UNIVERSITY OF EDUCATION, WINNEBA

PERCEPTION OF TEACHERS ON INTEGRATION OF INFORMATION COMMUNICATION TECHNOLOGY IN THE TEACHING AND LEARNING OF MATHEMATICS IN THE CAPE COAST METROPOLIS

BENJAMIN ARKORFUL

POST GRADUATE DIPLOMA

2021

UNIVERSITY OF EDUCATION, WINNEBA

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BENJAMIN ARKORFUL
190013954

A dissertation in the Department of Educational Foundations, Faculty of Educational Studies, submitted to the School of Graduate Studies, in partial fulfillment of the requirements for the award of the degree of Post Graduate Diploma (Education) in the University of Education, Winneba

FEBRUARY, 2021

DECLARATION

STUDENT'S DECLARATION

I, **Benjamin Arkorful**, declare that this dissertation, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted in part or whole, for another degree elsewhere.

SIGNATURE: ………………………………………….

DATE: …………………………………………………

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this dissertation was supervised in accordance with the guidelines for the supervision of dissertation laid down by the University of Education, Winneba.

……………………………………………………………… (Supervisor)

Signature: …………………………………………………..

Date: ………………………………………………………..

DEDICATION

To my parents, Mr. & Mrs. Samuel Sinclair Arkorful

ACKNOWLEDGEMENTS

The success of this dissertation has been possible largely because of the dedication and commitment of the contributors and their efforts are hereby acknowledged.

I wish to express my profound gratitude to my supervisor, Dr. Paul Kobina Effrim for his concerted efforts, time, patience, guidance, encouragement and contribution that has made this dissertation a success.

I want to thank all Heads of Mathematics Department for the various Senior High Schools selected. Also, I wish to express my appreciation to Mr. Maxwell Asumadu, Mr. Robert Atombo and Mr. Jacob Martey for their support in the data collection process.

Finally, to all who has contributed to this dissertation in diverse ways, I say thank you and may the good God richly reward your efforts.

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ABSTRACT

This study was designed to find out perception of teachers on integration of Information Communication Technology (ICT) in the teaching and learning of mathematics in the Cape Coast Metropolis. The study adopted cross-sectional survey as a design. The target population consists of all mathematics teachers in eight selected senior high schools in Cape Coast Metropolis of Ghana. The sample consisted of 102 mathematics teachers. Stratified random sampling and simple random sampling technique were used to select the samples. A questionnaire which has Cronbach Alpha reliability coefficient of 0.74 via internal consistency was used for data collection. Content validity of the instrument was ascertained through expert judgment. Factor Analysis, Independent samples *t* test, One-way analysis of variance, Pearson Product Moment Correlation and Multiple Regression analysis were used to analyse the data for the study. The findings revealed that sex of teachers had no significant influence on the perception of teachers towards ICT integration and teachers intentions to actually integrate ICT in teaching-learning of mathematics. It was also revealed that there is a significant difference in the perception of teachers' to integrate ICT based on the teachers' age group and years of teaching experience. The study further revealed that mathematics teachers have positive perception towards ICT integration, but have negative attitudes towards the use of ICT in teaching-learning of mathematics. Based on the findings of the study, it was recommended that mathematics teachers need to be trained on effective integration of ICT in teaching-learning of mathematics.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Educational systems around the world are becoming increasingly pressured to apply the new Information and Communication Technology (ICT) tools to their curriculum to provide students with the knowledge and skills that they need in the 21st century (Hue & Ab Jalil, 2013). Integrating ICT into teaching and learning has therefore become a great concern for many educators. Considering the fast development of ICT, Mathipa and Mukhari (2014) were certain that many educational systems would be formalising the integration of ICT in teaching and learning. According to Blair and Serafini (2014), technological advancement in education has revolutionised the teaching and learning strategies. As the use of ICT is increasing in all sectors, Ghavifekr, Kunjappan, Ramasamy and Anthony (2016) believe that its use in education has the potential to transform teaching for the desired results. Sahin-Kizil (2011) reviewed that use of ICT for educational purposes yield positive outcomes on the part of the students such as increased motivation, active learning, providing efficient resources and better access to information.

Information and Communication Technology (ICT) was proven to be influential in everyday activities of different organizations (UNESCO, 2015). Teaching and learning are complex processes requiring multiple tasks, efforts and flexibility of teachers and learners (Jaarsveldt & Wessels, 2015). The adoption of using ICT tools in education enhanced teaching and learning processes in different forms and levels of education (Vandeyar, 2015). Knowledge transferred through the means of ICT tools were shown to be influential for both formal and non-formal education (UNESCO, 2015). The major important characteristic of ICT is the ability to transcend time and space (Tarus, Gichoya & Muumbo, 2015). The use of ICT tools makes possible asynchronous learning, or learning characterized by a time lag between the delivery of instruction and its reception by learners (Bornman, 2016).

Information and Communication Technology (ICT) tools were found to be not only significant for teachers but also facilitate learners in their everyday-learning activities (Asongu & LeRoux, 2017). Integration of ICT helps in more focused teaching, tailored to students' strengths and weaknesses, through better analysis of attainment data (UNESCO, 2015). There are a number of factors that prevent the use of technology in education, such as shortage of training, time, equipment and materials (Mtebe & Raisamo, 2014; Porter & Graham, 2016; Tarus, 2015). Factors related to the teacher could be: teacher's self-confidence regarding the use of technology, personal access level of the teacher for the ICT tools, availability of teacher's time to get to know closely and deeply the hardware and software needed to use ICT in the classroom as well as the availability of teacher's time to prepare learning materials suitable for the use of ICT in teaching.

Teachers' role in curriculum implementation requires certain level of knowledge to integrate the content efficiently which might be taught (UNESCO, 2015). Similar to other subjects which are disseminated by teachers, the integration of ICT into teaching and learning processes requires teachers to acquire a certain level of different skills to handle all challenges attached to the integration of ICT in teaching and learning processes (Igbo & Imo, 2017). Technological knowledge are skills required to use ICT tools such as computers, projectors, camera, digital videos, white boards, internet and the abilities to use different software programs and many others required to be familiar with ICT use (Koehler, Mishra, Kereluik, Shin & Graham, 2014).

According to Drijvers, Doorman, Boon, Reed and Gravemeijer (2010), research into the integration of dynamic technologies into mathematics education is bringing transformative changes to mathematics teaching, but it is perceived as a complex process for individual teachers. Evaluation of large-scale computer distribution programmes suggest that professional development of teachers is key (Hoyles & Langrange, 2009) for the success in the integration of technologies in classrooms practices, so that students can experience its potential as powerful learning tools. In Ghana, mathematics is a compulsory subject at all levels in pre-university education. Due to its importance the government is committed to ensuring the provision of high quality mathematics education. Various attempts have been made in the past to improve the achievement of mathematics in schools. One of them is seen in the New Educational Reforms (Anamuah-Mensah National Education Review Committee Report, 2002) of which implementation started in September, 2007. As part of the reforms the curriculum places a lot of emphasis on Information and Communication Technology (ICT) as a tool for teaching mathematics (MOESS, 2007).

The government of Ghana recognizes the need for teacher support for mathematics teachers in various ways. He considers ICT literacy as an engine for accelerated development outlined in the Ghana Information and Communication Technology for Accelerated Development (Ghana ICT4AD Policy document, 2003). The policy of ICT use in Ghana Education Service is spelt out in the Information and Communication Technology for Accelerated Development Policy (ICT4AD) in general, and the ICT in education policy in particular, although, this has remained in draft form since 2006. Ghana introduced ICT into the school curriculum in September 2007 following the recommendations of the Ghana Information and Communication

Technology for Accelerated development (Ghana ICT4AD) document and the Anamuah-Mensah National Education Review Committee Report (2002). Both documents highlight the importance of integrating ICT into the curriculum at all levels.

The government of Ghana in collaboration with the Ministry of Education Science and Sports has made provisions to ensure that Senior High School (SHS) students get access to quality education which takes into accounts the integration of ICT in instruction (Ministry of Education, Science and Sports [MOESS], 2010). Besides, the new educational reforms in Ghana, there are also high emphasis placed on the integration of ICT in all subject areas (MOESS, 2010). Information and Communication Technology (ICT) should be fully integrated in the senior high schools across the nation for the challenges of the 21st century education to be met. Using ICT in the classroom comes along with better educational output (Annick, Janson & Falloon, 2007). The National Council of Teachers of Mathematics (2000) points at technology as essential for the teaching and learning of mathematics because it affects the mathematics that the teacher teaches and the students learn, and it improves the students learning.

Yidana (2007) indicated that there has been a significant increase in the number of computers in schools both in the United States and other developed countries such as Canada and Great Britain, as well as in developing countries such as Ghana. Cudjoe (2005) estimated the number of Ghanaian who had access to computers at half a million. Despite these investments in computers and related technologies, there have been few corresponding changes to the way teachers are being prepared to teach. The impact of information and communication technology (ICT) on teaching and learning has become the focus of many studies intended to improve the quality of education. A number of studies have revealed that integrating ICT in mathematics instruction have the potential to make learning effective and interesting towards improving student learning outcomes by providing opportunities for students to develop skills that will empower them in this modern society (Gill & Dalgarno, 2008).

The standards of the National Council of Teachers of Mathematics (NCTM) stresses that, ICT can facilitate mathematical problem solving, communication, reasoning, and proof; moreover, technology can provide students with opportunities to explore different representations of mathematical ideas and support them in making connections both within and outside of mathematics (NCTM, 2000). Students can use ICT to explore and reach an understanding of mathematical concepts because technology allows students to focus on strategies and interpretations of answers rather than spend time on tedious computational calculations (UNESCO, 2005). Schools should no longer continue to only be viewed as venues where knowledge is transmitted from the teachers to learners by using textbooks as the only source of information. Consequently, teachers are encouraged to integrate ICT into teaching.

However, the perceptions teachers hold towards the use of ICT in teaching and learning are the key determining factors to the success or failure of the use of ICT in education (Apeanti, 2014). Teachers' positive perception towards the integration of ICT in teaching-learning process serves as a catalyst in ICT usage in classrooms and subsequently stimulates learners' productive thinking such as pedagogical content knowledge. A study conducted by Buabeng-Andoh (2012) shows that teachers with positive perception that ICT will enable them teach with ease, provide an interactive platform with pupils, improve their pedagogy and performance were ready to integrate ICT in their teaching. Silviyanti and Yusuf (2015) stated that the negative perceptions from teachers are one of the barriers which limit the use of ICT in education.

Teachers' attitudes are influenced by their perception of the usefulness of ICT, their behaviour intentions and pedagogical aspects (Ayub, Bakar, & Ismail, 2012). Positive attitudes towards ICT use by teachers are important to ensure the integration of the technology is effectively carried out in the school curriculum and also during teaching and learning (Buabeng-Andoh, 2012). A positive attitude of the teacher can facilitate more diverse uses of ICT so that learning activities become more interesting and enjoyable. Conversely, teachers who have a negative attitude will not integrate ICT in their learning activities. Teachers' attitudes towards ICT use in education may enable or hinder their actual ICT use depending on how the teacher view the impact of ICT use on students' learning and achievements (Drent & Meelissen, 2008).

Can and Cagiltay (2006) assert that without teachers' knowledge and teachers' perceptions and future plans for using ICT in education, any potential innovations in this area may be deficient. Tezci (2009) posits that if teachers have a high level of ICT knowledge, then there will be a higher level of ICT use in their teaching. Gilakjani, Sabouri, and Zabihniaemran (2015) assert that most commonly identified factor in the literature affecting ICT integration by teachers was their level of knowledge and skills in using computers. Evidence suggests that majority of teachers who reported negative or neutral attitude towards the integration of ICT into teaching and learning processes lacked knowledge and skills that would allow them to make informed decisions (Bordbar, 2010).

Kreijns (2013) investigated teachers' intentions, attitudes, norms and self-efficacy regarding using ICT in teaching and learning. Teachers tend to use ICT based on their previously used ICT, perceived knowledge, and skills to use some ICT devices (Kreijns, 2013). Player-Koro (2012) found that despite that self-efficacy and attitudes were mutually related to ICT use, a strong sense of self-efficacy in using ICT in education influenced the use of ICT the most. According to Teo (2009) teacher's self-efficacy influences teachers' intention to use technology when teaching, this finding concurs with Higgins (2000) who reported that teachers with high levels of self-efficacy used ICT in teaching-learning often than the teachers with low levels of self-efficacy. A study by Tedla (2012) conducted in East African Countries reviewed among other things that teachers' competence, confidence, incentives, perceptions and beliefs had inhibited the integration of ICT in the teaching and learning process.

Information Communication Technology integration in the classroom will have positive results depending on the following factors: teachers' perceptions towards ICT integration, teachers' attitudes towards ICT integration, teachers' knowledge of the integration of ICT, teachers' self-efficacy of the integration of ICT and teachers' intentions to actually integrate ICT in their teaching. One of the major hindrances on ICT integration in teaching and learning can be the perception of teachers. Simply having a positive perception of ICT integration in a classroom increases the likelihood of adoption of the innovation by teachers. Teachers' perceptions towards ICT integration may be a significant factor in the implementation of ICT in education. As a result, it is vital for this study to gather information on the perceptions of the mathematics teachers in the Cape Coast Metropolis of Ghana towards the integration of ICT in mathematics classroom.

1.2 Statement of the Problem

In Ghana, it appears the use of ICT in the teaching and learning of mathematics by teachers in Senior High Schools is absent despite the enormous benefits that can be derived from the use of such tools in the teaching and learning process. Information and Communication Technology (ICT) has currently become a compulsory (core) subject for every SHS student in Ghana. Pre-service mathematics teachers are trained to integrate ICTs in the teaching and learning of mathematics with practicing teachers been trained through workshops (to promote acquisition of technological pedagogical content knowledge (TPACK) (Mishra & Koehler, 2006). With such an increased emphasis on ICT and a large investment in its infrastructure, teachers are expected to be competent and effective in using it. However, with teachers' increasing knowledge of and familiarity with ICT and there being infrastructure to support it, many mathematics teachers are still not effectively and efficiently integrating ICT into their teaching (Buabeng-Andoh, 2015).

The ultimate decision to use or not to use the ICT resources in the classroom lies with the teachers' perceptions, knowledge of ICT, attitudes, self-efficacy and their readiness to integrate ICT in the teaching and learning process. The use of ICT in teacher preparation in Ghana is, however, lagging behind expectation (Yidana, 2007). The use of ICT in the mathematics classroom has long been a topic for consideration by mathematics educators. According to the Ministry of Education (2009), 87% of second cycle institutions in Ghana are well equipped with ICT facilities but statistics indicate that majority of trained mathematics teachers in Ghana are not integrating ICT in their instruction (MOE, 2009; Mereku, Yidana, Hodzi, Tete-Mensah, Tete-Mensah, & Williams, 2009). Lua and Sim (2008) opined that many mathematics teachers who are ICT literate do not integrate ICT tools in their teaching.

There have been quite a number of researches to investigate Ghanaian mathematics teachers' use of ICT in teaching and learning and the factors that support or inhibit their effective integration into classroom practices (Omollo, 2011; Agyei & Voogt, 2011). Can and Cagiltay (2006) asserted that there appears to be no single factor that determines why mathematics teachers are not using ICT in their teaching, there is widespread agreement that their perception plays a significant role. It is equally crucial to investigate the issues that potentially surround ICT integration like teachers' perceptions, teachers' attitudes towards ICT integration, teachers' knowledge, teachers' self-efficacy on ICT integration, and teachers' intentions to actually integrate ICT in their teaching.

1.3 Purpose of the Study

The main purpose of the study is to find out perception of teachers towards integration of ICT in the teaching and learning of Mathematics in the Cape Coast Metropolis.

1.4 Objectives of the Study

The specific objectives of the study are to:

1) find out mathematics teachers' perceptions towards the use of ICT in teaching and learning of Mathematics in the Cape Coast Metropolis.
2) determine the relationship between teachers' perception to integrate ICT in their teaching with teachers' attitudes, knowledge and self-efficacy.
3) determine the relationship between teachers' intention to actually integrate ICT in their teaching with teachers' demographic information (sex, age, years of teaching experience and training on ICT integration), perception, attitudes, knowledge and self-efficacy.

1.5 Research Questions

The study was guided by the following research questions:

1) What are mathematics teachers' perceptions towards the use of ICT in teaching and learning of mathematics in the Cape Coast Metropolis?

2) What are the relationships between teachers' perception to integrate ICT in their teaching with teachers' attitudes, knowledge and self-efficacy?

3) What are the relationships between teachers' intention to actually integrate ICT in their teaching with teachers' demographic information (sex, age, years of teaching experience and training on ICT integration), perception, attitudes, knowledge and self-efficacy?

1.6 Research Hypotheses

Four hypotheses were generated to guide the study:

Ho 1: There is no statistically significant difference in perception towards ICT integration in teaching-learning of mathematics between male and female teachers.

Ho 2: There is no statistically significant difference between the perceptions towards ICT integration in teaching-learning of mathematics according to teachers' age groups.

Ho 3: There is no statistically significant difference between the perceptions towards ICT integration in teaching-learning of mathematics according to teachers' years of teaching experience.

Ho 4: There is no statistically significant difference in perception towards ICT integration in teaching-learning of mathematics between teachers trained and not trained on ICT integration.

1.7 Significance of the Study

Information and Communication Technology (ICT) integration in mathematics education would provide mathematics teachers with integrative teaching methods that would motivate students learning, make them more active and independent, and, as a result, supports them to have deeper understanding of the mathematical ideas and topics. The integration of ICT in the teaching and learning of mathematics, as a result of ICT educational affordances, would help students to have better attainment in mathematics.

The results of the research would give the mathematics teachers and all other stakeholders in education, a general picture of the current status of various aspects of mathematics teachers' readiness to integrate ICT in the classrooms. This general picture would help the leading characters of mathematics education make changes in teaching and learning of mathematics, especially, it would help them prepare appropriate workshops and programs for the professional development of mathematics teachers in ICT integration in the classrooms. The research would also help look at various strategies to remove the barriers that may not promote the effective ICT integration at the Senior High School level.

The results from this study would be helpful for the curricular development teams in the Ministry of Education and policy makers to make informed decisions as far as the provision and strategies for the integration of ICT in teaching and learning of mathematics are concerned. The findings from this research would add to the limited but growing body of knowledge and literature concerning preparing teachers to integrate technology in areas of the world where the digital divide is the greatest. Finally, the outcome of the study may serve as a resource material for students and researchers who may undertake similar studies in future.

1.8 Delimitation of the Study

Only mathematics teachers in eight public Senior High Schools in the Cape Coast Metropolis were selected for the study. The eight Senior High Schools were: University Practice Senior High School, Wesley Girls High School, Mfantsipim

Senior High School, Adisadel College, Holy Child High School, Ghana National College, St. Augustine's College and Aggrey Memorial Senior High School. The study was specifically sample views on teachers' perceptions, attitudes, knowledge and self-efficacy, and how these factors influence their intentions to integrate ICT in teaching-learning of mathematics.

1.9 Operational Definition of Terms

ICT (information and communications technology) is an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems, as well as the various services and applications associated with teaching and learning.

ICT (information and communications technology) integration is the process of using ICT related facilities in the teaching and learning process.

Teachers' perception is the thoughts or mental images teachers have about their ability in ICT integration in teaching and learning of mathematics. The teacher's perception can be either positive or negative.

Teachers' attitude is the way teachers act towards ICT integration in teaching and learning of mathematics.

Teachers' self-efficacy is the belief that the teacher is capable of integrating ICT to teach mathematics in the classroom. That is, the teacher's ability to integrate ICT in teaching mathematics in the classroom.

Teaching experience is the number of years teachers have been practicing teaching in schools.

Teachers' intention is the teacher's willingness to integrate ICT in teaching mathematics.

1.10 Organisation of the Study

The study is organized into five chapters. Chapter One is made up of the introduction, which looks at the background to the study, statement of the problem, purpose of the study, objective of the study, research questions, research hypotheses, significance of the study, delimitation of the study, operational definition of terms, and organisation of the study. Chapter Two deals with the literature review. It covers both theoretical frameworks and empirical reviews related to the concepts under study. Chapter Three is the research methodology of the study. It covers the research design, population, sample and sampling technique, variables of the study, research instrument, validity and reliability, data collection procedure, data analysis and ethical consideration. Chapter Four covers the results and discussions of the study while Chapter Five deals with the summary, conclusions, recommendations and suggestion for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature relevant to the study. The review has been done under the following sub-topics:

a) Learning theories

b) ICT integration models in education

c) Other ICT models in education

d) ICT integration and mathematics education

e) Teachers' demographics and ICT integration

f) Teachers' perceptions and ICT integration

g) Teachers' attitude and ICT integration

h) Teachers' self-efficacy and integration of ICT

i) Teachers' knowledge and integration of ICT

j) Benefits of ICT integration in teaching-learning

k) Factors inhibiting ICT integration in mathematics classroom

l) Conceptual framework

m) Summary of reviewed literature

2.2 Learning Theories

Learning is a process that brings together personal and environmental experiences and influences for acquiring, enriching or modifying one's knowledge, skills, values, attitudes, behaviours, and worldviews. According to Spector (2016), the changes could include one's abilities, attitudes, beliefs, knowledge, and skills. Learning theories are conceptual frameworks describing how knowledge is absorbed, processed, and retained during learning (Simandan, 2013). According to Dunn (2000), learning theories help us to understand how learning takes place; they enable us to understand the process of learning. Behaviourism, cognitivism and constructivism are the three extensive theories that are often applied in the creation of instructions in the classrooms or a learning environment. Besides behaviourism, cognitivism and constructivism, there are many other learning theories, which play an important role in guiding teaching and learning activities, such as connectivism. According to Siemens (2014), the long existing theories were developed in a time when learning was not impacted through technologies.

