SURVEY OF AVAILABILITY, ACCESSIBILITY AND READINESS TO USE DIGITAL TECHNOLOGIES FOR TEACHING MATHEMATICS IN SECONDARY SCHOOLS IN MINNA METROPOLIS, NIGER STATE

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ABSTRACT

The study examined the survey on availability, accessibility and readiness to use digital technologies amongst secondary school mathematics teachers in Minna, Metropolis. The study adopted a descriptive survey research design. The target population of the study comprised 251 Mathematics teachers. A sample size of 152 mathematics teachers was selected. Stratified sampling technique was used in selecting the desired sample size from both public and private secondary schools Minna, Metropolis. The instrument used for data collection was Digital Technologies Availability, Accessibility and Readiness to use Questionnaire (DITAARQ). The adopted instrument consists of 42 items. Cronbach Alpha was used to obtain the reliability coefficient of the instrument at 0.76. The data collected was analyzed using the mean, standard deviation and Mann Whitney test. Using Mann Whitney test statistics, the result shows that there was statistically significant difference in the mean scores of mathematics teachers' accessibility to digital technologies for teaching mathematics based on gender. Thus, Male mathematics teachers' have greater mean score over their female mathematics teachers' counterparts. Hence, this shows that the male mathematics teachers' have more access to digital technologies than female mathematics teachers' for teaching mathematics in public secondary schools in Minna Metropolis, Niger state. The study recommended that Public and private secondary schools authorities/administrators should conduct in-service teacher training to enhance digital technologies use among secondary school teachers to meet the standard of education in the 21st century. This will be helpful in an attempt to meet up the standard of education in the 21^{st} century in Niger state secondary schools.

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GLOSSARY

TPACK	Technological Pedagogical content Knowledge
TPK	Technological Pedagogical Knowledge
PCK	Pedagogical Content Knowledge
TCK	Technological content Knowledge
TK	Technological Knowledge
CK	Content Knowledge
PK	Pedagogical Knowledge
DITAARQ	Digital Technology Availability, Accessibility, Readiness to use Questionnaire

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Digital Technologies is making route into every facet of Nigeria, from the market economy, to social life and industrial enterprises as well as the educational sector. It is likewise obvious that for Nigeria to meet its economic vision for 2030, the country needs technology skills development, which is one of the central goals of the education sector (Nwosu *et al*., 2017). Though, the education system is facing challenges, including limited funding to meet the changing technology demands in Nigeria schools (Awofala *et al*., 2020). In spite of these challenges, public and private schools in Nigeria need to integrate digital technologies into teaching and learning process especially in their mathematics classrooms to achieve educational goals in the 21st century in Science, Technology and Mathematics (STM).

Mathematics affects all aspects of human life, regardless of the profession of an individual or the career path, mathematics remains an essential tool that prepares the individual for effective work. Significantly, the study of mathematics has been found to improve the imaginative and cognitive capabilities of the mind of an individual (Etuk and Bello 2016). The desire to improve mathematics performance in schools across Nigeria is a collective responsibility of the teachers, policymakers, federal and state government, administrators, schools owners, and leaders. As a result of this, the Nigerian government is committed toward developing its people and therefore has made mathematics a compulsory subject from primary school to secondary school (FRN, 2014).

The importance of mathematics cannot be over emphasized, as it cuts across all fields of learning such as engineering, medicine, architecture, agriculture and amongst other human professions. Kravitz, (2013), states that mathematics is the one skill everyone needs to master in life. According to him, even if it is the only one, one will at least be able to live without being cheated or abused. In his view, people need mathematics in their everyday lives and cannot survive without it, as just doing the basic essentials is dependent on one's ability to do mathematics.

Despite the relative importance of mathematics, it is very disappointing to note that the academic performance of students in the subject is still low. The West African Examination Council (WAEC) regulated the WASSCE has revealed that only 38.68% to 65.24% of the candidates who sat for the examination obtained a credit pass and above including mathematics (WAEC Head of National Office report, 2015-2020). A cluster of variables has been implicated as responsible for the dismal performance of students. These include, government related variables, and curriculum related variables, examination body related, teacher, student, home and textbook-related variables. A part from these variables, Amazigbo, (2016), has identified poor primary school background in mathematics, lack of incentives for teachers, unqualified teachers in the system, and lack of learner's interest, perception that mathematics is difficult, large classes and psychological fear of the subject as factors responsible for the failure of students' performance in mathematics and teachers' use of traditional method of teaching mathematics in their classrooms.

Teaching is the process of meeting the educational needs of the society through the application of skills, knowledge and attributes desirable of the individuals in the society. To realize the goals of education, choice of learning activities must be properly done so that the teacher who is at the center stage would be properly guided in the implementation of the desired learning experiences. A competent teacher is a lover of knowledge and will always desire to have the development of his students as one of his priorities. According to Imonivwerha *et al.*, (2014) a teacher has to be knowledgeable and should possess mastery of the topic of each lesson and have emotional and psychological competences. There are different teaching techniques today that mathematics teachers' employ to make teaching meaningful. Techniques like problem solving, laboratory method, Heuristic methods and the host of other. These techniques will not yield positive result of teachers' use of digital technology in mathematics, if the teachers are not interested and not ready to teach mathematics through the use of digital technology, particularly the use of computer.

It was observed that, some studies have been conducted on uses of ICTs (technology) by teachers particularly on the issue of their level of readiness, skills, experiences and professional development. Most of these studies were carried out in developed countries where the use of ICTs has come of age, and where there are resources and facilities to maintain them. Though, the use of ICTs by teachers in Nigeria is just beginning to gain popularity and researches in the area have just started emerging. However, the use of ICTs by teachers to teach the students, particularly mathematics is highly advantageous. This is because, it enables them to demonstrate understanding of the opportunities and implications of the uses for learning and teaching in the curriculum context; plan, implement, and manage learning and teaching in open and flexible learning environment (UNESCO, 2014).

Teachers' ability to use technology as a teaching and learning tool is one of the main limitations in education across Nigeria. The inability to effectively use technology to enhance instructional materials aligned to the learning objectives is a challenge when teachers cannot use computers, visual aids, electronic boards, and mobile devices as learning aids (Amanchukwu *et al*. 2015). This is because, the use of computer as instructional tool in any subject, particularly mathematics has made the process of teaching and learning not only enjoyable, interesting and meaningful to the learners and teachers but also, enable them to acquire wide range of skills and experiences in information and computer technology (Falade *et al*., 2016).

Johnson, (2012), stated that, teacher education should include knowledge and understanding of relevant research that can support ICT usage for teaching. Also, the primary goal of teacher technology usage in education is to promote and enhance standard which have numerous advantages in the teaching processes which allows for the production of digital resources such as digital libraries, where students, teachers, and professionals can access study material and course material from anywhere at any time. Therefore, educators at the teaching profession (especially at the secondary level) need to be able to exploit the potential of ICT to meet their teaching standard; teacher technology usage highlighted the need for an overhaul and review of current practices in teacher training to positively impact social change within the education sector, trickling down all other streams of learning (Aja, 2020).

ICT can be seen in the field of education as a collection of technologies for gathering, accessing and dissemination of data for enhanced learning (Miller and Akume, 2009). Johnson, (2012), viewed ICT as the utilisation of digital equipment to all aspects of teaching. The utilisation of ICT for teaching particularly use of computer has made education easier through the application of electronic media, the internet and many others. The various ICT facilities that are available and could be used in education include radio, television, computers, fax machine, VCD machine, scanner, CD Rom, electronic notice board, slides, digital multimedia, video machine, and many others (Johnson, 2012).

Availability is the level of accessible digital technology that can be used in teaching and learning, specifically, of mathematics by secondary school mathematics teachers in their classroom. The quality of education provided by an institute is of great concern and that depends upon the availability of resources. Overall school facilities determine the teaching as well as learning environment. Quality education can only be attained when the educational facilities are properly available, functional and properly utilized. According to Soetan *et al*. (2014), in a study revealed that, the level of availability of digital technology tools used in teaching were available in schools in Ilorin metropolis and were being used by teachers. It has also been noted that, the percentage of computers and cell phone usage were high when compared to others in terms of availability of ICT tools in Ilorin (McKenna, 2019). On the other hand, Fakeye, (2010), also found out in a study in Ibadan that most of the schools covered by the study did not have computers, hence they were not connected to the internet. He also added that, those who had computers did not use them for teaching but solely for administrative purposes. Okwudishu, (2015), states that the unavailability of some ICT components in schools hampers teachers' use of Information Communication Technology (ICTs). In addition, lack of adequate research skills and of access points in the schools were reported as forces inhibiting the use of digital technology tools such as internet by secondary school teachers for the purpose of teaching and learning, specifically mathematics (Adomi & Kpangban, 2010).

Hence, the focus on availability of digital technologies and its use in Nigerian Secondary schools particularly in secondary schools, in Minna, Metropolis to meet the standard of education in the 21st century in teaching and learning of mathematics is vital, for successful integration of digital technologies in the school system depends largely on the level of availability of digital technology tools in teaching and learning mathematics. Additionally, the methods that will be used to deliver digital technologies through the teaching of mathematics with ICT by teachers within their classroom teaching should provide opportunities for them to use the latest technologies they will encounter in school and outside the school.

Accessibility is the ability to reach out to digital technology (computer) in teaching, particularly mathematics while considering the access of digital technology by mathematics teachers. A lot of studies have been conducted and noted that there is disparity in the access to digital technologies between males and females teachers. Hafkin and Taggart, (2012), have noted that, factors which affect the use or non-use of ICTs by men may actually be different from those that affect the use or non-use by women and that it is important to study gender differentials in ICT adoption and use because technology is not gender neutral.

It is the general belief that, female mathematics teachers are lagging behind male mathematics teacher when it comes to the level of accessibility and usage of digital technology to teach in the classroom. Hafkin and Taggart, (2012), identified factors such as literacy and education, language, time, cost, and geographical location of facilities, social and cultural norms, as well as women's computer information and dissemination skills as constraints against women's access to information technology. The role of the ICT, oriented educator is, therefore, to enable teachers to have access to the latest technologies and to give them the experience, skills and training of ICT in a variety of contexts irrespective of gender.

Undoubtedly, teaching of mathematics requires teachers' readiness in terms of their technological knowledge, their training in digital teaching tools, and their digital competence for teaching, but it also needs digital technology infrastructures and resources. According to Almanthari *et al*. (2020), information communication technology (ICT) facilities are a significant mediator in the relation between mathematics teachers' readiness and information communication technology (ICT) application in mathematics teaching and learning. However, Msila, (2015,) affirms that, in general, teachers' received low level of awareness, knowledge of use, perceptions, and attitudes toward their capabilities and skills for technology integration as well as gaining experience in the use of educational technology, leaving the fact that digital technology is playing essential role in the system of education. Therefore, teachers need sufficient skills to integrate technology and to have high confidence level to use it in a classroom setting. Besides, knowledge and skills to use technology to support mathematics teaching, the National Council for Accreditation of Teacher Education (NCATE) emphasized that, teachers must take advantage of technology for instruction and be prepared to use it effectively in their classroom teaching (Afshari *et al*., 2013). In order to be ready to integrate technology into teaching of mathematics, teachers must be provided with a solid foundation of knowledge and skills in digital media and develop new understandings, new approaches, new roles, new forms of professional development, and new attitudes about technology integration (Ruggiero *et al*., 2015). Teachers need to make a paradigm shift in their conception of digital technologies and move from printed traditional instructional tools to digital technologies tools in the teaching of mathematics.

The successful integration of digital technology into mathematics teaching depends heavily on teachers' readiness and willingness to adopt technology (Singh *et al*., 2014). Hence, teachers can integrate digital technology to supplement and support teaching and learning of mathematics, facilitate teachers' work, and encourage student-centred learning (Ertmer *et al*., 2012). To meet these demands, teachers need to acquire all the technical, pedagogical skills and experience that will enable them to integrate digital technology effectively and efficiently into teaching and learning of mathematics.

Beyond basic skill training, technical, pedagogical skills and experience, schools and government have to use a variety of strategies to provide further professional development for teachers. According to Winzenried *et al*. (2010), teachers who have gone through information communication technology course are more effective in teaching by using technology tools as opposed to those that have no experience of such training. A school in Ireland reported that, teachers who did not develop sufficient confidence avoided using information communication technology (ICT). Similar case happened in Canada, some teachers admitted they were reluctant information communication technology (ICT) users because they worried they might get embarrassed that the students knew more about the technology than they did (Hennessy *et al*., 2015).

Research highlighted a complex pattern of interrelated factors that are expected to be determinants of the successful integration of technology in education (Player-Koro, 2012). These factors may facilitate or hinder teachers' use of technology and appear from either the external environment or the personal characteristics of teachers. Buabeng-Andoh (2012), added other factors that hinder teachers from the integration of technology in their classrooms, such as teacher technological skills, teacher confidence, pedagogical teacher training, and insufficient access to information communication technology (ICT), structure of education systems. Moreover, Agbatogun, (2012), states other factors beginning with policy, follows by the supplement of all the information communication technology (ICT) hardware and software facilities and readiness of mathematics teacher to integrate them into pedagogical process.

Therefore, mathematics teachers need to ensure that, they contribute to social change by embracing new initiatives in Nigeria to integrate technology because technology can be a tool to enhance children's learning experience in mathematics (Koehler *et al*., 2012). The focus on mathematics was particularly important because it is considered a gateway to engineering, medicine, and architecture careers, in developing countries, particularly Nigeria. Teachers can improve children's opportunities for socioeconomic well-being when the skills required to succeed are embedded in the mathematics classroom (Aja, 2020).

