Concept of Competence

(a) Meaning of Competence

(b) Types of Competence

(c) Competence-Based Training

(d) Teacher technology competence and appropriation

(5) Theoretical framework

(6) Conceptual Framework

2.1. Concept of Educational Technology

2.1.1 What is Educational Technology?

Shetty (2020) viewed technology as the tool for building tools. In the context of education, technology is seen as a tool to aid the teacher in enhancing delivery of effective lessons in class. It must however be noted that technology in and of itself cannot operate as a naturally occurring entity without human interaction. While we all dealt with the pandemic problem, technology became deeply embedded in every part of our daily lives, including paying bills, purchasing, giving presents, and even teaching (Alashhab, Anbar, Singh, Leau, Al-Sai, and Abu Alhayja'a, 2021, p. 2). When technology is used in education it is referred to as educational technology (Joshi, 2023), as a result, it is critical for modern educators to be technologically literate. Particularly given how much more technologically proficient the younger generation is than we are (Shetty, 2020).

According to Teachmint (2021), educational technology refers to the practice of introducing technology into the classroom in order to provide students with a more





diverse learning environment. Some classical examples are usage of interactive screens in classrooms, online training classes offered throughout the outbreak, and the development of software designed for schools to assign and submit assignments (Teachmint, 2021). Lathan (2019) argues that educational technology deals with using new technology to come up with and use creative ways to teach and help students do better in school. Technology use in education has proven to have a tremendous improvement in teaching and learning process, with teachers leveraging technology for researching online to prepare their teaching and learning materials (Prayudi, Hakiki, Putra, Anzka & Ihsan, 2021).

Educational Technology encompasses the examination and exploration of the various stages involved in the analysis, planning, development, implementation, and evaluation of the instructional environment, learning materials, learners, and the learning process. Its ultimate aim is to enhance the quality of teaching and learning (*What Is Educational Technology and Why Is It Important?* 2021, para. 1). With educational technology, teachers are able to improve upon their practice and meet the learning needs of their learners while also being innovative in solving work related problems. The implementation of technology in education has significantly transformed the landscape and generated a plethora of educational prospects. While numerous educational technologies have benefited both students and instructors, instructors have also gained the ability to integrate technology into their lessons (Roy, 2019). Roy argues further that, active involvement with the subject matter is facilitated by technology. By actively participating, conducting research, and receiving assessment feedback, it facilitates an interactive learning environment for students.



2.1.2 Historical Development of Technology in Education

Historical antecedents clarify the significance of technology in education, a practice that may be traced back to a minimum of 2,500 years (Stefanou, 2022). To gain a deeper comprehension of the role and impact of technology on education, it is necessary to delve into its historical context. By examining the past, we may uncover valuable insights and draw important conclusions (Bates & Bates, 2015). The group (Bates & Bates) explained further that, the long history of education is made up of four eras: the Stone and Rock age, the Book print and Blackboard age, the Mass media age, and the Digital age. Early humans' sole access to instructional technology during the Stone and Rock age, was through the employment of tools made of stones and rocks to mark up and show their learning on cave walls (Bates & Bates, 2015). The period of prints and chalkboards began in the fifteenth century with the introduction of the printing press (Elston & Rislow, 2021). This led to increased use of books and lecture notes, which replaced hand-made copies. The chalkboard or blackboard was also introduced during this period and became a common tool in the classroom for illustrating and writing learning materials.

The mass media age began with the invention of radio and television, which became popular tools for education in the 20th century (Cant, 2021). Later, educational films and slides were introduced as additional educational tools. Finally, we have the digital age, which started with the invention of computers in the mid-20th century (Meyer, 2018). The emergence of the internet and World Wide Web in the 1990s led to increased use of technology in educational settings (Smith & Meyen, 2017). Online courses became available, and new tools such as Learning Management Systems (LMSs) were introduced for effective delivery and management of educational content (Bradley, 2021). Today, in



the digital age, educational technology is an essential tool that is used extensively in all levels of education. The integration of technology in education is crucial for fostering robust academic systems (Andrei, 2023). Andrei argue further that, the quick shift in curriculum has significantly propelled the evolution of technology. Continuous professional development and training of teachers is therefore essential for technology use in education (Ahadi, Bower, Lai, Singh & Garrett, 2024), as novel and increasingly potent innovation emerges each year. Teachers must continuously modify their instructional methods to accommodate emerging technologies. With its continuous development, an increasing number of instruments are facilitating enhanced learning.

This need for professional development for teachers has been necessitated by a plethora of research findings from studies conducted since the inception of technology into education. Several of these studies have been carried out on the prospects of technology in education with a focus on teachers and their utilization of technology, relative to the computer skills teachers have and the availability of technology tools in schools. These studies have consistently found that the availability of technology tools has significantly increased (Anderson & Ronnkvist, 1999; Puma et al., 2000; Smerdon et al., 2000 as cited in (Judson, 2006)). There are yet other studies that delved into the frequency and ways in which these new technologies are being utilized by teachers for instructional purposes. For example, Seifert, Sheppard, and Wakeham, (2015) and Hartman, (2008) found out that, despite the increasing availability of technology in schools, there has been no significant transformation in the way teachers deliver instruction. Also, Gunasekera and Balasubramani, (2020) discovered that, just 50% of public school instructors who had access to computers or the Internet in their classrooms actually utilized them for

instructional purposes. There is therefore a greater need for teachers to continuously upgrade their technology skills to scale up to evolving trends of technological development in education.

2.2 The Concept of Technology Appropriation in Education

2.2.1 What is Technology Appropriation in Education?

Fidock and Carroll (2006), viewed technology appropriation as a framework for the adoption, adaptation, and integration of technology into work processes and that users finish the design process as they adopt a technology. The group opine further that users' attitudes and behaviours towards technology are influenced by the qualities of the technology, user characteristics, and organizational and environmental context. Similar to the view of Fidock and Carroll, You, Robert Jnr, and Rieh, (2015) also defined technology appropriation as the process of individuals or groups adapting and modifying technology to suit their specific needs. Innovation necessitates effective communication, devotion, and unwavering dedication from the individuals engaged in the creative process. Despite its widespread dissemination, technology has not yet fully achieved its promise of complete integration into society (Schumarova and Swatman, 2006 as cited in Simões & Gouveia, (2011, p. 4)). Technology appropriation in education therefore commences when educators experiment with a particular technology, adapting it to suit their personal or collective professional requirements, and subsequently incorporating it into their daily routine practices.

In their paper in Korea, You et al., (2015) argue that, although appropriation of technology may benefit individuals, it inhibits the sharing of information within and





between teams as result of misalignments in technology usage. Urrea (2006, pp. 2–3) puts technology appropriation into three levels; the technology tool, usage of the functionality of the tool, and using the technology tool as a way of learning. Simões and Gouveia (2011, p. 2) are of the view that, “whereas mastering a tool involves acquiring the skills necessary to use it, appropriation goes beyond that and includes also the development of competence to use that tool in a social context”. Rogoff (1995, cited in Simões & Gouveia, 2011) states that “Appropriation is a form of internalization, because it is not just a matter of a person knowing how to use the technology at ease, but rather to take ownership of something that hadn't previously belonged to that person” (p. 2). Appropriation occurs across various social strata, encompassing both the individual user and the broader sociocultural context in which the technology is applied. This suggests that individuals who utilize technology gradually develop greater skill and expertise in utilizing a certain set of tools within a social setting (Overdijk & Van Diggelen, 2006). Laffey (2004), considered technology appropriation as not linear but rather starts from creation of awareness through appropriation to innovation in technology use to bring about desired goals in using such tools. Laffey supports this claim by stating that mastery of a technology tool is not necessarily appropriation of it, it may be appropriated in some circumstances but not in others. This mean that appropriation could be viewed as contextual or situational. Technology appropriation is guided by models which can be used to access the level of integration of technology. In the context of education, many models direct how technology is integrated into education. Prominent among the models is the ASPID model (Adoption, Substitution, Progress, Innovation, Deterioration) by Karsenti & Bugmann (2018), which can be utilized by educators seeking to completely



integrate technology into their teaching practices and enhance its effectiveness for both instruction and learning. Karsenti and Bugmann argued that, to properly incorporate technology into their teaching practice and fully understand the inherent advantages for education, teachers must address intricate challenges that extend beyond mere proficiency with a few tools. They opined further that, in order for educators to appropriate technology, they need to be guided by conceptual models to assist them comprehend the intricacies involved in integrating technology into teaching.

Karsenti and Bugmann's ASPID model proposes several levels of appropriation, starting with *Adoption phase*; which requires teachers to commit a lot of time and resources into actually using technology. Teachers at this phase also need to find the pros and cons of using technology in practice and finding their way around them. The *Substitution phase*; which entails a clear substitution of technology with the traditional pedagogy, making teaching as comfortable as the pre-adoption period. The *Progress phase*; which entails a more beneficial use of technology by teachers in the teaching and learning environment. The *Innovation phase*; which involves the use of technology by teachers in a more evolved and innovative ways, achieving previously impossible task in the traditional pedagogy. The *Deterioration phase*; this phase shows a declining use of technology, highlighting the shortcomings of technology use and has the potential to send technology users back to the adoption phase. As teachers and students travel through these levels of technology appropriation, they discover themselves in the appropriation dilemma and make learning more successful.



Technology appropriation in education is influenced by several factors. In his doctoral thesis, Lin (2005) concluded that social and technological factors are salient and affect students' technology appropriation behaviour, learning, and satisfaction. Technology appropriation has a link with the concept of wholeness, in which all system elements are interconnected to form a single entity (Rizzo, Caporali, Conti, Montefoschi, Burrelli & Sinopoli, 2019). For instance, two important components of technology integration, namely content and pedagogy cannot be overlooked when incorporating technology into lesson delivery. In other words, Instructors are not effectively integrating technology into instruction when they merely provide students with a set of technological tools to engage with without also addressing pedagogical concerns" (Kim & Jensen, 2020, p. 140; Buabeng-Andoh, 2012 p. 2).

In an article written on how educators in Ghana utilize new technologies, Boateng (2022) explored how new media technologies is utilized for teaching, research and student engagements, and concluded that:

Educators 'appropriation of technology is impeded by macro-level infrastructural challenges, such as unstable internet connection and erratic electricity supply. However, other micro-level challenges, such as the ability to purchase internet data, invasion of personal privacy and low digital literacy of some educators, also challenge their usages of new media technologies. These impediments invariably impact technology appropriation and usage of new media. (p.7)

Maimun et al. (2017) as cited in Mijares, (2022, p. 23), enumerated more specific factors that encourage or discourage teachers from incorporating technology into instructional

implementation. These factors include teacher skills, school infrastructure, budget allocation, teacher confidence, quality technical support, workload, access to technology, teacher practices, education system structure, curriculum character, and system of collaboration among peers.

In his work which reviewed literature on the use of ICT by teachers and factors influencing the adoption and integration of ICT into teaching and learning in Ghana, Buabeng-Andoh (2012, pp. 137–147), outlined thirteen (13) factors which influenced teachers' decision to adopt and use technology in pedagogy as follows:

- Personal Characteristics
- Teachers' attitudes
- ICT Competence
- Computer self-efficacy
- Gender
- Teaching Experience
- Teacher workload
- Institutional characteristics
- Professional development
- Accessibility
- Technical support
- Leadership support
- Technological Characteristics





Personal Characteristics

Fear, anxiety, and a lack of confidence and competence can cause technology to take a back position to traditional instructional methods. Consequently, it is essential to comprehend the personal factors that influence teachers' adoption and utilization of technology in the classroom (Russell and Bradley, 1997). Appropriation of a technology may be affected by factors such as an individual's degree of education, age, gender, amount of computer expertise, level of comfort using computers in the classroom, and general attitude towards such devices. It is strongly recommended that teachers adopt and integrate ICT into their classes. However, the effectiveness of the technology relies not on its mere appearance, but on the instructors' proficiency in utilizing it (Jones, 2001; Schiller, 2003 as cited in Buabeng-Andoh, 2012).

Teachers' attitudes

Teachers' attitude and perspective about technology use in their teaching practices plays a central role in the successful implementation of technology in any educational setting. In a study which was conducted on the attitude of Turkish science teachers towards ICT use in teaching, Cavas, Cavas, Karaoglan, and Kislal (2009, p. 9) cited Chio (1992) as saying that "old teachers have more positive attitudes toward computer use in education than young teachers, but he found that young teachers are more computer literate people than the old teachers". The age of teachers is seen to have a correlation with their decision to appropriate technology. Several studies also found computer ownership and computer competence to be contributing to positive attitude of teachers towards technology use in teaching. However, personal computer ownership is seen as an indicator of computer competence of teachers, as it guarantees access and consistent exposure to computer



usage (Tyler-Wood, Putney, & Cass, 1997). Anxiety, which entails how uncomfortable some individuals become when they have to utilize a computer; how apprehensive a person feels while interacting with computers, is a terrible emotion in every way, that can make a teacher develop negative attitude towards computer use (Dias, 2009). In the view of Knezek and Christensen (2002), teachers' attitudes towards the use of technology are complex and can become more favorable with regular training that is tailored to their need. However, anxiety related to technology tends to decrease rapidly when teachers have real experience with it.

ICT Competence

In an article that investigated the influence of teachers' ICT (Information and Communication Technology) competence on their decision to adopt technology in the classroom, Smith and Sorensen (2019) opined that, educators' confidence in their own ICT skills has a favourable effect on whether or not they choose to use technology in the classroom. Peralta and Costata (2007) found that educators who had more expertise with technology were much more confident in their abilities to utilize them in the classroom. Jones (2004) is cited in Buabeng-Andoh (2012, p. 4) to have concluded that, a teacher's confidence level is proportional to their level of competence. Confidence of educators also connect to how they feel about their own computer skills and how they feel their children are using technology in the school.

Computer self-efficacy

Albert Bandura initially introduced the idea of self-efficacy in 1986, as part of his social cognitive theory, which posits that success in life is the result of complex interplay



between an individual's behaviour, thoughts, and experiences (Lazarides & Warner, 2020, pp. 1–2). How an individual view his or her capability plays a crucial role in their successful execution of any task. In the view of Dias (2009), computer self-efficacy is an evaluation of one's competence in using digital tools. It integrates people's assessments of their own abilities to use digital technology to perform certain job-related tasks. A person's self-efficacy is defined by how confident they feel in their own abilities to achieve their goals. Confidence, therefore, is a measure of both the probability that a teacher will successfully implement technology into the classroom and the extent to which that success will be under the teacher's control (Peralta & Costata, 2007 as cited in Lazarides and Warner, 2020). Lazarides and Warner (2020; citing Christensen and Knezek, 2006), linked computer self-efficacy to computer confidence which has a direct impact on teacher competence in computer use. They explained further that one of the most important aspects of technology integration is instructor competence with and comfortability with the available technological tools. In this regard, teachers' computer self-efficacy therefore entails teachers' judgement of their level of confidence with regards to the use of computers in their daily pedagogical practice and this has an influence on their decision to appropriate technology in their teaching practices or not.

Gender

In their study on Teacher gender and ICT integration, Gebhardt, Thomson, Ainley, and Hillman, (2019) concluded that, there were disparities between female and male teachers in their level of confidence when it comes to utilizing computer technology. Additionally, they contended that, on average, male teachers exhibited better ICT self-efficacy scores compared to female teachers, with a difference of slightly less than one-fifth of a standard



deviation. The group also believed that, female teachers who possess confidence in utilizing computer and information technology in their teaching can serve as influential role models for the young women in their classes, thereby nurturing a generation of hope for female technology appropriation in the future.

Knezek and Christensen (2002) did research in north Texas to examine the influence of new Information Technologies on Teachers and Students. Their findings indicate that females possess a natural inclination towards sympathy compared to males and that this difference holds true even among first graders. According to them, this gender gap seems to continue through into the early grades of schooling. Students' perspectives on technology do not often vary by gender until somewhere around fourth grade, where girls develop liking for computers than boys, while progressing towards sixth grade. Generally speaking, boys have developed more favourable views about Technology than girls as they have advanced through school.

Teaching Experience

On a face value, teachers' teaching may be seen not to have an impact on technology appropriation, since the technology pedagogy require some level of know-how by teachers. According to Gorder (2008), classroom technology utilization is strongly connected with teacher experience. She found that teachers who felt confident in their own technical abilities and who could adapt lessons to their students' individual needs were more likely to utilize computers effectively. In a direct contrast to Gorder's assertion, Baek, Jung, and Kim, (2008) argued that more experienced teachers are, the less likely they are to embrace the use of technology in the classroom.



Teacher workload

Results and discussion of a study conducted by Muia, Peter, Ndivo (2021, p. 8), concluded that teacher workload was a crucial factor in the successful use of ICT in the secondary school English classroom. This study's discussions found further that "the more lessons a teacher had per day, the lesser the time he or she had to prepare and use ICT in class, while the lesser the lessons the teacher had, the more the time available to plan and use ICT in teaching" (p. 8). From the forgoing discussion, it is clear that workload on teacher has a significant correlation with teachers' ability to appropriate technology in their teaching practices. Muia et al., (2021) cited Samarawickrema and Stacey (2007) in research conducted on the variables relating to the use of learning management systems in Australia, and discovered that, the instructors who participated in the study considered the use of ICT in the classroom as an extra burden due to the lack of curriculum documentation and standardization.

Institutional characteristics

Teachers' tendencies to appropriate technology are based on teachers' beliefs, self-efficacy and premium teachers place on technology as a pedagogical practice (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur, 2012). It is therefore role of teacher training institutions to inculcate these qualities in preservice teachers before they enter the field of work. Recent studies in the field of teacher education (Baran et al., 2017; Tondeur et al., 2017 as cited in Nelson, Voithofer, and Cheng, et al., 2019) points out that, Teacher educators' activities such as acting as role models, have been shown to influence their students' opinions about the value of technology in education and their

confidence in their own ability to use TPACK. In the field of work, institutional support given to in-service teachers serve as incentive to the appropriation of technology.

Vannatta and Fordham, (2004, p. 10) found that teacher dedication to their profession and technological training were significant predictors of how often teachers used technology in the classroom. They said that institutional administrators and trainers should "offer substantial training on educational technology, but should also encourage a contribution to teaching enhancement". This was supported by Fullan, (1993) and Sarason, (1990), who were cited by Vannatta and Fordham (2004) as saying that, "administrators in all settings and at all levels play key roles in establishing either "change" or "maintenance" cultures within their educational". It is therefore clear that, for the success of technology implementation in education, institutional characteristics and support places second to none. Teacher training institutions and institutional administrators need to up their game, if they truly need technology to be effectively appropriated by teachers who they train and who they employ respectively.