2.2.1 Behaviourism Learning Theory

Behaviourism is a theory of animal and human learning that only focuses on the objectively observable behaviours and discounts mental activities. Behaviour theorists define learning as nothing more than the acquisition of new behaviour (Philips & Soltis, 1998). Edward L. Thorndike (1905) developed an stimulus–response (S-R) theory of learning. In stimulus–response theory, knowledge is defined as a learner's collection of specific responses to stimuli that are represented in behavioural objectives (Koehler, Mishra, Kereluik, Shin, & Graham, 2014). Behaviourism is a perspective that focuses almost exclusively on directly observable things to explain learning (Spector, 2016). That which is directly observed and believed most relevant to learning are the immediate things in the learner's environment, and most closely contiguous in time and place to the targeted learning - the so-called stimulus conditions for learning.

Behaviourists believe that we can understand human behaviour by a meticulous study of particular behaviour (Ozmon & Carver, 1992). Behaviourists are psychologists who think that whatever a person thinks is what he exhibits in his behaviour. They are not interested in whatever the person is thinking which does not manifest in his behaviour. They measure human thoughts by studying his outward behaviour by word or deed. Behaviourism focuses on how students act and what impacts upon and changes how they act (Collins, 2012). The response of the learner to the stimulus is directly observable and serves as an indicator of learning (Spector, 2016). Collins (2012) explain that behavioural learning theory lent itself to instructional design based on very specific and discrete learning steps.

The computerization of instructional process through new forms of learning technologies such as programmed instruction, computer-assisted instruction (CAI) and teaching machines explains the link between ICT usage in teaching and learning and this theory. In behaviourist classrooms of the traditional kind, teachers are at liberty (within reason) to dictate the kind of learning and classroom procedures that they prefer, and to enforce them with the authority conferred upon them by the institution and by society. Behaviourist techniques have been employed in education to promote desirable behaviour in learners and discourage undesirable ones. Behaviourist techniques of teaching are used in technology to help in teaching and learning (Philips & Soltis, 1998).

2.2.2 Cognitivism Learning Theory

Cognitivism arose within psychology as behaviourism was proved to be insufficient to explain complex human learning. In order to explain some human behaviours, psychologists turned to investigate the information processing in the mind which is considered as unobservable black box by behaviourists (Spector, 2016). In the cognitivist learning theory, knowledge is seen as a symbolic mental construct in the student’s mind, and the learning process is the means by which these symbolic representations are committed to memory (Siemens, 2014). According to cognitivism, learning is not a stimulus–response sequence, but the formation of cognitive structures. The learners do not simply receive stimuli mechanically and react passively, but, rather, learners process stimuli and determine appropriate responses. Cognitive theorists recognize that much learning involves associations established through contiguity and repetition.

Cognitive theorists view learning as involving the acquisition or reorganization of the cognitive structures through which humans' process and store information (Good & Brophy, 1990). Cognitive psychologists believe that the human mind is an active and important factor in learning. They focus on how people think, how people understand and how people know. They think that learning involves the transformation of information in the environment into knowledge that is stored in the mind. Two prominent cognitive psychologists are Jean Piaget (1896-1980) and Lev Vygotsky (1896-1934) (Chang, Dooley & Tuovinen, 2002). Some principles of cognitive psychology are those put forward by the Gestalt psychologists; Max Wertheimer (1880-1943), Wolfgang Kohler (1887-1967) and Kurt Koffka (1886-1941). They think that human perception makes meaning when things are seen as a whole.

The gestalt theorists believe that the cognitive learning theory can best be explained with the laws of perception. Gestalt means "form" or "shape". Gestalt psychologists are of the view that psychological organization will always be as good as prevailing conditions allow. For Gestalt psychologists, form is the primitive unit of perception. When we perceive we always pick out form. Our perceptions are influenced by past experiences. According to Seng, Parson, Hinson and Sardo-Brown (2003), this principle is also called Pragnanz Law.

Keskin (2011) states that the focus of ICT in the cognitivist learning theory is on how information and content are delivered in learning, the use of multimedia learning such as images, audio, video, text, and animations. The focus of cognitivism theory in the use of ICT in teaching and learning is on content delivery that is supported by using technological devices such as videos, audios and or TV (Keskin, 2011). Cognitivism often takes a computer information processing model whereby learning is viewed as a process of inputs, managed into short-term memory, and coded for long-term remembrance (Driscoll, 2000).

2.2.3 Constructivism Learning Theory

Constructivist learning theory explains how people understand, know or learn (Savery & Duffy, 1995). Constructivism holds that learning is the process of constructing internal psychological representation in the process of the interaction with the environment. Helping learners involves helping them to understand the nature, regularity, and the inner connections among things (Chen & Liu, 2011). The basic elements of constructivism include context, collaboration, conversation, and meaning-making. According to Bruner (1966), learning is a process where students are allowed to actively construct new idea (knowledge) or concepts based on their existing and/or past knowledge. Duffy and Jonassen (2013) emphasised that instructions in teaching and learning should be provided together with the assistance that will aid the students in making sense of the learning environment. The theory is linked to the learner-centred approach to learning (Bonk & King, 2012).

In a learning environment like the classroom, there is some stimulus or goals for teaching and learning. In as much as teachers have a purpose for teaching, students also have a purpose for learning. In this learning theory, students construct fresh knowledge from the experiences they have in the process of accommodation and assimilation. The theory of constructivism aims for students to discover knowledge on their own when they are provided with the necessary learning tools. Constructivism is a crucial component of ICT integration. It is a learning theory that describes the process of students constructing their own knowledge through collaboration and inquiry-based learning. According to this theory, students learn more deeply and retain information longer when they have a say in what and how they will learn.

According to constructivism, teachers should not teach in the traditional way, but should encourage students to cooperate or interact with peers. Students should process information and construct meaning of knowledge actively, rather than listen to teachers passively. The constructivist teacher is not an impartial observer. The teacher remains very clear about what is most expected in learners as they engage with authentic learning tasks. The constructivist teachers' hopes and attitudes are determined by the implicit expectations of best-practice models of constructivist learning. Airasian and Walsh (1997) agree that constructivist teachers are responsible for creating the kind of sympathetic environment in which learners will not feel judged, exposed, criticized or humiliated as they take the initiative in group, personal or team learning situations.

A constructivist teacher needs therefore to be expert in non-directive intervention. He or she would be someone who believes in the educational value of encouragement, enthusiasm, personal warmth, tact, challenge, and professional self-effacement for didactic purposes. According to Ittigson and Zewe (2003) ICT supports constructivist pedagogy, which allows students to explore and reach an understanding of mathematical concepts. Making use of ICT to support learning and teaching and using more constructivist approaches appear to be perceived as risky strategies for some teachers and they prefer to stick with tried and tested methods which they believe enable them to predict and control outcomes more easily. Walker (2000) from the Open University in the United Kingdom purports to demonstrate how constructivist forms of teaching and learning may be enriched and enhanced by the increasing integration of technology in the classroom.

Teacher's prestige and authority are not undermined by the introduction of ICT into the classroom provided that the teacher is sufficiently flexible to adapt himself or herself to modes of interaction that learners are more democratic and self-effacing. In a classroom in which technology is equally accessible to all learners, the teacher becomes a facilitator rather than an infallible authority. The constructivist teacher also suggests where resources might be found, but does not usually present them in a ready-made and pre-digested format.

2.2.4 Connectivism Learning Theory

Connectivism theory is defined by Siemens (2005) as a learning theory for the digital age. Connectivism learning theory was established from a belief that there is a need for a learning theory, which takes due cognizance of the ways in which societies has changed because of the new technologies or technological advancement (Garcia, Brown & Elbeltagi, 2013). Connectivism is a hypothesis of learning which emphasizes the role of social and cultural context. It is the integration of principles from chaos, network, and complexity and self-organization theories.

The central aspect of connectivism is the metaphor of a network with nodes and connections (Siemens, 2005). In this metaphor, a node is anything that can be connected to another node such as an organization, information, data, feelings, and images. In this sense, connectivism proposes to see knowledge's structure as a network and learning as a process of pattern recognition (AlDahdouh, Osorio, Caires & Susana, 2015).

Learning networks can then be perceived as structures that we create in order to stay current and continually acquire experience, create, and connect new knowledge (external). Learning networks can be perceived as structures that exist within our minds (internal) in connecting and creating patterns of understanding (Siemens, 2005). Siemens (2005) did a thorough study on connectivism learning theory and later attests that it provides insight into learning skills and tasks needed for pupils to excel academically in the frame of the current trend of education which is vehemently driven by digitalization.

The significance of this theory is that it recognises that learning and knowledge are situated in a diversity of opinions and may as well reside in non-human appliances like ICT devices or tools (Siemens, 2005). The theory has been developed with the aim of providing a model through which teaching and learning, the use of ICT such as digital technologies, can be better understood and managed (Siemens, 2005).

2.3 ICT Integration Models in Education

Effective ICT integration focuses on pedagogy design by justifying how the technology is used. Different authors plan for integration of ICT into teaching and learning process.

2.3.1 Technological Pedagogical Content Knowledge (TPACK)

The integration of ICT into teaching and learning processes requires teachers to acquire a certain level of different skills to handle all challenges attached to the integration of ICT into teaching and learning processes (Igbo & Imo, 2017). Mishra and Koehler (2006) proposed an ICT model for teachers to integrate technology in knowledge teaching through pedagogical content. The proposed ICT model in Mishra and Koehler (2006) referred to as TPACK builds on Shulman's (1986) constructs of pedagogical content knowledge (PCK) to include technology knowledge. The development of TPACK by teachers is critical for effective teaching with technology. Mishra and Koehler (2006) elaborated on the nature of technologies and the importance of their inclusion in their proposed ICT model.

Researchers (Angeli & Valanides, 2009; Mishra & Koehler, 2006; Niess, 2005) extended Shulman's framework to gain insights to understand and define teachers' knowledge about the use of digital technologies. They argue that teachers need knowledge that build on and intersect with what Shulman (1986) described to use the digital tool effectively in the classroom. This additional knowledge has been conceptualized in various ways including *Technological Pedagogical Content Knowledge* (TPCK) (Mishra & Koehler, 2006; Niess, 2005), and ICT-TPCK (Angeli & Valanides, 2009). The theoretical framework of Technological Pedagogical Content Knowledge (TPACK) was introduced for understanding the teachers' knowledge required for integrating ICT into teaching and learning processes (Koehler, Mishra, Kereluik, Shin, & Graham, 2014; Mishra & Koehler, 2006; Schmidt, Thompson, Koehler & Shin, 2008). Knowledge of ICT use in teaching is a complex notion, and it is a challenge to develop a concise definition of this concept. The TPACK has seven components namely TK, CK, PK, PCK, TCK, TPK, TPACK.

Technological Knowledge (TK): These are skills required to use ICT tools such as computers, projectors, camera, digital videos, white boards, internet and the abilities to use different software programs and many others required to be familiar with ICT use (Koehler, Mishra, Kereluik, Shin & Graham, 2014).

Content Knowledge (CK): These are skills related to the subject to be taught. The teaching and learning processes are well favored if the teacher who delivers the content has the knowledge regarding the actual subject to be delivered to learners (Mishra & Koehler, 2006).

Pedagogical Knowledge (PK): Teachers are required to have knowledge regarding the teaching and learning processes. These skills include skills to manage classroom, assessing learners, development of lesson plan and following and handle all behaviours shown the learners in learning process (Schmidt, Thompson, Koehler, & Shin, 2008).

Pedagogical Content Knowledge (PCK): Presented in the intersection of content knowledge and pedagogical knowledge. The pedagogical content knowledge illustrates the content knowledge that deals with the teaching process (Shulman, 1986; Koehler, Mishra, Kereluik, Shin & Graham, 2014).

Technological Content Knowledge (TCK): Resulted from the combination of Technological knowledge and Content knowledge. Technological content knowledge refers to the knowledge of how technology can create new representations for specific content (Schmidt et al, 2008; Koehler, Mishra, Kereluik, Shin & Graham, 2014).

Technological Pedagogical Knowledge (TPK): Resulted from the combination of Technological knowledge and pedagogical knowledge. This type of knowledge refers to the knowledge of how various technologies can be used in teaching, and to understanding that using technology may change the way teachers deliver the content and influence learners to gain more and more knowledge (Schmidt et al, 2008; Mishra & Koehler, 2006).

Technological pedagogical content knowledge (TPACK): Resulted from the intersection of three main diagrams (CK, PK, TK) of knowledge required for integrating ICT into teaching and learning activities**.** Teachers should have the TPACK in order to be able to conduct effectively the integration of technology into their teaching activities (Schmidt et al., 2008; Koehler, Mishra, Kereluik, Shin & Graham, 2014; Igbo & Imo, 2017).

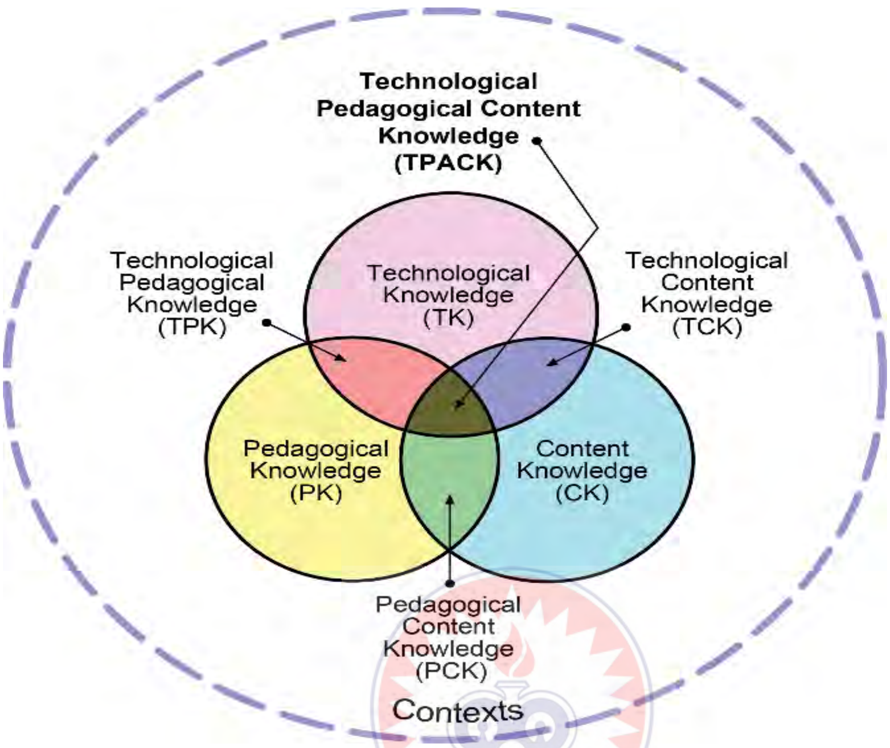

Figure 1: The components of the TPACK framework (Mishra & Koehler, 2006)

Angeli and Valanides (2009) adapted TPACK becoming ICT-TPCK through an interaction of five areas. They renamed the technology domain as Information and Communication Technologies (ICT) as well as they added two knowledge domains: knowledge of student and knowledge of the context within which learning occurs. In their model, Angeli and Valanides (2009) present five domains of knowledge that teachers would need when they integrate ICT in teaching: content knowledge; pedagogical knowledge; knowledge of learners; knowledge of context; and knowledge of ICT. The transfer of TPACK to the classroom was a complex process, as teachers revealed that student ability, curriculum, and pressure to deliver were among factors affecting ICT integration in the mathematics classroom (Handal, Campbell, Cavanagh, Petocz, & Kelly, 2013). Handal et al. (2013) adopted the

TPACK model to investigate secondary mathematics teachers' knowledge through administration of an instrument called TPCK-M (Technological Pedagogical Content Knowledge of Mathematics) and consisted of three major theoretically-based constructs: technological content knowledge (TCK), technology pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPCK).

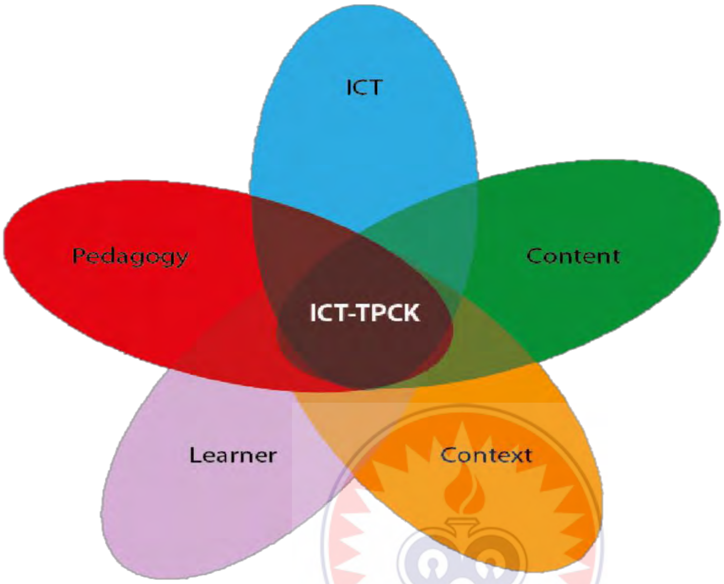

Figure 2: ICT-TPCK (Angeli & Valanides, 2009)

2.3.2 Theory of Planned Behaviour (TPB) and Technology Acceptance Model (TAM)

The Theory of Planned Behaviour (TPB) foresees an individual's intention to participate in behaviour at a specific time and place (Ajzen, 1991). According to the Theory of Planned Behaviour (TPB) (Ajzen, 1985, 1991), behaviour is determined by intention (I) to perform the behaviour. Intention is predicted by three factors: Attitude toward the behaviour (A), Subjective Norms (SN), and Perceived Behavioural Control (PBC). According the TPB model, to predict whether a person intends to do something, we need to know; (i) whether the person is in favours of doing it ('attitude') (ii) how much the person feels social pressure to do it ('subjective norm') and (iii) whether the person feels in control of the action in question ('perceived behavioural control').

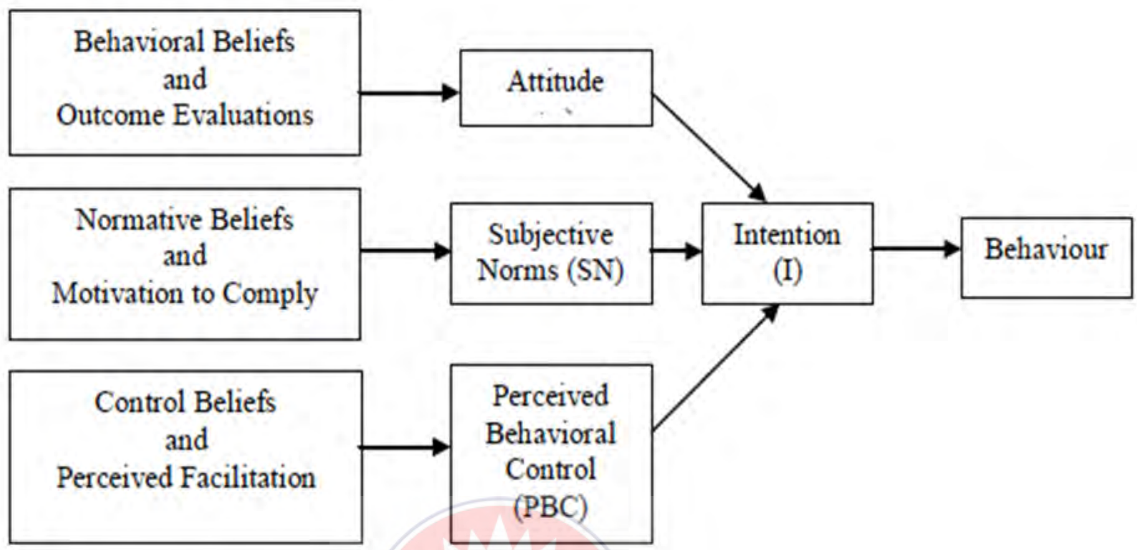

Figure 3: The Theory of Planned Behaviour (Ajzen, 1991)

The Technology Acceptance Model (TAM) is perhaps the most widely applied theoretical model in technology use research. TAM was developed by Davis (1989) to explain computer-usage behaviour. The goal of TAM was to provide an explanation of the determinants of computer acceptance that is in general, capable of explaining user behaviour across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified (Davis, 1989). TAM specifies the causal linkages between two key sets of constructs: (1) Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), and (2) user's attitude (A), behavioural intentions (BI) and actual computer usage behaviour. According to Jong and Wang (2009), review of scholarly research on technology acceptance and usage suggests that TAM has emerged as one of the most influential models in the stream of recent research.

Technology Acceptance Model is the most widely applied theoretical model in the technology use research which was developed to explain computer usage behaviour (Apeanti, 2014). TAM suggests that specific behaviour, beliefs, perceived ease of use and perceived usefulness determines on individuals' attitudes (or perceptions in this case) towards using any new technology. Perceived usefulness is the degree to which a person believes that using a technology increase his/her performance, while perceived ease of use is the degree to which a person believes that using a technology will be free of efforts and perceived usefulness is influenced by perceived ease of use. TAM is one of the most widely and empirically tested theories which draws on social psychological approach to explain adoption of technology and the factors that influenced individuals.