The role of information communication technology (ICT) mathematics teachers is to enable learners to have access to the latest technologies and to give them the experience of information communication technology (ICT) in a variety of contexts during their lesson activity. The methods used to deliver information communication technology (ICT) by mathematics teachers' should enable learners to embrace information communication technology (ICT) within their teaching and provide opportunities for them to use the technologies they will encounter in school and outside the school. Therefore, using technology effectively is determined by the teachers' attitudes, principles, and views towards technology's benefits (Awofala, 2020; Kola & Sunday, 2015). This study focuses on survey of availability, accessibility and readiness to use digital technologies for teaching mathematics in secondary schools in Minna, Metropolis, Niger State.

1.2 Statement of the Research Problem

The transformation agenda of the Nigeria government placed a premium on education as a vital tool towards the realization of the economic objective for vision 2030. Despite the effort that, been made by Niger state government to equip secondary schools with the most advanced digital technologies tools to substitute traditional tools for teaching and learning process, mathematics teachers' level of availability ,accessibility and readiness to incorporate digital technologies such as computer, projectors, graphic calculator for the purpose of teaching to change the narration of traditional method such as chalkboard and integrate technologies to suit into the 21st century system of education is limited. It appears the curricular orientor of secondary schools' mathematics teachers does not adequately cater for this digital technologies proficiency, thereby, affecting their readiness to use them in their classroom.

In addition, in spite of the benefit of digital technologies, there are several factors hindering mathematics teachers' readiness from integration of digital technology instructional tools into their classroom teaching of mathematics to meet up with standard of education in the 21st century particularly in Nigeria. Buabeng-Andoh, (2012), states factors such as teacher technological skills, teacher confidence, pedagogical teacher training, insufficient access to information communication technology (ICT) and structure of education systems.

Though, the use of digital technologies by mathematics teachers in Niger state, particularly public and private secondary schools is just beginning to gain popularity. Significantly, the use of digital technologies by mathematics teachers to teach the students particularly mathematics is highly advantageous, this is because, the use of digital technologies specifically computer as instructional tool in teaching any subject, particularly mathematics has made the process of teaching and learning not only enjoyable, interesting and meaningful to both learners and teachers but also enable them to acquire wide range of skills and experiences (UNESCO, 2014).

One way to bridge the gap and bring in the teaching of mathematics into 21st century to compete with developed country is by incorporating technology into teaching and learning process as well as providing mathematics teachers with the required skills, knowledge and professional development to use the latest digital instructional tools as a substitute of traditional tools. This will be helpful in and attempt to meet up with the standard of education in the 21st century. This study, therefore, examined the survey of availability, accessibility and readiness to use digital technologies for teaching mathematics in secondary schools in Minna, Metropolis, Niger State.

1.3 Aim and Objectives of the Study

The aim of this study is to find out the survey on availability, accessibility and readiness to use digital technologies for teaching mathematics in secondary schools in Minna, Metropolis, Niger State.

Specifically, the objectives of the study are to**: -**

1. determine the availability of digital technologies for teaching mathematics in public and private secondary schools in Minna Metropolis, Niger State;
2. Find out the mathematics teachers' accessibility to use digital technologies for teaching mathematics in public and private secondary schools in Minna Metropolis, Niger State;
3. Find out the mathematics teachers' readiness to use digital technologies for teaching mathematics in public and private secondary schools in Minna Metropolis, Niger State;
4. find out the level of availability of digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State;

5. determine the level of mathematics teachers' accessibility to use digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State;

6. Find out the level of mathematics teachers' readiness to use digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State;

7. determine the level of mathematics teachers' accessibility to use digital technologies based on gender for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State; and

8. determine the level of mathematics teachers' readiness to use digital technologies based on gender for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State.

1.4 Research Questions

The following research questions were guided the conduct of the study:

1. What is the digital technology available for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State?

2. What is the mathematics teachers' accessibility to use digital technologies for teaching mathematics in public and private secondary schools in Minna Metropolis, Niger State?

3. What is the mathematics teachers' readiness to use digital technologies for teaching mathematics in public and private secondary schools in Minna Metropolis, Niger State?

4. What is the level of availability of digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State?

5. What is the level of mathematics teachers accessibility to digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State?

6. What is the extent of mathematics teachers' readiness to use of digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State?

7. What is the level of mathematics teachers accessibility to digital technologies based on gender for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State?

8. What is the level of teachers' readiness to use digital technologies based on gender for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State?

1.5 Research Hypotheses

The following null research hypotheses were formulated at 0.05 level of significance.

H_{O1}: There is no significant difference in the mean score ranking on the level of availability of digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State.

H_{O2}: There is no significant difference in the mean score ranking on the level of teachers' accessibility of digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State.

H_{O3}: There is no significant difference in the mean score ranking on the level of mathematics teachers' readiness to use digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State.

H_{O4}: There is no significant difference in the mean score ranking on the level of mathematics teachers' accessibility of digital technologies based on gender for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State.

H_{O5}: There is no significant difference in the mean score ranking on the level of mathematics teachers' readiness to use digital technologies based on gender for teaching Mathematics in public secondary schools in Minna Metropolis, Niger State.

1.6 Scope of the Study

The scope of this study is to investigate the availability, accessibility and readiness to use digital technologies amongst mathematics teachers for teaching mathematics in public and private secondary schools in Minna Metropolis, Niger State which covers Bosso and Chanchaga local government area respectively. This study, covered mathematics secondary school teachers in both public and private in Minna Metropolis, Niger State. The focus areas specifically were: availability, accessibility and readiness to mathematics teacher's use of digital technologies for teaching mathematics in Secondary Schools in Minna Metropolis, Niger State. The independent variable of the study was digital technology while the dependent variables are Availability, Accessibility and Readiness. And the study lasted for six (6) weeks.

1.7 Significance of the Study

This research study would be of great benefit to the following groups of people: students, teachers, curriculum planners, parents, and government among others.

The study would be of great significant to teachers by helping them to use a wide variety of instructional tools for their lesson rather than traditional tools. It would also help them to understand and acquire knowledge, skills and professional application on digital technologies tools usage such computer, projector etc in solving problems in teaching and learning specifically of mathematics in their classroom situation. Furthermore, it would make the teachers to become more innovative and less dependents on government, school administrators to purchase teaching resources for them but instead utilize the wide range of local instructional media tools around their environments for effective teaching and learning process. In addition, it would make teachers to realize that most of the teaching and learning resources of mathematics could easily be improvised and that it is significant to involve learners with them. However, teaching technology usage highlighted the need for an overhaul and review of current practices in teacher training to positively impact social change within the education sector, trickling down all other streams of learning (Aja, 2020).

The study would also be significant to students by showing them reality of mathematics through the application of digital technologies tools in learning mathematics at secondary school level. It also allows for increased individualization of learning of mathematics. Moreover, the use of digital technologies such as computer, projectors etc as instructional tools would make mathematics more concrete and real leading to better understanding of mathematical concepts for students. It would also make students to be more innovative, creative and enable them to possess effective communication through the use of digital technologies to meet with the standard of education in the 21st century.

The findings of this study would also be of great importance to government officials in various ministries such as curriculum planners in formulating policies that would assist Nigeria government to meet her goal of being an information communication technology (ICT) compliant nation, through effective allocation of resources. In addition, it would also enable the curriculum planners of Niger State educational system to avail themselves with adequate, qualitative and advanced digital technologies for effective teaching and learning particularly mathematics across secondary schools in Minna Metropolis Niger State which covers both Bosso and Chanchaga local government area respectively.

1.8 Operational Definition of Terms

The terms used in this research study are defined as follows:

Availability: refers to the quantum of digital technology learning resources such as softwares and hardwares used by mathematics teachers for teaching Mathematics in secondary schools in Minna metropolis, Niger State.

Accessibility: refers to the ability of mathematics teachers to fully participate in the use of digital technologies tools such as computer, projectors, internet for the purpose of teaching mathematic in secondary schools in Minna metropolis, Niger State.

Readiness: refers to the level of mathematics teachers' workforce in transition to digitize workflows that are enabled by digital technologies tools such as computer; projector etc to accomplish the goals of teaching mathematics in secondary schools in Minna metropolis, Niger State.

Use: refers to the degree to which mathematics teachers embrace digital tools in the course of carrying out online tasks for teaching mathematics in secondary schools in Minna metropolis, Niger State.

Digital Technologies: refers to electronic tools, systems, devices used by mathematics teachers for generating and process data for teaching mathematics in secondary schools in Minna metropolis, Niger State.

Technology: technology referenced in this study includes laptops, calculators, computers, printers, scanners, interactive whiteboards, projectors, handheld devices such as phones, tablets, or pads and softwares for teaching Mathematics in secondary schools in Minna metropolis, Niger State.

Gender: refers to the social construct of norms, behaviors and roles that varies between male and female mathematics teachers on the use of digital technologies for teaching and learning of mathematics in secondary schools in Minna metropolis, Niger State.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Conceptual Framework

2.1.1 Concept of digital technology

In very broad terms, digital' refers to signals or data that are expressed by the digits 0 and 1, also called bits, which represent words and images. Digital technologies are electronic tools, systems, devices and resources that generate store or process data to achieve a particular set of user-defined results (Wikipedia). Evidence suggests that, technology approaches should be used to supplement other teaching, rather than replace more traditional approaches. It is unlikely that particular technologies bring about changes in learning directly, but some have the potential to enable changes in teaching and learning interactions (Digital Technology, 2015). For example, they can support teachers to provide more effective feedback or use more helpful representations, or they can motivate students to practice more.

In the present existence, the use of digital technologies is comprehensive and they are being extensively used by teachers and students to support teaching and learning in the academic school settings worldwide. The widespread use of digital technologies in the educational system includes computers, laptops, tablets, Smartphone's, mobile phones and among others. The main purpose of digital technologies is to form a connection between the individuals (teachers and learners) rapidly, effortlessly and cost-effectively in the system of education. The individuals get connected to each other with a huge range of digital services and resources within the system of education. There are several benefits of using digital technologies for teaching and learning process, on the other hand, they are accompanied by some challenges as well as risks for both the teachers and the learners. The digital challenges are real and prove to be impediments within the course of attainment of knowledge and information (Digital Technology, 2015). Measures are required to be implemented to overcome the problems and challenges associated with digital technologies.

The three main digital challenges are: cyber-safety, it involves conduct or behavioural concerns. Second is, cyber-crime, it involves illegal activity and the third is cyber-security, it involves unauthorized use of the computer system. The preventive approaches that individuals need to take into consideration, when they are making use of digital technologies include, development of knowledge, skills and abilities for safe and responsible use, individuals should learn how to manage digital technologies in an appropriate manner, development of a pro-social culture and co-operation of the whole community in preventing and responding to the incidents. Online safety of the students in education and other individuals is the main area that needs to be taken into consideration. Digital information is different from its physical counterpart in many ways, it can be rapidly duplicated, distributed in a manageable way and can be stored in various locations (Digital Technology, 2015).

2.1.2 Digital technology in education

The use of digital technology in education is an imperative aspect that has gained prominence. Digital technology is been utilized not only in higher education, but at all levels of education, from nursery to the university level. There have been number of individuals, who feel apprehensive when making use of technology, therefore, it is vital that one should possess adequate skills and abilities when utilising technology. In nursery schools, young students feel interested and develop curiosity when they observe technology. At this level, students are shown various pictures or movies on the internet, they are taught how to draw objects and colour them. As the individuals get enrolled into formal schooling, they learn how to make use of the internet to improve their knowledge and understanding. Gradually a person learns enhanced skills and abilities of how to make use of digital technology and as they grow, they make use of it in order to implement all their tasks and operations in an adequate manner. Technology can be made use of by the individuals in groups and pairs and this is considered as more effective than single usage (Higgins *et al.*, 2012). When individuals are young, they need guidance and assistance, but as a person grows older, he is able to make use of it independently.

Digital technology can be competent and valuable with the main purpose of making improvements within the learning areas (Higgins *et al.*, 2012). For instance, teachers make use of blackboards and write on them with chalks to provide training and instruction to the students. The students, who sit at the back of the classroom face problems in observing and understanding the concepts. In the present existence, there are usage of projectors and computers in classrooms, so that students are able to observe and understand the content in an effectual way. The usage of technology within classrooms has led to an increase in the enrolment of students. They have begun to take pleasure in learning and there has also been a decline in the rate of absenteeism. Remedial and tutorial use of technology can be particularly practical for the lower attainment of pupils. The individuals, who have special needs, for who are experiencing visual or hearing impairments, or those who belong to deprived, marginalized and socio-economically backward sections of the society, for them, technology has contributed to a major extent in the enhancement of learning.

In higher educational institutions, individuals dependent upon technology to a major extent. It is considered as the lifeline of learning. When individuals are working on articles, reports, research papers or research projects, then technology plays an imperative part. Books, journals, magazines and papers are useful, but individuals possess the viewpoint that they can gain access to a large amount of information on the internet. Universities in the present existence have made use of digital technology, so that individuals can have access to large number of e-journals and e-books online. In university education, supervisors normally have busy schedules, therefore, papers and projects can be emailed to them in order to gain immediate feedback. The individuals mostly communicate with their professors and supervisors through email or send them text messages. Digital technology is considered as the sole catalyst to bring about changes and transformations within the teaching-learning processes. It has rendered an efficient contribution in enabling students to improve their grades. The instructors at all levels of education prepare themselves for class lectures, lesson plans, assignments, tests and so forth through the use of digital technology.