In their study, Vannatta and Fordham (2004) suggested that teacher educators and administrators should equip instructors with the following in order to cultivate a culture that promotes adaptability and a commitment to professional development:

- Teachers engage in technology training to personally experience the transformative potential of technology as an educational tool.
- Technology training integrated with practitioner reflection and several demonstrations of successful technology-enhanced lessons.





- Frequent opportunities for cooperation and reflection with colleagues to engage in discussions about teaching methods, instructional strategies, and evidence-based practices
- Opportunities for engaging in discussions and self-reflection regarding one's own qualities and characteristics that are brought into the teaching profession and how they impact student learning.
- A positive leader who highly regards teachers as individuals who are constantly learning, practices that are supported by research, and making calculated decisions based on knowledge and information.
- Utilizing technology to simulate and analyse risk-taking behaviours.

Professional development

In his conference paper in the United States, Chang (2019) postulated that, although more and more students have access to technology, teachers may lack the necessary skills to properly appropriate these technologies in their lesson delivery in the classroom. The help that teachers need to meet this needed technology revolution may be provided via situated professional development. The effective use of technology in the classroom relies heavily on teachers continued professional development. Many studies have shown that ICT-related training programmes help teachers, both new and old, become more proficient with computers, change their perspectives on computers, and rethink the role of technology and the significance of new technological tools in students' education (Bauer & Kenton, 2005; Franklin, 2007; Wozney et al., 2006; Hew & Brush, 2007; Keengwe & Onchwari, 2008; Plair, 2008 as cited in Buabeng-Andoh, 2012, p. 142). According to Hansson (2006, p. 11), Institutional policies on professional development, which are often

either absent from or at odds with the national policy, will both affect teachers' opportunities to advance their professional knowledge and skills in the use of technology in education.

Key characteristics of a high-quality training program include extended training durations, implementation of cutting-edge educational technology, active engagement of teachers in crucial contextual tasks, enhanced collaboration among colleagues, and a well-defined vision for student success (Bremner, Sakata, & Cameron, 2023). It is possible that teachers will be more receptive to and comfortable using ICT in the classroom if training programmes place equal focus on content, values, and technology.

Accessibility

Integration of technology in education requires schools to have access to appropriate technological infrastructure and resources (Plomp, Anderson, Law, & Quale, 2009). They stated further that, the presence and ease of access to ICT resources, including hardware and software, are vital for effectively incorporating modern technologies into classroom instruction. Certainly, it is crucial to have access to computers, as well as up-to-date software and hardware, as teachers won't make use of these ICT materials if they can't get their hands on them.

The availability of hardware and software is crucial, but so is the selection of the right tools and programmes to facilitate instruction and learning (Tondeur, Valcke, & van Braak, 2008) cited in Buabeng-Andoh, (2012). Because of this interplay between affordances and restrictions, having access to suitable technology is crucial. A technological tool should be given great consideration before being used in a class.





Technical support

When teachers have problems using their ICT equipment, student learning suffers.

Teachers' faith in the technology may suffer if they encounter problems often or know that problems will arise during class time Bradley and Russell (1997; cited in British Educational Communications and Technology Agency -Becta, 2004, p. 3). Teachers may be hesitant to use ICT due to a lack of accessible technical assistance for fear of a malfunction that cannot be fixed and the subsequent failure of lessons (Seiradakis, 2024).

Ghavifekr, Kunjappan, Ramasamy, and Anthony, (n.d.; citing Korte and Hüsing, 2007) stated that, having an ICT support or maintenance contract in schools allows educators to make better use of ICT in the classroom by reducing the amount of time spent on troubleshooting software and hardware issues. "If there is a shortage of technical assistance accessible at a school, then it is probable that technical maintenance will not be carried out frequently, resulting in a higher risk of technical failures," the Becta (2004) study concluded (p. 16). Becta's study respondents cited the dread of having equipment break down in the middle of a lesson as a possible deterrent to the use of technology in educational settings.

Ghavifekr et al., (n.d., citing Toprakci 2006; Gomes 2005; Almohaissin, 2006) have shown that, teachers struggle to implement technology due to a lack of technical assistance which might be a barrier to ICT integration in the classroom if a technician is not accessible. This implies that, teacher will generally be receptive to incorporating technology into the classroom if the requirement of technical support is met, although

they may be hesitant in approaching technology due to issues like occurrence of technical fault and their limitations in addressing them themselves.

Leadership support

The presence of school technology leadership is a more dependable determinant of teachers' utilization of computers in the classroom compared to the mere availability of technological tools. In order for teachers to integrate technology into their courses, it is crucial to have a leader who not only implements technological plans but also shares a common vision with them. Schools must have well-crafted technology strategies guided by strong leadership in order for instructors to effectively utilize information and communication technologies (Buabeng-Andoh, 2012 & Tan, 2010). Ng (2008 cited in Buabeng-Andoh, 2012) conducted a quantitative study on aspects of transformational leadership with 80 secondary school teachers in Singapore. He discovered that transformational leadership characterized by qualities such as “identifying and articulating a vision, promoting acceptance of group goals, providing individualized support, offering intellectual stimulation, providing an appropriate model, creating high performance expectations, and strengthening school culture could influence the integration of diverse perspectives and ideas” (Buabeng-Andoh, 2012 p. 10 citing Ng, 2008).

Afshari, Bakar, Luan, Samah, and Fooi (2009), conducted a similar study in Tehran, distributing questionnaires to 30 directors of institutions in their second cycle. According to their findings, a leader's computer skills correlate with their use of transformational leadership techniques. They came to the conclusion that with the right kind of leadership,





it would be possible to better incorporate ICT into the classroom. According to South East and Islands Regional Technology in Education Consortium (1998), "Leadership is the single most important factor affecting the successful integration of technology. This is true at the state level and at the school level. Schools which have made the most progress are those with energetic and committed leaders."

Technological Characteristics

In the view of Rogers (2003), diffusion methods and innovation acceptance are affected by qualities of the underlying technology. He argued that, adoption rates may be affected by how people perceive the innovation's relative benefit, compatibility, complexity, trialability, and observability. In order to accurately forecast how widely an invention will be adopted in the future, it is crucial, he argues, to understand how people now feel about it. In a study conducted by Khlaif, Sanmugam, Joma, Odeh, and Barham, (2023) on factors influencing teacher's technostress experienced in using emerging technology, 54 of the participants revealed that, different aspects of technology contribute to different degrees of technostress. Constant innovation, user-friendliness, practicality, accessibility, and security are just few of the hallmarks of today's technological landscape. 17 of the participants also said that they were utilizing the new technology in the midst of a stressful and time-sensitive lesson when the system began upgrading (i.e., to upgrade the application and the platform) in the background. This indicate that certain characteristics of the technology makes it difficult for the end-users. Technological characteristics of a technology can either make technology attractive for use, or make the users dread the very mention of it.



2.2.2 Components of Technology Appropriation

According to Ertmer (1999), the acquisition of technical equipment, the growth of technological competencies, and the integration of technology into lesson preparation and curriculum design are essential components of technology appropriation. Ertmer expanded further that, instructors must have access to the required technical tools, such as computers, software, and internet connectivity, in order to successfully utilize technology in education.

In agreement with Ertmer's position, Mishra & Koehler, (2006) stated that teachers must learn the necessary technological abilities, such as digital literacy, information literacy, and media literacy, in order to properly employ technology in their teaching techniques.

2.2.3 Technology and the Ghanaian Basic School Curriculum.

For a decade now, the Ministry of Education, along with its development partners and private sector agencies, has worked to introduce information and communication technologies (ICTs) into the education system, specifically targeting the Ghana Education Service (GES). Efforts have been undertaken across pre-tertiary levels, encompassing both public and private schools, as well as at the tertiary level. In 2012, Ghana education service took major decision to review the curriculum for Ghanaian basic schools. One of the purposes for this move was to include the teaching of information and communication technology at that level. In 2019, the curriculum again was reviewed to replace the objective based curriculum with a standard-based curriculum. The main purpose was to educate the Ghanaian child up to the global standard, making them digitally literate and

global citizens. In line with this revision agenda, ICT as a subject was replaced with computing in the new standard-based curriculum.

The focus has primarily been on implementing ICTs in Ghanaian primary schools through the distribution of computers and the creation of ICT laboratories. The Ghanaian government has made attempts to equip basic school teachers with the necessary technological tools to aid in the incorporation of technology into the curriculum delivery. Nevertheless, the level of access falls short of the necessary benchmarks and statistics (Ibrahim et al., 2022). While tertiary level institutions have shown some improvement, issues nevertheless persist. Furthermore, various private sector endeavours have been undertaken to establish ICT centres that are community-based. However, it is noteworthy that these initiatives have predominantly been implemented in metropolitan regions, and there are limited examples that show their effectiveness in helping achieve educational goals (Asoma, 2018, p. 26).

There has never been a more pressing time for Ghana to adopt a nationally endorsed ICT in Education Policy. With the government's renewed focus on technology as a driver of economic growth and development, new programmes and projects are being rolled out seemingly on a daily basis. Yet, it is acknowledged that without a national policy and sector-wide coordination, such initiatives will continue to occur randomly, increasing the risks of duplication and wasting scarce resources that do not adequately address the educational objectives and priorities of the sector. This gave birth to the ICT for Accelerated Development (ICT4AD) Policy document in Ghana in the year 2003. According to this ICT4AD policy document, The Ghanaian government is dedicated to





implementing a comprehensive plan to quickly integrate, utilize, and take advantage of information and communication technologies (ICTs) in the educational system, starting from primary school and continuing through higher levels of education, with the aim being to transform the educational system in order to provide the necessary educational and training services and create an environment that can produce the appropriate skills and human resources needed to develop and advance Ghana's information and knowledge-based economy and society.

This policy document seeks to establish a clear purpose and justification for the effective integration of ICTs into the sector. It does so by identifying opportunities, issues, challenges, and strategies that will be used. It recognizes that ICTs should support, rather than dictate, the implementation of educational strategies. The main objective of the ICT4AD policy is to;

- To facilitate the deployment, utilization and exploitation of ICTs within the educational system to improve on educational access and delivery and to support teaching and learning from primary school upwards.
- To modernize the educational system to improve the quality of education and training at all levels of the educational system and expanding access to educational, training and research resources and facilities.
- To orientate all levels of the country's educational system to the teaching and learning of science and technology in order to accelerate the spread of science and technology in society and produce a critical mass of requisite human resource and a well-informed citizenry.



- To achieve universal basic education and improve the level of basic and computer literacy in the country.
- To ensure that all citizens are at least functionally literate and productive.
- To expand and increase access to secondary and tertiary education.
- To strengthen science education at all levels and in all aspects of the educational system, especially at the basic and secondary school levels.

According to the National Pre-tertiary Education Curriculum Framework of the Ministry of Education of Ghana, (2018, p. 9), Basic Education as enshrined in the 1992 Constitution of Ghana, is the minimum formal education that every Ghanaian child has the right to receive in order to actively participate in society. Basic Education refers to the provision of opportunities that equip graduates with the essential qualities of well-rounded and actively involved citizens in the 21st Century. Presently, this forms the basis of the framework for pre-tertiary education in Ghana. In recent times, as part of the policies guiding the development of the standard-based curriculum and common core curriculum for Ghanaian basic schools which was launched in 2019, the ICT4AD and ICT in Education policies makes provision for the integration of technology in the design and delivery of the curriculum through enhancing digital literacy and global citizenship of basic school children in Ghana.

The mission of the ICT4AD is to transform Ghana into an information-rich, knowledge-based and technology-driven high-income economy and society (Ministry of Education of Ghana, National Pre-tertiary Education Curriculum Framework, p. 11). On the other hand, the ICT in Education Policy aims to integrate ICT into education to enhance



learning and management. This includes providing computer laboratories, internet access, and network productivity, as well as supplying school laptops to instructors and students. Additionally, the policy focuses on developing the skills and knowledge of teachers in using ICT (*ICT IN EDUCATION REFORM - Ministry of Education Ghana*, 2021). The ICT in Education policy “seeks to develop early desire and competences in children to use ICT, equip pre-tertiary learners with ICT skills, infuse ICTs into education management, and transform teacher development and tertiary education through technology-based training” (*EDUCATION REFORM - Ministry of Education Ghana*, 2020).

In this regard, Ghanaian curriculum for basic schools proposes ICT use as a pedagogical tool. The policies serve as the bases for technology appropriation in the Ghanaian basic schools. Having these curriculum provisions in mind, the government of Ghana through the Ministry of Education (MOE) and Ghana Education Service (GES), have made several strides to facilitate the integration of technology into Ghanaian basic school through some interventions on teachers and students front. Some of these interventions are;

- The Better Ghana Laptops programme for Ghanaian teachers.
- Introduction of ICT into Ghanaian curriculum in 2012.
- Introduction of Computing into the standard-based curriculum in 2019.
- One-Teacher-One-Laptop project for basic school teachers in 2022.
- The girls in ICT programme.
- One-Student One-tablet project for senior high School students (ongoing).



Schools must have a solid technological infrastructure in order to foster digital learning and give children the knowledge they need to prosper in a globally linked world. Schools must develop, fund, acquire, and manage the infrastructure that will make connection a reality for every teacher and student in every learning location (U.S. Department of Education, 2017). In their study, Light and Pierson (2013), drew a relationship between what type of ICT-Based activities teachers could do with their students and the distribution of IT resources in schools and the flexibility in how they could be utilized by both teachers and students alike. This flexibility is not simply a function of the number of computers available, but of accessibility and reliability of the machines.

Perhaps the most popular use of technology in the classroom is the use of computers, a projector, and the Internet in tandem with a "traditional" oral lecture. In reality, even "online learning" conferences are often structured around speakers giving oral presentations to a large audience in the same room. Today's conferences rely heavily on PowerPoint presentations and spoken communication, which may stifle innovation, interaction, and impromptu storytelling. Although the use of computer projectors in lectures is becoming more commonplace in colleges, their adoption has been sluggish (Hansson 2006, p. 6).

Habibi, Sofyan and Mukminin (2023), are of the view that "Using digital technology in teaching can improve skills for vocational school teachers that can make their students more competent and skilful as future generations for better workforces" (p.2). Similarly in the basic school setting, the use of technology comes along with benefits including enhanced learner engagement (Bond & Bedenlier, 2019), increased user satisfaction,



improved task performance, and increased creativity (You et al., 2015). The group opine further that, Technological appropriation, on the other hand, may have negative consequences. As people use different technologies in different ways, alignments issues might occur, resulting in poor task-technology fit. Appropriation can also lead to the development of new and innovative uses for technology. Conforming to this, Toure (2009, p. 98) stated that, when technologies are utilized for educational purposes, they adapt to address certain learning demands that are specific to the setting, as their usage becomes integrated into the teaching process. With the integration of technologies like multimedia tools, electronic lectures, and knowledge control systems, teaching complex concepts to learners becomes much easier and less burdensome to teachers (Boichuk, Morozova & Boichuk, 2014).

In research conducted by Kennewell (2005) and cited by Asoma (2018, p. 58), it was shown that instructors in schools in Wales had made significant progress in terms of both course content and teaching methods by effectively incorporating ICT into their instruction, both individually and collaboratively. The researcher's discoveries corroborate the notion that the teacher assumes the role of the primary facilitator in the educational process within the classroom, and he chooses what method and tool to use in presenting his lesson. This resonates with the ICT in Education policy which places the teacher at the centre of technology integration process. Teachers with access to various technologies utilize them to enhance their current teaching methodologies, which typically involve teacher-led instruction and the dissemination of knowledge (Sheffield, 2011, p. 2). In the light of the foregoing, it is clear that the adoption of the ICT in Education policy by the government of Ghana will be beneficial to the teachers and

learners at the pre-tertiary level in Ghana, if teachers are well placed in the integration process.

2.2.4 Challenges teachers face in appropriating Technology

Despite the success chalked by technology in aiding education in the 21st century, teachers still face some level of difficulty in leveraging technology as an instructional tool. The technology appropriation process is an intricate process that is affected by many challenges that mitigate on teachers' ability to integrate technology in their pedagogy. Slaouti and Barton (2007) and Yildirim (2007) conducted their studies to look at challenges that leads to teachers' resistance to using technology in education. They found out that, congested classrooms, a lack of training, poor technical and pedagogical assistance, restrictive school curricula, a lack of desire, a lack of strong leadership, lack of collaboration among instructors, scarcity of resources, mentors, and professional development opportunities, were all identified as impediments to the use of technology in education (cited in Buabeng-Andoh 2012).

DiGregorio and Liston (2018), delves more into the difficulties encountered by instructors, encompassing both internal and external barriers and provides suggestions for surmounting these hindrances. Teachers' actual proficiency level in understanding and applying instructional technologies in the process of instruction is also part of the internal barriers, along with their attitudes or beliefs about technology, the amount of time they have to learn, use, or improve their digital abilities (Kalyvaki & Bacimanova, 2023). These internal barriers are directly linked with proficiency in instructional technology, time factor, and continuous professional development for teachers and has the potential





to make teachers conservative in adopting and using technology in their pedagogy. Bagley and Ryan (2015) outlined the rapid nature of technology evolution, which sometimes is not followed with the requisite continuous professional development of teachers, as some of the external barriers to technology integration by teachers. As a result, staying abreast of the most recent advancements in technology and comprehending how to seamlessly incorporate them into the educational programme might be challenging. The availability and accessibility of the technology itself, the presence of technical professionals, the presence or absence of particular programmes for staff digital development and skill building, and the lack of funds constitute external barriers to technology integration (Kalyvaki & Bacimanova, 2023). External impediments are linked to the unavailability of resources, such as inadequate equipment or insufficient training.

Rasheed, Kamsin and Abdullah (2020) further elucidates the subject, by pinpointing certain obstacles encountered in blended learning settings, including technical aptitude and expertise, inadequacy, and intricacy. Other obstacles that instructors have when integrating technology into their education is the deficiency of technological proficiency and expertise. Several educators may lack the training or professional development to proficiently incorporate technology into their instructional methods (Howland & Wedman, 2004). This might lead to a deficiency of self-assurance and proficiency while utilizing technological tools and resources in the educational setting. In agreement to these, Çoklar & Kabakci, (2017) stated that, during technology integration processes, there are several barriers to effective technology integration in the classroom, including:



“teachers' restricted access to the Internet, lack of time, lack of fundamental technical abilities, negative attitudes about technology integration, and the need for professional development in this area. Yet, the most significant barriers to successful technological integration are teachers' own lack of familiarity with the subject matter and its appropriate applications. Concerns have been raised not just about teachers' use of technology in the classroom, but also about instructors' inadequacies as educators. (p. 20)”.