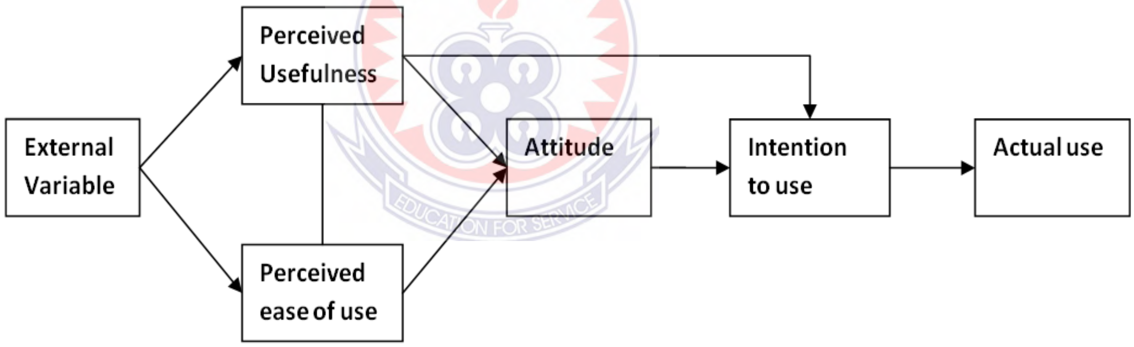

Figure 4: Technology Acceptance Model (Davis, 1989)

The Technology Acceptance Model (TAM) is simply an extension of Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB) a well-known model related to technology adoption and use, originally proposed by F. D. Davis in 1986 and later revised in 1989. Dominant theoretical models for determining the intention and readiness of prospective teachers to use technology in their future instructional practice includes the Technology Acceptance Model (TAM) (Davis, 1989) and the Theory of Planned Behaviour (TPB) (Ajzen, 1985, 1991). In line with the planned behaviour theory, the focus is on the teachers' perception and intentions of using ICTs in teaching and learning. The first base of the behaviours in this manner is the teacher's perception towards the use of ICT. This means the degree to which teachers have a positive or negative feelings perception of the use of ICT, which is the behaviour of interest (Ajzen, 2002).

The Technology Acceptance Model posits that because new technologies such as personal computers are complex and an element of uncertainty exists in the minds of decision makers with respect to the successful adoption of them, people form perceptions and intentions towards trying to learn to use the new technology prior to initiating efforts directed at using these technologies (John, 2015). As postulated in the TAM, usage of technology positively influences the perception towards using as well as perceived usefulness and computer self-efficacy has a significant effort on perceived ease of use. Technology acceptance is "an individual's psychological state with regard to his or her voluntary or intended use of a particular technology" (Maslin, 2007). TAM model adapted the belief-attitude intention-behaviour relationship of TRA and TPB to explain user's acceptance of technology.

2.4 Other ICT Models in Education

Nyvang (2006) proposed a theoretical model for the implementation of ICT in higher education using a Danish university as a case study using "Activity Theory". The model advocates that implementation in itself is an activity system. The implementation activity in Nyvang (2006) is made up of three processes: Selection of ICT; adaptation of ICT and change of practice with ICT.

Wang and Woo (2007) developed a systematic model for ICT integration. It is a systematic because it follows a logical flow and has components organized manner. The development of each module in their ICT model depends very much on the completion of its previous modules. Additionally, their ICT model essentially provides an easy-to-follow structure, where designers move to the next module only after they have completed the current module. The key components of their ICT model include: problem statement, learning objectives, technology required, rationale, strategies, assessment and reflection. Systematic model starts with a problem statement, which describes the major problems or issues to be addressed in a topic. Learning objectives specify the intended learning outcomes at the end of the topic. In order to address the problem and achieve the learning objectives, teacher-designers need to carefully compare all possible technologies that can be used for learning this topic. The technologies in this model may include software such as multimedia courseware, web-based resources, communication tools (such as voice chat, textual discussion forums, or video conferencing), mind tools (such as concept mapping tools and multimedia authoring tools), or any other possible ICT tools.

In the rationale for using the technology, technology should be used not because it is available or it has been shown effective in some cases. It should be used to enable the process and enhance learning. After determining what technology is needed and why, teacher-designers must now decide how to effectively and meaningfully incorporate the selected technology into the topic learning. Since a topic is usually composed of several lessons, details on ICT integration should be provided separately for each lesson as well as for the entire topic. At the end of the topic, the students will be assessed on how well they have mastered the topic. Finally, a plan is never good until it is executed and proven right. In the planning process, very often teacher-designers are faced with many constraints and restrictions that limit their choices and strategies. After conducting the ICT integrated lessons, the teacher-designers need to reflect upon their learning experiences of the ICT integration. The reflections can focus on the appropriateness of the technology used, strengths and weaknesses of the technology and possible improvement.

Wang (2008) proposed a generic ICT model which involved three fundamental elements: technology, social interaction, and pedagogy. Wang (2008) elaborated that the design of these components should help teachers to incorporate ICT into their curricula in effective ways. The theoretical foundation for the construction of the proposed ICT model provides the design of interactivity, constructivist learning theories and the notion of usefulness. The proposed generic model in Wang (2008) can be applied in the design of learning environments, facilitation of online discussions and comparison of ICT tools.

Engida (2011) proposed the ICT-enhanced teacher development model (ICTeTD), which is technology use in teaching. The ICTeTD model is conceptual in the sense that it provides a visual representation of the concepts/knowledge bases from which teachers draw during their teaching. In the ICTeTD model, teaching is understood to be broader and involves all the activities of a teacher relating to a specific subject such as lesson planning, classroom instruction, assessment/evaluation, curriculum review and development.

Bhasin (2012) design a cyclical model on the questions (who, why and how should ICT resources and applications be used) to be answered in the integration process. The question on what is the purpose of the integration process is important as teachers should be trying to strengthen students' learning by combining appropriate pedagogical approaches and ICT applications and resources in direction of acquisitions of topic. It is important also to determine the characteristics of learners who are the target group of the integration process. Moreover, in order to prepare and carry out learning environment which is appropriate to the purpose and the characteristics of the target group, the question "How" is very important.

Asabere, Togo, Acakpovi, Torgby and Ampadu (2017) proposed Awareness Incentives Demand and Support (AIDS) model. AIDS is an ICT model that is aimed at increasing the use of ICT in education through major stakeholders consisting of teachers and students. The AIDS model is made up of four (4) major components which relate to lecturers and students. The initial process of the model begins with Awareness (1) of the ICT usage in education by both lecturers and students. Once the advantages and use of ICT are made known to both students and teachers in their various field of learning, teaching and research, Incentives (2) have to be provided to both students and lecturers based on the sort of motivation that will encourage the use of ICT. Through the provision of incentives such as providing computer laboratory and increase in internet bandwidth, students increase their Demand (3) for lecturers to integrate ICT into teaching and research so as to utilize the available ICT facilities. This leads to the need for Support Services (4) to aid or provide help to students and lecturers on how to integrate ICT in their various fields of research or teaching.

2.5 ICT Integration and Mathematics Education

The use of ICT in education helps to facilitate teaching and learning in the school settings (Claro, 2012). Teachers receive insufficient training and the focus is mainly on basic ICT skills rather than pedagogical skills. This is consistent with the suggestion by (Cubukcuoglu, 2013) who stresses that the training among teachers should not only include basic technology skills but also provide training on improving pedagogical use of ICT. Schulz (2015) points out that the integration of ICT tools depends on how well they (ICT) fit into the teaching and learning process as well as on how easy it is to use such tools. Pecay (2017) explains that science teachers select

ICT such as YouTube to enhance their science instruction and to assist them in clarifying lessons concepts that they find challenging. In accordance with Bokhove (2010), teachers select ICT tools that are easy to use for them and for students.

According to Kuskaya and Yasemin (2013) the integration of ICT in the teaching and learning process can be defined in five levels:

1) Beginning of ICT integration: At this level, the teacher organizes activities aimed at developing students' basic ICT skills, preparing lesson plans, including utilizing available ICT applications.
2) First Level of ICT integration: At this level, the teacher gives students' homework and analyses it using ICT to support their learning process.
3) Second Level of ICT integration: At this level, the goal of using ICT by teachers is to develop high-level thinking skills of students. The teacher organizes activities to develop problem-solving and critical thinking skills.
4) Third Level of ICT integration: At this level, teachers and students communicate with experts or students from other schools through networks outside the classroom.
5) Fourth Level of ICT integration: At this level, students use ICT and its applications to provide solutions to real-world problems related to content.

One of the factors that determine educational development in general is teachers as they are the ones to use the ICT investments for educational development. ICT does not have an educational value in itself. It becomes important when teachers use it in teaching-learning process. The teacher has a pivotal role in ensuring the inclusion and implementation of ICT in the teaching and learning mathematics. The use of ICT when studying mathematics is not a new issue, since humankind always has been looking for solutions to avoid time consuming routine work. The use of ICT has a long history in mathematics education. Researchers (Agyei & Voogt, 2012; Agyemang, 2012) who looked at integrating ICTs into the teaching and learning of mathematics seem to delve into the feasibility of ICT use in mathematics teaching, surveying mathematics teachers on how they integrate ICTs into the teaching and learning processes, developing technological pedagogical content knowledge (TPACK) of mathematics teachers and similar studies.

Integration of ICT in mathematical instruction can hardly be achieved without teacher support on ICT. This support starts with teacher training/orientation to provision of teaching and learning resources in the schools. Many countries have developed deliberate policies that support integration of ICT in mathematics instruction. Mathematics is often communicated through symbols, and mathematical symbols are quite abstract for many students. It is necessary to teach mathematics using multiple modes of representation, e.g., words, numbers, diagrams, graphs, and concrete manipulatives. According to Annan (2012) although valuable lessons may be learned from best practices around the world, there is no one formula for determining the optimal level of ICT integration in the educational system.

2.6 Teachers' Demographics and ICT Integration

Teacher demographics such as age, gender, teaching experience and level of ICT training may influence the integration of ICT in teaching secondary schools. According to Buabeng-Andoh (2012) personal characteristics such as educational level, age, gender, educational experience, experience with computers for educational purpose and attitude towards computers can influence the adoption of a technology. Research studies revealed that male teachers used more ICT in their teaching and learning processes than their female counterparts (Kay, 2006; Wozney, Venkatesh & Abrami, 2006).

Research indicates that lack of teachers' confidence prevents teachers from using ICT in their teaching (Peeraer & Van Petegem, 2011). Many teachers use computers and internet only to prepare their lesson plans. In fact, Hassan and Sajid (2013) reveal that many teachers lack confidence in ICT use despite having adequate knowledge. This can be implied that the teachers' experience and motivation to use ICT in class is still below expectation.

Lau and Sim (2008) conducted a study on the extent of ICT adoption among 250 secondary school teachers in Malaysia. Their findings revealed that older teachers frequently use computer technology in the classrooms more than the younger teachers. The major reason could be that the older teachers having rich experience in teaching, classroom management and also competent in the use of computers can easily integrate ICT into their teaching.

Muchiri (2008) also opined that younger teachers are more open to use of ICT than most but not all older teachers. Ramasamy and Anthony (2016) shows that the use of ICT tools by male teachers in classroom is higher compared to female teachers. Conversely, in the Ghanaian Primary Schools, female teachers use ICT to teach more than their male counterparts (Natia & Al-hassan, 2015). Additionally, in Taiwan by Yuan and Lee (2012) the findings show no gender difference on school teachers' perceptions toward the use of ICT in teaching and learning mathematics.

Buabeng-Andoh and Totimeh (2012) study examined teachers' innovative use of computer technologies in classroom: a case of selected Ghanaian schools. A simple random sampling technique was used to select the teachers in second-cycle institutions who participated in the quantitative study. A questionnaire was used to collect the data from two hundred and thirty-one teachers in second-cycle institutions. The results of the study found that male teachers have access to computers more than the female teachers. However, the study revealed that there was no difference in the innovative use of ICT between female teachers and male teachers. Also, there was no significant difference between years of teaching experience and teachers' ICT use, but experience did influence teachers' use of ICT. These results indicate that teachers with more years of teaching experience seem to use ICT more frequently to transform their teaching. Moreover, analysis found that there was a high positive correlation between teachers' computer skills and computer experience ($r = .59$, $p < .001$). Also, there was a high positive correlation between teachers' computer skills and computer access ($r = .65$, $p < .001$). Furthermore, the study revealed that computer access was positively related to computer experience. All the relationships were statistically significant at the .01 level of significance. This explains that, as teachers have more access to computers, there is likelihood to use the computers in their teaching and learning process. The more experience teachers have with computers, the more likely that they will show positive attitudes towards computer use in the classroom.

Amuko, Miheso and Ndeuthi (2015) study examined opportunities and challenges: Integration of ICT in teaching and learning mathematics in Secondary Schools, Nairobi, Kenya. The study used descriptive survey design and data collection was conducted on twenty four mathematics teachers from twelve secondary schools in Nairobi County. Purposive sampling was used to select teachers from the twelve schools. The study sought to find out the contributing opportunities and challenges which influenced integration of ICT in teaching and learning mathematics from the teachers. Findings revealed that Mathematics teachers are not adequately prepared to handle ICT infrastructure's in Mathematics lessons. The study also found that teachers were not adequately trained on ICT integration in teaching and learning Mathematics in secondary schools.

Rosa (2016) also conducted a study on experiences, perceptions and attitudes on ICT integration: a case study among novice and experienced language teachers in the Philippines. The study was based on a qualitative research which was exploratory in nature. The subjects of the qualitative study were two English teachers from a resettlement high school, further identified as “novice” and “experienced” teachers. The study found that experienced language teacher had more exposure to ICT use than the novice teacher. However, the novice teacher makes use of more ICT-related materials and activities in her language class. Both teachers also have positive views on the impact of ICT on students’ overall learning and achievement. Moreover, the novice teacher views ICT use as time-consuming and does call for a more knowledgeable manipulation of technological devices. The experienced teacher gives more favour to the advantages ICT contributes to language teaching, but views insufficiency of resources and services like limited internet access as detrimental to effective ICT integration. On the other hand, both subjects also had positive attitudes towards ICT integration in English Language Teaching (ELT).

Muriithi (2017) study examined on factors affecting implementation of ICT Education in Public Primary schools in Kajiado North Sub-County, Kenya. Random sampling techniques were used to select 5 schools, 78 teachers and 155 pupils. Questionnaires were the main data collection instruments. The result of the study found that more than half (53.9%) of the respondents indicated that good match of training and skills are important to support ICT implementation in schools and poor school ICT policies have negatively affected implementation ICT education.

In the research conducted by Hlasna, Klímova, and Poulova (2017), they concluded that teachers who have had methodological training in the use of ICT in teaching quest to use ICT in teaching while the opposite is reluctant to use ICT in teaching. This goes to underpin the relevance of providing ICT training to teachers. Edefiogho (2005) indicated that there is a significant difference in ICT application based on teachers' gender and experience; young and newly employed female teachers reported higher technology use in teaching and learning process.

Abas and David (2019) conducted a study on teachers' self-assessment towards technology integration in teaching mathematics. A descriptive research design was employed based on the objectives stated in the preliminary part of the study. A total of 35 teacher-respondents from the six campuses of the Bataan Peninsula State University participated in the research endeavor during the academic year 2017-2018. Data were collected through questionnaire involving teachers' self-assessment regarding technology integration. The findings of the study found difference between the male self-assessment and female self-assessment of technology integration in terms of their competency in using technology in teaching mathematics. It was concluded that female teacher respondents were more likely to assess that they are competent in choosing learning and technology resources in teaching mathematics; mobilizing technical abilities for solving problems in instructional contexts; and integrating the technology's application with development of a given pedagogical and curricular proposition than male teacher respondents.

Another factors that make teachers accept and use ICT in the classroom is their experience of using ICT (Badri, Al-Rashedi, & Mohaidat, 2013), experience on how to use this technology in the classroom environment (Keramati, Afshari-Mofrad, & Kamrani, 2011), and experience of using types of applications based on ICT age, and self-confidence (Molnar & Benedek, 2013). Buabeng-Andoh and Totimeh (2012) also found that teachers with more years of teaching experience seem to use ICT more frequently to transform their teaching than those with few years of teaching experience. Gorder (2008) reported that teacher experience is significantly correlated with the actual use of technology. But, Baek, Jong and Kim (2008) claimed that experienced teachers are less ready to integrate ICT into their teaching.

2.7 Teachers' Perceptions and ICT Integration

2.7.1 Perception

The term *perception* is a noun. Wikipedia (2008) defines perception as "the process of attaining awareness or understanding of sensory information." Perception is defined as "a) the way you think about something and your idea of what it is like; b) the way that you notice things with your senses of sight, hearing etc.; c) the natural ability to understand or notice things quickly (Bagby, 1957)". Perception is man's primary form of cognitive contact with the world around him. As all conceptual knowledge is based upon or derived from this primary form of awareness, the study of perception has always had a unique significance for philosophy and science. In philosophy, psychology, and cognitive science, perception is the process of attaining awareness or understanding of sensory information.

The word "perception" comes from the Latin words *perceptio*, *percipio*, and means "receiving, collecting, action of taking possession, and apprehension with the mind or senses (Bai, 2001). It is an individual's or group's unique way of viewing a phenomenon that involves the processing of stimuli, and incorporates memories and experiences in the process of understanding. Perception is a uniquely individualized experience. Perception is never objective. Constructivist theories assume that the process of perception is a highly active process of extracting sensory stimuli, their evaluation, interpretation and backward organization of sensory stimulus. Perception is the end product of the interaction between stimulus and internal hypotheses, expectations and knowledge of the observer, while motivation and emotions play an important role in this process. Perception is thus influenced by a wide range of individual factors that can lead to an inadequate interpretation. (Eysenck & Keane, 2008).

Teachers' perceptions explain the beliefs that teachers have about the relevance of integrating ICT into teaching and learning, and the perceived obstacles that are associated with integrating ICT in Education (Hutchison & Reinking, 2011). Teachers' perceptions towards a new technology are a key element in its diffusion (Syomwene, 2017). Thoha (2010) argues that perception is more complex and broad compared to the sensing process because perception includes difficult interactions from selection, compilation and interpretation activities. Despite the variation regarding the relationship between perceptions and teachers' demographic profile such as age, gender, teaching experience and ICT training, studies reveal that teachers have relatively positive perceptions toward the use of ICT in learning activities (Gebremedhin & Fenta, 2015; Qasem & Viswanathappa, 2016; Rosa, 2016). Teachers' perceptions and motivation in ICT use are two of the main determinants of successful ICT integration in learning activities (Al-Awidi & Aldhafeeri, 2016; Qasem & Viswanathappa, 2016).

2.7.2 Teachers' Perception towards ICT Integration

Baya'a and Daher (2013) conducted a study on Mathematics teachers' readiness to integrate ICT in the classroom: the case of elementary and middle school Arab teachers in Israel. The sample included 475 elementary and middle school teachers from three regions. They found that more than seventy percent (70%) of the participating teachers have positive perceptions of their competence in technology and technology integration in their teaching. They further found positive attitudes towards the integration of ICT in teaching and learning and of their self-esteem in the presence of technology, in addition to positive emotions towards this integration. Thus the findings indicate that the teachers are ready for the integration of technology in their teaching, and this readiness is represented not only by the participating teachers' perceptions of and attitudes towards the integration of technology in teaching and learning, but also in their intention to do so.

Apeanti (2014) conducted a research on prospective mathematics teachers' perception about ICT integration in mathematics instruction in Ghana. One hundred and twenty six (126) third year undergraduate students were sampled from the Department of Mathematics Education in the University of Education, Winneba (UEW) which is the largest public university mandated to train teachers in Ghana. Purposive sampling technique was used to select participants. The relationship between prospective teachers' perception and their willingness to use ICT in their instruction was investigated using Pearson correlation. A significant positive correlation ($r = .534$, $p = .000$) was found between the perception of prospective teachers and their willingness to use ICT in their future instructional practice. Their finding indicates that, prospective teachers with positive perception about the effectiveness of ICT integration will be more willing to use ICT in their future instruction than those with negative perception.

Al-Munawwarah (2014) conducted a study on teachers' perception towards the use of information and communication technology (ICT) in English language teaching and learning process in one of vocational schools in Bandung. The study applied qualitative research design taking on characteristics of descriptive study. The participants were four EFL teachers out of six who were available to get involved in interview session. The data collection techniques employed in the study were open-ended questionnaire and interview. The results of the study although revealed some challenges encountered by the teachers in utilizing ICT, the study further found positive perceptions related to the use of ICT in the learning process.

Gebremedhin and Fenta (2015) conducted a study on assessing teachers' perception on integrating ICT in teaching-learning process: the case of Adwa College. The total population of Adwa College of Teachers Education was 74 teachers. Thus, the researchers took all these teachers using census study. Based on the list of teachers in the college, questionnaire was distributed appropriately to every teacher. Generally, 74 questionnaires were distributed for the teachers. The study employed both quantitative and qualitative method. The study also employed cross-sectional study. The study found a significant relationship between teachers’ perception towards ICT integration into teaching-learning process and the factors that encourage ICT usage. The findings indicates that the teachers perception towards ICT integration into teaching-learning process increase if ICT usage is encouraged and vice versa. Moreover, the results of the correlation also indicated a significant relationship between teachers’ perception toward ICT usage to increase quality of courses they teach and their productiveness due to ICT usage. They found that the teachers’ productiveness is realized if ICT is integrated to the course they teach.