2.1.3 Types of digital technology

The various types of digital technologies that have been used on a comprehensive scale and have proved beneficial to the individuals have been stated as follows: (Capaldo *et al.*, 2014).

Search Engines – Search engines and internet are the valuable tools that play an important part in making provision of knowledge and information to the individuals in various ways. In educational institutions and within the organizations, individuals make use of the internet to search for needed information and facilitate their understanding. Individuals in educational institutions often experience difficulties in understanding the concepts; hence, the main advantage of the internet is to provide solutions to the problems and answers to questions. When the instructor gives an assignment to the individuals and they possess limited knowledge, then search engines and internet are regarded as the main aspects that enrich understanding of the individuals.

Technologies used for Special Needs - In special education, there have been usage of technologies to facilitate learning and understanding of academic concepts amongst students with special needs. These software programs provide that when practice is implemented in a stimulating way that acquires the attention of the students. These programs are also advantageous for making the best use of a student's time. Students in educational institutions learn in accordance to the time, hence, these technologies help in making the best use of their time. The students with special needs, such as hearing impairments, visual impairments, autism, and so forth, need technologies in order to facilitate their learning. When students experience these problems, it is the job of the instructor to provide them assistance to acquire understanding of the concepts. To accomplish this purpose, it is vital for the instructors to possess adequate knowledge regarding the concepts and how to make use of technologies.

Digital Camera – The main purpose of digital camera is to take pictures of individuals as well as things. Individuals in the present existence, make use of digital camera for taking pictures of locations, objects, articles, things, other individuals and so forth. In educational institutions and in organizations, digital camera is also considered as an effective type of digital technology. Individuals take pictures of field trips, places, activities, experiments, meetings, presentations, seminars, conferences and so forth. When initiating magazines of past events, it is important to display pictures within them. Pictures are made use of to write books, articles, practice writing skills and to teach sequencing and vocabulary. Pictures enable to generate meaningful and important strategies for learning and communicating.

Microsoft Office: Microsoft office is an operating system, which is used to prepare articles, reports, assignments and projects. In this case, Microsoft word is used to prepare any type of writing assignments, such as articles, research papers, reports, or projects. Microsoft Power-point is used to prepare presentations and Microsoft Excel is used to prepare spreadsheets. The knowledge of Microsoft office in most cases, individuals begin to acquire when they get enrolled in junior school. At the school level, individuals are able to learn in a more effective manner, how they can make use of computers and Microsoft office to prepare their assignments. In higher educational institutions and within the organizations, individuals are able to make more enhanced use of it, to carry out their job duties in an efficient manner.

Smartphone's and Mobile Phones: Smartphone's and mobile phones in the present existence have been useful to the individuals in numerous ways. The first and the foremost function of these devices are to communicate with the other individuals, located nearby as well as at a distance. The individuals are able to communicate with each other through verbal conversation as well as through written texts and messages. They are able to use these devices to search information as well as for leisure and recreational purposes. Another important benefit of these devices is to carry out other day to day functions such as, paying of bills, purchasing groceries and other items, and so forth. They work as cameras that are used for taking pictures and individuals are able to transfer easily from one place to another by following the maps.

3D Printing: 3D printing is an addictive manufacturing technology for making three-dimensional objects of almost any shape using a digital model. The technology is already in use in a number of sectors, most noticeably in prototyping and in various sectors as varied as in the manufacturing of jewellery and aerospace industries and the number of applications is increasing in a rapid way. In particular, the use of graphene as a material for 3D printing would open up the number of items able to be produced in this manner, for example manufacturing entire computers and solar panels (Ten Technologies which would change Our Lives, 2015).

Massive Open Online Courses (MOOCs): There have been changes and transformations coming about in the world of education and in the introduction of MOOCs. These are the educational courses, accessed by the participants through online means, especially through the use of personnel computers. These can be followed by a large number of students simultaneously. Internet is used for open education around the world and in terms of accessing the course that is often available free of charge. The technology is still in an investigation phase and a basic MOOC model has not yet been recognized although the MOOC model has evolved to some extent with x and c MOOCs being produced (Ten Technologies which would change Our Lives, 2015).

Virtual Currencies (Bitcoin): Virtual currencies such as bitcoin are contributing in the expansion of the frontiers of the digital economy. The virtual currencies have gained attention of the individuals to a large extent and this significant technology has made provision of opportunities for policy making. A virtual currency, such as Bitcoin relies instead upon records of communications and businesses to be noted in an anonymous online ledger known as a block-chain. This averts double spending of Bitcoins and eliminates the need for third party substantiation of transactions, a function usually performed by financial institutions, such as banks (Ten Technologies which would change Our Lives, 2015).

Wearable Technologies: The term ‘wearable technology’ applies to a wide range of technologies being used all over the world. Wearable technologies are described in terms of being technical textiles which consists of alternative materials with innovative and beneficial properties such as, being light weight, flexible, heat resilient, etc., and new technologies that have been made to be more multipurpose and can be worn with ease, such as Google Glass or well-designed constituents of present technological systems. The significance of wearable technologies has also been acknowledged by the

European Commission, which is indirectly providing assistance for fundamental enabling technologies, through its Horizon 2020 programme, vital to developing such wearable technologies, such as nanotechnology and micro-electronics (Ten Technologies which would change Our Lives, 2015).

Smart Home Technologies: The Internet of Things (IOT) defines the increased level of connectivity between digital devices within the society, for example smart phones and televisions. These devices and technologies are being made use of in number of homes throughout the world. Smart homes are a practical application of the IoT in the buildings that individuals reside in. Smart Homes consist of a number of electrical devices that are involved in interconnections with each other via an internal network that is also connected to the Internet. Such a house of the future would be built around an intellectual observing and control system that makes provision of the user with larger flexibility in the management of their daily energy and water consumption. Smart homes are usually equipped with multimedia systems that can provide personalized content in each room (Ten Technologies which would change Our Lives, 2015).

2.1.4 Digital technology tools used in classroom teaching

ICTs are potentially dominant tool for extending educational opportunities for secondary students in mathematics classroom. It is a new paradigm of teaching-learning process. There are various ICT tools available which can be utilized for the knowledge creation in the modern world. Tools include Radio, T.V, Internet, Mobile phone calculator , computer, laptop , tablets , data projector , printer , scanner , e-mail and many other hardware and software applications . These devices can be used in imparting education and training for teachers and students. Use of radio for pedagogical practices has been very popular in the past but now students' of secondary level use calculator, computer, laptop and data projector for learning during class time. For online classes they uses laptop and cell phones at any places. These tools of technology typically serve to do and learn mathematics Geometry pad is another mathematical tool which helps the student in learning geometry. This tool also helps the students' in the presentation of geometrical construction, taking measurement and drawing different geometric shapes in an easy manner.

There are various technologies that can be introduced in the mathematics classroom to prepare the current generations of secondary students to improve the effectiveness of education. Some of them are mention below:

i. Visualization: During the last 30 years, Mathematics actively has become more experimental and more visual. Computer is a unique tool that has a potential of enhancing both visual and experimental features. The visual medium is widely used as instrumental resource as students can learn from viewing and interacting with video and television.
ii. Technology of interactive whiteboards, which have the capabilities of connecting immediately to the internet so students and teacher can access information immediately. By connecting the whiteboards to laptop, computer and projector, teacher can also convert freehand writing on the white board into texts and then print it for students.
iii. Vocational training tools: Such as Computer Based Training (CBT), Computer Aided Design (CAD), Power Point Presentation (PPT) etc. In the recent years, the use of power point in Mathematics classroom has significantly increased globally (Corner & Wong, 2014; Bartsch & Cobers, 2013). With the help of power point presentation secondary students' makes himself more comfortable to present any topics of Mathematics in hierarchical fashion with graphics. Secondary students preferred power

point over transparencies and likes the slides with large font sizes and easy to view color contrasts.

iv. Multimedia: Development in computers, communication, electronic and other multimedia tools provide a wide range of information. The animation packages to teach various subjects, speech , music, multimedia networks ,image enhancements ,etc., create virtual realities and experience and learners , which is helpful in making learning a more useful and joyful experience .Virtual Learning Environment (VLE) :VLE is a set of teaching and learning tools designed to enhance a students' learning experience by including computers and Internet in the learning process .Instead of going classroom, teachers and students communicate at a time through an electronic media such as e-mails, web conferencing or video conferencing. Digital equipment's: The digital equipment's like cameras, scanners can be used for information. Digital photographs and recording can be used for electronic and virtual field trips, science experiments and demonstration.

2.1.5 Importance of digital mathematics tools for the development of mathematical skills

i. When exploring mathematical interrelations, in particular through interactive exploration during modeling and problem solving.

ii. By promoting the understanding of mathematical interrelations, not least through a variety of representation options.

iii. With the reduction of schematic processes and the processing of large amounts of data.

iv. By supporting individual preferences and approaches when working on tasks including the reflected use of control options.

2.1.6 Measures to use digital technology in a safe and responsible manner in the school

According to Digital Technology, (2015) state that the measures to ensure the safety and responsible use of digital technology in institutions include:

i. Prevention: The prevention activities that involve digital technology are better than coping with the problems that arise. An effective prevention strategy is comprised of activities, such as, promotional that guide the learning of the young individuals in the digital world and protective, these aim to alleviate the risk by implementation of protecting, support and intervention strategies.

ii. Incident Response: There are occurrences of risks, and to cope up with them in an efficient manner, it is vital to eliminate the risks associated with incidents. The educational institutions develop response plans, before any kind of incident occurs. The main purpose of the incident response is to alleviate distress, and maintain security and protection. Emphasis is put upon the behavior of the individuals and one should maintain the integrity of the digital services.

iii. The legislation and Incident Management: The Education Act 1989 provides to the teachers and the staff members with the power and authority to believe that students have digital information stored in their digital technology or other technology that is imposing unfavourable effects upon the learning environment.

iv. Response Planning: The individuals and the staff members in organizations should identify the roles and responsibilities. When individuals are aware that they have to make use of digital technology for efficiency, assist and make provision of security, then they are able to make effective use of it. In case of any problems or difficult situations, individuals should plan their responses manageably and should not implement any measure in a rapid manner.

v. School's Responsibility and Authority to Act: When instructors or the supervisors are teaching students and other individuals how to make use of technology, they should first of all, communicate to them the notion that technology needs to be made use of in an honest and ethical manner. In the present existence, digital technology is used for leisure and recreational purposes as well, but individuals should possess the traits of morality, truthfulness, honesty and decency.

2.2 Availability of Digital Technology

In the context of this study, availability of digital technology facilities in the Teaching and Learning of mathematics, implies the availability of ICT facilities like computers, projectors, emails, social networking sites, video call, television, CD-ROMs, radio, phone among others for impacting knowledge from teachers to students, and for improving acquired knowledge by students through learning. According to Ngwu (2014), most ICT resources are not adequately available in schools. This therefore implies that, even though teachers are adequately trained and willing to impart the knowledge they have to students, they are blocked from doing so by this lack of technological equipment and laboratory facilities. The growing range of technology devices and resources enhances opportunities that influence the pedagogy and strategies that motivate teachers and students (Sung *et al*., 2016). Further, digital technology improves access to instructional resources for effective communication. These resources are available on student devices, and they stimulate independent learning within and outside the classroom (Blau *et al*., 2016).

2.3 Accessibility of Digital Technology

In the context of this study, accessibility refers to the access to and design of technology used in instruction. This can mean programs, apps, and other materials that teachers can use to access digital content for teaching and learning process. Gone are those days' when teachers purchase textbooks and spend hours making packets of work for students are largely over, today's teachers are expected to access digital resources in order to perform work in their various institutions effectively to meet with the standard of education in the 21st century in Nigeria secondary schools. This includes electronic documents, websites, software, hardware, video, audio, and other digital assets. Teachers who interact with technology are extremely diverse and possess a wide variety of knowledge, skills and competence to use the latest digital tools for teaching and learning particularly of, mathematics.

2.3.1 Gender and mathematics teachers' accessibility to use digital technologies in teaching in secondary schools in Nigeria

According to Hafkin (2012), gender issues in ICT policy fall into two categories. In the first category, there are gender issues that affect nearly all aspects of access, in the broad sense, and use of ICTs. Secondly, there are gender issues in the topics that classically arise in ICT policy. The first category of gender issues that results in differential access and impact of the new technologies on male and female has been articulated in many places and with numerous variations, but the major among them are discussed below.

(a) Physical Access to Infrastructure

Technological infrastructure is a gender issue. At present, a huge gender gap exists in access to communications; infrastructure is concentrated in urban areas, and the bulk of female mathematics teachers live in rural areas (Hafkin, 2012). In developing communications infrastructure, many choices must be made that involve location of facilities, cost and choice of technologies. All of these affect the majority of women, who are poor and living in rural areas in most African countries, to access these facilities. Hafkin (2012) reported that Internet connectivity is frequently available only within capital and major secondary cities in many developing countries, while the majority of the population lives outside these cities. Access to communication facilities is a vital concern that affects female lives. The infrastructural deficit of the rural areas coincides with gender demographics more female teachers live in rural areas than men. Simply by being the majority of the population in rural areas, women have a smaller chance than men to access new technologies.