Çoklar & Kabakci's study found that some of the challenges faced during the early stages of integration included limited access to the internet and educational websites, a shortage of projectors, inadequate physical environment, expensive technological equipment, and time wasted in transporting and setting up the equipment in the classroom. Initially, the challenges revolved around the availability and utilization of technology. Aside from the initial physical challenges, the current issues faced by teachers revolve around educational procedures, including the inability to effectively teach the subject within the allotted class time, failure to cover the complete curriculum, and a lack of appropriate student proficiency. Therefore, it can be concluded that, the challenges teachers face in initial technology appropriation arise from accessing and using technology for pedagogical purposes.

Balanskat, Blamire and Kefala (2007) broke down the challenges that educators face in using ICT into three categories: teacher-level, school-level, and system-level obstacles. Lack of ICT skills, lack of teacher confidence, lack of pedagogical teacher training, lack of follow-up on new and varied training programmes, and a lack of pedagogical teacher



training are all impediments at the teaching level. There are obstacles at both the school and system levels. At the school level, there is a lack of information and communication technology (ICT) infrastructure, obsolete or poorly maintained hardware, insufficient educational software, a lack of access to ICT, inadequate project-related experience, and a failure to integrate ICT into the school's overall strategy (Buabeng-Andoh 2012). Unequal access to digital infrastructure and devices in schools and classrooms might restrict teachers' ability to integrate technology into their teaching practices, in particular, disparities among pupils might arise, since individual learners may possess greater exposure and proficiency with technology beyond the classroom environment than others, making it difficult for teachers carry some students along in an integrated technology lesson.

In order to remain current in a constantly evolving technological environment, educators must consistently enhance their understanding and abilities. Moreover, the use of technology in education necessitates a change in teaching methods. teachers must reconsider their teaching methods and modify them to take use of the capabilities of technology (Benedetto, 2005). For teachers who are used to conventional teaching approaches and may be hesitant to adapt, this might provide a substantial barrier. Furthermore, instructors may face issues related to privacy, security, and ethical considerations about the use of technology in the classroom. Kumar, Chetty, Clegg, and Vitak (2019) and Leatham and Robertson (2017), both highlight the significance of including privacy and security factors into the use of technology in the classrooms, respectively. Kumar et al (2019) proposes that educators analyse these factors from the perspective of curriculum and classroom management objectives, whereas Leatham and



Robertson (2017) highlights a deficiency in privacy protection rules in Ontario schools and advocates for their establishment. Teachers have the responsibility to ensure that technology is utilized in a responsible manner that safeguards the well-being and rights of their students.

In conclusion, the 21st teachers need to up their game to overcome several obstacles when integrating technology into their teaching practices, such as insufficient proficiency in technology, restricted availability of resources, staying abreast of technological progress, adapting to changes in teaching methods, and resolving issues related to privacy and ethics. To overcome these problems, there is the need to look teacher training and support which is crucial in moulding educators' professional practice and beliefs, as stressed by Aydin and Aslan (2016). In addition, this is corroborated by Abebe and Woldehanna (2013), who stresses the need of well-organized programmes for professional development and teacher training, especially in underserved districts. It is necessary to engage in continuous professional development, get assistance from educational institutions, and demonstrate a dedicated effort to using technology in a deliberate and conscientious way.

2.3 Concept of Training

Chand (2014) referred to training as a procedure that aims to develop abilities, or add to the current level of knowledge, so that the employee is better equipped to accomplish his present work, or to mould him so that he is suited for a higher position that involves higher levels of responsibility. In this respect, training is viewed as an educational experience with the goal of effecting a change in an individual that is intended to be

relatively long-lasting and result in an improvement in that individual's capacity to execute his or her job. The development of abilities needs to be systematic and planned, in order to effect its expected change in the trainee.

This informs the view of Monish (2020) that, training is "an organized and systematic planning procedure for increasing the knowledge and skill of people for a specific purpose" and that Training can also be thought of as "the process of acquiring new knowledge and skills." It does this by providing employees with learning opportunities that will increase their ability to contribute to the organization's achievement of its goals and objectives. Employees that participate in training see improvements in their work output and are better prepared to take on additional responsibilities in the future job. Monish argued further that Training is a process in which all sided efforts are made to improve skills, aptitudes, abilities etc. of individuals.

2.3.1 Types of Training

Milhem, Abushamsieh, and Aróstegui (2014, pp. 8–9) identified two main methods of training in the workplace, namely on the job training and off the job training. The group explained that Off-the-job training, also known as OFJT, refers to training that is completed away from the workplace and away from the internet. On-the-job training, also known as OJT, is completed in the workplace during normal business hours. The most typical method of training is known as OFJT which is responsible for three to six times the number of expenditures as compared to the amount spent on OJT. (Rothwell & Kazanas, 2004 cited in Milhem et al., 2014 p. 8)





Rothwell (2005; cited in Milhem et al., 2014), states that, unplanned OJT serves to reduce the period of adjustment that follows a new employee's employment, transfer, or promotion. Unplanned OFJT may include in-service training in which staff "huddle" with supervisors or coworkers to address common issues. Like planned OJT, planned OFJT is meticulously designed to maximize the use of time spent away from the task. This form of training is appropriate when a large number of employees have training needs that are similar.

On-the Job Training (OJT)

The preponderance of organized on-the-job training takes place at the trainee's employment. On occasion, it takes place in a designated training location on the premises. During on-the-job training, managers, supervisors, trainers, and colleagues devote a significant amount of time to instructing trainees in previously learned skill sets. In addition, it may contain instruction that has minimal to no effect on output and integrates the task into the training (Bas, 1989; Tews & Tracet, 2008; Holden, 2001 as cited in Milhem et al., (2014 p.9).

Off-the Job Training (OFJT)

Off-the-job training can be grouped into discussions, one-on-one tutorials, lectures, reading, training courses, and workshops. This type of training enables learners to acquire and implement new skills and knowledge in a safe working environment. Training cannot solve all performance problems and should not be substituted for motivation, the proper tools or equipment, and proper supervision (Kempton, 1995 as cited Milhem et al., (2014 p.9).



Rothwell (2005) is cited to have said in Milhem et al., that, when employees lack the necessary skills or knowledge to function effectively, when the resources to devise, deliver, and follow up on training are available, and when training resolves performance issues, training should be provided. Off-the-job training is beneficial when a large number of employees have similar training requirements and there are adequate skills and resources for designing and delivering training. Planned OJT is appropriate when the aforementioned conditions are met, when it is possible to minimize work distractions, when training at work poses no threat to health, safety, or productivity, and when there are benefits to be garnered from real-time training (p.9). The off-the job training and on-the job training can be categorized into several types of training in the work place setting. According to Monish (2020), training programmes can be categorized into different types as listed below:

1. Induction or Orientation Training
2. Job Training
3. Craft Training
4. Training for Promotion
5. Refresher Training

The starting point for on-the-job training is introduction/orientation training, which provides new staff members with a sense of warmth and an initial level of skills and knowledge, which helps them quickly integrate into their work and the organization (Chidambaram, Ramachandran, & Thevar, 2013).



2.3.2 What is Teacher Training?

Guzdial (2010), refers to training as any action that results in the development of competent behavior. Soldiers, firefighters, police officers, and emergency medical professionals undergo rigorous training. Training is closely linked to community service, which is exactly what teachers carry out. Training involves the enhancement of skills, but teaching is unquestionably a career that requires certain skills. Within this particular context, the term "training" denotes the process of acquiring knowledge or skills to the point where they are performed automatically. This enables the learner to exhibit the acquired competence even in demanding or unsupervised situations.

2.3.3 Types of Teacher Training

In their website, the Inter-agency Network for Education in Emergencies (2022) describe teacher training as below:

“Teacher training refers to any support and capacity development that enables teachers and other education personnel to teach and evaluate students in accordance with the curriculum. Programmes for teacher development are founded on the actual and changing requirements of both teachers and students. There should be a clear connection between the curriculum, students' learning rights, the requirements of students and their families, and teacher preparation and ongoing support. Teachers and other education personnel should receive periodic, situation- and need-specific, structured training”.

Generally, teacher training is grouped into two; Preservice and In-service training.



Pre-service training

This refers to the preparation instructors receive prior to entering the classroom. It involves a well-recognized and structured educational programme that aims to train potential teachers for a certain level of education. Graduates are awarded a government-approved teaching certificate. Pre-service training does not apply to classroom teachers who do not fulfil legally acknowledged training criteria but are enrolled in a teacher training plan to acquire certification while working as a teacher (Unesco Institute for Statistics, 2020).

In-service training

Training to improve the credentials and abilities of teachers while they are on official teaching duty. In-service training may be mandatory for official professional development purposes, aimed at maintaining or improving professional qualifications. Alternatively, it can be undertaken voluntarily with the sole objective of boosting skills. It provides teachers the opportunities for continuous training after they have begun teaching (UNESCO Institute for Statistics, 2020).

2.3.4 Role of Technology Training in Teachers Pedagogical Competence in Appropriating Technology

The importance of technology training in enhancing teachers' pedagogical competency in effectively utilizing technology is paramount in the current era of digitalization. Given the fast progress of technology, it is imperative for educators to proficiently use technology into their instructional methodologies (Pylypenko & Shuliak, 2023). 21st Century Teachers must possess the requisite expertise and understanding to effectively



appropriate technological tools and resources in order to augment student learning. Pylypenko and Shuliak are of the view that, Technology training enables instructors to enhance their pedagogical proficiency in utilizing technology. It provides them with the abilities to proficiently integrate technology into their teaching methods, evaluation approaches, and classroom administration ways. By undergoing training, instructors may acquire the skills to choose suitable technological tools and resources that are in line with their teaching objectives and cater to the different learning needs of their pupils (Kore & Jadhav, 2017).

Technology training significantly build teachers' capacity to effectively include students in dynamic and purposeful teaching and learning experiences. With good teacher training, teachers are better placed to understand technology and appropriately alter it in their practice to enable them develop interactive classes, multimedia presentations, and collaborative learning environments. Through the use of technology in their instructional methods, teachers may cultivate a student-centered learning environment, stimulate the development of analytical reasoning and problem-solving abilities, and enable effective communication and cooperation among students.

In addition, technology training facilitates the enhancement of instructors' digital literacy abilities. Digital literacy encompasses the aptitude to proficiently and ethically locate, assess, and utilize information inside a digital setting (Thapliyal, 2020). By means of training, classroom teachers may acquire the skills necessary to proficiently use digital tools and platforms, assess the reliability of online information, and instruct pupils on digital citizenship and responsible utilization of technology. To optimize the efficacy of



technology training, schools and educational institutions must offer continuous support and chances for professional growth to teachers. These options encompass workshops, seminars, online courses, and professional learning communities, which facilitate the exchange of experiences and mutual learning among teachers.

Teacher training is essential for increasing teachers' appropriation of technology in their teaching practice (Maden, 2023), entailing the incorporation and assimilation of technology into instructional strategies to optimize learning results while improving the overall experience of learning. The adoption of innovative teaching and learning techniques by teachers for use in the classroom depends on the existence of competent teacher education programmes. Promoting the use of technology as pedagogical tool, requires effective pre-service and in-service teacher preparation in the technology pedagogy. Technology has not been meaningfully incorporated into teaching practices due to a lack of professional development programmes that address the requirements and difficulties of successful pedagogical and technological integration. As a result, it is necessary to develop new categories of pedagogies related to the use of technology (Ley, Tammets, Sarmiento-Márquez, Leoste, Hallik, & Poom-Valickis, 2022). Boechat-Heer, Impedovo, and Arcidiacono, (2015), examined the use of technology in pedagogy and concluded that, the use of technologies by teachers has an effect on various stages of the teaching and professional training processes, teachers therefore need to control the use of technology tools in the classroom, during instructional activities in the classroom.

Several studies point to the significance of teacher training programme towards pedagogical competence in appropriating technology. For instance, Ley et al. (2022)



argued that “effective teacher education programs can help teachers create new teaching and learning methods and adopt them for classroom use. Social learning processes play a key role in this, but there is a lack of understanding of their role in technology”. This mean that, training programmes for teachers should provide them with the skills and knowledge to effectively integrate technology in their teaching (Tunjera & Chigona, 2020). This includes the integration and application of Technological, pedagogical, and content knowledge (TPACK) in various educational situations. Tunjera & Chigona furthered their claim by stating that, teaching should be an interplay between the teacher’s content knowledge in their teaching disciplines, their methodology, and tools they use to bring about learning (including knowledge and competence to use such tools).

To sum up, technology training is crucial for improving instructors' ability to effectively utilize technology in their teaching methods. It provides instructors with the essential expertise and understanding to efficiently incorporate technology into their teaching methods, consequently improving student learning results. Schools may enable teachers to become proficient and self-assured users of technology in the classroom by investing in technology training and offering continuous support.

2.4 Concept of Competence

2.4.1 What is Competence?

Salman, Ganie, and Saleem (2020; citing Wilcox and King, 2013), stated that, “the concept of competence can be traced as far back as 3,000 years ago when the Chinese started conducting civil service exams replacing recommendations by superiors in a selection of employees for government jobs as they recognized differences in individual



ability” (p.9). Competence is socially and individual situated, hence its development is based on practice and development of capability models in individuals (Eraut, 1998). According to Lester (2014, p. 2) “Competence is broadly concerned with what a person is able to do ... the way in which ‘able to do’ is conceptualized differs between different traditions, with varying levels of emphasis between the skills and attributes of the individual and the quality of output of the task”.

Nelson and Trevitt (1993), defined competence as the skill level necessary to do a given task to the satisfaction of an employer and as part of creating Competence Based Training (CBT) for employees, it is necessary to build industry-specific, universally applicable skillsets, even for rural sectors (p. 38-39). In recent times, schools are drifting away from subject and input led curricula to a more practice based curriculum, one that incorporates active learning, acquisition of key competences, and places much emphases on learning outcomes (Riviou and Sotiriou, 2016, p. 1). According to Butler (1978, p. 7), competence is defined as having the necessary means to meet one's requirements and perform well in a valuable task. It encompasses the knowledge, skills, values, and attitudes needed to effectively carry out an activity that is essential for success in one's personal or professional life. Competence also involves the ability to not only meet but surpass the generally accepted standards of adequacy for a particular task.

2.4.2 Types of Competence

Competence is a wide word that relates to the capacity to integrate and use contextually relevant information, skills, and psychosocial aspects in order to consistently perform efficiently within a particular field. Competence is a broad notion that is domain-specific



and context-dependent. It entails continually performing well within a specific domain by utilizing contextually suitable knowledge and abilities. Competence is essential in a variety of educational settings and stages, including general (non-vocational) education, elementary, secondary, and further education (Sylvia & Jackie, 2022). In their literature review, Salman et al. (2020) provided a comprehensive summary of 16 competence dimensions. These dimensions are categorized into hard and soft competence, and are further subdivided into knowledge, skill, and self-actualization-related competence. The group categorizes skills based on their role and the context in which they are utilized. After conducting comprehensive literature research on the typology of competence, the group categorized the many forms of competence utilized in different domains and circumstances as follows;

1. Cognitive competence
2. Functional competence
3. Social/behavioural competence
4. Mete-competence
5. Conceptual competence
6. Operational competence
7. Occupational competence
8. Language/communicative competence
9. Cross-cultural competence
10. Ethical competence
11. Emotional competence
12. Job competence

13. Self-competence
14. Team competence
15. Change competence
16. Leadership competence

2.4.3 Competence-Based Training

According to Hodge (2007, pp. 180–181), Competence-Based Training is a philosophy of vocational education that places an emphasis on acquiring the precise information and abilities needed for a certain career or trade. Organizational development, research management, and healthcare are just a few of the industries where it has been applied. Identification of the competences necessary for a certain job or profession, creation of training materials and evaluations that are in line with these competencies, and evaluation of the training program's efficacy are normally steps in the development of a CBT programme. CBT may assist in ensuring that training programmes are pertinent to the demands of the business and that students get the information and skills necessary for their chosen career. The development of a CBT program typically involves the identification of the competencies required for a particular job or profession, the development of training materials and assessments that are aligned with these competencies, and the evaluation of the effectiveness of the training program. The use of a competency-based approach can help to ensure that training programmes are relevant to the needs of the workplace and that learners acquire the skills and knowledge required for their job or profession (Vare, Arro, de Hamer, Del Gobbo, de Varies, Farioli, Kadji-Beltran, Kangur, Mayer, Millican, Réti, & Zacharious, 2019).





2.4.4 Teacher technology competence and appropriation

The success of any new information and communications technology (ICT) relies heavily on the ideas and attitudes of educators about the use of technology in the classroom. Evidence suggests that teachers' preparation to incorporate ICT into their lessons is strongly connected to their confidence and competence in utilizing ICT, as well as their opinions regarding the importance of ICT in education (Bingimlas, 2009). Teachers need some level of competence in order to appropriate technology in their pedagogy, this competence is known as Digital competence. Digital competences are needed for teachers to use these tools and understand how they can help students learn in technical, cognitive, and social-emotional areas (Ng, 2012 as cited in Instefjord, 2014). In this regard, the complexities involved in technology and competences needed to appropriate them need to be explained to preservice teachers in order to prepare them for their future work.

Ferrari (2012; cited in Instefjord, 2014) refers to digital competence as the “set of knowledge, skills, attitudes (thus including abilities, strategies, values and awareness) that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, socializing, consuming, and empowerment”. The implication of teacher technology competence cannot be over emphasized in the technology appropriation process in teaching and learning. The technology appropriation process is greatly influenced by teachers' perception, knowledge and level of technology competence. Instefjord (2014) and Shapley, Sheehan, Maloney, and Caranikas-Walker (2010) emphasize the significance of

incorporating technology into teacher education programs. Shapley et al., (2010) specifically discovered that immersing teachers in technology may result in the development of their technological knowledge and abilities.

The exposure that pre-service teachers get with technology from their initial teacher education programmes influences how they choose to utilize technology later in their pedagogy (Instefjord, 2014). When initial teacher training programmes build the requisite technological knowledge and competence in teachers, the pathway to appropriation gets cleared for teachers. The influence of the technological competence of educators on the adoption of technology in education is an intricate and diverse matter. According to Shapley et al., (2010), the complete engagement of teachers in technology, which includes providing them with tools and continuous professional development, has a substantial positive impact on their expertise and competence in using technology, as well as their beliefs and support for integrating technology in education. Govender and Maistry (2012) emphasized the need of creating favourable environments to enable teachers to effectively utilize technology, since they may experience a lack of trust in these fields.