Qasem and Viswanathappa (2016) investigated the teacher perceptions towards ICT integration: professional development through blended learning. The study was quasi-experimental in nature wherein a pre-test/post-test design was employed with an experimental group and a control group. The experimental group was trained using the blended learning approach towards integrating ICT in e-course design, whereas a traditional learning (face-to-face) method was used to train the control group. The population for the study was in-service science teachers in Ibb city, Yemen, who are knowledgeable about computers and internet basics. The sample was selected by a stratified random sampling method based on the teachers' performance (75% and above) as indicated in their in-service training profile during their last training on computer and internet basics. The sample consisted of 60 in-service teachers divided evenly and randomly between the control group and the experimental group. A questionnaire was used to determine the in-service teacher perceptions towards integrating ICT in instructional design, which included 25 items. The data were analyse and interpreted using t-test and ANCOVA statistical techniques. The findings show that there was a significant difference in teacher perceptions towards integrating ICT, especially in the group who were trained through the blended learning approach. Since the teachers had already acquired the necessary skills for effective usage and implementation of ICT, the new technologies introduced influenced teacher perceptions towards ICT integration. Therefore, it was concluded that teachers' ability and willingness to integrate ICTs into their teaching is largely dependent on the professional training and development that they receive.

In another study, Mwendwa (2017) investigated the perception of teachers on ICT integration in the primary school curriculum in Kitui County in Kenya. The Mixed Methods research approach was used in the study. A total of 388 principals and 776 teachers participated in the study giving a total of 1164 sampled respondents. Purposive sampling method was used to select the principals while the teachers were selected through simple random sampling method. The findings revealed that the teachers and principals had positive perceptions on ICT integration in the curriculum.

Li, Yamaguchi and Takada (2018) investigated the understanding factors affecting school teachers' use of ICT for student-centered education in Mongolia. The survey covering 838 responses of primary school teachers of four provinces and Ulaanbaatar was utilized for quantitative analysis. The result was supplemented by qualitative data collected through interviews and focus group discussions. The study found that professional competency and benefit on use of ICT are affecting both teachers' perception on use of ICT tools and digital contents promoting student-centered education. Teacher cooperation was found to be the factor affecting teachers' perception on use of digital contents for student-centered education. Three factors identified to affect teachers' perception on use of ICT for student-centered education (such as professional competency, perceived benefit, and cooperation among teachers) are also endogenous teacher level factors while no exogenous factors were found to be affecting factors. Therefore, together with infrastructure development, policy makers could also consider designing training programs to improve teachers' professional competency, communicating the benefits of using ICT tools and digital contents, as well as stimulating teacher cooperation on the use of ICT.

2.8 Teachers' Attitude and ICT Integration

2.8.1 Attitude

Attitudes refer to one's positive or negative judgment about a concrete subject. Dawson (1992) defined attitude as a disposition towards or against a specified phenomenon, person or thing. This definition provides two aspects of an attitude. First, an attitude is bipolar; it can be positive or negative, favorable or unfavorable (Ochsner, 1996; Small, 1995). Second, an attitude is a response to a person, object, or situation (Beatty, 2000). Eagly and Chaiken (1993) define an attitude as 'a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor'. Inherent in this definition is the idea that reporting an attitude involves the expression of an evaluative judgement about a stimulus object. In other words, reporting an attitude involves making a decision concerning liking vs. disliking, approving vs. disapproving or favouring vs. disfavouring a particular issue, object or person. An attitude, when conceptualized as an evaluative judgement, can vary in two important ways. First, attitudes can differ in valence, or direction. Some attitudes that a person possesses are positive, others are negative, and yet others are neutral. Second, attitudes can differ in strength. For example, while one person might feel very strongly about the ICT integration in the teaching-learning of mathematics, a second person might feel much less strongly about the same topic.

Attitudes differ in strength and valence, and any stimulus that can be evaluated along a dimension of favourability can be conceptualized as an attitude object. Attitudes are summary evaluations of an object that have affective, cognitive and behavioural components (Eagly & Chaiken, 1993). The affective component refers to feelings or emotions associated with an attitude object. The cognitive component refers to beliefs, thoughts and attributes associated with an attitude object. In many cases, a person's attitude might be based primarily upon a consideration of the positive and negative attributes about the attitude object. The behavioural component refers to past behaviours with respect to an attitude object. Attitudes, like most constructs in psychology, are not directly observable. For instance, we cannot see that a person holds a positive attitude towards ICT integration. Rather, attitudes have to be inferred from the individual's responses to questions about these ICT integration (Fazio & Olson, 2003).

Khan, Hasan, and Clement (2012) in their examination of the barriers to the implementation of computers, observe a critical factor that all staff needed to recognize and understand that integrating ICT into classroom practice is a complex innovation which requires change to the whole schools' practices and culture, to the curriculum and in teachers' attitudes and classroom practice. Teachers' attitudes towards using ICT in teaching and learning are also influenced by several factors.

Berhane (2012) reported that secondary school teachers have different attitudes towards the use of ICT in the teaching process; and different perceptions were reported according to teachers' age and gender. Studies have shown that teachers generally agree about the relevance of ICT use and its substantial contribution in teaching and learning (European Commission, 2013; Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014). In order to support teachers' positive attitudes towards technology, as well as their use of ICT in teaching and learning, educational programs have to provide authentic, practical examples of teaching with technology (Ertmer & Ottenbreit-Leftwich, 2010).

2.8.2 Teachers' Attitude towards ICT Integration

Tan and Mishra (2001) also opined that teachers' attitudes influence their willingness to use ICT in teaching and learning. They concluded that teacher's attitudes and use of ICT are directly related. If teachers' attitudes are positive towards the use of educational technology then they can easily provide useful insight about the application and utilization of ICT for teaching and learning processes. Negative attitudes towards technology on the other hand among teachers are a key obstacle to successful ICT integration. According to Afshari (2009) to cultivate positive attitudes among teachers, they need to be knowledgeable on how to use technology.

Teo (2008) conducted a survey in Singapore on computer use in connection with the attitude of basic teachers towards it. One hundred and thirty nine (139) elementary teachers were sampled to be appraised for their computer attitudes using questionnaire with four factors: affect (liking), perceived usefulness, perceived control, and behavioural intention to use the computer. He found that teachers were more positive about their attitude towards computers and intention to use computer than their perceptions of the usefulness of the computer and their control of the computer.

Another study conducted by Sanchez, Marcos and GuanLin (2012) examined on in-service teachers' attitudes towards the use of ICT in the classroom. One hundred and seventy in-service teachers from kindergarten to high school participated in the study. A quasi-experimental study with one non-randomized study group (n=85) was also conducted using a pre-and post-test design with the purpose of searching for differences before and after training. The results show that teachers' attitudes towards ICT are highly positive but the use of them in class is scarce and it is subjected to innovative processes.

Ndibalema (2014) conducted a survey on teachers' attitudes towards the use of information communication technology (ICT) as a pedagogical tool in secondary schools in Kondoa district, Tanzania. A total of 80 teachers, through random sampling in 10 schools were involved in this study at the first phase of data collection and 10 teachers were obtained through purposive sampling from 2 schools at the second phase. Questionnaire and interview were employed to collect data for the survey. The study found that teachers have positive attitudes towards the use of ICT as a pedagogical tool but they did not integrate it in their teaching effectively.

Ayub, Bakar and Ismail (2015), study also examined on factors predicting teachers' attitudes towards the use of ICT in teaching and learning. A total of 187 mathematics teachers from the state of Selangor in Malaysia were randomly selected from a stratified cluster sample. The findings showed that the teachers' attitudes towards using ICT in teaching and learning were positively correlated. However, a negative relationship existed between years of teaching and attitudes towards using ICT in teaching and learning.

Mustafina (2016) study examined the influence of teachers' attitudes on technology integration in a Kazakhstani Secondary School. Mixed method design was adopted in the study. A convenience non-probability sampling among secondary school teachers and their students was used for selecting the participants. The result of the study shows that teachers possess positive attitudes toward ICT in school mostly due to the advantages that technology offers.

Mensah (2017) conducted a survey on Ghanaian mathematics teachers’ use of ICT in instructional delivery. A cross-sectional survey design was adopted in the present study. A stratified sampling technique was used to select 120 mathematics teachers from 24 public Senior High Schools (SHS). The study found that mathematics teachers had favorable attitudes towards the use of ICT in teaching mathematics although this was not reflected in actual use. The study also found inverse relationship between teaching experience and ICT use. This implies that the older the teacher, then the less they are likely to integrate ICT in their lessons. The study further established inverse relationship between teaching experience and competence. This means that the older teachers are less competent in use of ICT and therefore they use less of it in their lessons.

Semerci and Aydin (2018) examined high school teachers’ attitudes towards ICT use in education. The study group composed of 353 teachers working in different high schools in Ankara province of Turkey in the academic year 2016-2017. The study employed a non-experimental descriptive survey design in order to examine teachers’ attitude towards ICT use. Their findings revealed that teachers have a high level of positive attitude towards ICT use in their classes, yet there is no significant difference between teachers’ ICT willingness by their gender, age, teaching experience, ICT experience, ICT skills and ICT training. However, they have significantly different negative attitude (ICT anxiety) towards ICT use in education by their ICT experience, ICT skills and ICT training.

Mwila (2018) conducted a study on assessing the attitudes of secondary school teachers towards the integration of ICT in the teaching process in Kilimanjaro, Tanzania. One hundred (100) secondary school teachers were selected from the sampled secondary schools using convenience sampling technique. It was found in the study that the integration of ICT into teaching process largely depended on the attitude and perception of teachers concerning ICT integration; positive ICT attitudes are expected to foster ICT integration in the teaching process. The study by Mwila (2018) also show that there is a positive correlation between the frequency of ICT use and teachers' attitude towards ICT integration. The study also found a relationship between teachers' gender, age group and attitudes towards ICT use in the teaching process.

2.9 Teachers' Self-Efficacy and Integration of ICT

2.9.1 Self-Efficacy

Self-efficacy is the belief in one's own ability to successfully accomplish something. It is a theory by itself, as well as being a construct of social cognitive theory. Self-efficacy theory tells us that people generally will only attempt things they believe they can accomplish and won't attempt things they believe they will fail. The basic premise of self-efficacy theory is that "people's beliefs in their capabilities to produce desired effects by their own actions" (Bandura, 1997) are the most important determinants of the behaviors people choose to engage in and how much they persevere in their efforts in the face of obstacles and challenges. Self-efficacy is important because individuals with high self-efficacy for a task tend to try harder at the task and experience more positive emotions relating to the task (Bandura, 1997).

On the basis of this theory, the present research assumes that when one's self-efficacy towards ICT integration is high, he/she tends to put greater effort into integrating ICT in teaching mathematics, which eventually results in a good results. To put it in details, it means that when a teacher possesses a high self-efficacy towards ICT integration, it means that he/she has confidence in mastering the use of ICT. With such a positive self-efficacy, this will simultaneously affect the teacher's behavior. Since the teacher thinks he/she is capable of doing well, this will lead to a series of favorable behaviors. On the contrary, when one's self-efficacy towards ICT integration is low, he/she is less likely to put great effort into integrating ICT in teaching mathematics, which eventually results in a low results. To put it in details, it means that when a teacher possesses a low self-efficacy towards ICT integration, it means that he/she does not have confidence in mastering the use of ICT.

Self-efficacy is based on beliefs and confidence about what a person can accomplish with the skills and knowledge of computer they already possess. Teachers' perceptions in using ICT can tell about the teachers' beliefs, including their self-efficacy on ICT usage into teaching and learning. Hutchison and Reinking (2011) reported that for education sector to achieve fundamental changes from classroom teaching practices there is a need to examine the beliefs teachers hold about the use of ICT in teaching and learning. In teaching and learning of Mathematics, teachers' beliefs about Mathematics teaching-learning with or without using ICT are considered to be important because it could influence teaching and learning (Guven, Cakiroglu & Akkan, 2009). At the classroom level, teachers' beliefs can accelerate or slow down curriculum reforms as teachers' beliefs are resistant to change and play a role in teaching practices (Boaler, 2013).

2.9.2 Teachers' Self-Efficacy on ICT Integration

Research has proven that a strong sense of computer self-efficacy among teachers influences how often and how ICTs are used in their daily teaching and learning practices (Papastergiou, 2010). Higher levels of ICT self-efficacy has been shown to be predictive for teachers' choices regarding ICT use and adoption in general (Buabeng-Andoh, 2012). In education, self-efficacy of teachers has been linked to student outcomes that include increased academic achievement and intrinsic motivation (Feldlaufer & Ecclesia, 2010). Teacher's self-efficacy can predict their behaviour when using technology (Koliadis, 2010). In the process of ICT integration, there is the need for teachers to have strong self-efficacy for teaching with ICT if it is to be utilized regularly.

Alazam, Bakar, Hamzah and Asmiran (2012) study examined teachers' ICT skills and ICT integration in the classroom among vocational and technical teachers in Malaysia. The data of the study were collected using quantitative techniques, whereby the questionnaire was administered to 329 technical and vocational teachers who were teaching engineering subjects in Malaysian technical and vocational schools. The findings suggest that teachers' ICT skills were at moderate levels, and that a vast majority of teachers who participated in the study were moderate users of ICT in classroom teaching.

Howard, Chan and Caputi (2015) examined the relationship between three subject areas (English, Mathematics, Science) and teachers' beliefs as one of the factors influencing secondary-level teachers' ICT integration. Teachers' beliefs about how technology supports learning and about the importance of ICT were analysed. The findings indicated that English teachers held the strongest belief that ICTs supported learning, while science teachers reported stronger agreement than mathematics teachers regarding this belief. Kounenou, Roussos, Yotsidi and Tountopoulou (2015) study examined Trainee Teachers' intention to incorporating ICT use into teaching practice in relation to their levels of Self efficacy, the results revealed low levels of self-efficacy among trainee teachers in use of ICT in teaching practice. Literature shows that lack of self-efficacy among teachers negatively affect the use of ICT in classrooms.

EL-Daou (2016) study examined the relationship between teacher's self-efficacy, attitudes towards ICT usefulness and Student's Science Performance in the Lebanese Inclusive Schools 2015. The study used qualitative and quantitative methods. Findings of the study revealed that teacher's self-efficacy in the level of technology use, and attitudes have significant effects on the grades and interaction of students with special needs. The findings suggest that knowledge and beliefs can influence teacher's intent to use technology in the classroom, especially as evidenced by the integration of ICT in their lesson plans. Moreover, results indicate a significant positive Pearson correlation ($r = .6$) between teacher's self-efficacy, knowledge, attitudes and special education students' science results.

Sarfo, Amankwah and Konin (2017) conducted a study on computer self-efficacy among Senior High School teachers in Ghana and the functionality of demographic variables on their computer self-efficacy. In all, 434 teachers were randomly selected for the study. Questionnaire from 407 respondents were considered valid for the analyses. They found that SHS teachers in Ghana generally are not certain about their computer self-efficacy and specifically agree that they are self-efficacious in basic computer skills but not certain about their self-efficacy in web based skills and also not self-efficacious in media related skills. The findings suggest that the teachers are unlikely to use and integrate computers in their teaching and learning in classrooms effectively as expected. The study again revealed that there is no difference in overall computer self-efficacy between teachers of 20-30 years and those of 31 years and above. Again, the findings of the study show that the age of the teachers does not influence their computer self-efficacy. Again, the finding of the study also revealed that gender of SHS teachers has no effect on their computer self-efficacy. This suggests that both male and female SHS teachers have similar computer self-efficacy.

Teachers believe in being well prepared before going to teach. If a teacher wants to use ICT in teaching mathematics but feels incompetent in the use of ICT, he/she will shy off from using it. Farah (2011) suggested that even teachers who held strong beliefs regarding the value of technology in educating today's learners could be slowed in their use of available tools due to fears of not being able to effectively troubleshoot technological issues if they were to arise. According to Becta (2004), many teachers who do not consider themselves to be well skilled in using ICT feel anxious about it in front of a class who perhaps know more than they do. According to Balanskat, Blamire and Kefala (2006) lack of confidence and experience with technology influence teachers' motivation to use ICT in the classroom.

2.10 Teachers' Knowledge and Integration of ICT

2.10.1 Knowledge

Knowledge can refer to a theoretical or practical understanding of a subject. Knowledge is organized information that changes something or somebody; either by being foundations for action, or by creating an individual (or an institution) capable of different successful action (Brooking, 1999). The concept of knowledge is pervasive, evaluative, agential, and objective. Pervasive and ubiquitous: 'know' is one of the most used verbs, appears in every language and is learned very early in infancy

(Nagel, 2014). Evaluative: 'know' is used to assess the life of cognitive agents; when we state that someone knows, either because one claims oneself to know or because one attributes knowledge to others, we are presupposing that certain standards or norms have been met. Agential: agents engaged in cognitive tasks and practices are the primary units of epistemic assessment; in general, epistemic evaluation has to do with how agents get the truth (Sosa, 2007). Finally, objective: there must be an objective answer to the question of when the concept has been correctly applied.

Pamela Cipriano indicated that the five ways of knowing are useful in understanding how one knows something: empirical knowing, ethical knowing, aesthetic knowing, personal knowing and synthesizing knowing (Cipriano, 2007). Understanding the impediments to effective communication, sharing and use of knowledge is therefore fundamental to the future of our educational system. Knowledge is an established system of relations, which survives by being shared with more than one person, usually a significant number of humans. 'Knowledge' can continue to exist over a significant timespan with considerable reliability. At a higher level, 'knowledge' is stored systematically as an asset within the scientific disciplines and it is accessed and used for multiple purposes by an individual or by the broadest society. Knowledge is a fluid mix of experience, related information and expert insight that offers a structure for evaluating and integrating new experiences and information. It initiates and is applied in the mind of a knower.

Knowledge can be classified into four ways as: personal, shared and public, hard and soft, practical and theoretical, forefront and backdrop, and internal and external (Pathirage, 2008). But most commonly we can divide it into two parts: i) explicit knowledge, and ii) tacit knowledge (Nonaka and Takeuchi, 1995). Tacit knowledge provides direct experience that is not codifiable via artefacts. About 80%

of total knowledge is tacit and the rest 20% is explicit (Mohajan, 2016). Tacit knowledge is subjective and intangible knowledge which is intuitive and difficult to express and practice with language, diagrams, figures, or numbers (Magnier-Watanabe, Benton & Senoo, 2011). Explicit (codified) knowledge can be verbally explained (in formal and systemic language), codified it through many sorts of data that can be stored, and written down in specified documents.

Teachers are required to have knowledge regarding the teaching and learning processes. These skills include skills to manage classroom, assessing learners, development of lesson plan and following and handle all behaviours shown the learners in learning process (Schmidt, Thompson, Koehler & Shin, 2008). According to Jung (2005) modern technologies are obligating teachers to learn how to use them in teaching and thus, increasing opportunities for the teachers' training needs. The challenging part is that some teachers may not be willing to learn the modern technologies. This may be due to the lack of updated skills and knowledge to use in their lessons.

2.10.2 Teachers' Knowledge on ICT Integration

A number of studies have shown that secondary school teachers lack competencies on the use of ICT as a pedagogical tool in teaching and learning process (Nihuka & Voogt, 2011; Bingmlas, 2009). According to Bingimlas (2009) teacher competence refers primarily to one's ability to integrate ICT into pedagogical practice. Lack of knowledge or competence is regarded as a significant factor that discourages teachers in integrating ICT in their teaching. A teacher's lack of knowledge serves as a considerable challenge to the use of computers in teaching methods and practices. Syomwene (2017) highlights lack of teacher competences in ICT as a factor influencing integration of ICT in the curriculum. According to a study conducted by Ojo and Adu (2018) reveal that teachers did not utilize ICT in their teaching despite the adequate facilities due to limited knowledge and skill. According to Bordbar (2010), teachers' computer competence and training is a major predictor of integrating ICT in teaching. Computer literate teachers may view the integration of ICT into school's curriculum more positively than their counterparts who may lack knowledge of computers. Sonia (2012) expressed a concern that computer literate individuals will reap greater benefits than their counterparts who lack that knowledge. According to Balanskat, Blamire and Kefala (2006), the limitation in teachers ICT knowledge makes them feel anxious about using ICT in the classroom and thus not confident to use it in their teaching.

A study conducted by Agyei and Voogt (2012) in Ghana among pre-service and in-service Mathematics teachers, reported low levels of ICT integration levels as a result of low competencies and access levels of ICT. Successful integration of ICT in teaching is related to teachers' competence and also their attitudes towards the use of modern technology in their teaching and learning according to Ayub, Bakar and Ismail (2012). Successful use of technology for the benefit of students depends on the knowledge of teachers and their confidence and competence in using technology. Not only do teachers need to learn how to use technology, they also need to learn how to apply the technology to teaching and learning. In addition, they need to know which technologies will most effectively meet students' skills, abilities and needs (Girgin, Kurt & Odabasi, 2011).

According to Mirzajani, Mahmud, Ayub and Luan (2015), teachers are unable to utilize ICT in their classroom due to insufficient training, knowledge, skills, facilities, time and self-efficacy related to the use of ICT. This finding is supported by Hadriana (2017) who reveals that many factors may influence the teachers' use of

ICT such as limited skills and limited knowledge of ICT, the availability of ICT equipment in schools, and teaching overloads. Another study also highlights that the challenges of ICT integration are due to lack of ICT-related competency and support for capacity building (Amuko, Miheso, & Ndeuthi, 2015). Other researches revealed that even though teachers seems to have adequate skill in using ICT, they did not integrate it into their teaching because they are either lack of methodological skills or supporting facilities (Muslem, Yusuf, & Juliana, 2018; Prasojo, Mukminin, Habibi, Marzulina, Sirozi, & Harto, 2018).