Females, with their special responsibilities for children and the elderly, find it less easy than men to migrate to towns and cities. The urban bias in connectivity thus deprives female, more than male, of the universal right to communicate (UNIFEM and UNU/TECH, 2015).

(b) Social and Cultural Issues

Hafkin (2012) also reported that female tend to have less access than male to those ICT facilities that do exist. Frequently, rural information centers or cybercafes are located in places that female may not be comfortable frequenting. Since most communications facilities in rural areas are shared public access, women also have problems of time.

Given multiple roles and heavy domestic responsibilities, their leisure hours are few, and the centres may not be open when women (female) can visit them. Or they may be open in the evenings, when it is problematic for women to visit them and return safely to their homes in the dark. Their mobility (both in the sense of access to transport and ability to leave the home) is also more limited than that of men. Some accommodations that may be needed to ensure gender equality in access and use of ICTs are adaptation of schedules to suit women’s hours and availability of women support staff and trainers.

In addition to this, Hafkin (2012) stated that another cultural aspect of gender and ICTs is gender bias in attitudes towards women (female) studying or using information technology. The problem is worse in Africa than in any other regions. Many (predominantly male) math, science and technology teachers in Africa hold outmoded views that females cannot think or work scientifically and that science is too mechanical and technical for females, thus discouraging female students from enrolling in technical courses (Quaisie, 2013).

Attitudes that information technology is not for women are not limited to formal education. In an ICT project for farmers in Cajamarca, Peru, when women undertook information technology training with men, the men mocked them, saying that computers were for men, not women (Puican, 2012). Sometimes collateral cultural factors and other cultural attitudes based in gender bias, and not the immediate gender identification of technology use, which prevent young girls and women from accessing and using ICTs.

In Uganda, girls did not get access to the limited number of computers installed in school because of the socio-cultural norm that “girls do not run” (Gadio, 2014). As a result, boys ran and got to the computers first and refused to give them up to girls. Additionally, the earlier curfew hours for girls at boarding schools further constrained their access to computers. In India, in the well-known “hole in the wall” experiment, the aggressiveness of boys pushing away girls prevented the girls from using the computers (Mitra, 2011).

(c) Education and Skills

These involve literacy, language, computer skills and information literacy. In each case, women in developing countries are less likely than men to have the requisite education and knowledge. Two-thirds of the world’s 876 million illiterates are women, and the number of illiterates is not expected to decrease significantly in the next twenty years (UNIFEM, 2015). Women are also less likely to know the international languages that dominate the World Wide Web. Until two years ago, the Internet was predominantly in English. But in 2002, the percentage fell rapidly to the point where English is no longer the primary language of the majority of Web users. After English, most Web pages are in Chinese, Japanese and German, languages that women in poor countries are unlikely to know. Given their limited access to schooling, women, especially those in rural areas, are also much less likely than men to have computer skills. Information literacy essentially involves using information contextually, a skill that women are less likely than men to have (Morgan, *et. al.,* 2014). This generally results from the limited exposure and isolation of many women in developing countries, particularly those living in rural areas.

(d) Financial Resources

Almost all communication facilities cost money. Women are less likely than men to own radios and televisions, or to access them when they want to, in the case of household possession of the technology. When it involves paying for information access, such as at a rural information Centre or a cyber cafe, women are either less likely to have the disposable income to do so, or hesitate to use family food, education and clothing resources for information. According to Hafkin (2012), there are gender issues in the way that ICTs are used in developing countries. To date, most women’s use of ICTs has been confined to email and sometimes to lusters (email discussion lists), generally in connection with advocacy and networking activities. The main reasons for this concentration are cost of access and limitations of time, bandwidth and technical skills.

To date, few women have used it for business, entertainment (the predominant use in the developed world) or education, including education in matters related to livelihood and well-being of themselves and their families (e.g. health and nutrition education). A number of the factors above fall into the category of financial and educational deficits in accessing and using ICTs.

2.3.2 Gender and teachers' accessibility to use digital technologies in teaching in secondary schools in Africa

Research shows that there are disparities in education between genders, especially in Africa where more emphasis is put to boy-child than girl-child. EFA Global Monitoring Report (2012) indicates that girls face large obstacles to entering school than boys. Data collected showed that majority 150 (68.2%) of respondents were males while 70 (31.8%) were females. This indicated that most of school leaders and ICT/curriculum teachers in schools in Kenya were men. Further it revealed that most of teachers who were involved in ICT in schools were males than females. Jimoyiannis and Komis (2017) states that male teachers are more positive about ICT in school while female teachers are neutral or negative.

African nations need to make significant academic progress to compete on global level. Since declaring its independence from the United Kingdom in 1960, Nigeria has struggled to create an academically sound education system (Adedokun, 2016). Therefore, Nigeria must improve student learning to impact social change positively (Aja, 2020). Focusing on positive social change in the education sector in Nigeria is justified because of the need to address poverty, wide gaps in the socioeconomic status, out-of-school children, population increase, and social cohesion (Aja *et al.*, 2020). But the lack of technology has continued to stifle academic achievement recognizing the impact technology has had in the 21st century, this study focused on an aspect of technology integration that can positively influence social change.

2.4 Digital Technology Readiness

Undoubtedly, use of digital technology tools requires teachers' readiness in terms of their technological knowledge, their training in digital teaching tools, and their digital competence for teaching. According to Carlson and Gadi (2013) teachers' acceptance of technology is absolutely essential if technology provided to schools is to be used effectively. Simply put, it would be a sheer waste spending resources equipping schools with computer hardware and software without taking into account whether teachers' are comfortable using computers in schools. Studies carried out around the world in developed, industrialized and information based countries showed that teachers' use application of technology is the key determining factor for improved student performance in knowledge acquisition and skills development enabled by technology (North Central Regional Educational Laboratory, 2012).Despite the importance that information and communications technology (ICT) acquired in the teaching and learning of mathematics in the last quarter of the 20th century, the challenges for teachers in the 21st century are exponentially increasing. Today, teachers must face a generation of students who were born in a digital world, being users of different devices and having access to the Internet since their early childhood Sánchez *et al*., (2020).

Thus, it is obvious that computers cannot replace teachers since teachers are the key to whether technology is used appropriately and effectively. Even if there are students who could learn independently how to use digital technology to enhance their learning and skills development, with little or no improvement from their teachers, they are highly unlikely to improve since teachers remain the gatekeepers for students' access to educational opportunities afforded by technology (Stryker, 2012).Therefore, it is significant for teachers to be computer literate, and be ready to integrate digital technology in schools for further academic purposes.

However, many attempts have been made to gain insight on the adoption of computer by secondary school teachers (Faw *et al*., 2015). Gibbons and Fair weather, (2010) state that generally teachers use computers not just for the process of teaching and learning but also for a number of other reasons, though they may deem to be job-related. In addition, Martin and Ofori-Attah (2015) identified that the AUC by teachers are divided into three main components namely, for teaching purposes, administration purposes, and personal purposes. In terms of teaching and learning, the actual usage of computer by the teachers in classrooms is mainly to impart knowledge, create variety, and to give them the confidence in the process of teaching and learning (George *et al*., 2010). Besides, Martin and Ofori-Attah (2015) state that teachers also use the computer to ease their administrative works especially in preparation of job-related materials and to ensure the safe-keepings of data and information about students.

There have been many studies that were implemented to identify factors that facilitate or prohibit computer usage among teachers (Mumtaz, 2011). Based on the prominent models of digital technology usage, there are a number of personal, behavioral, and environmental factors that influence a teacher's use of technology and this could be classified as the technology acceptance constructs (Hu *et al.*, 2013). Personal and behavioral factors that have been identified frequently are attitude, perceived ease of use, perceived usefulness, self-efficacy, and computer compatibility. On the other hand, the environmental factors of subjective norm and job relevance too may contribute to or inhibit teachers' performance in using computers (Dusick, 2010).

2.5 History of Tools and Technology

Technology in mathematics education to refer almost exclusively to use of electronic devices. However, since the first elementary school teacher rolled the first television set into the first classroom to air the first course offerings from "educational television," there's been the hope and the promise that technology would revolutionize the way teaching and learning would be done (Guin, & Trouche, 2011)

Technology can be classified into two primary groups namely:

- **General-purpose tools**: refer to those of wide importance in many walks of life outside classrooms but Put to special use in an educational setting.
- **Specialized technologies**: in contrast, are most likely to be encountered in technical work such as science or engineering. Some of these have been explicitly developed for teaching mathematics and have been largely confined there.

2.5.1 General-purpose technologies used in mathematics education

The Overhead Projector

A more recent classroom display technology is the overhead projector. Its earliest manifestations seem to have been related to education but not in school classrooms: public nineteenth-century science lecturers seeking added visual air. Such use began to enter schools in the early twentieth century, as part of a wider movement for "visual education" that included photographic slides and filmstrips. About the same time, this technology also received a boost from a no educational venue, the bowling alley, where it was used as a convenient way to project scores for bowlers to view. Overhead projectors then received substantial use by the US military during World War II for training purposes, probably contributing to a major expansion of school use in the postwar years (Kidwell *et al*., 2018).

Much more than the blackboard, this technology as used in schools has remained the exclusive domain of the teacher. It has two primary attractions. First, it allows the teacher to continue to face the students while displaying materials to them. Second, it allows the teacher to display elaborate transparencies created before class. For example, a teacher of solid geometry can prepare or purchase complicated diagrams of an exactitude that could never be hoped for in hand-drawn diagrams quickly improvised while watched by the students. There is however a drawback, in that reliance on prepared slides can encourage a too rapid succession of material that can overload the students' ability to assimilate the information presented.

Overhead projectors have continued in use to the present but in many cases have been superseded by new technologies allowing greater ease of use and a greater range of display functionality. Computer projection systems permit the display of any image, static or moving, available to the host computer and in particular allow slide shows formerly done via transparencies on an overhead projector to be accomplished via software such as PowerPoint. Another enhancement of the overhead projector is the document camera (also known as an image presenter or visualizer), which permits any document, or even a three-dimensional object, to be displayed on the overhead screen without any prior preparation of the document or object (Ash, 2018).

Many classrooms in the twenty-first century provide not only a computer and projector for the teacher but also a computer for each student, networked with the teacher's computer. In some ways this is a return of the handheld slate, with a vast increase in functionality. Its potential for mathematics instruction is just being tapped.

The Computer

Like the book, this tool's wider societal uses are enormous. It has now established itself in mathematics education throughout the world, although its ultimate role is perhaps not yet clear. It can be argued that much educational use of computers is trivial compared to the full capabilities of the technology. For example, many students today can read textbooks on a computer screen, but this is surely not a profound capability. Probably the most common use of computers in elementary instruction is to provide instant feedback to students working on problems. This is undoubtedly an increase in convenience that might amaze earlier generations of students and teachers, but in principle it is no different from looking up the answer in the back of the book. Unlike the book, the advent of computers in education is not lost in the mist of time and indeed is still within living memory.

The original "main-frame" computers, developed during and just after World War II, were too expensive, too bulky, and required too much maintenance to have much attraction for educators. It was only in the 1960s, with time-sharing systems and with so-called minicomputers that there began to be any appreciable use of computers in education. It was now possible for several students to simultaneously interact with the same computer. A pioneering instance was the University of Illinois's Project PLATO (Programmed Logic for Automatic Teaching Operations) (Bitzer *et al.*, 2013). This was built upon earlier, nonelectric, "programmed" learning efforts which had become popular beginning in the 1950s. Programmed learning experiments, much of which were inspired by the work of B. F. Skinner and other psychologists, featured ordered sets of problems which the student was asked to work through (Bitzer *et al.*, 2013). The student's passage through the problems depended on whether the student gave correct or incorrect answers at each step; a student might be asked to cycle back through some material or else move on briskly to new topics. This could be accomplished merely with a book, by covering up the answers. Computers allowed this to be done more easily and with more flexibility. As already noted, this basic functionality continues to be one of the most widely used applications of computers in mathematics education.

A different tactic for computer use in education was explored at Dartmouth College, again beginning in the 1960s. Here the aim was to have undergraduates program the computer themselves, thus learning the fundamental logical principles behind the machines. They succeeded in making computer programming a feature not only of mathematics classes but of other classes where mathematics was applied, including business and the social sciences. A key piece in achieving this was the development by Dartmouth professors John Kemeny and Thomas Kurtz of the BASIC computer language, which subsequently spread worldwide among novice and expert computer users alike. Ultimately one major effect of the Dartmouth work, and other similarly oriented projects throughout the world, was that computer science branched off from mathematics as a separate academic discipline at the college and university level (Kemeny & Kurtz, 2012).

The emergence of the microcomputer, or personal computer, in the 1970s and 1980s, gave further impetus to educational use of computers, especially below the college level. For the first time computers became a home appliance, which made school use much more comfortable for both students and teachers. Computer games, some with an educational component, such as *Lemonade,* for the Apple II personal computer, began to proliferate (Apple, 2015). And now that the crude teletype terminals of earlier days were being replaced by video display screens, it was possible to generate much more elaborate graphics, with obvious application in geometry instruction. *Geometer's Sketchpad* and *Cabri-géomètre*are two examples of computer programs taking advantage of these capabilities (DeTurck, 2013). Statistical software such as *Minitab* and algebra software such as *Derive* also came on the market in the 1980s (Chonacky &

Winch, 2015). Large software packages incorporating a full range of algebraic capabilities, together with sophisticated graphics, included *Maple* and *Mathematical* (Chonacky & Winch, 2015). Such software has raised as yet unanswered questions about the content and methods of mathematics instruction.