Çoklar and Yurdakul (2017) underscored the significance of support, as instructors indicated obtaining assistance from peers, the Ministry of National Education, and internet resources. The beneficial influence of technology-assisted instruction training on the perceived technological competencies and attitudes of prospective teachers, cannot be over emphasized (Benson, Farnsworth, Bahr, Lewis, & Shaha, 2004). These studies indicate that technology immersion and training can improve teachers' competence in



using technology in their teaching. However, continual support and favourable environments are essential for successful implementation of technology in education.

2.5 Supporting theory (theoretical framework)

The study is supported by Technological Pedagogical Content Knowledge (TPCK) framework in order to enable the researcher to triangulate findings of the study (Voogt et al., 2013) and Diffusion of Innovations theory by Rogers, will enable the researcher determine how technological innovation is diffused or adopted among teachers in terms appropriation (Sahin, 2006, p. 1).

2.5.1 Technological Pedagogical Content Knowledge (TPCK) framework

TPCK, or Technological Pedagogical Content Knowledge, is a framework for understanding how technology, pedagogy, and content knowledge all come together in the classroom. Mishra and Koehler developed the TPCK framework in 2006 in response to the widespread adoption of technology in classrooms. According to the framework, educators need a thorough awareness of the interplay between technology, pedagogy, and content expertise in order to effectively integrate technology into their lessons. Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK) are the three pillars of the TPCK framework, as described by Mishra and Koehler (2006). Teachers' content knowledge (CK) is one aspect of their professional competence, while their pedagogical knowledge (PK) relates to the tactics and methods they employ to help their students learn (Leijen, Malva, Pedaste & Mikser, 2022). Fahadi and Khan, (2022) opine that, knowledge of how to use technology to improve education is what constitute Technological Knowledge "TK." In addition to these three pillars, the TPCK framework



also incorporates the integration of these areas of knowledge and the contextual elements that affect pedagogy.

The TPCK framework has been widely adopted since its inception as a means to organize studies on the impact of technology on learning (Herring, Koehler & Mishra, 2016). The TPCK paradigm has been utilized in numerous research that examine instructors' perspectives on technology integration and the impact that integration has on students' academic growth. For instance, Niess, Lee, and Kajder (2009) used the TPCK framework to analyse the evolution of science instructors' ability to integrate technology into their lessons. The study concluded that in order for teachers to effectively integrate technology, they must have a thorough knowledge of both the subject matter they are teaching and the most successful pedagogical practices and methods for fostering student learning. Koh and Divaharan's (2011) research into how incorporating technology into the classroom affects students' motivation and engagement, found that it does. The research concluded that in order for educators to successfully integrate technology into their lessons, they must employ a wide range of pedagogical approaches that are differentiated for individual pupils. Furthermore, the study emphasized the significance of educators' technology expertise in selecting and implementing effective technologies to assist learning.

To sum up, the TPCK framework has been extensively employed as a theoretical basis for studies of the incorporation of technology in education (Alemán-Saravia & Deroncele-Acosta, 2021; Lavrysh, 2019). The framework stresses the significance of educators' familiarity with the convergence of material, pedagogy, and technological





expertise in fostering successful instruction and student learning. Professional development programmes for educators and the planning of flipped classrooms have all taken cues from the TPACK framework. That's why the TPACK framework is so useful for researchers, politicians, and teachers who want to improve education through the use of technology. In light of the above, the researcher found the TPACK Framework as one of the most suitable theories that will support this study, and has for that matter chosen it as the supporting theory to this study. The TPACK is seen to be suitable for this study because it provides a convergence point for material (technological infrastructure), pedagogy (appropriation), and technological expertise (Competence).

2.5.2 Diffusion of Innovations theory

One of the most popular theories in the social sciences is the "Diffusion of Innovation" theory. Rogers (2003) first proposed this theory in 1962 to describe the diffusion of innovations and their adoption by consumers and businesses. The theory suggests that new ideas spread through communities in a predictable way, with different elements of the innovation, different types of communication, and different types of adopters all playing a role in the process.

The Diffusion of Innovation idea has been applied to education to describe how new technologies spread throughout classrooms (Goh & Sigala, 2020). The idea behind the hypothesis is that whether or not a new piece of technology is used in the classroom depends on five things: relative advantage, compatibility, complexity, trialability, and observability. The term "relative advantage" is used to describe how much of an improvement the new method offers over the status quo (Ghasri, Ardeshiri & Rashidi,



2019; Mairura, 2016; Rogers, 2003, p. 213). The term "compatibility" is used to describe how well the new idea fits in with people's preexisting beliefs, norms, and expectations (Prieto, Migueláñez & García-Peñalvo, 2015; Rogers, 2003, p. 223). The level of difficulty of an innovation is determined by how hard it is for people to understand and use. According to Rogers (2003, p. 231), The range of times an innovation can be tried out before it is widely used is called its "trialability". The innovation's observability is how easy it is for other people to see how it works (Rogers, 2003, p. 232).

The Diffusion of Innovation theory acknowledges these five characteristics and further categorizes adopters into five types: innovators, early adopters, early majority, late majority, and laggards (Boora, 2022). Boora explained further that, Early adopters are those who are highly socially connected and possess a greater level of influence in shaping opinions compared to innovators, who are the initial individuals to embrace a new idea or product. In the view of Boora, new technology is first adopted by the early majority, then by the late majority, and ultimately by the laggards. In education, the Diffusion of Innovation idea has been used to the spread of innovative pedagogical methods, curricular changes, and technological tools (Hidayat & Mukminin, 2022). Computer-based teaching, e-learning, and mobile learning are just a few examples of how this principle has been applied in education. The theory has also been used in the study of what makes certain educational breakthroughs stick around for a long time. Using the Diffusion of Innovation theory, Ertmer and Ottenbreit-Leftwich (2010) analyzed the factors that contribute to the effective integration of technology in classrooms. Teachers' attitudes and ideas towards technology integration, as well as their access to technological

tools and the backing of administrators and colleagues, all played a role in the study's findings.

In sum, the field of education has made extensive use of the Diffusion of Innovation theory in order to better comprehend and account for the spread and acceptance of diverse inventions. Educators and policymakers can better devise strategies to encourage the successful adoption and implementation of educational innovations if they have a firm grasp of the elements that influence adoption and implementation, as well as challenges faced by implementers in the implementation process. The Diffusion of Innovation theory is chosen for this study to understand how new technologies diffuse in education, as well understand the challenges teachers face in adopting new technologies in teaching.



2.6 Conceptual framework

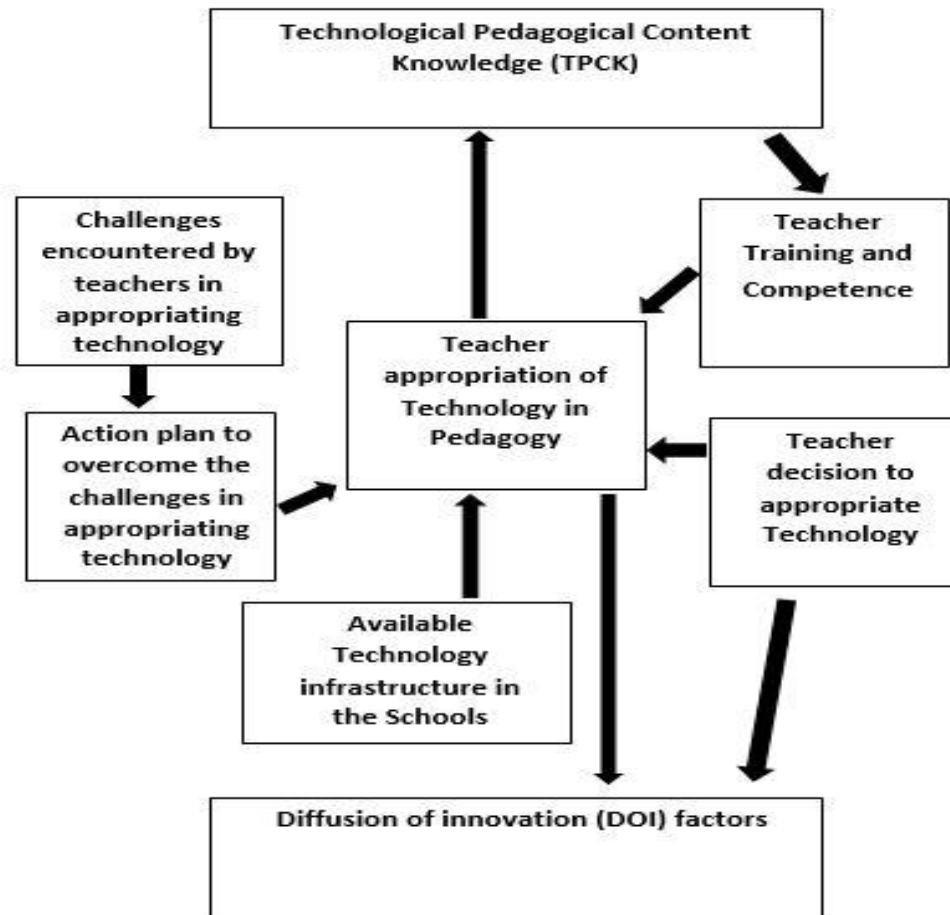


Figure 2.1

Source: Researcher's own construct (2023)

The study presents a well-organized and thorough conceptual framework in figure 2.1 above. It lays out in detail the primary factors and their interrelationships that will be studied. It is easier to see how each variable is related to the others with the directional arrows used to indicate the flow of influence. The framework is based on the premise that numerous factors—including teachers' TPCK, the accessibility of technology



infrastructure, teachers' training and competence, and the difficulties teachers face when appropriating technology, and the strategies they devise to overcome those difficulties—influence teachers' decisions to use technology in the classroom. These variables are likely to affect the degree to which technology is incorporated into classroom instruction, which in turn will affect the technology appropriation process. Recognizing that appropriating technology is rarely a smooth process, the framework's incorporation of the challenges and accessibility variables is crucial. Possible causes of these difficulties include access to technological infrastructure (material), lack of know-how to appropriate technology (pedagogy), and technological expertise (Competence). Teachers' content knowledge (CK) is one aspect of their professional competence, while their pedagogical knowledge (PK) relates to the tactics and methods they employ to help their students learn with technology. To know how to use technology to improve education is what we call "TK.". The quality of teaching that reflects a well diffused technology in teaching can be enhanced by recognizing and finding a good convergence point for these variables of technology appropriation. The study's conceptual framework is a well-organized summary of the topics, variables, and relationships that will be examined. It lays the groundwork for the research and ensures that the goals can be achieved through data gathering and analysis.

CHAPTER THREE

RESEARCH METHODS

3.0 Introduction

This study aimed to investigate teachers' training and competence in technology appropriation in the Savelugu Experimental cluster of schools. In this regard, this chapter presents the methodology of the study. It focuses on the following: research philosophy, research design, population of the study, sampling and sample size selection, sources of data, data collection instruments, data collection procedure, pre-testing of instruments, ethical considerations, data management plan, and data processing and analysis procedure.

3.1 Study Site

One of the 261 MMDAs in Ghana is the Savelugu Municipality; there are sixteen of these MMDAs in the Northern Region. The district was birthed then as Savelugu-Nanton District after the reorganization of the West Dagomba District Council in 1988. Its status was changed to that of a Municipal Assembly on 1st March, 2012. Subsequent to its upgrade to Municipal Assembly status, the southern section of the district was divided to create the Nanton District on 15th March, 2018, leaving the remaining part as the Savelugu Municipal District. Located northwest of the Northern Region, Savelugu is the capital city of the Municipality (Ghana Statistical Service, 2022). One of Tamale's northern suburbs in central Ghana is Savelugu. The city is home to around forty thousand (40,000) inhabitants. Savelugu is one of the commercial areas in the region, holding one of the busy farmers and seasonal markets, where one can find almost everything. Rapid growth has been a hallmark of this municipality since its



founding some 150 years ago. The precise coordinates of its location are 0°39' to 1°02' W, with a range of latitudes from 9°28' to 000°10:08' N. The population density is 68.9 people per square kilometre, and the total land area is around 1,599 square kilometres. It shares boundaries with four of the MMDAs in the region: to the North is West Mamprusi Municipal, East is Karaga District, West is Kumbungu District, and to the South is Tamale Metropolitan Assembly. There are 341,711 people living in the Municipality; 170,199 males and 171,512 females make up the population (Ghana Statistical Service, 2022).



(Source: Mapcarta, 2024)

3.2 Research Philosophy

The research philosophy that governed the conduct of this study was interpretivism which is associated with an Ontological view of multiple reality and an Epistemology of social





constructivism, as it deals with exploring the subjective reality of teachers, with regards to their integration of technology in their pedagogical practices. A research philosophy encompasses the set of underlying assumptions, beliefs, and concepts that serve as the basis for your methodology when carrying out a study (Jansen, 2023). It forms the framework that binds your work together. “It is belief about the way studies should be conducted, how data should be collected and how it is then analysed and used. At its deepest level, research philosophy includes considerations of what is (ontology), like, is there an objective truth or is it everything subjective, and how to know (epistemology), like, can we know the truth, and how can we get to know it” (Niada, 2022).

Epistemologically, social constructivism is chosen for the study because, it emphasizes that reality and knowledge are subjective in nature and are constructed through social interactions and interpretation (Kamal, 2019; Lawson, 2021). This makes social constructivism particularly suited for this study, which dives into teachers’ perspectives and experiences with technology. Ontologically, interpretivism is chosen to guide the conduct of this study because it aligns well with subjective and multiple reality of the respondents in the study, who had differing views on technology, technology training and how it affect their competence in appropriating these technologies in their pedagogy. Moreover, Interpretivism allows for meaning to be constructed from the experiences of individual participants (Pulla & Carter, 2018). Interpretivism is also chosen for the study because it also aligns well with the case study design used in the study, as it allows for a holistic understanding of the phenomena under study, thereby allowing the researcher’s exploration of all contextual factors (teacher perception about technology, technology training and competence, and experience with technology training programmes)

surrounding technology appropriation, how those factors are related to respondents' subjective experiences and the meanings derived thereof by the researcher relative to the phenomena under study.

Last but not the least, data collection in the study also makes the interpretivism paradigm suitable for this study, as data was solicited from the subjective reality from respondents and from the meaning that the researcher make of respondents' experiences, in relation to technology appropriation. Therefore, the researcher's choice of Observation and Semi structured interview as data collection tools was also well suited for this study, as it provided the researcher with a clear picture of respondents' experience with technology, which was interpreted for construction of meaning to address the research questions in the study.

3.3 Research Approach

The qualitative research approach was adopted to guide the conduct of this study.

Qualitative research approach deals with the systematic collection and analysis of in-depth non-numerical data [interview, observation, field notes, textual, survey, memos, personal journal, audio, picture, video] for statistical analysis (Ivan, Ulfah, Awalludin, Novarita, Nilawijaya & Fitriyyah, 2023). Qualitative research shed light on people's unique life experiences in a naturalistic and interpretive approach, it explores a phenomena or social reality as shown through one's beliefs, speech, ideas, culture, motivation, intentions and imaginations (Lahiri, 2023, p. 1). Grounded theory, phenomenology, case study, ethnography, etc. are some of the methods used in the qualitative research approach (Lahiri, 2023). This approach was chosen for this study





because, it allows for exploration of human behaviour, perspective, and experiences in research, thereby capturing beliefs, motivations and opinions of research subjects, which cannot easily be expressed in numerical terms (Jameel, Shaheen, & Majid, 2018; Mohajan, 2018). This makes the qualitative approach suited for this study, which sought to shed light on teachers' training and competence in appropriation of technology in the context of Savelugu Experimental Cluster of Schools, through utilization of non-numerical data such as interviews, participant observation, and documents (Professional Learning Community-PLC and participants' technology usage log).

3.4 Research design

The design for this study was case study design. A case study is a qualitative research methodology which deals with “an intensive analysis of an individual unit (as a person or community) stressing developmental factors in relation to environment” or context (Flyvbjerg, 2011). In the view of Yin (2014), a case study is “an empirical inquiry that investigates a contemporary phenomenon (the ‘case’) in depth and within its real-world context” (p. 16). Yin argued further that, the case study design is suitable for studies that investigate a contemporary phenomenon relative to a specific context and is also crucial to understanding real-world cases around the phenomena. Case study research typically uses a variety of evidence from different sources, such as interviews, documents, observation, and artefacts (Hancock, Algozzine & Lim, 2021). Case study is therefore used as the design for this study to explore the experiences of teachers with regards to their training and competence in technology use as a case, with the context being Savelugu Experimental Cluster of Schools. This design is also so chosen to tap into teachers' context-dependent experiences with technology appropriation through

researcher proximity to and feedback from the objects of study (teachers). The case study design will also afford the researcher the opportunity to appreciate the contemporary phenomena under study in its complete form and natural context.

A research design is the systematic framework that establishes a logical connection between the data that will be gathered and the conclusions that will be derived from it, all in relation to the initial questions of a study (Yin, 2009). Its purpose is to maintain consistency and coherence in the research process. Alternatively, a research design is regarded as a strategic blueprint for progressing from inquiries to definitive findings.

3.5 Population of the study

The population for this study was made up of the Municipal training officer of Savelugu Municipal Education Directorate and all teachers of the Savelugu Experimental Cluster of Schools in the Savelugu East Circuit of Savelugu Municipality of the Northern region of Ghana, where the study was conducted. The total population for the study was 60 teachers. This included ten (10) kindergarten teachers, thirty (30) primary school teachers, twenty (20) junior high school teachers and the municipal training officer. This was made up of twenty-four (24) females and thirty-six (36) males. This cluster of schools were chosen because they were schools that were most enabled technologically among the schools in the Savelugu East Circuit of the Savelugu Municipality in the Northern Region. This positioned them well for them to appropriate technology in their teaching and learning in the schools.