Michael, Maithya and Cheloti (2016) conducted a study on influence of teacher competency on integration of ICT in teaching and learning in Public Secondary Schools in Machakos. The study adopted descriptive survey research design. Total number of one hundred and twenty six (126) teachers and twenty one (21) head teachers were sampled for the study which gave a sample size of one hundred and forty seven (147). The findings showed that 12(57.1%) of the head teachers were fairly confident in using computers, 4(19%) were confident while only 1(4.8%) was very confident in using computers. The study implied that though the head teachers had been using computers, they needed further training in ICT in order to build confidence in computer use which is key to effective ICT integration in teaching and learning. On if teachers were confident on use of computers, 33(27.5%) were confident, while 28(23.3%) were not sure of their confidence on the use of computers. Only a small minority were confident on the use of computers. The study findings indicate that few head teachers were fairly confident in use of computers (11%) while 37% of the teachers were fairly confident on computer use, meaning that they cannot effectively integrate ICT in teaching and learning. Also, findings of the study show that majority of head teachers and teachers were not using computers in teaching and learning although they also agreed that computers enhance the quality of teaching and learning. Finally, the study found a positive relationship between teachers' competency and ICT integration.

Pelgrum (2001) found that teachers' lack of knowledge and skills was the second most inhibiting obstacle to the use of ICT in schools. In order to be able to implement the integration of ICT in the teaching process as mentioned, the teacher must have certain competencies. According to Inggit (2011) the minimum standard competencies that must be possessed by teachers includes: (1) operating computers; (2) assembling, in-stalling, setting-up, maintaining, and solving problems of personal computers; (3) computer programming; (4) word processing; (5) spreadsheet; (6) managing databases and (7) creating interactive presentations that meet the rules of visual and interpersonal communication.

2.11 Benefits of ICT Integration in Teaching-Learning

The use of ICT in teaching and learning is considered as the transformational tools and if these tools are used adequately, they can promote and the shift to a learner-centered method of learning (UNESCO, 2015). The importance of ICT in teaching and learning processes is undoubtedly because ICT may be looked as "mediator or a bridge" among factors intervening in teaching and learning (Vandeyar, 2015). According to UNESCO (2015), ICT tools help learners develop their writing skills, fluency, originality, flexibility and elaboration. The current findings of Asongu and LeRoux (2017) showed that the use of ICT tools increases the learners' interests of learning and doing research. The similar study of Tarus, Gichoya and Muumbo (2015) showed how ICT tools help learners to have opportunities of addressing their work to an external audience which allows the fully opportunities to collaborate on assignments with people outside or inside school. Internet and the World Wide Web play a vital role in disposing different types of learning materials to unlimited spaces without any restriction of people and without any time constraints (Tarus, Gichoya & Muumbo, 2015).

ICT tools also play a vital role in improving the access to and the quality of teacher training. It is possible to train many teachers together by using different means of ICT tools where teachers from different area may attend and gain skills to develop their teaching professions (Tarus, Gichoya & Muumbo, 2015). ICT tools can enhance the quality of education in different ways: (1) to increase learner's motivation and engagement, (2) to facilitate the acquisition of basic skills, and (3) to enhance the teacher's training. The introduction of ICT in teaching and learning processes has been very influential to teachers as ICT facilitates teachers to share teaching resources (Jaarsveldt & Wessels, 2015); expertise and advice (UNESCO, 2015; Tarus, Gichoya & Muumbo, 2015). ICT tools remove the barrier and allow flexibility in what, how, when and where to carry out all teaching and learning activities (Altinay-Gazi & Altinay-Aksal, 2017). From ICT's applications, teachers are benefiting the full access to up-to-date students and school data, anytime and anywhere (UNESCO, 2015). A study by Mohammed and Abdulghani (2017) indicates that ICT helps students become independent, develop research and problem solving skills and enjoy learning in general. Learners who integrate ICT in learning may easily understand complex topics and concepts. They are more likely to recall information and use it to solve problems in the classroom (Mohammed & Abdulghani, 2017).

ICT integration into classroom teaching and learning helps to achieve the goals of educational programs for several reasons. Miima (2013) contends that ICT integration into the teaching and learning process makes the educative process more proficient and additionally fascinating to students in this way enhancing the quality of education. Gebremedhin and Fenta (2015) believe that integrating ICT in teaching and learning increases the quality of productiveness in teaching, as teachers will be more efficient in their delivery of lessons. ICT integration in mathematics education would provide mathematics teachers with integrative teaching methods that motivate students learning, make them more active and independent, and, as a result, supports them to have deeper understanding of the mathematical ideas and topics. So, the integration of ICT in the teaching and learning of mathematics, as a result of ICT educational affordances, helps students have better attainment in mathematics. These potentialities of the ICT make its integration in the mathematics classroom a recommended practice.

2.12 Factors inhibiting ICT Integration in Mathematics Classroom

Mathematics teachers are faced with inhibiting challenges or barriers to computer use (Hudson & Porter, 2010). For this reason, there have been several studies which have specifically focused on ICT integration in secondary Mathematics teaching. Tsai and Chai (2012) and Wachira and Keengwe (2011) describe two types of barriers, currently hampering the integrated use of ICT by teachers: external (first order) barriers and internal (second order) barriers. Hudson and Porter (2010) found that, one of the barriers that Mathematics teachers identified in failing to adopt the use of ICT in the classroom, is the lack of computer use is due to lack of experience in using computers in teaching Mathematics, lack of adequate professional training and lack of professional support in the use of computers in Mathematics instruction. Gao, Tan, Wang, Wong and Choy (2011) suggested that, the integration of ICT into the Mathematics classroom depends on individual teachers as well as the schools' contextual factors.

Integration of ICT is not a simple application (Bhasin, 2012). This means there are many barriers to apply it in teaching-learning process. Bingimlas (2009) findings show that teachers had a strong desire for the integration of ICT into education but they encountered many barriers. Gebremedhin and Fenta (2015) have admitted that ICT integration into education is fraught with numerous challenges that have bedeviled its effective integration into education. Also, Gebremedhin and Fenta (2015) identified the challenges as a shortage of resources or technological tools, lack of technical support, poor ICT preparation for teachers and lack of encouragement for teachers which may have negative implications on the teachers' perceptions towards the use of ICT in teaching and learning. Ghavifekr, Kunjappan, Ramasamy, and Anthony (2016) found significant challenges associated with the use of ICT tools in teaching and learning. With their findings, the implementation of ICT in teaching and learning is faced with limited accessibility and poor network connection, limited technical support, limited time and lack of teachers' competency.

Another challenge that teachers face when integrating ICT in education is that some schools have forbidden mobile phones, iPods claiming that they often interfere with their lessons (Kolog, Tweneboah, Devine, & Adusei, 2018). Goktas, Yildirim and Yildirim (2009) reveal that the majority of the educational stakeholders believe that lack of in-service training, lack of appropriate software and materials, and lack of hardware are the main barriers for integrating ICT in teaching and learning. Jones (2004) study found a number of barriers for the integration of ICT into lessons: (1) lack of confidence among teachers during integration, (2) lack of access to resources, (3) lack of time for the integration, (4) lack of effective training, (5) facing technical problems while the software is in use, (6) lack of personal access during lesson preparation and (7) the age of the teachers. Snoeyink and Ertmer (2002) have identified these or similar variations as widespread barriers: lack of computers, lack of quality software, lack of time, technical problems, teacher attitudes towards computers, poor funding, lack of teacher confidence, resistance to change, poor administrative support, lack of computer skill, poor fit with curriculum, scheduling difficulties, poor training opportunities, and lack of vision as to how to integrate ICT in instruction.

Peeraer and Van Petegem (2009), assert that important barriers to use of ICT in teaching and learning are the teacher educators' computer skills and confidence in using ICT. However lack of exposure to lessons fully-designed with ICT tools, lack of opportunities to try ICT, the need to practice in a technology laboratory, lack of educational technology teachers, an exam-driven educational system and studying to learn only what is to be tested were some of the underlying reasons for the prospective teachers' negative perceptions of ICT use in the teaching process (Hismanoglu, 2012). Some teachers continue to display a reluctance to engage with new technology, others remain fearful of trying new approaches which they perceive might have a negative impact on examination results. In developing countries, limited facilities are found to be the major constraint in integrating ICT in teaching-learning activities (Karunaratne, Peiris, & Hansson, 2018).

2.13 Conceptual Framework

Conceptual framework is a description of the main independent and dependent variables of the study and relationship among them. "ICT in Education" means the use of technology in educational instruction or employing technology in teaching and learning. The study was conceptualised on the variables used in the objectives. The independent variable in this research refers to factors. A factor can be described as a circumstance, fact or influence that contributes to results. In this study factors that were considered as the independent variables are; teachers' demographic variables (sex, age, years of teaching experience and training on ICT), teachers' perception, teachers' attitudes, teachers' knowledge and teachers' self-efficacy. The dependent variable is the teachers' intention to actually integrate ICT in teaching-learning of mathematics.

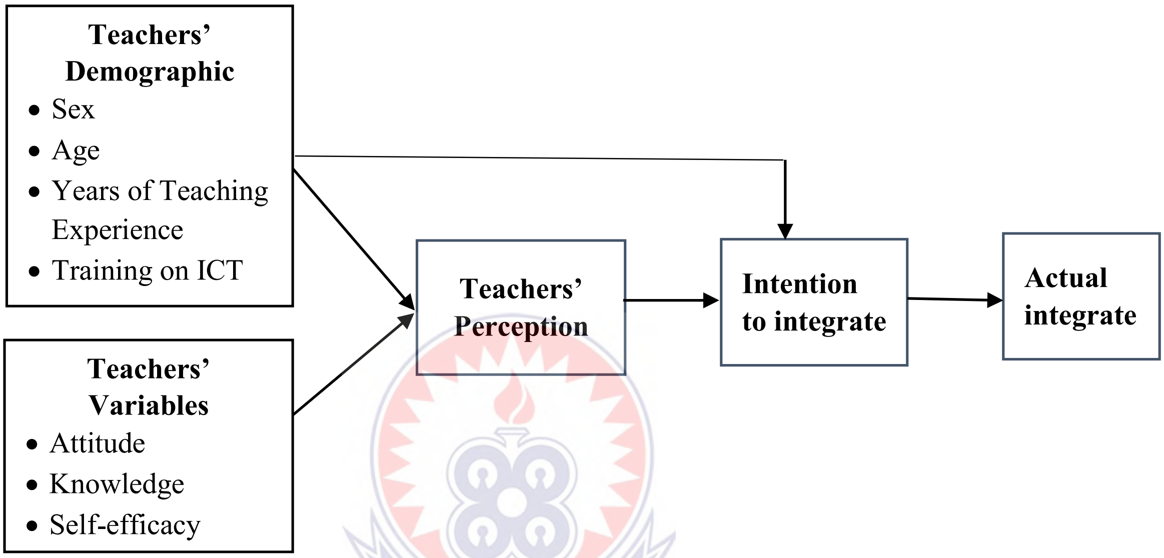

Figure 5: Conceptual framework on ICT Integration

(Source: Adapted from Davis, 1989)

The study employed the conceptual framework above which describes how the independent variables which include teachers' demographic variables (such as; sex, age, years of teaching experience and training on ICT), teachers' perception, attitudes, knowledge and levels of self-efficacy influence integration of ICT in the mathematics classroom. The conceptual framework postulates that if teachers have positive perception, positive attitude towards ICT, are well equipped with ICT knowledge and they have high levels of self-efficacy, they will competently integrate ICT in their mathematics classroom. Also, teachers' demographic factors such as sex, age, years of teaching experience and training on ICT are likely to influence teachers' intention to actually use ICT in teaching-learning process. This is the conceptual framework that guides the research.

2.14 Summary of Reviewed Literature

The study draws its frame from four learning theories, the behaviourism, cognitivism, constructivism and connectivism theories. Some ICT model for teachers to integrate technology includes; Technological Pedagogical Content Knowledge (TPACK), Theory of Planned Behaviour (TPB) and Technology Acceptance Model (TAM). Mathematics is often communicated through symbols, and mathematical symbols are quite abstract for many students. It is necessary to teach mathematics using multiple modes of representation, e.g., words, numbers, diagrams, graphs, and concrete manipulatives. According to Buabeng-Andoh (2012) personal characteristics such as educational level, age, gender, educational experience, experience with computers for educational purpose and attitude towards computers can influence the adoption of a technology.

One of the factors that influence successful integration of ICT into teaching is teachers' perception towards technology. Negative perceptions from teachers are one of the barriers which limit the use of ICT in education (Silviyanti & Yusuf, 2015). Teachers' perceptions are critical to the success or failure of ICT integration in education (Apeanti, 2014). Also, there is a positive correlation between the frequency of ICT use and teachers' attitude towards ICT integration (Mwila, 2018). Again, higher levels of ICT self-efficacy has been shown to be predictive for teachers' choices regarding ICT use and adoption in general (Buabeng-Andoh, 2012). Therefore, teachers' perception, attitude, knowledge and self-efficacy towards technology influence successful integration of ICT into teaching-learning of mathematics. Finally, the conceptual frame of the research was also put forth.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The methodology of this study focuses on the systematic procedures by which the study was conducted to achieve the objectives of the study. This chapter gives a description of the research design, population, sample and sampling technique, variables of the study, research instrument, validity and reliability, data collection procedure, data analysis and ethical considerations followed in this work.

3.2 Research Design

The study was based on cross-sectional survey. This survey design allows for gathering information on perception. The design was employed to gather information on perception of teachers towards ICT integration among Senior High School (SHS) mathematics teachers and the factors that influence its' integration. Lavrakas (2008) opines that cross-sectional data are usually collected from respondents making up the sample within a relatively short time frame (field period). In a cross-sectional study, time is assumed to have random effect that produces only variance, not bias. Creswell (2012) argues that cross-sectional survey design has the advantage of measuring current perception. Cross-sectional survey was preferred as a method of data collection over others in this particular study due to the fact that many questions were asked and it was possible to reach the SHS mathematics teachers within a short period of time (Fowler, 2002). Cross-sectional designs generally use survey techniques to gather data, and they are relatively inexpensive and take up little time to conduct. Cross-sectional study is a collection of data at one point in time. It is carried out to obtain information that exists at that particular time. In addition, quantitative data method was employed in the data collection. This design helped me to collect quantitative data for the study. Therefore the design suits the study on obtaining information on perception of teachers towards integration of ICT in the teaching and learning of Mathematics in the Cape Coast Metropolis.

3.3 Population

The population for this study consists of all mathematics teachers in Senior High Schools in the Cape Coast Metropolis. The target population consists of all mathematics teachers in the eight selected senior high schools in Cape Coast Metropolis of Ghana. However, the accessible population consisted of mathematics teachers in the eight public Senior High Schools (University Practice Senior High School, Wesley Girls High School, Mfantsipim Senior High School, Adisadel College, Holy Child High School, Ghana National College, St. Augustine's College and Aggrey Memorial Senior High School) in the Cape Coast Metropolis. The total population is 136 mathematics teachers in the eight selected senior high schools in the Cape Coast Metropolis of Ghana.

Table 1: Number of Mathematics Teachers in each School

Name of School	No. of Mathematics Teachers
University Practice Senior High School	19
Wesley Girls High School	16
Mfantsipim Senior High School	17
Adisadel College	16
Holy Child High School	15
Ghana National College	17
St. Augustine's College	17
Aggrey Memorial Senior High School	19
Total	**136**

Source: Field Data (2020)

3.4 Sample and Sampling Technique

The sample size was determined from the population using 95% confidence level. Slovin's formula was used to calculate the sample size;

$$n = \frac{N}{1 + Ne^2}$$

Where, $n = Number\ of\ samples$

$e = Error\ tolerence\ (level)$

$N = Total\ population$

Using a population of 136 mathematics teachers and $e = 0.05$

$$n = \frac{136}{1 + 136(0.05)^2} = \frac{136}{1.34} = 101.5 \approx 102$$

Therefore, 102 mathematics teachers were selected as sample size for the study.

The stratified random sampling technique was used to categorised the mathematics teachers according to their already existing schools. And then simple random sampling technique was used to select the mathematics teachers from each school. A sample is then selected from these subgroups and then the sample for the study is thus selected from the stratum. With stratified random sampling each individual is chosen randomly and entirely by chance, such that each individual has the same probability of being chosen at any stage during the sampling process, and each subset of individuals has the same probability of being chosen for the sample as any other subset of individuals (Starnes, 2008). Each member of the population has an equal chance of being selected and the probability of a member of the population being selected is unaffected by the selection of other members of the population. Stratification process was employed in dividing *N* sampling units into say, *S* groups that share a given characteristic. Each group forms what is called a stratum of population size N_S. In this study, the stratums are the schools namely; University Practice Senior High School, Wesley Girls High School, Mfantsipim Senior High School, Adisadel College, Holy Child High School, Ghana National College, St. Augustine's College and Aggrey Memorial Senior High School. The sample size for each stratum is given by;

$$n_S = \frac{nN_S}{N}$$

Where n_S is the sample size of stratum; N_S is the population size of stratum *s*; and n/N is the sampling fraction.

Table 2: Number of Mathematics Teachers Sampled from each School

Name of School	No. of Mathematics Teachers	No. of Teachers Sampled
University Practice Senior High School	19	$\frac{102(19)}{136}$=14
Wesley Girls High School	16	$\frac{102(16)}{136}$=12
Mfantsipim Senior High School	17	$\frac{102(17)}{136}$=13
Adisadel College	16	$\frac{102(16)}{136}$=12
Holy Child High School	15	$\frac{102(15)}{136}$=11
Ghana National College	17	$\frac{102(17)}{136}$=13
St. Augustine's College	17	$\frac{102(17)}{136}$=13
Aggrey Memorial Senior High School	19	$\frac{102(19)}{136}$=14
Total	**136**	**102**

Source: Field Data (2020)

The general procedure for calculating stratified sampling in order to get the required sample from each stratum (school) to represent the entire population is as follows:

Step 1: The population was stratified, defining a number of separate partitions. The researcher categorised the mathematics teachers according to their already existing schools.

Step 2: The proportion of the population lying in each partition (school) was then calculated.

Step 3: The total sample size was split up into the above proportion in Step (2).

Step 4: Sample was taken by simple random sampling from each partition (school) using the sample sizes as defined in Step (3). In simple random sample, subsets of individuals (a sample) are chosen from a larger set (a population). The researcher therefore employed the lottery method of simple random sampling technique in selecting the samples from each stratum.

Step 5: The result from each partition (school) was then combined to obtain the required stratified sample of 102 mathematics teachers.

3.5 Variables of the Study

There are two types of variables used in this study. Independent variables which included teachers' demographic information (sex, age, years of teaching experience and training on ICT integration), teachers' perception, teachers' attitudes, teachers' knowledge and teachers' self-efficacy; while the dependent variable is the teachers' intentions to actually integrate ICT in teaching-learning of mathematics.

3.6 Research Instrument

Questionnaire was used in the study as a data collection instrument. It was made up of 50 items and 6 sections. Section one (A) of the instrument was made up of 4 items requesting demographic information of the respondent. Section two (B) of the questionnaire had 15 items. It inquired information about teachers' perception on ICT integration; section three (C) had 10 items that collected data about teachers' attitudes towards ICT integration. Section four (D) had 14 items that asked for information about teachers' knowledge on ICT tools; section five (E) had 5 items that collected data about teachers' self-efficacy in ICT integration and final section six (F) had 2 items that asked for information on intention to ICT integration. These questions in the questionnaire were close-ended type and 5-point Likert type of scale.

The researcher chose closed ended type and 5-point Likert type of scale questions because they are quite easy to construct, quicker to answer and easier to code and analyse. The appearance and layout of the questionnaire are very important factors and essential in ensuring that relevant data is collected. With the 5-point Likert type of scale questions, the variables were explored to measure the extent of agreement (from 1- strongly disagree to 5- strongly agree) with those statements that come before them. The range of responses available to respondents was from "*strongly disagree*" through "*neutral*" to "*strongly agree*". Another 5-point Likert scale was also employed, where 1– poor, 2– fair, 3– good, 4– very good and 5– excellent.

3.7 Validity and Reliability

The instrument of the study was pre-tested in two schools which did not participate in the actual research. Pretesting of research instrument was conducted on mathematics teachers at Academy of Christ the King High School and Efutu Senior High Technical School in the Cape Coast Metropolis. In conducting the pre-test, 20 copies of questionnaire were distributed to their mathematics teachers. The pre-test was conducted to identify ambiguities in the instructions, clarify the wording of questions, detect omissions or unanticipated answers in the questionnaire, and to determine the internal reliability of the questionnaire. Also, the pre-testing gave response to me on whether the intended study objectives are captured well, any omissions and any need for additional items for adequate information gathering. One of the objectives of pre-testing the research instruments was to measure the reliability and validity.

Instrument validity pertains to the ability to accurately measure what it intends to measure based on objectives of the study. Validity of a research instrument assesses the extent to which the instrument measures what it is designed to measure (Robson, 2011). The instrument was subjected to content validity. Therefore, a drafted copy of the questionnaire was made available to the researcher's supervisor for content validity. The basis of the validity of a questionnaire is to ensure that the right questions are asked without ambiguity. The questionnaire was checked to determine which of the items are suitable and can elicit the intended responses and information. The instrument was acclaimed to meet the content validity.

Reliability is the degree of consistency or accuracy with which an instrument measures an attribute. The researcher checked the reliability of the scale. The reliability of a scale indicates how free it is from random error. According to Drost (2011), reliability is the extent to which measurements are repeatable when different people perform the measurement on different occasion, under different condition, supposedly with alternative instruments which measure the construct or skill. The idea expressed here however is, how consistent it measures its variables or construct? Internal consistency was used to check the reliability of the scale. In internal consistency aspect of reliability, Shuttleworth (2015) recommends an acceptable reliability score of 0.7 and higher. According to Madan and Kensinger (2017) if the coefficients yield above 0.7, are considered acceptable, and coefficients yield above

0.8, are considered very good. Cronbach alpha of 0.74 was achieved, indicating that the questionnaire is reliable.