Even general-purpose software such as Microsoft *Excel* offers extensive mathematical capability which potentially could totally reshape the mathematics curriculum. It must be noted, however, that computer use in mathematics classrooms varies greatly worldwide. The cost of purchasing and maintaining computers, together with training instructors to use them effectively, remains a significant obstacle in many places, especially compared with the older technology, the book.

2.5.2 Specialized Technologies Used in Mathematics Education

In addition to general-purpose tools, mathematics education has made use of specialized tools. Some of these have originated outside education, especially in commerce, science, and engineering. Others have originated within education and then moved outside. A few are essentially unique to mathematics education. We classify them here into three broad categories: tools for calculation, tools for drawing and display, and tools for physical manipulation.

Calculating Tools

Calculation is an activity that many in the general public consider synonymous with mathematics, to the distress of many mathematicians and mathematics educators. Of course there can be little doubt that the historical roots of much mathematics are found in the practical need for calculation, and consequently calculation has been a central justification for mathematics education since antiquity. In general, physical tools for calculation have first received extensive use outside the classroom, in realms where speed and efficiency are more pressing issues, before becoming an accepted part of standard school instruction. The slide rule, for example, was a tool of practicing engineers for decades before it was seriously taught in schools. Possibly the abacus, as used in Asia, is an exception to this trajectory. No physical calculating device has been a part of mathematics instruction in the West in the manner, or for the long duration, that the abacus has been part of such instruction in Asia.

The Abacus

The abacus depicts numbers by means of beads on wires. It apparently evolved from marks in sand or counters on a board. The device seems to have developed somewhere in the eastern Mediterranean world in antiquity, moved east to Asia, then moved back west via Russia into Europe and thence to the Americas. The transmission to Asia is conjectural, and it is possible that it originated there independently. What is clear is that whereas the abacus became a widely used tool of calculation in China and Japan, without serious competitor until very recent times, it never attained the same level of popularity in this role in Europe and North America. Instead, in the latter regions, it was primarily confined to use as a demonstration tool for teaching elementary arithmetic to young children.

The abacus has been part of education in both nations for centuries, and the device has continued to be part of mathematics instruction in many East Asian nations to the present day, although not without some controversy and competition from newer technology. In Malaysia, for example, although abacus use in schools declined for a time after handheld calculators became widely available, the abacus (*sempoa*in Malay) has more recently experienced an educational resurgence in connection with an increased emphasis on mental arithmetic (China Daily, 2010).

The Calculator

Unlike the slide rule, the calculator is fundamentally a digital instrument, which seems to have given it a decided advantage in achieving a place in mathematics instruction. Its place in the classroom is still in an experimental stage. European development of mechanical calculators dates from the seventeenth century, with such notable mathematicians as Pascal and Leibniz prominently involved (Aldon, 2010). But it was not until the middle of the nineteenth century that industrial processes were sufficiently advanced to allow construction of calculating devices on a commercial basis, both in Europe and the United States. By the 1920s they had become a standard feature of many office settings.

Was not until after the World War II that they received digital calculator much consideration as educational assistants. In the 1950s, there was some minor experimentation in classrooms with mechanical calculators, or mechanical calculators with electrical assistance, but the size and cost of these machines made them inconvenient as personal devices (Kidwell *et al*., 2018).

The major breakthrough occurred in the 1970s, with the arrival of inexpensive, fully electronic calculators. Initially these calculators were still relatively bulky and were able to perform little beyond the familiar four operations of arithmetic. But by the 1980s calculators had become readily portable and were able to compute trigonometric and other transcendental functions and to display graphs, thus far surpassing the functionality of mechanical calculators and slide rules. Classroom use became practical and although very uneven, soon became widespread enough to create disputes between enthusiasts and detractors. Calculators greatly increased the range of feasible problems that could be given to students, but concern was expressed about the effect on basic arithmetic skills, and doubts were raised about the readiness of teachers to use calculators effectively (Aldon, 2010). By the mid-1990s computer algebra systems (CAS) were available on handheld devices, leading to further debate. Now, in the twenty-first century, although the generic name persists, high-end devices referred to as "calculators" in fact provide a huge range of information storage, information display, and demonstration capabilities, in addition to pure calculation (Aldon, 2010). Some controversy has persisted, but in recent years the use of calculators has been increasing around the world in secondary and elementary schools and at the college level as well.

2.6 Benefits of Digital Technology Integration

The benefits of technology integration in the classroom include having a positive impact on students attitude and motivation. The research implies that technology empowers teachers with relevant skills to promote an enriching learning environment (Carver, 2016). Integration of technology in the classroom provides an opportunity for independent and personalized learning. Technology use also promotes collaboration, group discussions, and professional development for teachers, including how to better motivate and engage learners (Carver, 2016). Technology use allows learning to occur beyond the classroom and brings the world into the learning space. Better technology use in the classroom also creates opportunities for assessing and measuring progress through varied assessments (Sung *et al*., 2016).

The advent of technology integration promoted the need to design the ICT curriculum to equip children with the skills to use technology as a learning resource. This system's use improves students' 21st-century skills and supports the enhancement of knowledge (Ameen *et al*., 2019). The need to engage learners and develop the skills for life-long learning becomes embedded in their educational experiences in mathematics is vital. With the use of technology, mathematics becomes easier and more accessible. Technology integration can promote active learning in the mathematics classroom and enhance creativity and equality in learning opportunities. Research also shows teachers who effectively use technology in the mathematics classroom provide timely formative feedback (Awofala, 2020). Therefore, if schools aspire to promote an in-depth learning experience for learners, the leaders and administrators need to support and promote a positive learning environment that integrates technology (Amanchukwu, *et al.*, 2015). When looking at technology integration in Nigeria, there is some evidence of a positive impact on mathematics (Aja, ,2020). The employment of capable and skilled teachers allows students to use a range of interesting and engaging instructional resources in the classroom to raise achievement (Suleiman *et al.*, 2020). However, evidence from three different countries in Africa, namely, South Africa, Kenya, and Nigeria, suggests that there are common challenges when integrating technology in schools. These challenges include inadequate educational funding, poor infrastructure, limited technology integration, and the socioeconomic impact on children (Mereku *et al.*, 2015).

2.7 Limitations of Digital Technology Integration

It is essential to evaluate teachers' challenges using technology to focus on the implementation, accessibility, and PK. Teachers support the notion that technology integration increases achievement because of engagement and interest. However, it does not develop the Bloom's Taxonomy higher-order skills necessary for lifelong learning (Carver, 2016). Teachers' use of technology and comfort with technology is vital if its integration into schools is expected to improve student participation (Rathore & Sonawat, 2015). Therefore, managing technological challenges requires that school leaders understand the benefits of technology in the classroom. Technology must be fully integrated into teacher training programs to fully capitalize on the positive impact on student achievement (Carver, 2016; Junaid & Maka, 2015).

In Nigeria, technology has been deployed to higher institutions of learning across the country; however, there are limited studies that focus on its availability, accessibility and readiness in teaching and learning in secondary schools (Etuk & Bello, 2016; Kalagbor, 2016). The justification for the limited studies is that technology integration is still at the preliminary stages of implementation. Infrastructural challenges such as lack of electricity and basic amenities, including water, roads, educational funding, teacher empowerment, and other resources, are recognized as areas that impact technology integration in Kenya, Nigeria, and South Africa (Howard *et al*., 2015; Mereku & Mereku, 2015; Msila, 2015). With these contextual challenges, there is evidence that technology integration will become an area for further research when measuring availability, accessibility and readiness of teachers on technology usage in Nigeria.

It is therefore essential to implement technology strategies in Nigeria, which then positively impacts social change in the country (Willermark, 2017; Ozili, 2020). When teachers understand technology integration, they are more likely to embed the technology in teaching and learning to transform the students' learning experiences. Though, in the past 10 years, there have been technological innovations in a mathematics curriculum that have benefitted students (Bicer & Capraro, 2017; Kaleli-Yilmaz, 2015; Shittu *et al.*, 2018). Therefore, qualified teachers must teach and engage students with these tools (Rordin *et al*., 2016). Placing computers and other technological devices in the classroom has little influence unless teachers embrace technology and use it effectively (Dele-Ajayi *et al*., 2019).

2.8 Theoretical Framework

Numerous theories have been identified in relations to digital technologies integration but this research is concerned with the theory that bears relevance to the study. This theory is as follows:

2.8.1 Technology pedagogical content knowledge theory (TPACK)

This theory was developed by (Mishra and Koehler, 2018). It is a framework developed to explain a variety of knowledge bases required by teachers to effectively teach students the course content using technology (Koehler, 2012). Though use of technological, pedagogical, and content knowledge (TPACK) was a practical framework to examine how teachers were integrating technology in the classroom (Mishra and Koehler, 2018). Teachers' effective use of technology can be divided into three primary domains using the TPACK framework: CK, PK, and TK. These domains' combinations are broken down further into four additional knowledge bases PCK, TCK, TPK and the aggregate of all three, TPACK. The rationale for selecting the TPACK model was that it is most appropriate when divided into constructs that show the effects of teachers' use of technology. Technology Pedagogical Content Knowledge is depicted in figure 1 below.

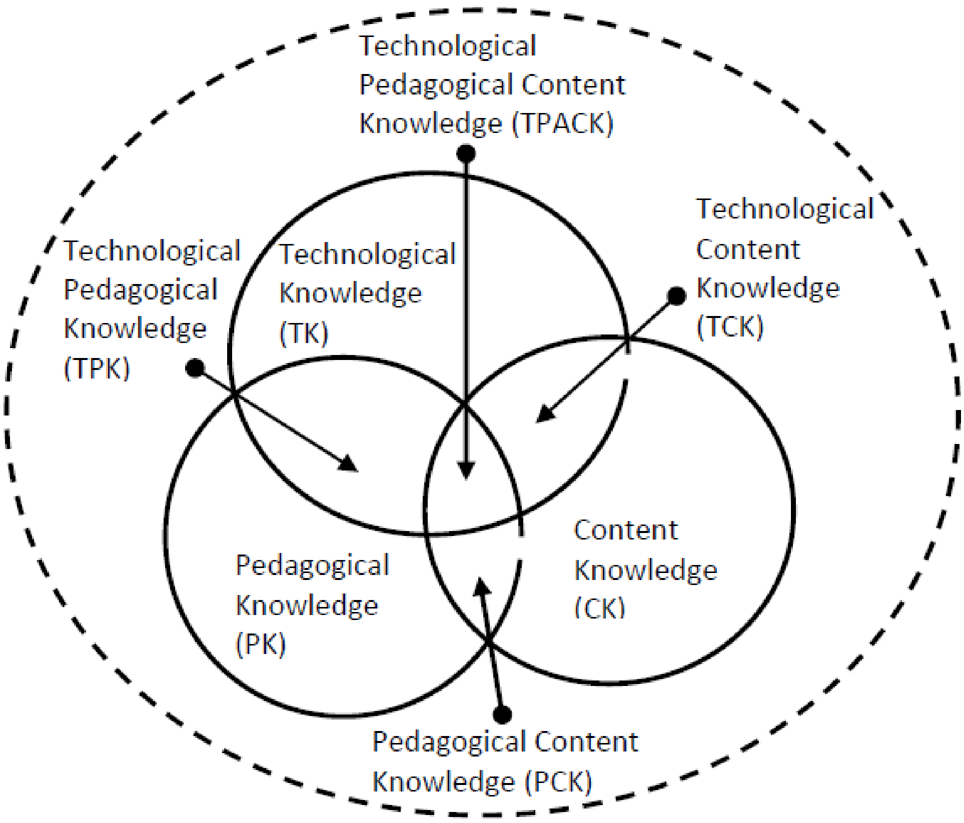

Figure 2.1: The TPACK framework

Source: Mishra & Koehler (2008)

2.8.2 Content knowledge (CK)

The organization of knowledge in engaging teachers' communication process is known as or referred to as CK. CK is significant when reflecting on a teacher's ability to disseminate course contents. It reveals the teacher's knowledge about the course content taught or learned by students (Koh *et al.*, 2015). It is essential for mathematics teachers to develop the skills required to teach with fluency in the subject/CK (Sari and Bostancioglu, 2018; Stoilescu, 2015; Shulman, 1987; Willermark, 2017). PCK depicts the fact that knowledge and context are determined by having a clear understanding of the course content and the most effective and efficient strategies to present the knowledge to students (Shulman, 1987).

CK forms part of a whole when examining the various components and how it influences students' learning experiences. Philosophies, values, perceptions, organizational contexts, and resilient practices provide teachers with an understanding of the importance of CK (Malubay and Daguplo, 2018; Rosenberg and Koehler, 2015; Shulman, 1987). The impact of CK is imperative if teachers are to make a difference in motivating students in mathematics. The content of a course empowers learners to succeed when given the tools to develop the necessary skills.

2.8.3 Pedagogical knowledge (PK)

The teachers' experiences and confidence in delivering course content also require an understanding of PK's influence on the learning experiences of learners. PK implies that teachers effectively use a range of teaching strategies to engage learners and while teaching course content (Koh *et al*., 2015). PK can be demonstrated when teachers develop learning plans to include prior knowledge and incorporate various strategies addressing the targeted groups' different learning styles (Voogt & McKenney, 2017). Appreciating how the content is shared or presented to learners based on clearly defined learning objectives highlights the complexities related to teachers' technological ability (Koh, 2015).