3.6 Sampling and Sample Size Selection

3.6.1 Sample Size Selection

Following the determination of the population for the study, the researcher relied on purposive sampling technique to select a sample size for the study. The sample size for the study was made up of 16 respondents: comprising of five (5) teachers each from the three schools within the cluster and the Municipal Training officer. At the primary school ‘A’, ‘B’ and Junior High School; the Headteachers, their curriculum Leaders and three (3) other teachers were purposively selected, making the five (5) respondents from each of the three schools. The Municipal Training officer was also purposively selected to participate in the study, bringing the total sample size for the study to 16 respondents. As part of the considerations for purposively selecting the sample size, the researcher considered the exposure of the selected respondents to technology training programmes initiated in the schools under study and the municipality as a whole. However, there is disagreement with what constitute appropriate sample size in qualitative studies. The researcher relied on the principle of saturation as in all qualitative studies to arrive at the sample size of sixteen (16) in this study. This is because no new theme was generated after the 16th respondent.

In qualitative research, saturation refers to the point at which researchers have acquired enough data to fully capture all potential emergent themes within the phenomenon under study (Mwita, 2022). It is used to verify a study's validity and rigour. However, saturation is a widely used and usually misunderstood concept. Some researchers cease collecting data too early, while others continue to collect unnecessary data. Thus, the arrival of new data, topics, categories, and codes can all be utilized to determine saturation. The

complexity of the research question, the group under investigation, and the researcher can all influence how saturation is determined.

3.6.2 Sampling technique

Since this study is a qualitative study, the researcher relied on non-probability sampling technique for the study. The Savelugu Experimental cluster of schools were purposively selected for this study because they had the requisite technology infrastructure to implement technology in their teaching. The respondents in the study were also selected using purposive sampling techniques.

Sampling technique is a statistical technique used to select a subset of a population to represent the entire population (Qualtrics website, 2023). Sampling is an essential element of research, employed to make inferences about a population based on a representative sample. There are two primary sampling techniques: probability sampling and non-probability sampling. Probability sampling is a method in which each unit in the population has an equal chance of being selected for the sample. Simple random sampling, stratified sampling, and systematic sampling are examples of probability sampling techniques (Bhattacharjee 2012). In non-probability sampling technique, some units of a population have no chance of being selected or in which the probability of selection cannot be determined with precision (Wolf, Joye, Smith & Fu, 2016). Non-probability sampling techniques include convenience sampling, quota sampling, and purposive sampling.

Purposive sampling is preferably used in this study because the researcher wanted to ensure that the sample for the study was dependable and represented the main group. It is



also used to select respondents based on their exhibited characteristics or specific criteria that are relevant to the research questions (Martin, n.d.). This technique (purposive sampling) is particularly effective in this study because it ensures purposefulness and selection of information rich participants as the selected sample for the study.

3.7 Sources of Data

To ensure depth in the study, data was solicited from both primary and secondary data sources during the research. Primary data was gotten from observation and interview sessions with teachers and the training officer, on the nature of technology training programmes delivered to teachers and how they affect teaching and learning. To compliment the primary data that was obtained, secondary data was gleaned from document analysis of teachers' technology utilization in lesson preparation, presentation, and history of training records available in the schools at the time of the study.

3.8 Data collection Instruments

The data collection instruments for the study were observation, semi-structured interview (SSI) guide, and document review. The semi-structured interview guide consisted of fifteen open-ended questions, divided into five sections. Section I collected data on the demographic characteristics of respondents. The demographic characteristics of respondents included: age, sex, school, class/level taught, number of years in the service and highest professional qualification. Section II also gathered data on teachers' perception on the role of technology in their pedagogical practices. Section III also sought data on teachers' experience with technology training programmes in the school. Section IV collected data on the contribution of technology training programmes to teachers'



pedagogical competence in integrating technology in the classroom, while section V gathered data on the challenges encountered by teachers when incorporating technology in their instructional practices. The researcher also used probing questions to seek for clarification on responses that are not clear to him.

On observation, the researcher did an unstructured observation of not just lesson delivery but how lessons are delivered with the use of technology. Observation was chosen as an instrument in the study because the study is not just on how teaching is done, but how it is done with the use of technology, also observation enable the observer to discover information that participants or staff members may be oblivious of or unwilling or unable to discuss during the interview sessions. Dudovskiy explained also that “Observation as a data collection method can be structured or unstructured. In structured or systematic observation, data collection is conducted using specific variables and according to a pre-defined schedule. Unstructured observation, on the other hand, is conducted in an open and free manner in a sense that there would be no pre-determined variables or objectives” (Dudovskiy, 2016). The unstructured observation method was employed in this study as it allowed the researcher to observe not only how teaching is done but also with what teaching is done- i.e., nonverbal indicators in the process of teaching, facial expression and other indicators that could not be captured by interview sessions. In observing, the researcher looked out for integration of technology in pedagogy, utilization of technology infrastructure and how competently they are being handled. Available records on technology utilization were also looked at by the researcher.





Document review was another data collection instrument the researcher utilized in data collection in this study. As one of the data collection tools, documents will provide a history of teachers' training, how teachers have worked, and with what competence teachers are implementing technology in pedagogy in the schools under study. The researcher reviewed physical evidence present in the schools under study in the form of Professional Learning Communities (PLC) reports, teacher training logs, and technological hardware utilization logs. Also reviewed in the study is official recordings of the schools' teaching and learning activities such as lesson notes preparation, pupils' performance in ICT etc.

Document analysis is employed by researchers as a qualitative research methodology. The process involves assessing digital and tangible records to decipher their content, understand their significance, and utilize the information they offer. Researchers commonly utilize three main categories of documents for document analysis:

- **Public records:** These are the formal documentation of the actions carried out by an organization, usually a governmental body or educational establishment. Examples of such documents include manuals, census data, birth and death records, and court paperwork.
- **Personal documents:** pertain to records detailing an individual's personal encounters and events. Some examples of written forms of communication are diaries, journals, emails, blogs, and social media posts.
- **Physical evidence:** refers to the tangible artifacts that are found within the research setting. Examples of such materials include flyers, posters, reports, and training materials/logs.



3.9 Data collection procedure.

Data collection in the study was kick started by the researcher obtaining an introductory letter from the education department of the university for development studies, giving him the permission to enter into the field for data collection. This introductory letter was presented to the Savelugu Municipal Director of Education as part of the field entry protocols. The Municipal Director in turn gave the researcher an introductory letter into the schools, giving the researcher permission to engage teachers as respondents for data collection in the study. At the schools, the researcher presented the municipal director's letter to the headteachers who then read and introduced the researcher to the teachers for data collection to start. The headteachers admonished teachers to be cooperative with the researcher to make the research a success. The researcher was also introduced to municipal training officer by the municipal human resource officer, who entreated the training officer to support the researcher in the course of the study.

After the necessary permissions were sought at each level for field entry, the researcher pre-tested the data collection instrument (semi-structured interview guide) with six (6) selected teachers in the schools under study (two from each of the three schools), who did not participate in the main study. This was to check the validity and reliability of the instruments before use. The researcher re-administered the same pre-tested interview questions to the participants as a post-test within two weeks interval, to ensure that participants do not repeat the same answers they gave for the first pretest session. After successfully pretesting the instrument, adjustments were done to the instrument based on feedback obtained after pretest and it was subsequently administered to the actual selected respondents for data collection on an agreed date and time. To complement data collected



from the interview sessions, the researcher did an unstructured observation of teacher lesson preparation, delivery, and with what lessons are delivered. Available documents in the school were also looked at for data pertaining to history of teacher training and appropriation of technology in their teaching practices.

3.10 Pre-testing the Semi-Structured Interview Guide.

In research, pretesting is done to ascertain the suitability and applicability of the research instrument for the study. It is aimed at validating the content of instrument or otherwise, relative to the understanding of the respondents to the questions contained in it (Abu-Taieh, Hadid, and Mouatasim, 2020). Thus, the main target of pretesting is content validity, internal validity and external validity. Abu-Taieh et al., (2020) are of the view that, while internal validity measures the extent to which the instrument elicits the researcher's targeted data from respondents, external validity deals with the extent to which data obtained with the instrument can be used to generalize for the entire study population.

In their series of 10 pretest interviews conducted to assess instrumentation rigor and formulate measures to address any limitations or threats; Hurst, Arulogun, Owolabi, Akinyemi, Uvere, Wrath and Ovbiagele (2015) viewed pretesting as “simulating the formal data collection process on a small scale to identify practical problems with regard to data collection instruments, sessions, and methodology” (p.56). Thus, pretesting can lead to detecting errors in the instrument, relevance of the instrument and word ambiguity in the questions, as well as discovering possible flaws data collection methods employed.



Hurst et al., (2015) outlined the main selection criteria used for review, to assess the rigor and relevance of data collection instruments and procedures as follows:

- Evaluating language competency and content validity of data collection materials.
- Estimating time length of full interview delivery and marking periods of respondent fatigue.
- Maximizing methodological skills and achieving proficiency standards for qualitative data collection.
- Assessing the feasibility and fidelity of translation and transcription protocols in preparation of the interview text for qualitative analysis.

To know how best the research instrument works in this study, the researcher administered the semi structured interview guide to six (6) respondents from the study population who did not participate in the main study as respondents. The researcher ensured that these six selected respondents have similar characteristics with the actual respondents for the study. The aim of this procedure was to test the effectiveness and relevance of the questions contained in the interview guide. In the course of the pre-testing, the researcher gave clarity to conflicting or ambiguous questions in the guide, based on how respondents answered those questions. Feedback from the pretest was used to refine the guide to ensure consistency, reliability, validity, and enhanced capability of the instrument to gather the required data for the study, from the respondents.

3.11 Methodological Rigour

Owing to its subjective nature, rigor in qualitative studies is more intricate than in quantitative studies (Kakar, Rasheed, Rashid & Akhter, 2023). However, in what is



described as the Four-Dimensional Criteria (FDC) by Guba and Lincoln (1985), the extent of methodological rigor in a qualitative study can be guaranteed by ensuring credibility, dependability, confirmability, and transferability of the study's methodology. To ensure this study was methodologically rigorous, the researcher employed the Four-Dimensional Criteria (FDC) by Guba & Lincoln to assess the research's rigor as follows:

3.11.1 Credibility.

Credibility refers to the level of trust that may be attributed to the accuracy and truthfulness of the research findings (Anney, 2014). One of the fundamental steps in establishing credibility of qualitative research is clearly indicating how issues of bias were identified and resolved throughout the conduct of the study (Johnson, Adkins & Chauvin, 2020). To ensure the study was credible, the researcher spent time establishing rapport with the research participants in a self-immersion, to understand the research setting and culture of the participants. This was targeted at having the participants open up to the researcher in order for him to have a wholistic appreciation of the phenomena under study to identify possible biases from the participants and addressing them throughout the study. To avoid systemic and participants bias, the researcher triangulated the data sources (interview transcripts, observation notes, and document review) to confirm veracity of findings. Interviewees were also made to validate the interview transcripts and findings.

3.11.2 Dependability.

Dependability pertains to the consistency and reliability of research findings over an extended period, it is a response to consistency (McGinley, Wei, Zhang & Zheng, 2021).



The establishment of dependability is achieved by the use of several methodologies, including an audit trail, code-recode strategy, stepwise replication, and peer evaluation (Anney, 2014, p. 13). As a way of ensuring dependability in this study, the researcher in an audit trail, accounted for research activities in the research process, such as how data was collected, analyzed and interpreted. The researcher also collaborated with the participants to validate the study findings, to ensure they are a true reflection of the views they shared in the course of the study. The researcher also did a within-method triangulation of data collected through the semi structured interview, observation and the learning centre usage log. This was aimed at complementing the weakness in one of the data collection tools.

3.11.3 Confirmability.

Confirmability indicates if the research is unbiased; that is, if the results are based only on the research participants and context and not on any additional biases, motives, or points of view (Amin, Nørgaard, Cavaco, Witry, Hillman, Cernasev & Desselle, 2020; Guba, 1981). Confirmability is the extent to which other researchers can confirm or corroborate the findings of a research (Anney, 2014). This indicates that the findings are not just from the imagination of the researcher and that other researcher will find same when the study is replicated. Confirmability can be ensured through strategies such as audit trial, triangulation and reflexivity (Carcary, 2009; Lincoln & Guba, 1985). As a way of proving the unbiased nature and confirmability of this study's findings, the researcher kept record of audio interview recordings, transcribed interviews, observation notes, personal reflections and documents reviewed, to guide the write up of findings and inform

interpretations. Again, the researcher also did data triangulation to enhance quality of the data collected from different data sources.

3.11.4 Transferability

The concept of transferability refers to the extent to which research findings can be applied to individuals other than the researcher or the researched of a particular study, it helps in establishing the applicability construct in any given research study (Hammarberg, Kirkman & De Lacey, 2016). This involves detailed reporting on the research findings, context and participants, to make readers determine whether the findings can be replicated with similar participants in similar settings (Curtin & Fossey, 2007) . Through thick description and purposive sampling, researchers can facilitate the transferability judgment by a potential user who contemplate replicating a study (Bitsch, 2005). The researcher ensured transferability in this study by providing thick description in the write up to detail about methodology and context and using purposive sampling to provide details about participants and why they were chosen for the study.

3.12 Ethical considerations

Ethical considerations are a collection of guidelines and principles in research that will direct the conduct of research, and these must be adhered to at all times when gathering information from individuals, scientists and researchers (Bhandari, 2021b). They include the norms that guide how the study will be conducted. The researcher and respondents are mutually inclusive in following these norms, as to uphold the rights of both parties involved in the conduct of the study. As the researcher in the conduct of this study, I ensured ethical considerations as follows;



- First, I sought clearance for school entry from the Municipal Directorate of Education, by identifying himself to the directorate through a letter from UDS.
- Second, I respected the rights of participants by obtaining informed consent and making participation in the study voluntary, as respondents were allowed to withdraw at any point in the study as they please.
- Third, before engaging respondents in data collection, they were briefed about the objective of the study and items on the data collection instrument were explained to them.
- Fourth, ensuring that any information the respondents shared in study were kept confidential and private between him (the researcher) and the respondent, and for the purpose of the study only.

The above-mentioned ethical considerations were followed in the conduct of this study to protect the research subjects in the study, who in this case were the Savelugu municipal training officer and teachers in the Savelugu Experimental Cluster of Schools.

3.13 Data management plan.

Data was effectively organized into field notes, documents and audio recordings. Field notes and documents were carefully coded to ease analysis, while audio recordings of interview sessions with participants were carefully encrypted/zipped and stored online for enhanced confidentiality and security of the data. This data will only be shared to a third party under a data sharing agreement, except for academic use where it will be shared for reuse.



3.14 Data processing and analysis procedure.

Data analysis in this study was done manually and involved a systematic process of thematic analysis that was used to identify and analyse recurring patterns or themes in the qualitative data, in order to build relationships or trends related to the research questions and the supporting theories. In this regard, the analytical and critical thinking skills of the researcher played a crucial role. According to Sutton and Austin (2015), the systematic process of critically and analytical analysing data involves:

- Data organization: The acquired data, including interview transcripts and field notes, will be organized and prepared for analysis. This may entail transcribing audio recordings, developing a coding system, and organizing the data for simple retrieval.
- Coding of data: The data will be analysed through coding, which involves identifying and labelling meaning units or data segments. This can be accomplished through either deductive coding (based on predetermined categories derived from the research questions or theoretical framework) or inductive coding (categories arising from the data itself).
- The development of themes: This will be accomplished by combining related codes into higher-level concepts or patterns. Themes are reoccurring patterns or concepts that emerge from the data and provide insightful answers to the research questions.
- Interpretation of Data: The themes and patterns will be interpreted and analysed to achieve a deeper comprehension of the research questions. This involves analysing the relationships between themes such as teacher training and



competence, comparing and contrasting various perspectives such as factors influencing teachers' decision to appropriate technology and their level of training and competence, and then seeking explanations and connections within the data generated.

- Triangulation and validation of response: To increase the reliability and credibility of the findings, multiple researchers can be involved in the data analysis process to employ triangulation. In addition, member verification can be conducted by providing participants with the findings to validate the interpretation of their responses.
- Writing of report on findings: The results of the data analysis will be synthesized and delivered in a comprehensible and meaningful manner. This may involve composing a narrative description of the findings, including significant quotes or data excerpts to support the themes, and providing an in-depth analysis of the research questions.

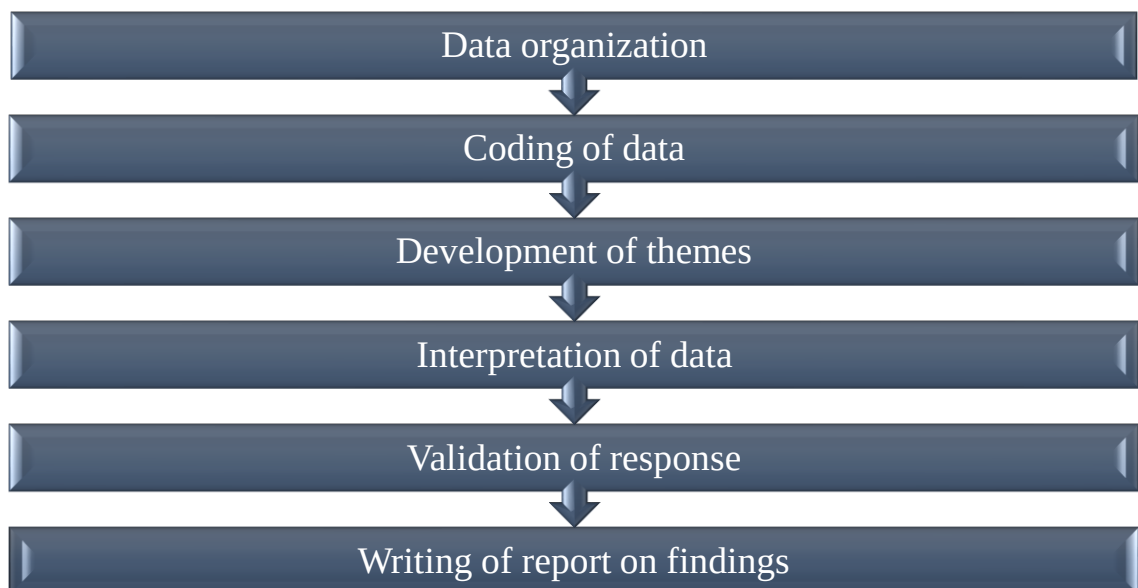


Figure 2.0: Thematic data analysis process (Adapted from Sutton and Austin, 2015)

In line with the above outlined systematic process, data analysis in this study was done to develop patterns, generate themes, and provide insight that will add to already existing knowledge and as well provide answers to questions the study sought to answer.