Table 3: Reliability Test Results

Variable	Cronbach's Alpha	No of Items
Teachers' perceptions	.809	15
Teachers' attitudes	.779	10
Teachers' knowledge	.706	14
Teachers' self-efficacy	.723	5
Intention to ICT integration	.702	2

Source: Pre-test Data (2020)

3.8 Data Collection Procedure

With an introductory letter from the Head, Department of Educational Foundations, University of Education Winneba, permission was sought from authorities of the schools concerned together with the day, time and number of participating teachers required for the research. On the day of the administering of the questionnaire, the researcher briefed the participating teachers about the importance of answering each question independently and truthfully. Administration of the instrument was executed by the researcher in person during normal school hours to ensure adequate co-operation from respondents. The questionnaires were administered to selected respondents in an atmosphere that guaranteed their independence in answering the questions truthfully. The questionnaires were collected after completion from the respondents and verified. On spot collection of the questionnaire was made and the researcher achieved 98.04% retrieval rate. The data collection lasted for six weeks.

3.9 Data Analysis

The data collected was subjected to the following three stages: (1) data coding, (2) data input and cleaning, and (3) data analyses. Descriptive statistics including percentages, means, standard deviations and frequency tables were employed in the analysis. Inferential statistics were also used in the analysis.

Factor Analysis was used to answer research question 1. In addition, Independent samples *t* test and One-way analysis of variance (ANOVA) were used to find the differences between teachers perception to integrate ICT and each of the following four categories of teachers' demographic (sex, age, years of teaching experience and training on ICT) variables.

Analysis of descriptive statistics, Pearson Product Moment Correlation and multiple regression analysis were used to answer research question 2. The variables that were considered in the research question were: teachers' perception, teachers' attitudes, teachers' knowledge and teachers' self-efficacy. These variables; teachers' attitudes, teachers' knowledge and teachers' self-efficacy were used in determining their relationship with the variable, teachers' perception to integrate ICT in their teaching-learning of mathematics.

Pearson Product Moment Correlation was used to answer research question 3. The independents variables that were considered in the research question were: teachers' demographic information (sex, age, years of teaching experience and training on ICT integration), teachers' perception, teachers' attitudes, teachers' knowledge and teachers' self-efficacy. These variables were used in determining their relationship with the dependent variable (teachers' intention to actually integrate ICT in their teaching-learning of mathematics).

3.10 Ethical Consideration

Firstly, an introductory letter was sought from the Department of Educational Foundations to the Senior High Schools for permission to carry out the study. Secondly, the introductory letter from the Department of Educational Foundations together with a proposal was submitted to the selected Schools management to seek for approval before conducting the study at the School facility. Permission to give questionnaires to participating teachers was sought from the headmasters of the Senior High Schools.

Lastly, informed consent was also sought before questionnaires were given out to all participating teachers and hence subjects participated willingly. Participating teachers who refused to give their consent were excluded from the study and those who agreed to participate were assured of their complete anonymity and confidentiality.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results, their interpretations and discussions. The study was based on perception of mathematics teachers on integration of ICT in the teaching and learning of mathematics in the Cape Coast Metropolis

4.2 Demographic Information of Participants

The demographic information of the teachers are considered under this section. This comprises the sex composition, age distribution, years of teaching experience and training on ICT integration in mathematics. This demographic information of mathematics teachers was determined using the first four items found on section A of teachers' questionnaire.

Table 4: Demographic Information of Mathematics Teachers

	Variables	Frequency	Percentages (%)
Sex of teacher	Male	92	92
	Female	8	8
	Total	*100*	*100*
Age of teacher	20-30 years	24	24
	31-40 years	33	33
	41-50 years	29	29
	51-60 years	14	14
	Total	*100*	*100*
Years of experience	1-3 years	16	16
	4-6 years	45	45
	7-10 years	22	22
	11 years and above	17	17
	Total	*100*	*100*
ICT Training	Yes	46	46
	No	54	54
	Total	**100**	**100**

Table 4 represents the demographic information of mathematics teachers. Out of the total 100 mathematics teachers selected, 92 (92%) were males and 8 (8%) were females. This suggests that most of the teachers used in the study were males. Mathematics teachers were grouped into 4 categories depending on their age: teachers aged 20-30 years (24%); teachers aged 31-40 years (33%); teachers aged 41-50 years (29%) and teachers aged 51-60 years (14%). Majority of the mathematics teachers sampled in the study were aged 31-40 years. Moreover, teachers were also categorized into four groups, depending upon their years of teaching experience: teachers with less than 3 years of teaching experience (16%); teachers with 4-6 years of teaching experience (45%); teachers with 7-10 years of teaching experience (22%)

and teachers with 11 years and more years of teaching experience (17%). Majority of the mathematics teachers in the study have taught mathematics for 4-6 years. As to the training on ICT integration in mathematics, 46 (46%) teachers have been trained on ICT integration in mathematics and 54 (54%) teachers have no specific training on ICT integration in teaching-learning of mathematics. These results shows that majority of the teachers had taught for a long period and so they had a wealthy experience on the teacher preparedness in integrating ICT in mathematics classroom.

4.3 Research Question 1

What are mathematics teachers' perceptions towards the use of ICT in teaching and learning of mathematics in the Cape Coast Metropolis? The first research question sought to find out mathematics teachers' perception towards ICT integration in teaching-learning of mathematics taking into consideration the teachers' sex composition, age distribution, years of teaching experience and training on ICT integration in mathematics. This question was answered using the 15 items found on section B of the teachers' questionnaire.

Table 5: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.810
Bartlett's Test of Sphericity	Approx. Chi-Square	1394.534
	df	105.000
	Sig.	.000

The 15 items on teachers' perception on the integration of ICT in teaching-learning of mathematics were subjected to principal components analysis (PCA). Prior to performing PCA the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of .3

and above (see Table B1 in Appendix B). From Table 5, the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy value was .810, exceeding the recommended value of .6 (Tabachnick & Fidell, 2001; Pallant, 2013) and the Bartlett's Test of Sphericity reached statistical significance (p=.000<.05), supporting the factorability of the correlation matrix, therefore factor analysis was appropriate.

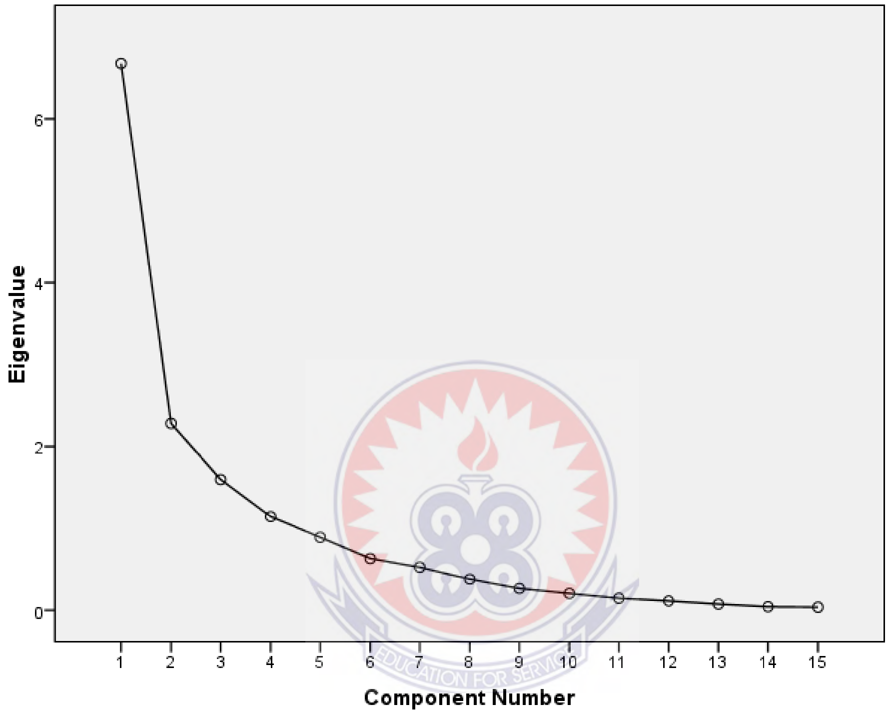

Figure 6: Scree plot of the eigenvalues of the factors

Principal components analysis revealed the presence of four components with eigenvalues exceeding 1, explaining 44.5%, 15.2%, 10.6% and 7.6% of the variance respectively (see Table B2 in Appendix B). An inspection of the screeplot revealed a clear break after the first component as shown in Figure 6. Following this criteria only one component would be picked. The first component explains 44.5% of the total variance, but because this is less than 50%, the researcher probably want to rotate more than one component. Also, a more subjective interpretation of the scree plots suggests that any number of components between 1 and 4 would be plausible and further corroborative evidence would be helpful. The researcher therefore decided to retain 2 components for further investigation.

Table 6: Total Variance explained after Factor Rotation

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	4.598	30.65	30.65
2	4.361	29.07	59.72

Varimax rotation was performed to aid in the interpretation of the two components retained. The two component solution explained a total of 59.72% of the variance, with Component 1 contributing 30.65% and Component 2 contributing 29.07%; as presented in Table 6. As a result, 14 items out of 15 perception items were categorized into two components (see Table B3 in Appendix B). The rotated solution revealed the presence of simple structure with both components showing a number of strong loadings and somewhat overlapping groups of items. The naming of each component is shown as follows: (1) Perception of promoting students learning and (2) Perception of relevance to mathematics teaching.

Testing of hypotheses

Hypotheses testing were done using independent samples t-test and one-way ANOVA. The assumptions for t-test independent and ANOVA were taking into consideration and were based on the following decision rules given a significance level of .05: If the observed p value is greater than .05, do not reject the Null hypothesis. If the observed p value is less than .05, reject the Null hypothesis.

The following hypotheses stated from null hypothesis were tested:

Ho 1: There is no statistically significant difference in perception towards ICT integration in teaching-learning of mathematics between male and female teachers.

Ho 2: There is no statistically significant difference between the perceptions towards ICT integration in teaching-learning of mathematics according to teachers' age groups.

Ho 3: There is no statistically significant difference between the perceptions towards ICT integration in teaching-learning of mathematics according to teachers' years of teaching experience.

Ho 4: There is no statistically significant difference in perception towards ICT integration in teaching-learning of mathematics between teachers trained and not trained on ICT integration.

Hypothesis testing 1:

Ho 1: There is no statistically significant difference in perception towards ICT integration in teaching-learning of mathematics between male and female teachers.

Table 7: Independent Samples t-test on Perception towards ICT Integration by Sex

Sex of teacher	N	Mean	Std. Deviation	*t*	*df*	*p*
Male	92	53.75	4.95	-0.205	98	.838
Female	8	54.13	5.06			

p>.05 (Not significant)

Table 7 presents the independent samples t-test on perception towards ICT integration by sex. The perception mean of female teachers (M=54.13, SD=5.06) was found to be greater than the perception mean of male teachers (M=53.75, SD=4.95).

The preliminary analysis shows that female teachers have more positive perception towards ICT integration in teaching-learning of mathematics than male teachers. From the results of the analysis in Table 7, the Null hypothesis is accepted since the $p > .05$ [$t(98) = -0.205$; $p = .838 > .05$]. Therefore, there is no statistically significant difference in perception towards ICT integration in teaching-learning of mathematics between male and female teachers. This means that there is no difference between teachers' sex and perception towards integration of ICT in teaching and learning of mathematics. The result indicates that the male and female teachers were equivalent in their perception or, to put it differently, that the male and female teachers were similar in their perception. This entails that both male and female teachers perceive ICT as an important part of teaching mathematics.

Hypothesis testing 2:

Ho 2: There is no statistically significant difference between the perceptions towards ICT integration in teaching-learning of mathematics according to teachers' age groups.

Table 8: Teachers' Perception towards ICT Integration by Age

Age of Teacher	N	Mean	Std. Deviation
20-30 years	24	50.13	5.74
31-40 years	33	56.70	3.32
41-50 years	29	54.24	3.45
51-60 years	14	52.21	4.95
Total	**100**	**53.78**	**4.93**

Table 8 presents the teachers' perception towards ICT integration by age. The perception mean of teachers of age 20-30 years is 50.13 of SD 5.74, age 31-40 years is 56.70 of SD 3.32, age 41-50 years is 54.24 of SD 3.45 and for those 51-60 years is

52.21 of SD 4.95. The perception mean of teachers' age 31-40 years (M=56.70) was found to be greater than the perception mean of the other age groups. According to Table 8, teachers' age group 41-50 years (M=54.24) recorded the second highest perception mean followed by teachers' age group 51-60 years (M=52.21) recording the third highest. The teachers' age group 20-30 years recorded the least perception mean (M=50.13). The preliminary analysis shows that older teachers have more positive perception towards ICT integration in teaching-learning of mathematics than younger teachers.

Table 9: ANOVA Table on Perception by Age

	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	424.250	3	141.417	6.853	.000
Within Groups	1980.910	96	20.634		
Total	2405.160	99			

p<.05 level.

Table 9 presents ANOVA summary table on perception towards ICT integration and teachers' age. A one-way ANOVA was conducted to explore the impact of mathematics teachers' age on their perception towards ICT integration in teaching-learning of mathematics. Mathematics teachers were divided into four age groups (age group 20-30, age group 31-40, age group 41-50 and age group 51-60). The one-way ANOVA results displayed that there is a significant difference at the $p<.05$ in perception for the four age groups [F (3, 96) =6.853, p=.000]. The result of the study found a significant difference in perception according to teachers' age. This means different perceptions toward ICT integration in teaching mathematics were reported according to teachers' age group.

Post-hoc comparisons using the Tukey HSD test indicated that the mean for age group 20-30 (M=50.13, SD=5.74) is significantly different from age group 31-40 (M=56.70, SD=3.32) and age group 41-50 (M=54.24, SD=3.45). Again, the mean for age group 31-40 (M=56.70, SD=3.32) is significantly different from age group 20-30 (M=50.13, SD=5.74) and age group 51-60 (M=52.21, SD=4.95). But the mean of age group 41-50 (M=54.24, SD=3.45) did not differ significantly from either age group 31-40 or age group 51-60 (see Table B4 in Appendix B). Multiple comparisons in Table B4 showed that, compared to teachers in age group 20-30, 31-40, 41-50 and 51-60 domain; teachers in 31-40 domain had higher levels of perception in ICT integration in teaching-learning of mathematics. Likewise, teachers in different domains (31-40 and 41-50) did not differ in terms of their perception of ICT integration in teaching and learning of mathematics.

Hypothesis testing 3:

Ho 3: There is no statistically significant difference between the perceptions towards ICT integration in teaching-learning of mathematics according to teachers' years of teaching experience.

Table 10: Teachers' Perception by Years of Teaching Experience

Years of experience	N	Mean	Std. Deviation	Std. Error
1-3 years	16	49.19	5.24	1.31
4-6 years	45	55.13	4.22	0.63
7-10 years	22	54.18	4.26	0.91
11 years and above	17	54.00	5.02	1.22
Total	**100**	**53.78**	**4.93**	**0.49**

Table 10 presents perception of teachers with 1-3 years of teaching experience (M=49.19, SD=5.24), 4-6 years of teaching experience (M=55.13, SD=4.22), 7-10 years of teaching experience (M54.18, SD=4.26) and 11 years and above teaching experience (M=54.00, SD=5.02). The perception mean of teachers' with 4-6 years of teaching experience (M=55.13) was found to be greater than the perception mean of the other three groups. Teachers with 1-3 years of teaching experience recorded the lowest perception mean (M=49.19) among the groups. This means that teachers with more years of teaching experience have more positive perception towards ICT integration in teaching-learning of mathematics than teachers with few years of teaching experience.

Table 11: ANOVA Table on Perception by Years of Teaching Experience

	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	641.898	3	213.966	11.649	.000
Within Groups	1763.262	96	18.367		
Total	2405.160	99			

p<.05 level.

Table 11 presents ANOVA table on perception and teachers' years of teaching experience. A one-way ANOVA was conducted to determine the difference between the perceptions towards ICT integration in teaching-learning of mathematics according to teachers' years of teaching experience. Mathematics teachers were divided into four groups of years of teaching experience (1-3 years, 4-6 years, 7-10 years and 11 years and above). The One-Way ANOVA results displayed in Table 11, revealed that there is a statistically significant difference between teachers' perception [F (3, 96) =11.649; p<.05] according to teachers' years of teaching experience. This means different perceptions toward ICT integration in teaching mathematics were reported according to teachers' years of teaching experience.

For a deeper exploration of the significant means across the categories of teachers' years of teaching experience, Tukey HSD was conducted as a post-hoc test.

Tukey HSD results illustrated that the teachers with 1 through 3 years of teaching experience have significantly less positive perception about integration of ICT in teaching and learning of mathematics (M=2.69, SD=1.10) compared with the teachers of other years of teaching experience categories [4-6 years (M=55.13, SD=4.22); 7-10 years (M=54.18, SD=4.26); 11 years and more (M=54.00, SD=5.02)] (see Table B5 in Appendix B). Multiple comparisons in Table B5 also showed that, teachers in these years of teaching experience groups [4-6 years (M=55.13); 7-10 years (M=54.18); and 11 years and more (M=54.00)] did not differ in terms of their perception of ICT integration in teaching and learning of mathematics.

Hypothesis testing 4:

Ho 4: There is no statistically significant difference in perception towards ICT integration in teaching-learning of mathematics between teachers trained and not trained on ICT integration.

Table 12: Independent Samples t-test on Perception by ICT Training

ICT training	N	Mean	Std. Deviation	*t*	*df*	*p*
Trained on ICT integration	46	57.50	2.56	9.706	98	.000
Not trained on ICT integration	54	50.61	4.19			

Significant at the $p<0.05$ level.

Table 12 presents the independent samples t-test on perception towards ICT integration in teaching-learning of mathematics according to teachers trained and not trained on ICT integration. The perception mean of teachers trained on ICT integration (M=57.50, SD=2.56) was found to be greater than the perception mean of teachers not trained on ICT integration (M=50.61, SD=4.19). This means teachers trained on ICT integration have more positive perception towards ICT integration in teaching-learning of mathematics than teachers not trained on ICT integration. From the results of the analysis in Table 12, the Null hypothesis is rejected since the $p<.05$ [$t(98) = 9.706$; $p=.000 < .05$]. Therefore, there is a statistically significant difference between the perceptions towards ICT integration in teaching-learning of mathematics according to teachers trained and not trained on ICT integration. The result indicates that the teachers trained and not trained on ICT integration have different perceptions towards ICT integration in teaching-learning of mathematics. This entails that teachers trained on ICT integration perceive ICT as an important part of teaching mathematics than teachers not trained on ICT integration.

4.4 Research Question 2

What are the relationships between teachers' perception to integrate ICT in their teaching with teachers' attitudes, knowledge and self-efficacy? The aim of this research question was to establish whether teachers' attitudes, knowledge and self-efficacy have influence on teachers' perception to integrate ICT in their teaching. This question was answered using the 44 items found on section B, section C, section D and section E of the teachers' questionnaire.

Table 13: Mathematics Teachers' Perception on ICT Integration

Statements	Mean	Std. Deviation	Remarks
Use of ICT increases the interest of students towards mathematics	3.84	0.88	Strong agreement
Using ICT is important for good teaching of mathematics	3.02	1.12	Moderate agreement
The use of ICT in learning activities is quite easy and is not troublesome	3.19	1.33	Moderate agreement
Using ICT in teaching mathematics enhances learners' critical thinking	3.55	1.11	Strong agreement
Using ICT in teaching mathematics promote innovation and problem-solving skills of my learners	3.49	1.05	Strong agreement
Using ICT in teaching mathematics enhance collaborative learning among learners and teachers	3.67	1.09	Strong agreement
Using ICT in teaching mathematics promote research-based teaching and learning	3.78	1.06	Strong agreement
The use of ICT can improve the quality of student learning of mathematics	3.84	0.96	Strong agreement
The use of ICT in teaching requires high administrative support and time	3.93	0.93	Strong agreement
Use of ICT can help make difficult topics easy to understand	4.45	0.86	Strong agreement
Use of ICT may speed up syllabus coverage in mathematics	2.83	1.20	Moderate agreement
I feel the use of ICT for instruction would affects my students positively	2.53	1.29	Disagreement
The use of ICT in teaching mathematics can increase students' motivation	3.91	0.99	Strong agreement
Use of ICT enables students to understand mathematics concepts better	3.91	0.84	Strong agreement
The use of ICT can make learning process more effective	3.84	0.87	Strong agreement
Total	**3.56**		

Table 13 presents mathematics teachers perception on ICT integration. The mathematics teachers used a five-point Likert-type scale (i.e. 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree and 1=Strongly Disagree) to rate their level of agreement on 15 perception statements about ICT integration. The perception mean of teachers about ICT integration ranging from 1.00 to 2.80, demonstrate disagreement; the perception mean of teachers ranging from 2.81 to 3.20, demonstrate moderate agreement; and the perception mean of teachers about ICT integration ranging from 3.21 to 5.00, demonstrate strong agreement. Of the 15 perception statements, mean of 11 of them are ranged from 3.49 to 4.45 which indicate strong agreement by the teachers and these are rated as strong positive perception about ICT integration in teaching-learning of mathematics. The teachers demonstrated moderate agreement for three of the perception statements [Using ICT is important for good teaching of mathematics (M=3.02); Use of ICT in learning activities is quite easy and is not troublesome (M=3.19); and Use of ICT may speed up syllabus coverage in mathematics (M=2.83)].