2.8.4 Technological knowledge (TK)

Technology's relevance to promoting an engaging, flexible, and exciting learning environment is fundamental when considering TK's impact on teachers. TK focuses on how teachers use their skills and various technologies to engage learners through the Internet and digital resources (Bingimlas *et al*., 2018). Confident teachers who use technology tend to have a wider variety of strategies and Instructional materials to stimulate the learners (Deng *et al*., 2017).

Technology supports learning through the effective use of acquired skills embedded in various opportunities and tasks. Teachers acquire and use their skills to develop effective lesson plans that impact learning. Technology tools provide learners with opportunities to explore tasks through developmental stages and open-ended questions linked to real-life scenarios and relevance (Herring *et al*., 2016; Voogt and McKenney, 2017). TK does not suggest an end, but rather it participates in open-ended integration that generates and evolves over a lifetime. Nevertheless, technology has its challenges; therefore, teachers should recognize the need to develop their skills and confidence before engaging them. Digital technology, including computers, mobile devices and applications are usable as an instructional tool in several ways (Ergen *et al*., 2019).

2.8.5 Pedagogical content knowledge (PCK)

Mishra and Kohler (2018) defined PCK as the knowledge of pedagogy that is applicable to the teaching of specific content such as knowing what teaching approaches fit content, and likewise, knowing how elements of the content can be arranged for better teaching. In mathematics, the key to PCK is not only being aware of students' mathematical errors and misconceptions, but also making connections between the different areas of mathematics and between mathematics and other areas of knowledge and students' contexts.

2.8.6 Technology content knowledge

Mishra and Koehler (2018) defined TCK as the knowledge about the manner in which technology and content are reciprocally related. They further asserted that a teacher needs to know not just the subject matter he/ she teaches but also the manner in which the subject matter can be changed by the application of technology. Furthermore, Technological content knowledge (TCK) means understanding which ICT are best suited to address the specific subject-matter learning, and vice versa. In mathematics, certain technologies can assist in the representation of mathematical concepts or ideas that are tough to figure out without pictorial support. Likewise, certain mathematical notions or theories restrict the range of digital tools that are suitable for understanding such contents.

2.8.7 Technological pedagogical knowledge (TPK)

Mishra and Kohler (2018) defined TPK as knowledge of the existence, components and capabilities of various technologies as they are used in teaching and learning settings and conversely, knowing how teaching might change as the result of using particular technology. Technological pedagogical knowledge (TPK) is particularly aligned with the universal and creative dimensions of digital literacy which not only implies using digital tools for teaching, but also being able to produce educational content using ICT and understanding the contribution of ICT to a specific learning context. In this sense, TPK requires looking beyond the common uses of ICT, seeking tailored pedagogical purposes.

2.8.8 Application of TPACK in mathematic teaching

The Mathematics teacher to have success they need a deep understanding of Mathematics (content), of teaching/learning process (pedagogy) and of technology, in an integrated way, so that when planning lessons, as teachers think about particular Mathematics concepts, they are concurrently considering how they might teach the important ideas embodied in the mathematical concepts in such a way that the technology places the concept in a form understandable by their students" (Niess, 2006). However, teachers, in general, have a limited knowledge about educational technology and its application in the Mathematics teaching/learning process, reinforcing the idea of the need for a teacher continuous training to integrate technology education according to TPACK's framework.

From this framework are set goals for the technology integration in Mathematics. Niess *et al.* (2009) proposed a model that shows the Mathematics TPACK progression according to technology integration in Mathematics held by teachers, inspired by the model of innovation decision process introduced by Rogers (2003). Thus, mathematics teachers need to go through a five-step process to address the final decision to accept or reject a particular innovation for teaching Mathematics with technology:

i. *Recognizing* (knowledge), where teachers are able to use the technology and recognize the alignment of the technology with Mathematics content yet do not integrate the technology in teaching and learning of Mathematics.
ii. *Accepting* (persuasion), where teachers form a favorable or unfavorable attitude toward teaching and learning Mathematics with an appropriate technology.
iii. *Adapting* (decision), where teachers engage in activities that lead to a choice to adopt or reject teaching and learning Mathematics with an appropriate technology.
iv. *Exploring* (implementation), where teachers actively integrate teaching and learning of Mathematics with an appropriate technology.
v. *Advancing* (confirmation), where teachers evaluate the results of the decision to integrate teaching and learning Mathematics with an appropriate technology.

AMTE's Technology Committee created a visual description (figure 2) for this theoretical framework, emphasizing the non-linearity of the process, this is, the no regularity progression at the transition from one level to another. Different experiments may lead to a level's lowering or conversely the acceptance of a new technology. A teacher can achieve different levels for different aspects of its activity.

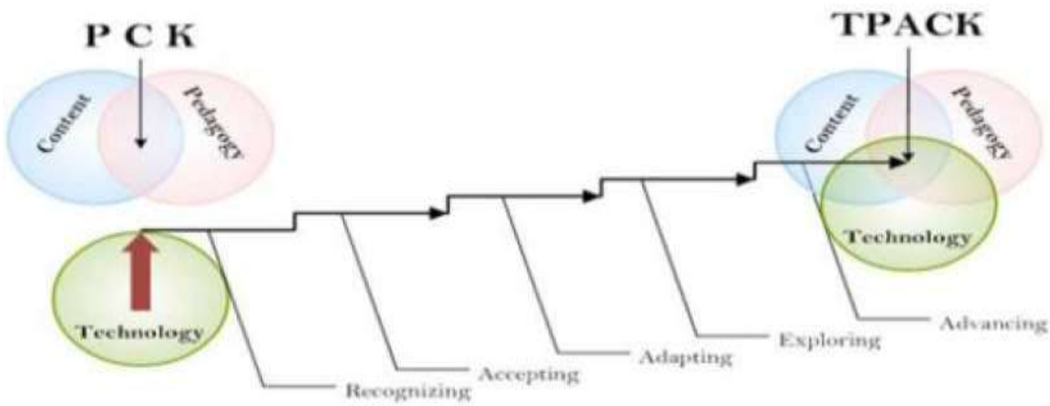

Figure 2.2: TPACK's development (Niess *et al*, 2009).

Given that this interpretation of TPACK's development is not directly related to Mathematics, the AMTE's Technology Committee decided to create a model of teacher's TPACK Mathematics development, developing a set of descriptors according to four major themes: curriculum and assessment, learning, teaching, access. In summary, it was developed a model of educational technology integration in Mathematics teaching/learning process, which unfolds in five stages: recognition, acceptance, adaptation, exploration and advancement, according to four major themes: curriculum and assessment, learning, teaching, access.

Overview of TPACK

TPACK is a framework to understand the knowledge bases teachers need to promote technology integration in learning environments (Koehler, 2012; Malubay & Daguplo, 2018; Rangel, 2019). It is a framework implemented to enhance teachers' skills and recognizes the need to offer appropriate teaching and learning experiences (Batiibwe & Bakkabulindi, 2016; Koehler, 2012). The rationale for selecting TPACK model was that it is most appropriate when divided into constructs that show the effects of teachers' use of technology.

TPACK has 21 assessment instruments divided into subsections that measure different competencies. The 4Cs of communication, creativity, collaboration, and critical thinking are central to TPACK. Other sections include life and career skills, information technology skills, and 21st-century themes. The 21st-century themes are assessments and standards, curriculum and instruction, professional development, and learning environments, measuring teacher and student use of digital technology. Teachers are expected to ensure that their pedagogical skills and CK support the students' development and lifelong learning experiences (Voogt & McKenney, 2017). However, even within the 21st century, many teachers are still not familiar with using technology devices to develop and drive effective and efficient learning strategies (Kafyulilo *et al*., 2015; Koh *et al*., 2015; Rangel, 2019). Therefore, a combination of CK, teacher knowledge, pedagogy, and technology make the learning process engaging, exciting, and enriching (Koehler, 2012; Rosenberg & Koehler, 2015).

Further lesson plans need to include multiple teaching and technology pedagogies while ensuring the course's learning objectives are met (Koehler, 2012; Rosenberg and Koehler, 2015; Koh, Chai, & Lim, 2015; Sung *et al*., 2016). Effective lesson planning for technology integration includes tools to enable relevant, real-life learning experiences through authentic examples. Technology can motivate and engage learners while making learning exciting (Voogt & McKenney, 2017). It can also improve students' attitudes toward learning (Perry *et al*., 2016). Teachers who integrate technology into the classroom use resources and tools to make learning authentic (Getenet, 2017; Herring *et al.*, 2016; Sari & Bostancioglu, 2018).

Three knowledge bases form the TPACK framework: CK, PK, and TK. However, these knowledge bases' intersections are necessary to understand the TPACK framework: TCK, TPK, and PCK. The cumulative variable of all six is the complete framework of the TPACK framework. The components of TPACK are illustrated based on their contexts. Knowledge of both the content and the relationship between the seven components of TPACK is important for teachers (Mishra and Koehler, 2018). Pedagogy and CK were the original descriptors of Shulman's framework (Mishra and Koehler, 2018). However, Koehler and Mishra later added technology as part of the framework's description because technology became a vital part of instruction. Identifying the type of knowledge base required to integrate technology was critical when contemplating the complexities and complications crucial to teacher knowledge (Koehler, 2012; Willermark, 2017).

2.9 Review of Related Empirical Studies

Internationally, several studies have been conducted on availability, accessibility and readiness to use digital technologies amongst secondary school mathematics teachers in teaching and learning process. Naresh *et al,* (2015) also conduct a research study on Teachers' Readiness to Use Technology in the Classroom: An Empirical Study. The growing body of literature associated with educational computer use has examined numerous variables and interrelationships in order to gain a better understanding of computer beliefs and use of computers within education. Teachers' computer acceptance is an important factor to the successful use of computers in education. Thus there is a need to examine the factors affecting teachers' computer use and its implications to teachers' professional development strategies. This article reports a research on the relationship between actual usage of computer (AUC) and technology acceptance constructs among secondary school Mathematics, Science and English language (MSE) teachers in Malaysia. Overall, the study found that the AUC among MSE secondary school teachers were at the moderate level. Meanwhile, the constructs of attitude, perceived usefulness, and perceived ease of use, job relevance, and computer compatibility showed significant positive relationship with AUC. Practical recommendations for school administrators and teachers been discussed.

Sofowora and Egbedokun (2010) also examined An Empirical Survey of Technology Application in Teaching Geography in Nigerian Secondary. The present study is very important and necessary because many teachers are still very apprehensive about using the new technologies in instruction. In addition is the fact that, there are little empirical data on the level of preparedness and the extent of utilization of ICTs in instruction in Nigerian secondary schools. This study was therefore carried out to provide empirical data on the extent of the integration of the new technology in teaching and learning Geography in Nigerian Secondary Schools. The study employed the descriptive survey design. The sample for the study is made up of 214 Geography teachers drawn from secondary schools in Osun State. The schools and the teachers were selected through stratified sampling techniques based on school types, location, Local Education Area and gender. A structured questionnaire was used to collect data from the participants. It was divided into five sections and was validated using construct validity. The co-efficient of reliability was 0.68. The findings showed that 55% of Geography teachers had access to computer but did not have the pre-requisite ICT skills. Out of the modern technologies available for teaching Geography, the most commonly used are: instructional television (54%), instruction radio (59%) and video (59%).Other findings showed that 54% of Geography teachers do not know the instructional value of CDROM/ interactive web packages available free for teaching Geography. Not only this, 84% of the teachers also rarely use the news groups .While 42% rarely make use of multi- media presentation in teaching Geography. Where as many of these facilities are available free on the web for teachers use. Lastly, lack of skills and cost of utilization ranked highest as one of the factors preventing teachers from using the new technologies in teaching Geography

In Kenya a study conducted by Bitok (2014) shows the Availability of Information and Communication Technology Resources in Teaching and Learning of Biology by Secondary Schools in UasinGishu County, Kenya. The aim of the paper was to assess integration of information and communication technology in teaching and learning Biology in secondary schools in UasinGishu County in Kenya. In this paper, the author specifically assesses the availability of information and communication technology resources in teaching and learning of Biology in schools in the area. A descriptive survey research design was used in the study. The target population was 123 secondary schools. The study used stratifying sampling to select a sample of 114 teachers. Structured questionnaire and interview schedule were used to collect data. Descriptive statistics (frequencies, percentage, mean and standard deviation) were used to analyze data. The study findings indicated that the schools lacked some of the important information and communication technology resources for teaching and learning of Biology. The study recommends that the government should provide more funds for ICT materials in secondary schools.

In another descriptive study, Adelabu (2014) conducted a study on the Assessment of Accessibility and Utilization of Information and Communication Technology (ICT) for Effective Teaching of Biological Science in Secondary Schools. This study investigated information and communication technology (ICT) accessibility and utilization for effective teaching of biological science in secondary schools in Ibadan north Local Government Area of Oyo State. Survey research design was adopted for the study. A 20 item instruments of (ICTFAQ) and (ICTFUQ) were adopted for this study. The study sampled 72 biological science teachers in selected secondary schools in Ibadan-north, Oyo State. The descriptive statistics was adopted in analyzing the data collected for this study, while the generated hypotheses were tested at 0.05 level of significance, using t-test. Hence, the results revealed that ICT facilities were less available, and accessed by teachers in secondary schools in Ibadan-north. In addition, it was revealed that biological science teachers in these schools do not also have the proper skills required to utilize ICT for effective teaching of the subject.