3.15 Summary of Chapter three.

This chapter discussed sections of the study such as research philosophy, research design, population of the study, sampling and sample size selection, sources of data, data collection instruments, data collection procedure, pre-testing of instruments, ethical considerations, data management plan, and data processing and analysis procedure. Following a qualitative research approach, a case study design was adopted to explore teachers' training and competence in technology appropriation at the Savelugu experimental cluster of schools. Data obtained from the exploration of the topic is presented and discussed in chapter four, which is the next chapter of the study.



CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

The purpose of the study was to examine teachers' training and competence in appropriating technology in pedagogy at Savelugu Experimental Cluster of Schools in the Savelugu East Circuit of Savelugu Municipality of Northern Region, Ghana. The qualitative case study design was chosen for the study. Sixteen (16) respondents, comprising the municipal training officer and fifteen teachers from the Savelugu Experimental cluster of schools, were purposively sampled to participate in the study. Results of the study is presented in this chapter in two folds: the first part deals with the demographics of respondents, while the second part presents the results in themes, along with their corresponding discussions, in line with each research question.

4.1 Demographic Data of Respondents

The demographic data obtained from respondents included age, sex, school taught, class/level taught, number of years in the service and highest professional qualification of the respondents.

4.1.1 Age

Majority of the respondents (7 respondents) had their ages fall within the age range of 25-35 years. This was followed by five respondents, who had ages that fell within the range of 36-45 years. Four (4) of the respondents had the highest ages among the respondents, which fell between ages 46 and 55 years. A careful look at the age structure of the respondents showed a youthful teaching force in the schools under study.





4.1.2 Sex:

Majority of the respondents were male teachers, who constituted twelve (12) respondents out of the total study respondents. Female teachers also constituted four (4) out of the sixteen respondents of study.

4.1.3 Professional Qualification

Data obtained from the respondents revealed that nine (9) of the respondents had professional qualifications up to a degree in education, while six (6) of the respondents had professional education up to a diploma in basic education. One (1) respondent also had professional qualifications in a Master of Education. This data indicates a strong and well-educated teaching force in the schools under study, most of whom had at least a degree in education.

4.1.4 School

Respondents for the study were pulled from three schools within the Savelugu Experimental cluster of schools and then from the training officer for the Savelugu municipal education directorate in the northern region of Ghana. Five respondents were selected each from Savelugu Experimental Primary School “A”, Savelugu Experimental Primary School “B” and Savelugu Experimental Junior High School, respectively. The municipal training officer was also chosen from the municipal education directorate. These schools were selected because they had the requisite technology infrastructure to implement technology-based teaching.



4.1.5 level taught

Out of the respondents selected from the schools under study, it was revealed that two respondents were teaching at the kindergarten and lower primary levels, respectively. Four respondents were teaching at the upper primary level, two were teaching JHS 2, and one was teaching JHS 1. The three headteachers in the study were teaching as supporting teachers who stepped in, in the absence of a teacher. The municipal training officer takes part in teaching when he is facilitating training sessions or PLC sessions at all levels.

4.2 Presentation of Results and Discussion

4.2.1 Presentation of Results

4.2.1.1 Perception of teachers in the Savelugu Experimental Cluster of Schools regarding the role of technology in their pedagogical practices

When respondents were asked about their perception regarding the role technology plays in their pedagogical practices, they responded that technology plays a crucial role in their practice as teachers in the 21st century. Respondents were asked: 1. To state in their opinion whether they think technology is helpful in teaching, 2. Tell their experience in using technology in the context of classroom teaching. 3. Their perception about technology's impact on their ability to deliver lessons effectively. Their responses to these sub-questions under this research question were coded into patterns and then into thematic areas such as:

Use of technology for teaching purposes:

This theme captured teachers' responses to the effect that technology aids them as a teaching tool, making teaching or lesson delivery effective or interesting. All respondents



agreed that technology is helpful to them as teachers. According to respondent 1,3 and 5, when asked for their opinion, do they think technology is helpful in teaching? They said;

“Yes, because with technology, learners will actively participate fully in the teaching and learning in the class, using both visual and auditory teaching materials. Students appear happier and more prepared to learn, with the sight of a computer and projector with the teacher” (Respondent 1, interview, April 2024). From this respondents’ view, he sees technology as capturing the attention and interest of learners in the classroom.

Another respondent sees technology as a game changer in teaching, as it reduces the burden of teaching complex concepts to learners, which would otherwise have been impossible. He has this to say:

“Yes, technology is helpful; teaching becomes less burdensome with technology. I do not struggle to teach complex concepts using technology as a teaching tool, so it is helpful in teaching.” (Respondent 3, interview, April 2024).

One respondent categorically told the interviewer that he looks ineffective when teaching without technology. He had these to say:

“Yes, technology is actually helping me in my work as a teacher, especially in lesson delivery. These days, I feel like I struggle to teach when I deliver lessons without audio-visuals. My lessons appear boring with low student participation” (Respondent 5, Interview, April 2024).

Again, another respondent explained that teaching and learning in the 21st century will be meaningless without the role of technology, especially when disaster strikes. He had this to say: *“The role technology plays in teaching and learning cannot be over-emphasized, especially these days with every sector going the way of technology. A specific case was*

technology's role for our learners, who received lessons through radio during the Covid-19 pandemic in 2019.” (Respondent 12, Interview, April 2024).

When asked about their experience in using technology in the classroom context, one respondent told the researcher that even though technology integration looks challenging, the benefits to both the teacher and students are enormous. She told the interviewer that:

“I have quite a challenging experience with the use of technology in the classroom. Sometimes, the know-how to run a technology-delivered lesson is challenging to some of us, but with some level of assistance from some colleagues and teachers, we see our lesson delivery being smoother than that delivered without technology integration. Students seem to develop great interest in lessons delivered with technology” (Respondent 4, Interview, April 2024). This respondent sees technology as an enhancement to her pedagogical practices in the classroom.

In agreement with Respondent 4 on the experience with technology use, respondent 7 stated, *“Technology use in the classroom is rewarding to both teacher and student if the teacher has the right knowledge and skills about the technology tool being used. In my initial days of using PowerPoint presentations for my lessons, I had challenges with connecting the projector and computer until the ICT teacher came to my aid. As I speak, I am now conversant with the process.”* (Respondent 7, Interview, April 2024). This respondent had challenges with technology in his early days of appropriating technology as a teaching tool.





In contrast to respondents 4 and 7, respondent 8 is of the view that technology use is beneficial but appears difficult to use in his class, considering the large class size of one hundred and fifteen students (115) coupled with inadequate computers to give students real practical technology-based lessons. He had this to say:

“The first day I tried integrating technology with my lesson delivery in class, I realized that though students showed a great deal of interest in the lesson, their interest posed a challenge to the lesson as I had to allow each student to take turns to have a feel of how to click and drag the mouse, in a class of about one hundred and fifteen (115) students. This took much time beyond the time stipulated for the lesson even though students showed understanding of the lesson.” (Respondent 8, Interview, April 2024). This respondent agreed that technology impacted the understanding of his lessons but contributed to a waste of instructional time, considering the large classroom size of his class coupled with inadequate technology tools to support technology integration.

When asked about the impact of technology on their ability to deliver lessons effectively, Respondent 9 told the researcher that technology has positively impacted her ability to deliver her lessons effectively to the learning needs of all his learners in class. She mentioned that: *“technology has impacted my ability to deliver lessons effectively, especially with science concepts that are difficult to explain in the abstract to students. With a YouTube search, I can now search for videos that effectively explain scientific concepts like germination, osmosis, fertilization and many more”* (Respondent 9, Interview, April 2024). This respondent perceived technology to impact her ability to deliver lessons effectively and positively.



Use of technology for researching lesson information:

This theme captures respondents' responses related to the use of technology to get more information for teaching. When asked about their perception regarding technology's role in their pedagogical practices, respondents 2,7,9 and 10 responded positively to the effect that technology plays a key role in helping them as teachers. They attached reasons related to technology's role in helping them prepare for lesson delivery through research. They attested that technology broadens their horizon as teachers through research in any discipline that they want to teach their learners in.

Respondent 2 indicated that technology particularly helps him expand more activities to teach his lesson indicators. He had this to say:

“I can say that technology plays a key role in my pedagogical practices, especially in recent times when we have few or no textbooks for some subjects. I search online for teaching and learning activities and teaching and learning materials like videos and pictures to be able to put content together to teach indicators I am to teach in a lesson. I also use the same procedure to put teaching notes together for my students” (Respondent 2, Interview, April, 2024).

In agreement with respondent 2, another respondent mentioned that in teaching English language lessons, she uses technology to understand difficult keywords in her lesson. She said this to the interviewer:

“I have always had challenges finding meaning and usage examples for some keywords and key concepts in my lessons, until a colleague taught me how to use google and ChatGPT. Now, with the use of this technology, I always search for meaning and usage

examples of key concepts in my English lessons before entering class to teach, using basic Google search engine and ChatGPT.” (Respondent 9, Interview, April 2024).

When asked for their opinion on whether they think technology is helpful in teaching or not, Respondents 7 and 10 responded positively and stated that technology helps them in researching materials to learn on their own for continuous professional development.

Respondent 7 is quoted as saying that:

“The use of technology in education made it possible for some of us to search online for professional development courses and learn at our own pace through learning management systems (LMS) for continuous professional development. This has impacted how I deliver my lessons in my class” (Respondent 7, Interview, April 2024). This respondent also expressed how technology has impacted his effectiveness in lesson delivery, stating his acquisition of new knowledge each time he learns online.

Similarly, respondent 10 told the interviewer that technology has positively impacted how she delivers her lessons as an early childhood classroom teacher. She mentioned that:

“As an early childhood classroom teacher, I go online to search for clip art pictures and use them in place of drawing in my preparation of teaching and learning materials for my learners. This has made me an effective early childhood teacher as I have a picture or video for every lesson in my class.” (Respondent 10, Interview, April 2024). This respondent saw technology to have a positive impact on her lesson delivery.





Use of technology for assessment purposes:

Responses that are captured under this thematic area encompassed all responses from the respondents that pointed to the fact that technology assists them in their assessment tasks as teachers. After being asked whether technology was helpful in teaching, all respondent agreed technology was helpful and proceeded to assign the role technology plays in helping them assess their learners as being the reason why they think technology was helpful. They also attached these reasons to the experiences they had in using technology in the context of classroom teaching.

One of the respondents remarked that he uses technology to prepare assessment tools for his learners. He recounted to the interviewer how technology has positively impacted his ability to design his assessment materials at the end of every term and every school year. He had this to say:

“I always go to Google to download hard-to-draw diagrams, illustrations, and pictures that I want to use in typing exam questions for my learners at the end of every term and every school year.” (Respondent 7, Interview April 2024). This respondent sees technology as an enhancer of his work as a teacher but not a replacement for it.

Also, Respondent 5 pointed out to the interviewer that she leverages technology a lot when handling the assessment data of her learners. According to her, she was having some challenges in completing learners’ report cards in time due to the large class size that she is handling, and thanks to technology, she now works within time. She explained as follows:



“Technology is beneficial to me as a teacher and has impacted my work a lot. In the past, I struggled a lot with compiling and analysing assessment data of my learners in time each time I assessed them for end-of-term or end-of-year exams due to the large class size I handle. With the use of Excel these days, I am now better placed to effectively collate, tabulate, and analyse the exam scores of my learners. After tabulating their scores for each assessment task, I also rank and grade my learners.” (Respondent 5, Interview, April 2024).

In agreement with Respondent 5, Respondent 16 believes that technology is truly useful and impactful to him as a teacher, stating his reason for using technology for data management of learners online. He is captured as saying:

“Technology is useful to my work, and with technology, I am able to assess all data about learners anywhere and anytime. The use of education management information systems (EMIS) and mobile school report cards (Msrc) by schools now make data storage and retrieval more effective and secure. I upload all examination scores of my learners online for safe keeping and easy retrieval any time it is needed for decision making about them.” (Respondent 16, Interview, April 2024).

An observation carried out by the researcher in the schools under study showed that the schools had some technology tools that were being used to support integrated technology lesson delivery in the schools. The researcher observed at least two lessons each from the schools, delivered with technology, and these lessons were delivered by the teachers with some level of challenges, including inadequate technology tools for their large classroom sizes and difficulty in handling the few available technology tools.



A review of usage logs carried out by the researcher at the IT learning centres in the schools revealed that, though there were some technology tools in the schools (like TV, DVD players, Flat-screen television sets, Video teaching and learning materials, Desktop computers, Laptop computers, and one projector), teachers did not frequently utilize them in lesson delivery as they should.

4.2.1.2 Nature of teachers' experiences with technology training programmes in the Savelugu Experimental Cluster of Schools

With this question, respondents were asked to tell the nature of their experiences with technology training programmes in the Savelugu Experimental Cluster of Schools. In order to elicit answers to this question, respondents were asked three sub-questions: whether they have taken part in any technology training programmes provided by their school or the municipal education directorate, if yes, to what extent did those training programmes align with their expectations and whether there was any particular component of the training programmes that they found particularly beneficial or difficult. Their responses were transcribed and put into themes as follows:

On the question of whether they have taken part in any technology training programme provided by the municipal education directorate, majority of the respondents (except 14 and 15, who were newly posted teachers) indicated that they took part in technology training programmes organized by the municipal directorate of education in collaboration with Discovery Learning Alliance (DLA), a Non-Governmental Organization (NGO) that supported the cluster of schools with TV set, DVD players and DVD cassettes containing video Teaching and Learning Materials (TLMs), to enable the schools implement



multimedia-based instruction. They mentioned that these training programmes were organized to equip them with the rudiments to implement audio-visual TLMs in their teaching. Two of the respondents were newly trained teachers posted to the school, and they indicated they had not received any technology training from the school or the municipal education directorate.

Among those who received some technology training in the multimedia-based instruction programme were respondents 13, 6, and 7, who indicated that they received some level of training to implement the said programme by the Municipality in collaboration with DLA. This technology-based programme, however, stalled upon the folding up of the NGO from the Municipality. One of the respondents told the interviewer that, he has received some training, he is quoted as saying:

“Yes, I took part in some technology training programmes from DLA in the 2017/2018 academic year when our school was enrolled into the multimedia in the classroom programme by DLA, and that was basically on how to use video in the classroom to enhance the teaching and learning process. Since the DLA folded up, there hasn’t been any refresher training on that” (Respondent 13, Interview, April 2024).

Another respondent said that he took part in the video in the classroom programme by DLA and built teachers’ e-portfolios online, but he was trained at the school level by another teacher who participated directly in the training programme. He noted that this made his training less practical and time-constrained than those trained earlier on those topics. He had this to say:



“I was trained by the school’s curriculum leader, who took part directly in the training programmes run by DLA and the municipal directorate. This was because I was posted to the school after all the teachers had already been trained for the programme. Even though the training was not practical and did not last long, I managed to grasp the video techniques needed for my lesson delivery and the procedure for creating and managing a teacher portal account” (Respondent 6, Interview, April 2024).

Respondent 7 pointed out that he was also trained but, of late, unable to use the technology devices because the devices had broken down, and he could not fix them because he had not been trained on them. He had this to say:

“Even though I also received training on multimedia in the education programme and used the knowledge gained to implement the same in class, nothing has ever been heard of the programme since DLA folded up and the devices became faulty. Therefore, I cannot use the device because I lack the technical know-how to revive them for use” (Respondent 7, Interview, April 2024).

Similarly, respondents 1, 12, 8, and 11 revealed that they took part in technology training programmes, which were organized solely by the municipal directorate of education, on how to build their electronic portfolio online on the teachers’ portal, internet search skills, Microsoft Office applications, Mobile school report Card application (Msrc) and basic computing skills. According to them, the sessions were not extensive and did not allow enough time for guided practice. Respondent 1 said he was trained on technology and had this to say;



“Yes, we were trained by the municipal directorate of education on how to register ourselves on the Ghana teacher portal in order to build our electronic portfolio on the online teacher portal so our license numbers could be generated and given to us. The session was short-lived and did allow for more hands-on activities” (Respondent 1, Interview, April 2024).

Another respondent indicated that the municipal directorate trained him on the Microsoft Office applications in just one day, which was short-lived for such a topic. He had this to say:

“Yes, I took part in the training organized by the municipal education directorate on Microsoft Office applications, specifically PowerPoint and Excel, for just one day. The content for this training was so loaded to be studied in a day, so training was rushed” (Respondent 12, Interview, April 2024).

In the same vein, respondent 8 also indicated that the municipal directorate trained him to use a mobile school report card application to collect students' and teachers' data. This results from converting data collection in Ghana Education Service (GES) from paper-based to electronic-based. He noted that:

“I have been trained on how to use the mobile and desktop versions of the Mobile School Report Card application to collect, store, analyse, and retrieve data on both teachers and students in the school. This training became necessary when GES migrated from paper-based data collection to electronic-based” (Respondent 8, Interview, April 2024).



Further to this, one respondent indicated that the municipal directorate also trained him on basic computing skills when teachers in Savelugu municipal received their share of the Government's one teacher, one laptop project. This was meant for teachers to find their way around using the laptop for instructional purposes. He told the researcher this during the interview:

"Yes, I participated in the basic computing skills training offered to teachers after Savelugu municipal teachers their TM1 laptops. This was to position teachers to be able to utilize the laptops for instructional purposes" (Respondent 11, Interview, April 2024).

When respondents were asked to know the extent to which the technology training programmes aligned with their expectations? Almost all the respondents indicated that, to some extent, the technology training aligned with some of their basic expectations, like good facilitation and rich course content, but it largely did not align with most of their expectations. According to them, those pieces of training were mostly more theoretical than practical and did not last as long as they expected, leaving them with the basic theoretical knowledge of how to use technology in teaching. They indicated further that there were also inadequate or no computers in technology training sessions, making it impractical, so they lacked hands-on practice. Some of them had this to say to the interviewer: in his response, respondent 10 had this to say

"I participated in some technology training sessions organized by the Savelugu Municipal Education Directorate in the past. Most often, venues for these training sessions made it impossible for computers to be used. For example, Savelugu ICT Centre, which has been disconnected from the national electricity grid, for technology training workshops leaves much to be desired. Only the facilitator can use the generator for his

laptop and projector, leaving the participants as passive observers” (Respondent 10, Interview, April 2024).