The statement "I feel the use of ICT for instruction would affects my students positively (M=2.53)" is not found as agreement to the perception statement since it's mean is below 2.80 and this demonstrates disagreement by the teachers. The highest perception agreement by the mathematics teachers was the statement "Use of ICT can help make difficult topics easy to understand (M=4.45)". The result of the study shows that most mathematics teachers are in agreement to the perception statements. Therefore, the teachers have high positive overall perception (M=3.56) towards ICT integration. The results of the study shows that mathematics teachers in the Cape Coast Metropolis have positive perception towards integration of ICT in teaching-learning of mathematics.

Table 14: Mathematics Teachers' Attitudes towards ICT Integration

Statements	Mean	Std. Deviation	Remarks
ICT tools are difficult to use in mathematics classroom	3.48	1.49	Strong agreement
The use of the computer in teaching and learning of mathematics stress me out	3.12	1.35	Moderate agreement
Use of ICT in teaching mathematics will make the work of teacher difficult	2.87	1.42	Moderate agreement
The use of ICT in teaching and learning of mathematics scares me	3.05	1.42	Moderate agreement
The use of ICT in teaching mathematics will change the way I teach	3.22	1.43	Strong agreement
Use of ICT in teaching mathematics makes the lessons more interactive	3.58	1.44	Strong agreement
I believe that ICT can really improve my teaching practice in the mathematics classroom	3.98	0.96	Strong agreement
ICT use in mathematics makes it easier to respond to the needs my students	3.15	1.37	Moderate agreement
Engaging with ICT in teaching mathematics makes me feel frustrated	3.60	1.23	Strong agreement
I find the use of ICT in teaching and learning of mathematics a time consuming	3.95	1.09	Strong agreement

Table 14 presents mathematics teachers attitudes towards ICT integration. The mathematics teachers used a five-point Likert-type scale (i.e. 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree and 1=Strongly Disagree) to rate their level of agreement on ten attitudes statements about ICT integration. The mean attitudes of teachers ranging from 1.00 to 2.80 indicates disagreement to the statement; the mean attitudes of teachers ranging from 2.81 to 3.20 indicates moderate agreement to the statement; and the mean attitudes of teachers ranging from 3.21 to 5.00 indicates strong agreement to the statement. Results in Table 14 revealed that out of 10 attitudes statements, the statement which states that "I believe that ICT can really improve my teaching practice in the mathematics classroom" recorded the highest mean of 3.98 and the standard deviation of 0.96. The statement which stated that "I find the use of ICT in teaching and learning of mathematics a time consuming" recorded the second highest mean of 3.95 and the standard deviation of 1.09.

However, all other statements follow with the least of them being "Use of ICT in teaching mathematics will make the work of teacher difficult" recording the mean of 2.87 and the standard deviation of 1.42. The mathematics teachers indicated their level of agreements to positive attitudes statement like; I believe that ICT can really improve my teaching practice in the mathematics classroom (M=3.98, SD=0.96) and Use of ICT in teaching mathematics makes the lessons more interactive (M=3.58, SD=1.44). As can be seen from Table 14, teachers responded well to all the positive statements about attitudes with most of the teachers indicating that ICT can really improve their teaching practice in the mathematics classroom (M=3.98, SD=0.96).

On the negative statements the teachers indicated that; ICT tools are difficult to use in mathematics classroom (M=3.48, SD=1.49), engaging with ICT in teaching mathematics makes them feel frustrated (M=3.60, SD=1.23) and they find the use of ICT in teaching-learning of mathematics a time consuming (M=3.95, SD=1.09). They also indicated their level of moderate agreements to the following attitudes statements: use of the computer in teaching and learning of mathematics stress me out (M=3.12, SD=1.35); use of ICT in teaching mathematics will make the work of teacher difficult (M=2.87, SD=1.42); use of ICT in teaching and learning of mathematics scares them (M=3.05, SD=1.42); and ICT use in mathematics makes it easier to respond to the needs of their students (M=3.15, SD=1.37). The result of the study revealed that the mathematics teachers agreed to more negative attitudes statements than positive attitudes statements. Therefore, it can be said that mathematics teachers have negative attitudes towards the use of ICT in teaching-learning of mathematics.

Table 15: Mathematics Teachers ICT Knowledge

Factors	Mean	Std. Deviation	Remarks
Extent of knowhow in use of Word Processing (e.g. Word)	3.91	0.84	High
Extent of knowhow in use of Spreadsheets (e.g. Excel)	3.84	0.87	High
Extent of knowhow in use of Presentation software (e.g. PowerPoint)	3.84	0.96	High
Extent of knowhow in use of Databases (e.g., Access)	2.78	1.43	Low
Extent of knowhow in use of Email and Internet	3.58	1.44	High
Extent of knowhow in use of Graphics (e.g. Paint, Photoshop)	2.02	0.96	Low
Extent of knowhow in use of Multimedia authoring Software	3.15	1.37	Moderate
Extent of knowhow in use of Concept Mapping (e.g., Kidspiration, Inspiration)	2.40	1.23	Low
Extent of knowhow in use of Webpage authoring software (e.g. Front page)	2.83	1.20	Moderate
Extent of knowhow in use of Programming Language (e.g., Logo, C++)	2.63	1.45	Low
Extent of knowhow in use of Publishing Software (e.g., Publisher)	2.48	1.51	Low
Extent of knowhow in use of Modeling software (e.g., Model it, Stella)	2.16	0.88	Low
Extent of knowhow in use of Projector and Educational CDs	3.91	1.07	High
Extent of knowhow in use of Computer	4.17	0.93	High

Table 15 shows mathematics teachers ICT knowledge. The mathematics teachers used a five-point Likert-type scale (i.e. 5=Excellent, 4=Very good, 3=Good, 2=Fair and 1=Poor) to rate their extent of knowhow on the use of 14 computer tools. The mean score ranging from 1.00 to 2.80 indicates low; the score ranging from 2.81 to 3.20 indicates moderate; and the mean score ranging from 3.21 to 5.00 indicates high extent of knowhow in use of the computer tool. The study showed that most of the teachers perceive themselves as very good to excellent and had high scores in use of computer tools such as Word Processing (M=3.91, SD=0.84), Spreadsheets (M=3.84, SD=0.87), Presentation software (M=3.84, SD=0.96), use of Email and Internet (M=3.58, SD=1.44), use of Projector and Educational CDs (M=3.91, SD=1.07) and use of Computer (M=4.17, SD=0.93). The teachers have good extent of knowledge in some of the minimum standard competencies such as word processing, spreadsheet, operating computers, creating interactive presentations, use of email and internet.

The teachers rated themselves, and had moderate scores in use of computer tools such as Multimedia authoring Software (M=3.15, SD=1.37) and Webpage authoring software (M=2.83, SD=1.20). They also rated themselves, and had low scores in use of computer tools such as Databases (M=2.78, SD=1.43), Graphics (M=2.02, SD=0.96), Concept Mapping (M=2.40, SD=1.23), Programming Language (M=2.63, SD=1.45), Publishing Software (M=2.48, SD=1.51) and Modeling software (M=2.16, SD=.88). The result of the study revealed that the mathematics teachers lack knowledge or competence in the use of some computer tools. The teachers lack some of the minimum standard competencies that must be possessed by teachers such as computer programming, managing databases, use of graphics, use of publishing and modeling software.

Table 16: Mathematics Teachers' Self-efficacy in ICT Integration

Statements	Mean	Std. Deviation	Remarks
I feel confident in my ability and knowledge to use ICT in teaching-learning of mathematics	4.08	0.90	Strong agreement
I feel confident that I can search, evaluate and choose ICT devices that are appropriate to support my teaching-learning of mathematics	4.03	1.05	Strong agreement
I feel confident that I can select appropriate software to use in my teaching of mathematics	3.84	1.07	Strong agreement
I feel confident that I can design technology-enhanced learning activities for my learners	2.42	1.44	Disagreement
I feel confident I can prepare teaching-learning materials for my mathematics class using ICT	3.15	1.37	Moderate agreement
Total	**3.50**		

Table 16 illustrates the responses of mathematics teachers' self-efficacy towards ICT integration. The mathematics teachers used a five-point Likert-type scale (i.e. 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree and 1=Strongly Disagree) to rate their level of agreement on five self-efficacy statements about ICT integration. The self-efficacy mean of teachers ranging from 1.00 to 2.80 indicates disagreement to the statement; the self-efficacy mean of teachers ranging from 2.81 to 3.20 indicates moderate agreement to the statement; and the self-efficacy mean of teachers ranging from 3.21 to 5.00 indicates strong agreement to the statement. The results from the five self-efficacy statements show that majority of the teachers indicated confidence in three items which include; I feel confident in my ability and knowledge to use ICT in teaching-learning of mathematics (M=4.08, SD=0.90), I feel confident that I can search, evaluate and choose ICT devices that are appropriate to support my teaching-learning of mathematics (M=4.03, SD=1.05), and I feel confident that I can select appropriate software to use in my teaching of mathematics (M=3.84, SD=1.07).

From the results, mathematics teachers also indicated lack of confidence in one item which is: I feel confident that I can design technology-enhanced learning activities for my learners (M=2.42, SD=1.44). Also, with only one self-efficacy statement that the teachers indicated moderate agreement for the statement: I feel confident I can prepare teaching-learning materials for my mathematics class using ICT (M=3.15, SD=1.37). In the process of ICT integration, mathematics teachers sampled have strong self-efficacy for teaching with ICT. The result of the study revealed high level of self-efficacy (overall self-efficacy mean=3.50) among mathematics teachers in the Cape Coast Metropolis towards ICT integration in teaching-learning of mathematics.

Table 17: Relationships between Perception versus Attitudes, Knowledge, Self-efficacy

	Teachers' perception		
	Pearson correlation	Sig. (2-tailed)	N
Teachers' attitudes	.517**	.000	100
Teachers' knowledge	.679**	.000	100
Teachers' self-efficacy	.424**	.000	100

Note: **Correlation is significant at the .01 level (2-tailed).

Table 17 shows the relationships between teachers' attitudes, knowledge, self-efficacy and teachers' perception. A Pearson product-moment correlation coefficient was computed to determine the significant relationships between teachers' perception and teachers' variables (attitudes, knowledge and self-efficacy). The result indicated that there is a significant positive correlation between teachers' perception and teachers' attitudes ($r=.517$, $N=100$, $p<.01$). A strong positive relationship exists between teachers' perception and teachers' attitudes to integrate ICT in their teaching-learning process, with high positive attitudes will be associated with high positive perception on ICT integration. The study also revealed a significant positive correlation between teachers' perception of integrating ICT in teaching-learning of mathematics and teachers' knowledge of ICT tools ($r=.679$, $N=100$, $p<.01$). A strong positive relationship was found between teachers' perception and teachers' knowledge, with increase in teachers knowledge will result in high positive perception on ICT integration and vice versa. The study further revealed a significant positive correlation between teachers' perception and teachers' self-efficacy ($r=.424$, $N=100$, $p<.01$). A moderate positive relationship exists between teachers' perception and teachers' self-efficacy. The findings of the study shows that teachers' attitudes, teachers' knowledge and teachers' self-efficacy are all positively correlated with the teachers' perception to ICT integration. This means an increase in positive teachers' attitudes, level of knowledge and teachers' self-efficacy will result in positive perception to ICT integration.

Table 18: Model Summary of Perception Regression Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.716	.513	.497	3.494

Table 18 presents the model summary of the regression analysis performed. The multiple regression analysis model summary was used to test if teachers' attitudes, teachers' knowledge, and teachers' self-efficacy significantly predicted teachers' perception on integration of ICT in the teaching-learning of mathematics. The multiple regression model with all the three predictors explained 51.3% of the variance ($R^2 =.513$, $p < .05$).

Table 19: ANOVA Table depicting the Overall Significance of the Model

Model	Sum of Squares	*df*	Mean Square	*F*	Sig.
Regression	1233.03	3	411.01	33.66	.000
Residual	1172.13	96	12.21		
Total	2405.16	99			

The overall p-value as shown in Table 19 is .000 which implies that the probability of F statistic (33.66) of the overall regression is statistically significant ($F(3, 96) = 33.66$, $p < .001$). The probability value of .000 indicates that the regression model was highly significant in predicting how teacher's attitudes, teachers' knowledge, teachers' self-efficacy influenced teachers' perception towards integration of ICT in teaching-learning of mathematics. The overall model is significant and thus, explains 51.3% of the variance in the mathematics teachers' perception in the use of ICT in teaching and learning of mathematics.

Table 20: Regression Table on Teachers' Perception

Model	Unstandardized Coefficients		Standardized Coefficients	*t*	*p*
	B	Std. Error	Beta		
(Constant)	15.268	4.087		3.735	.000
Teachers' Attitude	0.247	0.094	0.271	2.620	.010
Teachers' Knowledge	0.612	0.089	0.563	6.858	.000
Teachers' Self efficacy	-0.027	0.121	-0.023	-0.224	.823

Table 20 shows the regression table of teachers' perception on integration of ICT. The standard or simultaneous multiple regression analysis was used. In standard or simultaneous multiple regression all the independent (or predictor) variables are entered into the equation simultaneously. In evaluating each of the independent variables, as shown in Table 20 reveals that teachers' attitudes ($p=.010$) and teachers' knowledge ($p=.000$) had significant regression weights, which implies teachers' attitudes and teachers' knowledge are making a unique contribution to the prediction of teachers' perception. Meanwhile, the independent variable teachers' self-efficacy had an insignificant ($p=.823$) regression weight. This means teachers' self-efficacy is not making a significant unique contribution to the prediction of teachers' perception.

The established regression equation by the study was:

$$Y = 15.268 + 0.247X_1 + 0.612X_2$$

Where Y = teachers' perception, X_1= teacher's attitudes, X_2= teachers' knowledge.

From the above regression model, holding teacher's attitudes and teachers' knowledge; teachers' perception on integration of ICT in teaching-learning would be 15.268. The results also show that taking all other independent variables at zero, an increase in teacher's attitudes would lead to a 0.247 increase in teachers' perception. In addition, an increase in teachers' knowledge would lead to a 0.612 increase in teachers' perception. The findings of the study shows that teachers' attitudes and teachers' knowledge significantly predicted teachers' perception on integration of ICT in the teaching-learning of mathematics.

The Beta value was also used to compare the contribution of each independent variable. The largest Beta coefficient is 0.563, which is for teachers' knowledge. The Beta value for teachers' attitudes was lower (0.271), indicating that it made less of a contribution. This means that teachers' knowledge as an independent variable makes the strongest unique contribution to explaining teachers' perception when the variance explained by all other variables in the model is controlled for.

4.5 Research Question 3

What are the relationships between teachers' intention to actually integrate ICT in their teaching with teachers' demographic information (sex, age, years of teaching experience and training on ICT integration), perception, attitudes, knowledge and self-efficacy? This research question attempted to determine the relationship between teachers' intention to actually integrate ICT in their teaching with teachers' demographic information (sex, age, years of teaching experience and training on ICT integration), perception, attitudes, knowledge and self-efficacy. The correlation between teachers' intention to actually integrate ICT with perception, attitudes, knowledge and self-efficacy was first examined. The study further examined the correlation between teachers' intention to actually integrate ICT and teachers' demographic information (sex, age, years of teaching experience and training on ICT integration). This research question was answered using the combination of all items found on the teachers' questionnaire.

Table 21: Correlation between Teachers' Intention versus Teacher Variables

	Intention to actually integrate ICT		
	Pearson correlation	Sig. (2-tailed)	N
Teachers' perception	.484**	.000	86
Teachers' attitudes	.102	.350	86
Teachers' knowledge	.303**	.005	86
Teachers' self-efficacy	.114	.296	86

Note: **Correlation is significant at the .01 level (2-tailed).

Table 21 shows the correlation between teachers' intention to integrate ICT and teacher variables (teachers' perception, teachers' attitudes, teachers' knowledge and teachers' self-efficacy). A Pearson product-moment correlation coefficient was computed to determine the significant relationships between teachers' intention to actually integrate ICT and teacher variables (perception, attitudes, knowledge and self-efficacy). The result indicated that there is a significant positive correlation between teachers' intention to actually integrate ICT and teachers' perception ($r=.484$, $N=86$, $p=.000<.01$). A moderate positive relationship exists between teachers' perception and teachers' intention to actually integrate ICT in their teaching-learning process. This means teachers with positive perception will have the intention to actually integrate ICT in their teaching-learning process.

Again, the result of the study revealed no significant correlation between teachers' intention to actually integrate ICT and teachers' attitudes ($r=.102$, $N=86$, $p=.350>.01$). Therefore, no relationship was found between teachers' intention to actually integrate ICT and teachers' attitudes. The findings of the study also revealed a significant positive correlation between teachers' intention to actually integrate ICT and teachers' knowledge ($r=.303$, $N=86$, $p=.005<.01$). A moderate positive relationship exists between teachers' intention to actually integrate ICT and teachers' knowledge. The result of the study further showed no significant correlation between teachers' intention to actually integrate ICT and teachers' self-efficacy ($r=.114$, $N=86$, $p=.296>.01$). Therefore, the research variables (teachers' perception and teachers' knowledge) positively correlates with teachers' intention to actually integrate ICT in their teaching-learning of mathematics.

Table 22: Correlation between Teachers' Intention versus Demographic Variables

	Intention to actually integrate ICT		
	Pearson correlation	Sig. (2-tailed)	N
Sex of teachers	.142	.191	86
Age of teachers	.487**	.000	86
Years of teaching experience	.411**	.000	86
Training on ICT integration	-.446**	.000	86

Note: **Correlation is significant at the .01 level (2-tailed).

Table 22 presents correlation between teachers' intention to integrate ICT and demographic variables (sex, age, years of teaching experience and ICT training). The relationship between teachers' intention to integrate ICT and demographic variables (sex, age, years of teaching experience and ICT training) was investigated using Pearson product-moment correlation coefficient. The first correlation analysis indicated that there is no significant correlation between teachers' intention to integrate ICT and sex of teacher ($r=.142$, $N=86$ $p>.01$). The study found no relationship between teachers' intention to integrate ICT and sex of teacher. Teachers' age significantly correlated positively ($r=.487$, $N=86$, $p<.01$) with teachers' intention to integrate ICT which presupposes that there is a moderate positive relationship between teachers' age and teachers' intention to integrate ICT.

The findings of the study revealed that years of teaching experience significantly correlated positively ($r=.411$, $N=86$, $p<.01$) with teachers' intention to integrate ICT which presupposes that there is a moderate positive relationship between years of teaching experience and teachers' intention to integrate ICT. This indicates that age of teachers and years of teaching experience have positive influence on teachers' intention to integrate ICT in teaching-learning of mathematics. However, training on ICT integration correlated negatively ($r= -.446$, $N=86$, $p<.01$) with teachers' intention to integrate ICT.

The results of the study revealed that personal characteristics such as age, years of teaching experience, perception and knowledge are positively correlated with teachers' intention to actually integrate ICT in their teaching-learning of mathematics. This indicates that these variables have positive influence on teachers' intention to integrate ICT in teaching-learning of mathematics. However, the study found inverse relationship between training on ICT integration and intention to integrate ICT.

Table 23: Intention to integrate ICT by Teachers' Training on ICT Integration

ICT training	Intention to actually integrate ICT			
	Disagreement		Agreement	
	f	%	f	%
Trained on ICT integration	0	0.0	40	46.5
Not trained on ICT integration	16	18.6	30	34.9
Total	**16**	**18.6**	**70**	**81.4**

Table 23 illustrates intention to integrate ICT according to teachers' training on ICT integration. The findings of the study shows that all mathematics teachers who have had training on ICT integration in teaching-learning of mathematics have the willingness to actually integrate ICT in their teaching. Mathematics teachers who have had training on ICT integration in teaching have the intention to integrate ICT in their teaching.

4.6 Discussion

The result of the study revealed that both male and female teachers have positive perception towards ICT integration. These results are consistent with the findings of Berhane (2012) and Yuan and Lee (2012). Berhane (2012) reported that high school teachers across gender share similar thoughts and perception about the usefulness of ICT in their teaching process. Additionally, Yuan and Lee (2012) in their findings show no gender difference on school teachers' perceptions toward the use of ICT in teaching and learning mathematics.

The result of the study found a significant difference in perception according to teachers' age. This means different perceptions toward ICT integration in teaching mathematics were reported according to teachers' age group. This is consistent with the findings of Berhane (2012). According to Berhane (2012) different perceptions were reported according to teachers' age. The result of the study revealed a significant difference between teachers' perception and years of teaching experience. The findings of the study further revealed that teachers with more years of teaching experience have more positive perception towards ICT integration in teaching-learning of mathematics than teachers with few years of teaching experience. This findings are in line with works of Buabeng-Andoh and Totimeh (2012) who established that teachers with more years of teaching experience seem to use ICT more frequently to transform their teaching.

The finding of the study revealed a significant difference between teachers' perception according to teachers trained and not trained on ICT integration. This meaning that the teachers trained and not trained on ICT integration have different perceptions towards ICT integration in teaching-learning of mathematics. Similar result was found in Qasem and Viswanathappa (2016) that there was a significant difference in teacher perceptions towards integrating ICT, especially in the group who were trained through the blended learning approach.

The results of the study shows that mathematics teachers in the Cape Coast Metropolis have positive perception towards integration of ICT in teaching-learning of mathematics. The results are consistent with Mwendwa (2017) who revealed that the teachers and principals had positive perceptions on ICT integration in their curriculum. The result of the study revealed that the mathematics teachers agreed to more negative attitudes statements than positive attitudes statements. Therefore, it can be said that mathematics teachers have negative attitudes towards the use of ICT in teaching-learning of mathematics. This contradicts previous findings that teachers have positive attitudes towards the use of ICT (Teo, 2008; Sanchez, Marcos & GuanLin, 2012; Ndibalema, 2014; Mustafina, 2016; Mensah, 2017). This result is also in contrast to what Baya'a and Daher (2013) reported. They found positive attitudes towards the integration of ICT in teaching and learning process (Baya'a & Daher, 2013).