Conclusively, recommendations on ways of solving the problem were implemented for further consideration and execution by the government authorities, and the stakeholders. As regards challenges inhibiting the utilization of ICT in teaching and learning, Katamba (2009) enumerated some of the problems militating against effective use of ICT in teaching to include Inadequate computers, lack adequate system analysts/technicians in schools, Erratic power supply, inadequate computer laboratory and inadequate practical, Poor infrastructure and absence of teaching and learning facilities among others. Katamba suggested that Stand-by generating plant should be provided to solve the problem of erratic power supply, ICT facilities should be acquired, telecommunication infrastructures should be made available among others to enhance the utilization of ICT I teaching and learning in schools.

In western Nigeria, Adelabu (2014) in a study revealed that the extent of utilization of ICT resources for teaching and learning Biological sciences in secondary schools in Ibadan-North LGA, Oyo state is very low due to lack of availability of these resources in the schools. Information and Communication Technology utilization can represent both the content of courses and essential tools for effective learning of the content. Onasanya *et al*. (2011) in a study on teacher's awareness and extent of utilization of ICT for effective science and health education in Nigeria revealed that the level of utilization of ICT resources is very low due to lack of availability of ICT resources in secondary schools in ten (10) local government area in Oyo state.

In Northern Nigeria**,** Dateba (2015) Carried out a study on a survey of the availability and use of instructional materials for art teaching in four colleges of education in Kaduna and Plateau States, Nigeria. The major findings of the study indicate; Inadequate modern instructional materials in Colleges of education in Kaduna and Plateau states, the adequacy and use of such instructional materials for teaching Fine and Applied Arts was far below average as the modern materials were less available, Teachers competence on the use of modern instructional materials was more than that of students who largely depended on the colleges to provide them. Teachers and students face some problems which include lack of availability of modern instructional materials. Based on the findings, there is need for all stake holders in the educational sector to provide adequate modern materials. Institution should organize professional workshops and seminars that will guide the teachers on the use of contemporary materials.

Utilization is the ability to make effective and independent use of the resources and services. This implies that the materials are in the appropriate format and language for use. It also extends to the frequency of use of the materials and services and the concomitant utility derived from the resources (Adebayo, 2007). Usage of Information and Communication Technology in teaching and learning mathematics in secondary schools can be described as the adequate use of technological resources in the teaching and learning processes of mathematics in secondary schools. Such technological resources are meant to facilitate the understanding and practices involved in the teaching and learning of mathematics. Nwana *et al.,* (2017) in a study observed that ICT resources frequently utilized for teaching computer education in secondary schools in

Anambra State are computers, printers, Modems, CD-ROMs, audio-video discs, flash memories and courseware templates.

In another study conducted by Amuchie (2015) has revealed that availability and utilization of ICT resources in teaching and learning in secondary schools in Ardo-Kola and Jalingo, Taraba State. The findings revealed that the extent of utilization of ICT resources such as desktop computers, laptops, television, video players, radio, digital camera, printers, multimedia projectors, scanners, photocopying machines, satellite disc, Internet, Interactive white board, and electronic notice board for teaching and learning in secondary schools in Nigeria are at a very low extent, which is caused by the lack of ICT resources in the secondary schools.

In a study conducted by Ibrahim (2015) titled An Examination of Factors Affecting Students' Behaviour in Cultural and Creative Arts in Junior Secondary Schools in Nasarawa State, Nigeria. The aim of the study was to identify the significant factors that affect students" behaviour in Cultural and Creative Arts among some selected secondary schools in Nasarawa State, Nigeria. The objective of the study is to ascertain if instructional strategies employed by art teachers have any significant influence on students behaviour in Cultural and Creative Arts, assess the environmental factors (such as family, school, peers and the society) which affect students learning. The researcher discovered in the study that poor methodology, socio cultural and religious views, environmental influences are factors against effective teaching of Cultural and Creative Arts. The researcher concluded by recommending that there is also the need to provide opportunities for learners to develop language, express feelings, ideas, and moods through Cultural and Creative Arts activities, because lack of past art experiences have a negative impact on attitude to art education.

In another study by Tella *et al*., (2017) observed that only computers are available for teachers use in secondary schools in Ibadan, Oyo state. In another descriptive study, Adelabu (2014) conducted a study on the Assessment of Accessibility and Utilization of Information and Communication Technology (ICT) for Effective Teaching of Biological Science in Secondary Schools. This study investigated information and communication technology (ICT) accessibility and utilization for effective teaching of biological science in secondary schools in Ibadan north Local Government Area of Oyo State. Survey research design was adopted for the study. A 20 item instruments of (ICTFAQ) and (ICTFUQ) were adopted for this study. The study sampled 72 biological science teachers in selected secondary schools in Ibadan-North, Oyo State.

In the eastern Nigeria, study conducted by Nwana *et al*. (2017) on the Availability and Utilization of information communication technology (ICT) Resources in Teaching Computer Education in Secondary Schools in Anambra State, Nigeria. The study investigated the availability and utilization of ICT resources in the teaching of Computer Education among Secondary School Teachers in Anambra State. The findings revealed that many of the ICT resources needed for the teaching of computer education are not available. It was also revealed that majority of the resources needed for the teaching of computer education are not being used by the teachers. In view of the findings, the following recommendations were made; The government should provide adequate ICT resources for effective teaching and learning of computer education; The government should embark on training and retraining of teachers for effective teaching of computer education through short-term courses, seminars, workshops and conferences; The government should ensure regular supply of electricity for effective use of ICT resources for computer education; Infrastructural facilities such as the computer laboratory and computerized library should be provided in the schools for effective teaching of computer education; The government should employ technicians for repair and maintenance of ICT resources being used in computer education among others.

Another study conducted by Abd Rahim and Shamsiah (2018) also examined a research study on Teaching Using Information Communication Technology. The result shows that trainee teachers in Malaysia have confidence to integrate ICT in their teaching practices. And the male teachers are more confident than female teachers in using ICT integration in teaching. Moreover it shows that vocational teachers are more confident to integrate ICT in teaching, because they can handle technical subjects and their experience enable them to integrate ICT effectively in teaching (Abd Rahim and Shamsiah, 2018). Furthermore, only minority of teachers in Malaysia professionally know the basic of ICT. The majority of them just had average knowledge in ICT, and even a group of the teachers are poor in the related knowledge of ICT in Malaysia (Rosnaini and MohdArif, 2010). It indicates that level of ICT knowledge among teachers is one of the key factors for Malaysia society to make successful adoption of ICT in its education.

Alison *et al*. (2020) conducted a survey research on teaching mathematics with technology with an emphasis on the secondary school phase. We synthesize themes, questions, results and perspectives emphasized in the articles that appear in this issue alongside the relevant foundations of these ideas within the key journal articles, handbooks and conference papers. Our aim is to give an overview of the field that provides opportunities for readers to gain deeper insights into theoretical, methodological, practical and societal challenges that concern teaching mathematics with technology in its broadest sense. Although this collection of articles was developed prior to the global coronavirus pandemic, we have taken the opportunity to survey the contributing authors to provide some country perspectives on the impact the pandemic has had on mathematics teaching with technology. They concluded the survey research by identifying some areas for future research in this increasingly relevant topic.

Muhammad *et al*., (2020) also revealed a survey study on Inequities of Digital Skills and Innovation between Public and Private Schools in Punjab. Technology has influenced instructional styles and enhanced learning opportunities for teachers. These innovative trends enable teachers in developing self-motivated and effective learning environments. The present paper carried out a comparison between the teachers of public and private schools about their digital skills. The researchers recruited 216 teachers from both sectors through two stage simple random sampling method. The data was composed by employing self-developed instrument having 9 indicators of digital skills. However, the consistency and validity of research instrument was confirmed while results were reported performing t-test and ANOVA. The findings show that public and private institutes mostly vary regarding the use of digital skills. It was also noted that private school teachers were more innovative in accessing digital skills. The paper suggests that initiatives may be taken to develop interest in public sector teachers regarding practice of technology moreover the government can also collaborate with private sector to learn from their digital experiences and train teachers from public sector. In a similarly vein, Goshit (2016) in his study concluded that most schools, both private and public, do not offer ICT training programe.

Similarly, Onah *et al*., (2020) examined the Availability and Utilization of Information and Communication Technology (ICT) in Teaching and Learning Cultural and Creative Arts in Nsukka Local Government Area. The findings revealed that there is little or less availability of Information and Communication Technology (ICT) in secondary schools for teaching and learning Cultural and Creative Arts. The extent of utilization of

Information and Communication Technology (ICT) for teaching and learning Cultural and Creative Arts in secondary schools is poor. Inadequate funding; erratic power supply; Inadequate ICT facilities among others are the major challenges. The paper recommended that the secondary schools should device means of generating in-house or internal revenue to support themselves to acquire necessary ICT facilities for teaching and learning. The government should provide funding for the acquisition of needed ICT facilities or teaching and learning of cultural and creative arts. Also Constant power supply should be provided also, hence, standby generator should be acquired to remedy the erratic power supply in the country among others. In a study by Ubulom and Amaehule (2011) revealed a very low extent of utilization of computers, audiotapes, internet, e-mails, interactive radio, multimedia projectors, teleconferencing, photocopiers, fax machines and dictating machines for teaching and learning Business Studies in secondary schools in Andoni local government area, River State.

Melchor *et al*. (2020) investigate research study on Technological Factors That Influence the Mathematics Performance of Secondary School Students. Although the value of information and communication technology (ICT) is positive and its use is widespread, its potential as a teaching tool in mathematics is not optimized and its methodological integration is rare. In addition, the availability of ICT resources in schools is positively associated with the academic success of students, and the availability of ICT resources at home is negatively associated with their success. To determine the relationships among academic performance, uses, and available ICT resources, a total of 2018 secondary school students participated in the present study. The uses and available ICT resources, and the learning of mathematics and ICT, were evaluated using a validated 11-item questionnaire. Statistical analysis reveals that, of the secondary education levels, the lowest results are observed in the third year. A total of

64% of students’ arm that they use ICT at home to study mathematics. In addition, 33.61% of the students’ arm that they use their mobile phones frequently while studying at home. However, it should be noted that between 23.80% and 28.44% arm that they dedicate more than 4 hour per day to phone calls. Educational level is a predictor of academic performance in mathematics associated with students’ uses of ICT. The scores indicate that the computer is generally used for Internet searches, thus, limiting the use of ICT for educational purposes. Furthermore, there is a divergence regarding gender.

John and Shallimar (2020) revealed a research study on the impact of the COVID-19 pandemic changed the course of delivering quality education to learners. This study analyzed the level of digital competence of school administrators, the readiness of schools, and perceived challenges on the delivery of distance learning. Using a descriptive research design, the researchers used an online survey to gather pertinent data for the study. Thirty-six (36) administrators took part in the online survey using universal sampling from a school division in the province of Bulacan, Philippines. The researchers created an online research instrument and subjected it to validation before the actual administration. After data gathering, the researchers encoded and tabulated the data. This study used the following statistical tools to analyze the data: frequency, percentage, and rank. The study found that the administrators have varied results on the aspect of digital competence based on the statistical analysis. In terms of school readiness on distance learning, the schools were not yet ready to implement a distance learning scheme. For the perceived challenges, internet connection/ connectivity is the primary concern. Other challenges involve preparation, competencies, funding, and devices for distance learning. Based on the result of the study, the researchers provided some essential recommendations for the administrators, teachers, and other stakeholders.

In Nigeria, related studies have been conducted also on availability, accessibility and readiness to mathematics teacher's usage of digital technology for teaching mathematics in secondary school in the aggregate of Northern, Southern and Eastern which form Nigeria.

Olafare *et al*., (2020) conducted a research study on mathematics teachers' readiness towards utilization of multi choice resource centre for teaching in Ogun state. The study is a descriptive study of the cross-sectional survey type. Mathematics teachers from 20 schools provided with the multi-choice resource centre in Ogun State. Purposive sampling technique was used to select 35 Mathematics teachers from the schools in Ogun state that have access to the Multi-choice resource centre. The study found out that out of all the technological resources provided in the schools for teaching Mathematics, 12 major ones were available in schools. The study recommended that training should be organized for teachers to encourage and motivate them to use the technological tools since they perceived it useful.

Similarly, Lukuman *et al.* (2021) in a study also examined the effect of pre-service teachers' perceived relevance and technology anxiety on their readiness to use digital storytelling for instructional delivery. The study adopted a mixed method research design. Pre-service teachers were trained on the basic procedures in creating digital storytelling for classroom instruction. Quantitative data was analyzed using inferential statistics and qualitative data was content analyzed. The result indicated that there was a high level of readiness among pre-service teachers to use digital storytelling for classroom instruction. Pre-service teachers' perceived relevance also played a significant role in their readiness to use digital storytelling for instructional delivery. It is, therefore, recommended that teacher training institutions need to provide relevant learning resources and digital tools to ensure that prospective teachers are able to acquire requisite skills in creating digital storytelling for effective classroom instruction. On the other hand, Olokoba *et al*., (2014) showed that many schools in Kwara State did not have adequate digital technology tools and teachers did not use the ICT tools in their instructional activities.