Another respondent pointed out to the researcher that he expected the technology training sessions to be competence-based, which, in many cases, was not so. According to him, the technology training sessions he attended were more or less theory-based or taught in abstract. They do not always give participants enough time to practice and develop the requisite competence to appropriate technology in their work, as they just have to watch the facilitator. He noted that:

“Most often, the technology training programmes organized for teachers in this Municipality don’t always give the necessary skills and competence for us to be conversant with the use of technology tools in our teaching. Sometimes, we will be invited to a technology training programme, and when we attend, sometimes only a few computers will be available for hands-on practice. Participants don’t get enough time or the chance to practice what is taught, leaving them passive observers of the steps involved in practically carrying out the training tasks.” (Respondent 3, Interview, April 2024).

Finally, in an interaction with another respondent, the researcher was told how rehashed technology training programmes in the Municipality are. The respondent bemoaned the consistent trend in which technology has been taught to him without adequate practice devices.

“Some of the training programmes organized for teachers in this Municipality were mostly done without adequate computers for every participant to lay their hands on in a





guided practice. This always makes us comfortable at the training venue because we still remember the step freshly, but with time and without practice, teachers forget these steps and are back to start again, waiting for the next training.” (Respondent 14, Interview, April 2024).

When asked whether there was any component of the training programmes that they found particularly beneficial or difficult, almost all of the respondents responded in the affirmative. To buttress this response, respondents indicated that the technology pieces of training they received initiated them into the world of technology, bringing a paradigm shift in how they teach. This has been made possible by components of the technology pieces of training such as the use of Microsoft Word in lesson plan preparation, Microsoft PowerPoint in lesson presentation, and Excel to manage learner assessment results and online search skills. The respondents, however, expressed difficulties coping with some components of the technology pieces of training they received, such as learning practical technology concepts like troubleshooting with few computers or in abstract, short periods allocated for learning practical concepts and staying safe online.

While interacting with the respondents, one respondent told the researcher that her lesson delivery had not been the same since she was trained in some Microsoft Office applications. The respondent, however, said she found it difficult to solve problems with her computer each time she ran into trouble. She told the researcher this:

“ Some components of the training were beneficial to me. For instance, my lesson preparation and delivery have not been the same since I got trained in Microsoft Word, PowerPoint and Excel. Like I said earlier, I now present my lesson plan in Word format



for vetting. I project my teaching notes in PowerPoint for learners. I use Microsoft Excel to collate, analyse and rank my learners after every assessment. However, I lack the technical skills to fix basic issues with my PC each time a problem arises". (Respondent 10, Interview, April 2024).

Another respondent expressed how beneficial the training on internet search skills is to his work as a teacher. The respondent, however, found the aspect of cybersecurity difficult to handle since new threats pop up on a daily basis. This was what he told the researcher:

"As I told you earlier, I really benefited from aspects of those pieces of training that had to do with internet search skills and online security. This component of one training I received actually helped me to be able to search for information on any topic online while staying safe. However, I have issues staying safe with downloaded materials. It always comes with some security risk involving viruses, which are sometimes difficult to fix at once, since new threats come up daily" (Respondent 2, Internet, April 2024).

4.2.1.3 Contributions of technology training programmes to teachers' pedagogical competence in integrating technology in the classroom.

With respect to this research question, responses from respondents were transcribed and grouped into thematic areas as follows:

When asked about the extent to which technology training received contributes to their pedagogical competence to utilize technology. Almost all the respondents indicated that they have been somewhat equipped but needed more technology training to develop their

competence fully. Some respondents mentioned their ability to use technology as a pedagogical aid relative to teaching, research, and assessment of their learners. The response of some respondents is captured as follows:

One respondent told the researcher that technology has opened up a world of possibilities for him in his teaching, as it helped him look for teaching materials online following the absence of textbooks after the implementation of the standard-based curriculum. He said his competence in doing this resulted from his training on internet search skills offered by the Savelugu municipal education directorate. This was what he told the researcher:

“I think that technology has contributed to my work in dimensions that I did not think of. It has opened up a world of possibilities for me in my teaching. Immediately, the new standard-based curriculum was implemented in 2019 and had no textbooks. Then, I thought about how to teach until the municipal directorate trained us on internet search skills. This training was my turning point since it enabled me to search for how to teach the indicators of the curriculum. This training actually contributed a lot to my pedagogical competence in using technology the way I did. Even though I sometimes need assistance from experts to do this, I still think the training kept me on a good footing to start” (Respondent 7, Interview, April 2024).

Another respondent was of the view that the technology training helped her improve her teaching practices as a teacher. She had this to say:





“To some extent, the training I received has equipped me with the basic competencies required to use technology for pedagogical purposes. I am now able to deliver my lesson using Microsoft PowerPoint presentation.” (Respondent 9, Interview, April 2024).

Again, one respondent could not hide her joy, following her ability as a teacher to have comprehensive learner assessment data through the use of technology after being trained by the municipal education directorate on Microsoft Excel. She told the researcher:

“I can say that the technology training I received has equipped me with basic knowledge to enter and analyse assessment results of my learners using Microsoft Excel. I know I also have the skills to rank my learners for grading purposes.” (Respondent 4, Interview, April 2024).

When respondents were asked whether they were more self-assured in their capacity to select and use appropriate technology for different teaching objectives, they did not. They ascribed for saying no because, even though they had the basic competence needed to leverage some technology tools in teaching, they still needed more competence-based technology training to confidently use any technology tool for teaching any lesson objective. Their responses are captured as follows: One respondent pointed out to the researcher that he needed more competence-based training to troubleshoot tasks. He asserted that:

“For me to be more self-assured, I need to have the skill to fix any error in the course of using technology tools in my lesson delivery. Sometimes, I step out of class to call on the ICT teacher to come to my aid each time I encounter a problem in the course of using technology for lesson delivery. I might also not have the competence to operate some

technology tools even if they are deemed to be appropriate for my lesson.” (Respondent 2, Interview, April 2024).

Again, the researcher got an indication from one respondent, who said he is not self-assured of his capability to appropriate technology for achieving different teaching objectives. This, he said, is because he still needed more hands-on or guided practice to be able to do that.

“I am not self-assured because I still need more hands-on activities, even the technology training I received. During training sessions on how to use technology in teaching, more time was not allocated to participants to have more hands-on or guided practice at the training venues. So, I think I am not all that self-assured.” (Respondent 8, Interview, April 2024).

4.2.1.4 Challenges teachers encounter when incorporating technology into their instructional practices in the Savelugu Experimental Cluster of Schools

To elicit a response to this research question, the researcher asked the respondents to mention some of the major obstacles they encounter when utilizing technology for instructional purposes and how those challenges affect their capacity to deliver lessons with technology effectively. Response to these sub-questions were thematically grouped and presented as follows:

On the question of major obstacles respondents faced and how they affect teachers’ utilization of technology for instructional purposes, respondents revealed to the researcher that, even though they have some basic competence in using some technology





tools for instructional purposes, they face a lot of challenges when using technology as a tool in their teaching and learning, which affects their capacity to utilize these technologies. They mentioned a lack of technical support to troubleshoot and solve problems, intermittent power outages in the school community, inadequate technology tools for classroom use, and inadequate competence-based training. Responses of some respondents are as follows:

A respondent in the course interview informed the researcher he lacked the technical know-how or support to fix any technical fault that came up in the course of using technology for instructional purposes. He said this affects his effective utilization of the technology for instructional purposes. He had this to say:

“I have the basic of how to use technology in teaching, but I have some challenges in fixing any technical fault that comes up in the course of using these tools in my lessons. For instance, when DLA brought the audio-visual equipment, we were given basic training on video operation skills in fixing technical issues when using the equipment, but with time, most of what we learnt has been forgotten. There also hasn’t been any follow-up monitoring or refresher training from the school nor the municipal education directorate in that regard, and this affects our ability to use these technology tools effectively for instructional” (Respondent 3, Interview, April 2024).

Similarly, another respondent told the researcher that intermittent power outages almost always interrupt their lessons each time they want to utilize technology for instructional purposes. This disrupts lessons and affects the effective utilization of these tools. He had this to say:



“The few times we attempt to use these technology tools in this school, we are most often interrupted by intermittent power outages in this area. This most often discourages us from using them in lesson delivery because you don’t want to hang in the middle of your lesson due to a power outage, and this affects our capability to use these tools in instructional activities effectively.” (Respondent 16, Interview, April 2024).

One respondent also told the researcher that his use of technology for instructional purposes is largely due to the inadequate number of technological gadgets in the school. He said this impedes his capacity to appropriate these tools in teaching. He had this to say:

“the inadequate number of technology gadgets relative to the large classroom sizes in this school poses a challenge to our utilization of technology in lesson delivery. Sometimes, you use more instructional time in delivering with technology if you want all learners to take turns and have a practical feel for the lesson.” This makes us incapable of achieving lesson efficiency in such a situation” (Respondent 11, Interview, April 2024).

Furthermore, in the course of interviewing another respondent, the researcher found out from the respondent that he had not received any practical technology training since being posted as a newly trained teacher at the school. The respondent indicated that a colleague in the school just explained how to use those tools, and he cannot effectively utilize them for instructional purposes. He had this to say:

“As a newly trained teacher posted to this school, I only received some basic explanation from a colleague teacher on how to use the TV and Deck provided to the school by DLA. This training did not offer me all the skills I need to use the technology equipment we

have. This has, in one way, affected how I use the equipment in my teaching. I was also waiting for a day we will discuss it in a PLC, but to date we haven't" (Respondent 15, April 2024).

4.2.2 Discussion of Findings

4.2.2.1 Perception of teachers in the Savelugu Experimental Cluster of Schools regarding the role of technology in their pedagogical practices

The findings from the study indicated that all respondents agreed that technology is helpful to them as teachers. They believe that technology captures the attention and interest of learners in the classroom and can be a game changer in teaching by reducing the burden of teaching complex concepts. One respondent even stated that they feel ineffective these days when teaching without technology. The respondents also emphasized the importance of technology in teaching and learning in the 21st century, especially in times of disaster. This finding is in consonance with the work of Alashhab, Anbar, Singh, Leau, Al-Sai and Abu Alhayja'a (2021, p. 2), who stated that, while we all dealt with the pandemic problem, technology became deeply embedded in every part of our daily lives, including paying bills, purchasing, giving presents, and even teaching. This finding also agreed with Boichuk et al. (2014), who found out in their study that, with the integration of technologies like multimedia tools, electronic lectures, and knowledge control systems, teaching complex concepts to learners becomes much easier and less burdensome to teachers (Boichuk, Morozova & Boichuk, 2014). The implication for this finding is that educators need to skill up with the technology pedagogy if they want to ensure enhanced student engagement, and it might also be the only means to their relevance as teachers in the 21st century, especially when disaster strikes. It also implies



that the Ghana Education Service and teacher training institutions should make educational technology an integral part of their teacher training programme, as it enhances the implementation of technology-based teaching.

However, data gathered from the study revealed that respondents' experience with using technology in classroom teaching was one riddled with difficulties, which occasioned reduced learner engagement in large class sizes with inadequate technology tools. This finding is consistent with the findings of (Slaouti & Barton, 2007 cited in Buabeng-Andoh, 2012; Ertmer & Ottenbreit-Leftwich, 2010), who recognized access to technological tools and congested classrooms as one of the challenges to effective integration of technology in the classroom. This finding implies that the Ministry of Education and Ghana Education Service must put in deliberate measures to provide schools with adequate technology tools, like computers, to enable teachers to run technology-based instruction in schools.

In terms of research, the respondents highlighted that technology plays a key role in helping them prepare for lesson delivery through research. It broadens their horizons as teachers and allows them to find materials for continuous professional development. Technology is also used to understand difficult keywords in English language lessons. This finding resonates with the work of Prayudi et al. (2021), who are of the view that technology use in education has proven to have a tremendous improvement in the teaching and learning process, with teachers leveraging technology for researching online to prepare their teaching and learning materials. It also agrees with the findings of



Simelane (2010), who explored the potential of technology to offer alternative professional development courses.

This finding implies that teachers should more often build their competence in leveraging technology to search for teaching and learning materials and find alternative learning channels for continuous professional development programmes such as online courses. When it comes to assessment, the respondents agreed that technology is helpful in assessing learners. They use technology to prepare assessment tools and manage assessment data online. They believe that technology is truly useful and impactful in their teaching practice. This finding agrees with Roy (2019), who explored the use of technology in teaching and found that the implementation of technology in education has significantly transformed the education landscape and generated many educational prospects. While numerous educational technologies have benefited students and instructors, instructors have also gained the ability to integrate technology into their lessons. This finding also follows Roy's explanation that technology facilitates an interactive learning environment for students by actively participating, conducting research, and receiving assessment feedback. The implication of this finding is that the education sector has undergone substantial transformations because of the integration of technology. It has provided educators and students with abundant educational opportunities and possibilities. This paradigm shift possesses the capacity to augment educational experiences, streamline resource accessibility, and enable the implementation of inventive pedagogical approaches. In view of this, the Ministry of Education should strengthen policies on the integration of technology in education and supervise the effective implementation of such policies by the Ghana education service.





The researcher also observed that the schools under study had technology tools to support integrated technology lesson delivery. However, as observed during lessons, teachers faced challenges in handling these tools. The usage logs of the IT learning centres also revealed that teachers did not frequently utilize the available technology tools in lesson delivery. This finding complies with the findings of Seifert, Sheppard, and Wakeham (2015) and Hartman (2008) which revealed that, despite the increasing availability of technology tools in schools, only a few teachers in the schools utilized these tools for classroom instruction. This finding implies a serious challenge to technology integration on the front of teachers, the Ghana Education Service and School administrators. The Ghana Education Service should provide effective, continuous professional development programmes for teachers in the service to equip them with appropriate technology in pedagogy. The findings also imply regular and effective monitoring and support for teachers by school administrators. In sum, based on the foregoing outcomes, the evidence positively associates technology with the teaching ability to be utilized in teaching and assessment alongside research. Nevertheless, integrating teaching with technology among teachers and utilizing presently available tools is confronted with several challenges. This research finding holds much significance to teacher preparation and support.

4.2.2.2 Nature of teachers' experiences with technology training programmes in the Savelugu Experimental Cluster of Schools

The study's findings revealed that most of the respondents took part in technology training programmes organized either solely by the municipal directorate of education or in collaboration with Discovery Learning Alliance (DLA), a Non-Governmental



Organization (NGO). This collaboration technology training programme aimed to equip teachers with the necessary skills to implement audio-visual Teaching and Learning Materials (TLMs) in their classrooms. Other trainings organized solely by the municipal education directorate were building electronic portfolios online, internet search skills, Microsoft Office applications, Mobile school report card application (Msrc), and basic computing skills.

One interesting but unexpected finding is that there is no monitoring or follow-up and support for technology training programmes initiated in the Savelugu Municipality, as some respondents indicated that the audio-visual Teaching and Learning Materials (TLMs) programme that DLA initiated in collaboration with the municipal education directorate was discontinued when the NGO folded up from the Savelugu Municipality. This was evident in the usage logs at the IT learning centres of the schools, where the technology devices are kept. The usage log proved that the technology tools have not been utilized for lesson delivery since the resumption of schools after the Covid 19 pandemic. The researcher also observed that the audio cassette players and television sets were dusty and truly appeared not to have been used for some time. This finding is supported by (Balanskat et al., 2007, cited in Buabeng-Andoh 2012), who consider the lack of follow-up on new and varied training programmes to be an impediment to the technology appropriation process at the teacher level. This finding has implications for ongoing support, feedback, and evaluation of programmes initiated by the Savelugu Municipal Directorate, especially those that are done in collaboration with non-governmental organizations (NGOs).



The findings also revealed that induction training is not organized for newly trained teachers in the schools under study, as two newly qualified teachers reported that they had not received any technology training. This finding contradicts (Chidambaram, Ramachandran, & Thevar, 2013), who argued that the introduction training provides new staff members with a sense of warmth and an initial level of skills and knowledge, which helps them quickly integrate into their work and the organization. The finding also moves away from (Kore & Jadhav, 2017), who argued that by undergoing training, teachers may acquire the skills to choose suitable technological tools and resources that are in line with their teaching objectives and cater to the different learning needs of their pupils. This finding implies that the Ghana Education Service need to attach some level of seriousness to the conduction of induction training for their staff at both the district and school levels, as this is going to help them get attuned to the institutional culture and avoid a lot of professional misconduct by newly recruited staff.

When questioned about the degree to which the technology training courses matched their expectations, the majority of respondents expressed that the technology training programmes fell short of their expectations. According to them, the reason behind this is that the training was primarily theoretical and had an insufficient duration. They believed the training sessions lacked sufficient or non-existent computer resources, restricting their ability to engage in practical, hands-on learning. Additionally, certain participants noted that the training sessions lacked a focus on competency and failed to facilitate the acquisition of essential skills. This finding aligns with (Kalyvaki & Bacimanova, 2023), Who stated that the presence or absence of particular programmes for staff digital development and skill building constitute external barriers to technology integration and



that the amount of time teachers have to learn, use, or improve their digital abilities constitute internal barriers. These findings have implications for training officers in the Ghana Education Service (GES), who should start designing comprehensive technology training programmes and implement them with the right quantity of the requisite technology tools needed to run practical training sessions. It also implies that technology training programmes should be allocated enough time for all trainees to have hands-on practice.

However, respondents found certain training programme components beneficial, such as using Microsoft Word for lesson plan preparation, Microsoft PowerPoint for lesson presentation, Excel for managing assessment results, and online search skills. However, they also expressed difficulties with practical technology concepts, limited learning time, and staying safe online. Respondents expressed that the daily occurrence of Cybersecurity threats was perceived as becoming challenging. This finding also agrees with Kalyvaki and Bacimanova (2023), who believe that the amount of time teachers must learn, use, or improve their digital abilities can pose a challenge to them when it comes to technology integration in the classroom. This means that enough time should be given to teachers during training programmes to practice what has been taught to them in the session.

The results indicate that the nature of technology training programs offered to teachers in the Savelugu Experimental Cluster of Schools is an encouraging factor in the teachers' technology use in teaching. Nonetheless, the areas of practical training, duration of the programs, and resource availability are still lacking. Learning from the findings, comprehensive technology training programmes are key. Furthermore, a consistent

follow-up program may be needed to tackle the issues that may still emerge in future endeavours.

4.2.2.3 Contributions of technology training programmes to teachers' pedagogical competence in integrating technology in the classroom.