The result of the study revealed that the mathematics teachers lack knowledge or competence in the use of some computer tools. According to Inggit (2011) the minimum standard competencies that must be possessed by teachers includes: (1) operating computers; (2) assembling, in-stalling, setting-up, maintaining, and solving problems of personal computers; (3) computer programming; (4) word processing; (5) spreadsheet; (6) managing databases and (7) creating interactive presentations that meet the rules of visual and interpersonal communication. The study revealed that the teachers lack some of the minimum standard competencies that must be possessed by teachers such as computer programming, managing databases, use of graphics, use of publishing and modeling software. The study further revealed that teachers have good extent of knowledge in some of the minimum standard competencies such as word processing, spreadsheet, operating computers, creating interactive presentations, use of email and internet. Also, the result of the study revealed high level of self-efficacy among mathematics teachers in the Cape Coast Metropolis towards ICT integration in teaching-learning of mathematics. This contradicts the findings of Kounenou, Roussos, Yotsidi and Tountopoulou (2015) who revealed low levels of self-efficacy among teachers in use of ICT in teaching practice.

The findings of the study shows that teachers' attitudes, teachers' knowledge and teachers' self-efficacy are all positively correlated with the teachers' perception to ICT integration. This means an increase in positive teachers' attitudes, level of knowledge and teachers' self-efficacy will result in positive perception to ICT integration. The findings confirms the works of Ayub, Bakar, and Ismail (2012), who found that teachers' perception are influenced by their attitudes towards the use of ICT. The findings of the study further showed that teachers' attitudes and teachers' knowledge significantly predicted teachers' perception on integration of ICT in the teaching-learning of mathematics.

The results revealed that there is a significant positive correlation between teachers' intention to actually integrate ICT and teachers' perception. This means teachers with positive perception will have the intention to actually integrate ICT in their teaching-learning process. However this finding agree with the works of Buabeng-Andoh (2012) and Apeanti (2014) who reported a significant positive correlation between the perception of teachers and their willingness to use ICT in their future instructional practice. Their finding indicates that, teachers with positive perception about the effectiveness of ICT integration will be more willing to use ICT in their future instruction than those with negative perception.

Results of the study revealed no significant correlation between teachers' intention to actually integrate ICT and teachers' attitudes. Therefore, no relationship was found between teachers' intention to actually integrate ICT and teachers' attitudes. This result is at variance with Tan & Mishra (2001) and Mwila (2018). Tan and Mishra (2001) opined that teachers' attitudes influence their willingness to use

ICT in teaching and learning. They concluded that teacher's attitudes and use of ICT are directly related. Mwila (2018) also show that there is a positive correlation between the frequency of ICT use and teachers' attitude towards ICT integration. The findings of the study also revealed a significant positive correlation between teachers' intention to actually integrate ICT and teachers' knowledge. The result of the study further showed no significant correlation between teachers' intention to actually integrate ICT and teachers' self-efficacy. This contradicts with works of Higgins (2000) and Teo (2009) who established that teacher's self-efficacy influences teachers' intention to use technology when teaching. Therefore, the research variables (teachers' perception and teachers' knowledge) correlates with teachers' intention to actually integrate ICT in their teaching-learning of mathematics.

The findings of the study revealed that years of teaching experience significantly correlated positively with teachers' intention to integrate ICT which presupposes that there is a moderate positive relationship between years of teaching experience and teachers' intention to integrate ICT. This findings are in line with the findings of Gorder (2008). Gorder (2008) reported that teacher experience is significantly correlated with the actual use of technology. But at variance with the findings of Baek, Jong and Kim (2008). Baek, Jong and Kim (2008) claimed that experienced teachers are less ready to integrate ICT into their teaching.

The findings of the study shows that all mathematics teachers who have had training on ICT integration in teaching-learning of mathematics have the willingness to actually integrate ICT in their teaching. This submission is in agreement with Qasem and Viswanathappa (2016) and Hlasna, Klímova and Poulova (2017). Hlasna, Klímova, and Poulova (2017), they concluded that teachers who have had methodological training in the use of ICT in teaching quest to use ICT in teaching while the opposite is reluctant to use ICT in teaching. Similar result was found in Qasem and Viswanathappa (2016), they concluded that teachers' ability and willingness to integrate ICTs into their teaching is largely dependent on the professional training and development that they receive.

The results of the study revealed that personal characteristics such as age, years of teaching experience, perception and knowledge are positively correlated with teachers' intention to actually integrate ICT in their teaching-learning of mathematics. This indicates that these variables have positive influence on teachers' intention to integrate ICT in teaching-learning of mathematics. However, the study found inverse relationship between training on ICT integration and intention to integrate ICT. Buabeng-Andoh (2012) also found personal characteristics such as educational level, age, gender, educational experience, experience with computers for educational purpose and attitude towards computers can influence the adoption of a technology. Mensah (2017) found inverse relationship between teaching experience and ICT use. Mwila (2018) found a relationship between teachers' gender, age group and attitudes towards ICT use in the teaching process. This result is in line with the previous literatures, Buabeng-Andoh (2012) and Mwila (2018) who also found age of teachers as a positive influence on teachers' intention to integrate ICT in teaching-learning process.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The chapter presents a summary of the findings, conclusions and recommendations as per the research objectives.

5.2 Summary of Findings

The following were the major findings that emerged from the study:

1. The study established that there is no significant difference between the mean perception scores towards ICT integration in teaching-learning of mathematics for male and female teachers [t (98) = -0.205; p=.838 > .05]. Therefore, the study revealed that both male and female teachers have positive perception towards ICT integration. The result of the study found a significant difference in perception according to age of teachers [$F(3, 96)=6.853$, $p=.000$]. The study established a significant difference between teachers' perception and years of teaching experience [$F(3, 96)=11.649$; $p<.05$]. The study further revealed that teachers with more years of teaching experience have more positive perception towards ICT integration in teaching-learning of mathematics than teachers with few years of teaching experience. The finding of the study showed a significant difference between teachers' perception according to teachers trained and not trained on ICT integration [t (98) = 9.706; p=.000 < .05]. The study extracted two component to describe perception of the teachers and it was named as follows: (1) Perception of promoting students learning and (2) Perception of relevance to mathematics teaching.
2. The study revealed that mathematics teachers have positive perception (mean=3.56) towards ICT integration. The study showed that mathematics

teachers have negative attitudes towards the use of ICT in teaching-learning of mathematics. The study also revealed that the mathematics teachers lack knowledge or competence in the use of basic computer tools. The study further established high level of self-efficacy (mean=3.50) among mathematics teachers. The study established that teachers' attitudes, teachers' knowledge and teachers' self-efficacy are all positively correlated with the teachers' perception to ICT integration. The findings of the study further showed that teachers' attitudes and teachers' knowledge significantly predicted teachers' perception on integration of ICT in the teaching-learning of mathematics.

3. The study established that personal characteristics such as age, years of teaching experience, perception and knowledge are positively correlated with teachers' intention to actually integrate ICT in their teaching-learning of mathematics. However, the study found inverse relationship between training on ICT integration and intention to integrate ICT. The study further showed that mathematics teachers who have had training on ICT integration in teaching-learning of mathematics have the intention (willingness) to actually integrate ICT in their teaching.

5.3 Conclusions

On the basis of the findings of this study, the following conclusions are made:

1. Sex of teachers had no significant influence on the perception of teachers towards ICT integration and teachers intentions to actually integrate ICT in teaching-learning of mathematics. There is a significant difference in the perception of teachers' to integrate ICT based on the teachers' age group and years of teaching experience. It was established that teachers with more years

of teaching experience have more positive perception towards ICT integration in teaching-learning of mathematics than teachers with few years of teaching experience.

2. Mathematics teachers have positive perception towards ICT integration, but have negative attitudes towards the integration of ICT in teaching-learning of mathematics. The mathematics teachers also lack knowledge or competence in the use of basic computer tools. The study further established that mathematics teachers have high level of self-efficacy towards ICT integration. Teachers' attitudes and teachers' knowledge were found to be the factors influence teachers' perception on integration of ICT in the teaching-learning of mathematics.
3. The teachers' intentions (willingness) to actually integrate ICT in their teaching largely depended on the age group of the teacher, years of teaching experience, teachers' perception concerning ICT integration and teachers' level of knowledge. Training on ICT integration in teaching-learning of mathematics also influence teachers' intentions (willingness) to actually integrate ICT in their teaching.

5.4 Recommendations

Based on the above findings and conclusions, the following recommendations are made for possible consideration and implementation:

1. Both young and old teachers should be encourage on ICT integration in their teaching and learning process. It is important to motivate and rewarding teachers to integrate ICT in instructional activities.
2. The Ministry of Education and Ghana Education Service to organize seminars/workshop to sensitize teachers on the benefits of integrating ICTs in

education in order to create a positive teacher attitude towards ICT. Schools should play a leading role to implement ICT at the school with self-help initiative. Teachers should show initiative and the school leadership should support and create an enabling teaching-learning environment for teachers and students.

3. Teachers should be given the necessary training in ICT integration so that they become familiar with modern pedagogy of imparting knowledge and skills, and possibly become part of curriculum structure for their professional training. That is, mathematics teachers need to be trained on effective integration of ICT in teaching-learning of mathematics.

5.5 Suggestion for Further Research

This study was done in only selected Senior High Schools in the Cape Coast Metropolis in the Central Region of Ghana; therefore, the researcher is recommending that the scope of the studies should be expanded to other regions in Ghana.

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APPENDIX A: QUESTIONNAIRE FORM

UNIVERSITY OF EDUCATION WINNEBA
DEPARTMENT OF EDUCATIONAL FOUNDATIONS
QUESTIONNAIRE FOR TEACHERS

Dear Teacher,

This questionnaire has been designed to solicit information from mathematics teachers from some selected senior high schools in the Cape Coast Metropolis on the research topic "***Perception of teachers on integration of Information Communication Technology in the teaching and learning of mathematics in the Cape Coast Metropolis***". It is purely for an academic purpose and it is in partial fulfillment of the requirements for the award of Postgraduate Diploma in Education. Please be assured that your responses will be treated confidential.

Please tick √ in the appropriate box where applicable.

SECTION A: Demographic Information

1. What is your sex?
   [ ] Male
   [ ] Female

2. What is your age?
   [ ] 20-30 years
   [ ] 31-40 years
   [ ] 41-50 years
   [ ] 51-60 years

3. What is your years of teaching experience in mathematics.
   [ ] 1 - 3 years
   [ ] 4 - 6 years
   [ ] 7 - 10 years
   [ ] 11 years and above

4. Have you receive any training on integration of ICT in teaching of mathematics?
   [ ] Yes
   [ ] No

SECTION B: Teachers' Perception on ICT Integration

Indicate the extent to which you agree with the following statements regarding teachers' perception on the integration of ICT.

Key: SD – Strongly Disagree D – Disagree N – Neutral A – Agree SA – Strongly Agree

S/N	Statements	SD	D	N	A	SA
5.	Use of ICT increases the interest of students towards mathematics					
6.	Using ICT is important for good teaching of mathematics					
7.	The use of ICT in learning activities is quite easy and is not troublesome					
8.	Using ICT in teaching mathematics enhances learners' critical thinking					
9.	Using ICT in teaching mathematics promote innovation and problem-solving skills of my learners					
10.	Using ICT in teaching mathematics enhance collaborative learning among learners and teachers					
11.	Using ICT in teaching mathematics promote research-based teaching and learning					
12.	The use of ICT can improve the quality of student learning of mathematics					
13.	The use of ICT in teaching requires high administrative support and time					
14.	Use of ICT can help make difficult topics easy to understand					
15.	Use of ICT may speed up syllabus coverage in mathematics					
16.	I feel the use of ICT for instruction would affects my students' positively					
17.	The use of ICT in teaching mathematics can increase students' motivation					
18.	Use of ICT enables students to understand mathematics concepts better					
19.	The use of ICT can make learning process more effective					

SECTION C: Teachers' Attitudes towards ICT Integration

Indicate the extent to which you agree with the following statements regarding teachers' attitudes towards ICT integration.

Key: SD – Strongly Disagree D – Disagree N – Neutral A – Agree SA – Strongly Agree

S/N	Statements	SD	D	N	A	SA
20.	ICT tools are difficult to use in mathematics classroom					
21.	The use of the computer in teaching and learning of mathematics stress me out					
22.	Use of ICT in teaching mathematics will make the work of teacher difficult					
23.	The use of ICT in teaching and learning of mathematics scares me					
24.	The use of ICT in teaching mathematics will change the way I teach					
25.	Use of ICT in teaching mathematics makes the lessons more interactive					
26.	I believe that ICT can really improve my teaching practice in the mathematics classroom					
27.	ICT use in mathematics makes it easier to respond to the needs of my students					
28.	Engaging with ICT in teaching mathematics makes me feel frustrated					
29.	I find the use of ICT in teaching and learning of mathematics a time consuming					

SECTION D: Teachers' Knowledge on ICT Tools

Indicate the extent of your knowledge on the use of the following computer tools.

S/N	Statements	Poor	Fair	Good	Very Good	Excellent
30.	Extent of knowhow in use of Word Processing (e.g. Word)					
31.	Extent of knowhow in use of Spreadsheets (e.g. Excel)					
32.	Extent of knowhow in use of Presentation software (e.g. PowerPoint)					
33.	Extent of knowhow in use of Databases (e.g., Access)					
34.	Extent of knowhow in use of Email and Internet					
35.	Extent of knowhow in use of Graphics (e.g. Paint, Photoshop)					
36.	Extent of knowhow in use of Multimedia authoring Software					
37.	Extent of knowhow in use of Concept Mapping (e.g., Kidspiration, Inspiration)					
38.	Extent of knowhow in use of Webpage authoring software (e.g. Front page)					
39.	Extent of knowhow in use of Programming Language (e.g., Logo, C++)					
40.	Extent of knowhow in use of Publishing Software (e.g., Publisher)					
41.	Extent of knowhow in use of Modeling software (e.g., Model it, Stella)					
42.	Extent of knowhow in use of Projector and Educational CDs					
43.	Extent of knowhow in use of Computer					

SECTION E: Teachers' Self-Efficacy in ICT Integration

Indicate the extent to which you agree with the following statements with regards teachers' self-efficacy in ICT integration.

Key: SD – Strongly Disagree D – Disagree N – Neutral A – Agree SA – Strongly Agree

S/N	Statements	SD	D	N	A	SA
44.	I feel confident in my ability and knowledge to use ICT in teaching-learning of mathematics					
45.	I feel confident that I can search, evaluate and choose ICT devices that are appropriate to support my teaching-learning of mathematics					
46.	I feel confident that I can select appropriate software to use in my teaching of mathematics					
47.	I feel confident that I can design technology-enhanced learning activities for my learners					
48.	I feel confident I can prepare teaching-learning materials for my mathematics class using ICT					

SECTION F: Intention to ICT Integration

49. I have the intention to integrate ICT in teaching mathematics.

[ ] I strongly agree
[ ] I agree
[ ] I do not know
[ ] I disagree
[ ] I strongly disagree

50. I plan to integrate ICT in teaching mathematics.

[ ] I strongly agree
[ ] I agree
[ ] I do not know
[ ] I disagree
[ ] I strongly disagree

APPENDIX B: DATA OUTPUT

Table B1: Correlation Matrix

	TP1	TP2	TP3	TP4	TP5	TP6	TP7	TP8	TP9	TP10	TP11	TP12	TP13	TP14	TP15
TP1	1	-0.46	0.56	-0.49	0.66	-0.47	-0.39	-0.43	-0.28	-0.21	0.47	0.32	0.50	0.88	0.10
TP2	-0.46	1	-0.33	0.27	-0.40	0.32	0.33	0.37	0.19	0.09	-0.93	-0.76	-0.31	-0.42	0.03
TP3	0.56	-0.33	1	-0.53	0.76	-0.51	-0.41	-0.51	-0.18	-0.09	0.34	0.21	0.48	0.51	0.16
TP4	-0.49	0.27	-0.53	1	-0.59	0.94	0.85	0.79	0.47	0.24	-0.32	-0.11	-0.40	-0.44	-0.05
TP5	0.66	-0.40	0.76	-0.59	1	-0.58	-0.48	-0.51	-0.27	-0.09	0.44	0.35	0.58	0.59	0.15
TP6	-0.47	0.32	-0.51	0.94	-0.58	1	0.90	0.82	0.51	0.24	-0.34	-0.13	-0.36	-0.43	-0.02
TP7	-0.39	0.33	-0.41	0.85	-0.48	0.90	1	0.92	0.65	0.31	-0.36	-0.23	-0.29	-0.35	0.03
TP8	-0.43	0.37	-0.51	0.79	-0.51	0.82	0.92	1	0.66	0.41	-0.41	-0.26	-0.32	-0.39	-0.02
TP9	-0.28	0.19	-0.18	0.47	-0.27	0.51	0.65	0.66	1	0.57	-0.17	-0.14	-0.24	-0.29	-0.10
TP10	-0.21	0.09	-0.09	0.24	-0.09	0.24	0.31	0.41	0.57	1	-0.03	-0.02	-0.10	-0.18	-0.06
TP11	0.47	-0.93	0.34	-0.32	0.44	-0.34	-0.36	-0.41	-0.17	-0.03	1	0.78	0.39	0.41	-0.12
TP12	0.32	-0.76	0.21	-0.11	0.35	-0.13	-0.23	-0.26	-0.14	-0.02	0.78	1	0.20	0.28	-0.10
TP13	0.50	-0.31	0.48	-0.40	0.58	-0.36	-0.29	-0.32	-0.24	-0.10	0.39	0.20	1	0.49	0.02
TP14	0.88	-0.42	0.51	-0.44	0.59	-0.43	-0.35	-0.39	-0.29	-0.18	0.41	0.28	0.49	1	0.13
TP15	0.10	0.03	0.16	-0.05	0.15	-0.02	0.03	-0.02	-0.10	-0.06	-0.12	-0.10	0.02	0.13	1

Table B2: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.678	44.520	44.520	6.678	44.520	44.520
2	2.281	15.204	59.724	2.281	15.204	59.724
3	1.594	10.629	70.354	1.594	10.629	70.354
4	1.144	7.624	77.978	1.144	7.624	77.978
5	0.890	5.932	83.910			
6	0.631	4.209	88.119			
7	0.525	3.501	91.619			
8	0.378	2.519	94.138			
9	0.264	1.763	95.901			
10	0.203	1.353	97.253			
11	0.145	0.970	98.223			
12	0.113	0.754	98.977			
13	0.074	0.495	99.472			
14	0.043	0.286	99.758			
15	0.036	0.242	100.000			

Table B3: Rotated Component Matrix

Items	Component 1	Component 2
Use of ICT may speed up syllabus coverage in mathematics	0.903	
Using ICT is important for good teaching of mathematics	-0.876	
I feel the use of ICT for instruction would affects my students' positively	0.792	
Use of ICT increases the interest of students towards mathematics	0.690	-0.366
Using ICT in teaching mathematics promote innovation and problem-solving skills of my learners	0.659	-0.446
Use of ICT enables students to understand mathematics concepts better	0.639	-0.343
The use of ICT in learning activities is quite easy and is not troublesome	0.541	-0.437
The use of ICT in teaching mathematics can increase students' motivation	0.541	
Using ICT in teaching mathematics promote research-based teaching and learning	-0.313	0.848
Using ICT in teaching mathematics enhance collaborative learning among learners and teachers	-0.348	0.839
Using ICT in teaching mathematics enhances learners' critical thinking	-0.338	0.834
The use of ICT can improve the quality of student learning of mathematics	-0.367	0.828
The use of ICT in teaching requires high administrative support and time		0.721
Use of ICT can help make difficult topics easy to understand		0.515
The use of ICT can make learning process more effective		

Table B4: Multiple Comparisons of Perception and Teachers' Age

(I) Age of teacher	(J) Age of teacher	Mean Difference (I-J)	Std. Error	*p*
20-30 years	31-40 years	-6.572*	1.150	0.000
	41-50 years	-4.116*	1.183	0.004
	51-60 years	-2.089	1.441	0.472
31-40 years	20-30 years	6.572*	1.150	0.000
	41-50 years	2.456	1.091	0.117
	51-60 years	4.483*	1.367	0.008
41-50 years	20-30 years	4.116*	1.183	0.004
	31-40 years	-2.456	1.091	0.117
	51-60 years	2.027	1.395	0.470
51-60 years	20-30 years	2.089	1.441	0.472
	31-40 years	-4.483*	1.367	0.008
	41-50 years	-2.027	1.395	0.470

Note: * The mean difference is significant at the $p<.05$ level.

Table B5: Multiple Comparisons of Perception by Years of Teaching Experience

(I) Years of experience	(J) Years of experience	Mean Difference (I-J)	Std. Error	*P*
1-3 years	4-6 years	-5.946*	1.322	0.000
	7-10 years	-4.994*	1.493	0.006
	11 years and above	-4.813*	1.582	0.016
4-6 years	1-3 years	5.946*	1.322	0.000
	7-10 years	0.952	1.182	0.852
	11 years and above	1.133	1.293	0.817
7-10 years	1-3 years	4.994*	1.493	0.006
	4-6 years	-0.952	1.182	0.852
	11 years and above	0.182	1.467	0.999
11 years and above	1-3 years	4.813*	1.582	0.016
	4-6 years	-1.133	1.293	0.817
	7-10 years	-0.182	1.467	0.999

Note: * The mean difference is significant at the p<.05 level.