Results from the study indicate that the technology training received by the respondents has contributed to their pedagogical competence to some extent. However, the respondents expressed a need for more technology training to develop their competence fully. This finding is supported by (Tunjera & Chigona, 2020; Benson, Farnsworth, Bahr, Lewis, & Shaha, 2004), who are of the view that training programmes for teachers should provide them with the skills and knowledge to integrate technology in their teaching effectively. They believe that the beneficial influence of technology training on teachers' perceived technological competencies and attitudes cannot be over-emphasized. This finding implies that more technology immersion and training can improve teachers' competence in using technology in their teaching. Therefore, the Ministry of Education and Ghana Education Service must ensure this. It also implies that teachers should continually immerse themselves in the use of technology.

One respondent mentioned his quest to find teaching and learning materials has been made possible by his initiation into the world of technology, notably the online and digital world. This ability was a result of his training in internet search skills. This was evident when one respondent stated that the technology training helped her improve her teaching practices. This finding is supported by Shapley et al. (2010), who specifically discovered that immersing teachers in technology may develop their technological knowledge and





abilities. This implies that the more teachers are consistently trained on how to use technology, the more their technological knowledge and abilities will be improved. This means that the Ghana Education Service should consistently provide refresher training and Continuous Professional Development programmes for its staff, especially in the Savelugu Municipal Education directorate, to ensure they are continually immersed in technology for improved technological knowledge and abilities.

Furthermore, they seemed hesitant when confronted with the possibility of efficiently choosing and utilizing suitable technology for specific instructional objectives. The participants said that they possessed a moderate level of confidence due to their considerable proficiency in certain technology tools for teaching. However, they lacked the self-assurance to utilize any technology tool for any instructional purpose. Furthermore, a participant expressed a desire for enhanced training focused on developing skills in troubleshooting activities. This finding agrees with the views of (Howland & Wedman, 2004; Vare et al., 2019; Bingimlas, 2009), who argue that the use of competency-based training can ensure that training programmes are relevant to the needs of the workplace and can help trainees acquire the knowledge and skills required for their job or profession. They stated further that a lack of training to incorporate technology into instructional practices proficiently might lead to a deficiency of self-assurance and proficiency while utilizing technological tools and resources in the educational, as evidence suggests that teachers' preparedness to integrate technology is directly linked with their confidence and competence. This implies that the training programmes that the Ghana Education Service offers to its staff should be competence-

based, especially those that are technology trainings, to make them self-assured and build their competence to utilize technology tools in teaching any lesson objective.

Generally, the results show that, although the technology training has provided respondents with the basic pedagogical competence to use technology in teaching, more preparation is still needed to make them feel comfortable using technology for various teaching goals. In other words, this result suggests that professional development in the field of technology integration should be ongoing

4.2.2.4 Challenges teachers encounter when incorporating technology into their instructional practices in the Savelugu Experimental Cluster of Schools

The findings from the study's results highlighted several challenges teachers face in effectively utilizing technology for instructional purposes. The results pointed out a lack of technical know-how or support on the part of teachers to fix technical faults that may arise. Respondents pointed to this lack of expertise as an obstacle to effectively using technology in the classroom. This finding is supported by British Educational Communications and Technology Agency -Becta (2004), whose study concluded that technology programmes stand a high risk of failure if there is a shortage of accessible technical assistance in schools. The study said this could hinder the frequency of technical maintenance of devices, which could deter teachers from integrating technology into teaching because of the fear of equipment breaking down in the middle of a lesson. This finding and that of British Educational Communications and Technology Agency's findings is supported by findings of Anderson and Putman (2020), who found out that, lack of technological knowledge to fix equipment malfunction is a challenge to the





technology integration process. This implies that the Ghana Education Service must ensure that technical support is available and accessible to its staff each time a technology programme is rolled up for it. The Municipal Education Directorate also have to train teachers on the troubleshooting skills to fix minor technical faults at their level.

Another unexpected finding is the identification of power outages as an obstacle to school technology utilization by teachers. This finding is surprising considering that power outages have been nationwide in recent times, and schools should implement an alternative power supply system to support technology use. What increases the surprise in this finding is the fact that the schools have generators, which the researcher saw during observation of the learning centres. A possible explanation for this finding might be a look into the attitude of teachers towards technology adoption and use. A positive attitude of teachers towards technology has a great influence on their utilisation of such technologies (Alzaidiyeen, Mei & Fook, 2010; Nueva, 2019) and vice versa. That notwithstanding, the finding agrees with Boateng (2022), who explored how new media technologies are utilized for teaching, research and student engagements and concluded that teachers' technology appropriation is impeded by macro-level infrastructural challenges such as erratic electricity supply. This finding implies that the Savelugu Municipal Education directorate needs to ascertain the state of the generators supplied to the schools, to ensure that they serve as alternative power supply in the schools to aid availability of power supply for technology integration.

Additionally, the findings from the results consistently pointed out the inadequate number of technology equipment in the schools as an obstacle to the realization of fully integrated



technology lessons. One respondent noted that the inadequate nature of computers in his school makes it difficult for him to use technology to practically teach a class of about one hundred and fifteen (115) students. This finding is in keeping with that of Buabeng-Andoh (2012), who argues that it is crucial to have access to computers, as well as up-to-date software and hardware, as teachers won't use these ICT materials if they can't get their hands on them. This finding also agrees with the findings of Chisango and Marongwe (2018), who argued that inadequate technology infrastructure adversely impacted teaching and learning in a rural university in South Africa.

Another revelation from the study results is the lack of practical teacher training regarding technology. Two respondents claimed they had not been given any practical training in either induction or professional learning community sessions on how to use the technology tools in the school and relied on coworkers' explanations for that. This lack of training makes the teacher less effective in utilizing technology for teaching. Smith and Sorensen (2019) opined that educators' confidence in their own ICT skills has a favourable effect on whether or not they choose to use technology in the classroom. This finding reflects those of (Bagley & Ryan, 2015; Abebe & Woldehanna, 2013; Smith & Sorensen, 2019; and Maden, 2023), who also found that the lack of effective teacher training programmes constitutes an impediment to teachers' utilization of technology for instructional purposes. The finding also agrees with Tunjera and Chigona (2020), who argued that training programmes for teachers should provide them with the skills and knowledge to effectively integrate technology into their teaching. However, the implication of the finding is that the Ministry of Education and Ghana Education Service

need to take a critical look at how technology training programmes are delivered to teachers to implement technology in teaching and learning in Ghanaian schools.

Generally, the results from the study show that teachers in schools under study face several obstacles when it comes to appropriating the technology tools available in their schools.

4.3 Summary of Chapter Four

In chapter four, the study's results and findings were presented and discussed, following the research questions the study sought to answer. This chapter also looked at the implications of the findings for practice. The main findings of the study are as follows: First of all, teachers in the schools under study perceive technology to play a vital role in their work. Secondly, teachers experience difficulty coping with technology training programmes because they are not comprehensive and practical. Also, technology training programmes offered to teachers in the schools under study have not contributed much to their use of technology in teaching. Finally, teachers face some challenges trying to implement technology in their instructional practices in the schools under study.



CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.0 Introduction

In this chapter, the study's outcome is presented in the form of summary, conclusion, and recommendations. The summary section of the chapter is comprised of the study's objectives, methodology, the study's results, and major findings. Also presented in this chapter are the conclusions, recommendations and suggestions for further research.

5.1 Summary of the Study

This study aims to examine teachers' training and competence in appropriating technology in pedagogy at the Savelugu Experimental Cluster of Schools. To achieve this purpose, the study sought to primarily find out the perception of teachers in the Savelugu Experimental Cluster of Schools regarding the role of technology in their pedagogical practices. Also, to understand the nature of teachers' experiences with technology training programmes in the Savelugu Experimental Cluster of Schools. Furthermore, to determine how technology training programmes have contributed to teachers' pedagogical competence in integrating technology in the classroom. And finally, to identify challenges encountered by teachers in the Savelugu Experimental Cluster of Schools when incorporating technology into their instructional practices.

The study used a case study design in order to gain insights into teachers' training and competence in technology appropriation in the schools under study. As a qualitative research method, this design was chosen to give the researcher a complete picture of how teachers behaved with the use of technology in the schools. Respondents for the study



were teachers from the three schools within the Savelugu Experimental Cluster of Schools and the Municipal training officer, who were chosen based on their exposure to technology. In all, 16 respondents were purposively selected to participate in the study. Data collection in the study was done through the use of observation, document review, and a self-constructed Semi-Structured Interview (SSI) guide. Data was analysed through thematic analysis of the results from each of the research questions.

5.2 Major findings

An analysis of the study's results identified the major findings of the study as follows:

1. Teachers in the schools under study perceive technology to play a vital role in their work as teachers, especially in terms of its use in teaching, assessment, and research.
2. The nature of technology training programmes offered to teachers in the Savelugu Experimental Cluster of Schools opened them up to the world of technology use in teaching. Nonetheless, the training fell short of meeting teachers' needs in aspects like practical training, duration of the programmes, and resource availability.
3. There is some competence gap among teachers in the Savelugu Experimental Cluster of Schools when it comes to the utilization of technology for instructional purposes. Although their technology training has provided them with basic pedagogical competence to use technology in teaching, assessment and research, more preparation is still needed to make them feel comfortable using appropriate technology for various teaching goals.





4. Teachers in the schools under study have stopped using the technology tools due to the challenges they face. These challenges included inadequate technology tools, congested classrooms, erratic electricity supply, lack of practical technology training, and lack of technical know-how or support. This has been occasioned by the fact that, teachers in the schools under study do not get ongoing training and support to sustain technology projects initiated in the schools by NGOs, once those organisations fold out of the municipality.

5.3 Conclusion

This study has found that teachers generally see technology as crucial in their work as teachers and have basic knowledge of how to use it in teaching. However, teachers face a plethora of challenges in appropriating technology in their pedagogical practices.

These challenges can be overcome by providing more competence-based training for teachers. The findings are consistent with those of existing studies in the literature that looked into technology use in education and policies governing it in Ghana.

The findings of this study will inform policy decisions and policy-making on educational technology by the Ministry of Education in Ghana. It will also guide the Ghana Education Service on how to effectively implement policies on educational technology in Ghana, as the literature showed the existence of policies on technology integration into education, which have not been well implemented. The findings will also aid education stakeholders and other Non-Governmental Organizations (NGOs) in education to appreciate and support technology in education.



These findings have implications for the capacity building of Ghana Education Service employees on technology integration into teaching and learning. Learning from the findings, comprehensive and competence-based technology training programmes are key for successful technology integration. The findings also imply that the Savelugu Municipal Education Directorate have not had a consistent follow-up and support programme in place to sustain technology projects they started alone or in collaboration with an NGO.

In a nutshell, the study conforms with its guiding conceptual framework because the findings suggest that the diffusion of technology in the schools under study is impeded by the inaccessibility to technological infrastructure (material), lack of know-how to appropriate technology (pedagogy), and insufficient technological expertise (Competence). Teachers' content knowledge (CK) is one aspect of their professional competence. In contrast, their pedagogical knowledge (PK) relates to the tactics and methods they employ to help their students learn with technology. To know how to use technology to improve education is what we call technological knowledge "TK". Therefore, the quality of teaching that reflects a well-diffused technology in teaching can be enhanced by recognizing and finding a good convergence point for these variables of technology appropriation. The findings point to the convergence point of these three variables as the provision of continuous professional development in the field of technology integration for teachers to enhance their technological pedagogical content knowledge (TPCK).

5.4 Recommendations

This study's findings have several important implications for future practice. The study, therefore, put the following recommendations forward to inform practice:

1. The Ministry of Education through Ghana Education Service should strengthen effective implementation of its policies on technology integration, as teachers acknowledged the significant role technology plays in their work and demonstrated some level of its utilisation.
2. The Ghana Education Service should provide schools with the requisite technology infrastructure to implement technology in their teaching. Teachers should also be given comprehensive and competence-based technology training to equip them with the requisite competence to appropriate the technology tools provided for their practice.
3. Training personnel in Ghana Education Service, working with their directors, should conduct needs assessments to come out competence gaps that teachers have before implementing teacher training programmes. This will enable them train to the needs of teachers.
4. The Savelugu Municipal Education Directorate should put in place effective monitoring and supervision to unravel the challenges that teachers face in integrating technology and provide a consistent follow-up and technical support programmes on termly basis to eliminate such challenges, to sustain technology projects initiated in schools within the Municipality.
5. The Ghana Education Service should ensure that Continuous Professional Development (CPD) programmes on technology integration are mandatory for



teachers as part of their point building for license renewal. Locally, the Parents Association (PA) and School Management Committees (SMC) of the schools in the Savelugu Municipality should collaborate with the Municipal Education Directorate, to come up with and implement sustainability plans for existing technology projects in the schools and before the start of every technology project in the schools.

5.5 Suggestions for Further Research

The findings of this study provide the following insights for future research:

1. Further research could be conducted to establish the impact of technology-integrated lessons on student performance.
2. Further studies could also extend beyond to determine the influence of teachers' beliefs and attitudes on technology appropriation.
3. Further studies need to be done on the prospects of the ICT for development policy in Ghana: examining the technological infrastructure in Ghanaian basic schools.



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APPENDICES

APPENDIX A: Semi-Structured Interview Guide for teachers.

Semi-Structured Interview Guide for Teachers

Thank you for taking the time to speak with me today. My name is Fuseini Abdul-Somed, I am a final year student of Master of Philosophy in Training and Development (MPhil. Training and Development) at the University for Development Study. This interview is part of a study exploring teachers' training and competence in technology appropriation in the Savelugu Experimental cluster of schools. Your participation is completely voluntary and all your responses will be kept confidential and anonymously recorded. It would be used for academic purpose only. Do you have any questions before we begin?

SECTION A: Demographics

1. How old are you?
2. What is the name of the school you teach?
3. What class or level do you teach?
4. For how long have you been teaching in this school?
5. What is your highest professional qualification?

SECTION B: Teachers' perception on the role of technology in their pedagogical practices

6. In your opinion, do you think technology is helpful in teaching?
7. Can you tell me your experience in using technology in the context of classroom teaching?
8. How do you perceive the impact of technology on your ability to deliver lessons effectively? Provide specific examples of positive or negative impacts.





SECTION C: Nature of teachers' experiences with technology training programmes

9. Have you taken part in any technology training programme provided by your school or the Municipal Education Directorate? Provide a brief description of them.
10. To what extent did those training programmes align with your expectations? Could you provide further details?
11. Was there any particular component of the training programmes that you found particularly beneficial or difficult? Give reasons

SECTION D: contribution of technology training programmes to teachers' pedagogical practices.

12. To what extent did the technology training sessions you received adequately equip you to utilize technology for instructional purposes?
13. After engaging in the training sessions, are you more self-assured in your capacity to select and use appropriate technology for different teaching objectives? Please could you elaborate further on this?

SECTION E: Challenges encountered by teachers when incorporating technology in their instructional practices.

14. What are some of the major obstacles encountered when utilizing technology for instructional purposes?
15. How do these challenges affect your capacity to effectively utilize technology for instructional purposes?

APPENDIX B: Ethical Clearance Letter from UDS.

**UNIVERSITY FOR DEVELOPMENT STUDIES
FACULTY OF EDUCATION
EDUCATIONAL MANAGEMENT AND POLICY STUDIES**

Mobile: +233-244214802
Email: jquansah@uds.edu.gh
Website: www.uds.edu.gh/FOE



P.O. Box TL1350
Tamale
Northern Region
Ghana, West Africa

Our Ref:
Your Ref:

DATE: 22nd April, 2024

The Municipal Director,
Ghana Education Service
Savelugu

Dear Sir/Madam,

LETTER OF INTRODUCTION

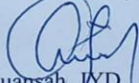
The bearer of this letter, Mr. Fuseini Abdul-Somed is a postgraduate student studying at the Department of Educational Management and Policy Studies at the University for Development Studies (UDS).

He requires some information from teachers in the Savelugu Municipality to write his thesis titled **"Teachers' Training and Competence in Technology Appropriation: The Case of Teachers in Savelugu"** as a requirement for his MPhil programme.

Kindly give Mr. Fuseini Abdul-Somed the necessary assistance to enable him gather the information he needs for the research.

I would greatly appreciate it if you could provide the required assistance for his data collection in your outfit. Thank you.

Yours faithfully,


Quansah, JYD
Head of Department



APPENDIX C: Ethical Clearance Letter from GES, Savelugu Municipal.

GHANA EDUCATION SERVICE

*In case of reply,
the date and reference
number of this letter
should be quoted*

Phone No: 0372094732



REPUBLIC OF GHANA

Savelugu Municipal Education Directorate,

P. O. Box 26,

Savelugu,

Northern Region.

E-mail Addresses:

info@smedges.org

savelugudeo@yahoo.com

Website: <https://smedges.org>

Our Ref: GES/NR/SMEO/PG/VOL.17

Your Ref:

Date: 25th April, 2024

RE: PERMISSION TO CARRY OUT RESEARCH WORK

You have been granted permission to carry out research work in the Savelugu Experimental Cluster of Schools in the Municipality.

You are however expected to conduct yourself within the rules and regulations of the Ghana Education Service

Thank you.

ISSAHAQUE MUNAWARU (DR)
MUNICIPAL DIRECTOR OF EDUCATION
SAVELUGU

Fuseini Abdul-Somed
Municipal Education Directorate
Savelugu Municipal
Savelugu.

APPENDIX D: Learning Centre Technology Usage Log.

11/



Discovery Learning Alliance
EDUCATION CHANGES EVERYTHING

Discovery Project Monitoring Tool (DLA Staff)

Name of School: SAVELUGU EXPERIMENTAL PRIMARY

Please all DLA staff should sign this form anytime they visit the LC to keep a record of all visits. The Head Teacher (HT) at each site should submit this form to DLA management approximately once per month, when they visit. Please let us know if you have any questions. Thank you!

Date	Time of Visit: From <u>10:30am</u> to <u>12:00pm</u>	Name of DLA Staff	Community Outreach			Teacher Training			Signature (DLA staff)	Remarks
			Progress of community Action Plan	Girls' Club Activities	Chat Show/Mass Media	Title of video program	Subject(s)	Number of lessons observed		
29/01/19	10:30am to 12:00pm	Amy Mohammed				Best C Mathematics Program 79	Mathematics	Book for class 5 (A & B)		Effective use of video in teaching
29/02/19	12:45 to 1:30pm	Batung Bonatus				Point Application	ICT	Single lesson (SA1)		
31/01/2019	11:30 to 2:30pm	Mohammed Faruk				Program 78	Maths	Double lessons		
11/02/19	1:40 to 2:40 pm	Mohammed Faruk				Program 78 English	English			

THE HEADTEACHER
SAVELUGU EXP. PRIM. SCH. A2
P. O. BOX 226
SAVELUGU NR