Luis *et al*., (2021) also revealed a study on Secondary Mathematics Teachers' Perception of Their Readiness for Emergency Remote Teaching during the COVID-19 Pandemic. The corona virus disease 2019 (COVID-19) pandemic caused a worldwide unexpected interruption of face-to-face teaching and a sudden conversion to emergency remote teaching (ERT). In this exploratory study, a sample of 244 secondary mathematics teachers was considered to analyze their perception of their readiness to ERT during the COVID-19 pandemic based on their technological pedagogical content knowledge (TPCK), their previous training in digital teaching tools, their level of digital competence for teaching mathematics, and their adaptation to ERT. An online questionnaire was applied, and the answers were quantitatively analyzed. Given the use of a large number of digital resources and the high percentage of self-developed materials using educational software, secondary mathematics teachers reflected adequate digital competence and TPCK for teaching mathematics. The sudden transition to ERT forced teachers to slow down the pace of teaching and to reduce the content taught. Significant differences were observed based on gender and age with respect to teachers' perception of their adaptation to ERT. Despite the positive influence of previous training on their perception of readiness for ERT, in general, teachers recognized that they need more training. The demand for preparation for video editing and online quiz composition can be considered for the design of future training programs.

Adenike *et al.,* (2021) also carry out a research on Correlation Studies between Secondary School Teachers' Access to and Utilization of Internet Facilities for Instruction in Ilorin, Nigeria. The findings of the study revealed a significant positive relationship between teachers' access to and utilization of Internet facilities for instruction. This implies that teachers who have access to Internet facilities use Internet facilities for classroom instruction more than their counterparts. The study concluded that teachers effectively utilize accessible Internet facilities for instruction. It was recommended that the government and schools should make provision for Internet facilities in secondary schools to enhance the effectiveness of instruction.

Nathaniel (2021) in a study also examined Nigerian Secondary Students' Accessibility, Utilization, Competence and Attitude towards the Use of Tablet PC for Pedagogic Experience students' basic skills, accessibility, utilization, attitudes, competence and challenges encountered in using digital mobile technologies and the internet for pedagogic experience among the Senior Secondary School 1, 2 and 3 students in Ogbomosho, Oyo State Nigeria. Findings from this study revealed that a considerable number of students have access to Tablet PC and the internet; possessed skills frequently accesses and utilizes their tablet PC for fun, entertainment and non-academic related functions. They also cultivated a good deal of interest in accessing social, fun and entertainment functions with their Tablet PCs. However, students encountered challenges like slow Internet connection, the fragility of the touch screen, short battery life span, irregular electricity supply and uncontrollable challenge on the devices' charging point. Therefore, seminars, workshops, and training should be organized for students on competence and skills development to facilitate maximum utilization of newer mobile devices for academic purposes.

2.10 Summary of Related Literature

This chapter has reviewed relevant related literature on the survey of availability, accessibility and teachers readiness to use digital technologies for teaching process especially mathematics in secondary schools, it policy and the future of education in order to set the research context and lay foundation upon which this research is based and research areas of relevance to the research focus. Research evidence seems to indicate that information communication technology (ICT) usage is increasing among mathematics teachers and their increasing contact and exposure to ICT has resulted in positive attitude towards the use of ICT, this is because mathematics teachers are becoming more aware of its potential benefits for teaching process. Furthermore, the literature review has shown that mathematics teachers are also facing obstacles in using information communication technology (ICT), the obstacles frequently cited in the literature being lack of inadequate ICT resources, computer laboratory, inconsistency of power, infrastructure and among others. Nevertheless, some mathematics teachers have been found to be self-motivated with positive views of the future of education.

More also, the use of technological, pedagogical, and content knowledge (TPACK) theoretical approach to understanding mathematics teachers capabilities related to technology integration that bears relevance to the study was also reviewed. Though use of technological, pedagogical, and content knowledge (TPACK) was a practical framework to examine how mathematics teachers were integrating technology in the classroom (Mishra & Koehler, 2018) The rationale for selecting TPACK model was that it is most appropriate when divided into constructs that show the effects of teachers' use of technology.

TPACK has 21 assessment instruments divided into subsections that measure different competencies. The 4Cs of communication, creativity, collaboration, and critical thinking are central to TPACK. Other sections include life and career skills, information technology skills, and 21st-century themes. The 21st-century themes are assessments and standards, curriculum and instruction, professional development, and learning environments, measuring teacher and student use of digital technology. Teachers are expected to ensure that their pedagogical skills and CK support the students' development and lifelong learning experiences (Voogt & McKenney, 2017). However, even within the 21st century, many teachers are still not familiar with using technology devices to develop and drive effective and efficient learning strategies (Kafyulilo *et al.*, 2015). Therefore, a combination of CK, teacher knowledge, pedagogy, and technology make the learning process engaging, exciting, and enriching (Koehler, 2012; Rosenberg and Koehler, 2015).

Further lesson plans need to include multiple teaching and technology pedagogies while ensuring the course's learning objectives are met (Koehler, 2012; Rosenberg & Koehler, 2015; Koh *et al.*, 2017; Sung *et al.*, 2016). Effective lesson planning for technology integration includes tools to enable relevant, real-life learning experiences through authentic examples. Technology can motivate and engage learners while making learning exciting (Voogt & McKenney, 2017). It can also improve students' attitudes toward learning (Perry *et al.*, 2016). Teachers who integrate technology into the classroom use resources and tools to make learning authentic (Getenet *et al*., 2017).

Three knowledge bases form the TPACK framework: CK, PK, and TK. However, these knowledge bases' intersections are necessary to understand the TPACK framework: TCK, TPK, and PCK. The cumulative variable of all six is the complete framework of the TPACK framework. The components of TPACK are illustrated based on their contexts. Knowledge of both the content and the relationship between the seven components of TPACK is important for teachers (Koehler and Mishra, 2009). Pedagogy and CK were the original descriptors of Shulman's framework (Mishra & Koehler, 2009). However, Koehler and Mishra later added technology as part of the framework's description because technology became a vital part of instruction. Identifying the type of knowledge base required to integrate technology was critical when contemplating the complexities and complications crucial to teacher knowledge (Koehler 2012; Willermark, 2017).

However, teachers, in general, have a limited knowledge about educational technology and its application in the Mathematics teaching/learning process, reinforcing the idea of the need for a teacher continuous training to integrate technology education according to TPACK's framework.

From this framework are set goals for the technology integration in Mathematics. Niess *et al*. (2016) proposed a model that shows the Mathematics TPACK progression according to technology integration in Mathematics held by teachers, inspired by the model of innovation decision process introduced by Rogers (2013). Thus, teachers need to go through a five-step process to address the final decision to accept or reject a particular innovation for teaching Mathematics with technology:

a. *Recognizing* (knowledge), where teachers are able to use the technology and recognize the alignment of the technology with Mathematics content yet do not integrate the technology in teaching and learning of Mathematics.
b. *Accepting* (persuasion), where teachers form a favourable or unfavourable attitude toward teaching and learning Mathematics with an appropriate technology.
c. *Adapting* (decision), where teachers engage in activities that lead to a choice to adopt or reject teaching and learning Mathematics with an appropriate technology.

d. *Exploring* (implementation), where teachers actively integrate teaching and learning of Mathematics with an appropriate technology.

e. *Advancing* (confirmation), where teachers evaluate the results of the decision to integrate teaching and learning Mathematics with an appropriate technology.

Focusing on related research studies on availability, accessibility and readiness to use digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger State It was observed that several related research studies have been conducted locally and internationally (where the use of digital technologies have come of age and there is resources to maintain them) based on availability, accessibility and readiness to use digital technologies for teaching mathematics in secondary schools. Hence, the study therefore examined the survey of availability, accessibility and readiness to use digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger State.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Research Design

A descriptive survey design was adopted for this study since the researcher collected quantitative information based on Availability, Accessibility and Readiness to use digital technologies amongst secondary schools' mathematics teachers in Minna Metropolis, Niger State. This design was adopted since it allowed the researcher to collect, describe and interpret existing problems about a specific population, often using a questionnaire distributed to the respondents without any attempt to manipulate the variables.

3.2 Population of the Study

The target population of this study comprised all the secondary schools' mathematics teachers in public and private schools in Minna Metropolis, Niger State. Minna Metropolis covered Bosso and Chanchaga Local Government area with a total number of two hundred and fifty-one (251) Mathematics teachers', one hundred and sixty (160) males and ninety-one (91) females, in all the sixty-one (61) public and private secondary schools in Minna Metropolis (Department of Planning, Research and Statistics, Ministry of Education, Niger State, 2020).

3.3 Sample and Sampling Technique

The study's sample size was 152 mathematics teachers from both public and private secondary schools in Minna Metropolis. A stratified random sampling technique was used to select the sample size from 20 public and private schools. The technique was also used to select 10 public owned schools and private-owned schools, respectively. In this study, Krejcie and Morgan's table for determining sample size (1970) was adopted to determine the appropriate sample size for the study with the total of one hundred and fifty-two mathematics teachers. For more detail on Krejcie and Morgan's table adopted, See appendix A.

Table 3.3.1 Distribution of sample by schools and gender

NAME OF SCHOOLS	MALE	FEMALE	TOTAL
Public Schools	41	41	82
Private schools	57	13	70
Total	92	60	152

For more detail on distribution of sample by schools and gender table, See appendix B.

3.4 Research Instrument

The instrument used for this study was a researcher designed questionnaire titled: Digital Technologies Availability, Accessibility and Readiness to use questionnaire (DITAARQ). The questionnaire contained forty-two (42) closed-ended items designed to collect accurate and adequate information from the respondents to verify the research questions. The questionnaire was divided into four sections, A to D. Section, A part of the questionnaire, contained two (2) items about the demographic background of the respondents such as gender and school type, section B contained fifteen (15) relevant items measuring the level of availability of digital technologies used in schools, section C contained fifteen (15) items measuring the level of accessibility of mathematics teachers on digital technologies usage, section D contains ten (10) relevant questions measuring the level of Readiness of Mathematics Teachers on digital technologies Usage. See appendix B for the details of the research design instrument.

The item statements in sections B, C and D were measured based on three Likert-Scales, which indicate how the respondents feel about the statements. The three Likert rating scale for section B, C and D are as follows: 3 =Adequately Available (AA), 2 = Fairly Available (FA), 1= Not Available (NA), for section C: 3= Adequately Accessible (AA), 2= Fairly Accessible, 1= Not Accessible (NA) and for section D: 3= Ready (R), 2= Fairly Ready (FR), 1 = Not ready (NR), the mean score criterion used for decision-making point was obtained thus: $\frac{3+2+1}{3} = \frac{6}{3}$ = 2.0. Therefore, any mean score variable greater than 2.0 was considered available, accessible and ready, while a variable less than 2.0 was considered as fairly/not available, fairly/not accessible and fairly/not ready.

3.5 Validity of the Instrument

Validity is how the results can measure what is supposed to be measured (Madan & Kensinger, 2017). Therefore, to determine the face, contents, psychological, and construct validity of the instruments, the research instrument was given to mathematics and technology experts from the Science and Educational Technology Department of the Federal University of Technology, Minna, for validation. In order to maintain clarity of purpose relevance to the subject-matter, appropriate use of language and relevance of the instrument to the study were taken into consideration. The observations and suggestions made by the experts were also used to produce a final copy of the instrument.

3.6 Reliability of the Instrument

Reliability is the degree to which a test consistently measures whatever it measures (Mugenda, 2013). To determine the instrument's reliability, a pilot study was conducted on thirty (30) Mathematics secondary school teachers from the study population who were not among the sampled Mathematics secondary school teachers of the study. The scores obtained from the respondents were used to justify the test items using the

Cronbach Alpha Reliability Coefficients formula. However, the instrument, Digital Technologies Availability, Accessibility and Readiness to use questionnaire (DITAARQ) containing forty-two items, yielded an estimated value of 0.76. Therefore, the instrument was considered reliable and valid for the research study. See Appendix C.

3.7 Method of Data Collection

The researcher collected an introductory letter from the (HOD), Department of Science Education, Federal University of Technology, Minna which served as evidence to enable the researcher carry out the study effectively. The introductory letter was presented to the sampled schools seeking permission to access ICT laboratories and cooperation to use their mathematics teachers in the various sampled schools as part of the study.

The research instrument was administered to one hundred and fifty-two (152) mathematics teachers in the sampled schools in Minna, metropolis Niger state which covered Bosso and Chanchaga local government respectively. However, the researcher explained in detail and gave instruction to the subject verbally and allowed the respondents to read and provide responds to the questions. The questionnaire administered on the respondents were filled and returned to the researcher at the agreed time to avoid damages or missing them to ensure 100% retrieval with the help of mathematics teachers. The study lasted for six (6) weeks for collection of data from the sampled schools.

3.8 Method of Data Analysis

The data collected from the respondents were analysed using descriptive analysis (mean and standard deviation) to provide answers to the research questions. In contrast, Mann Whitney is a counterpart analysis of t-test and it was used to test the research hypotheses which were stated in chapter one with the help of the Statistical Package for Social Science (SPSS) version 23.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Analysis of Demographic information based on Gender

Table 4.1: Demographic Analysis of Respondents Based on Schools and Gender

School Type	Gender	Frequency	Percentage
Private	Male	41	27%
	Female	41	27%
Public	Male	57	38%
	Female	13	9%
Total		152	100%

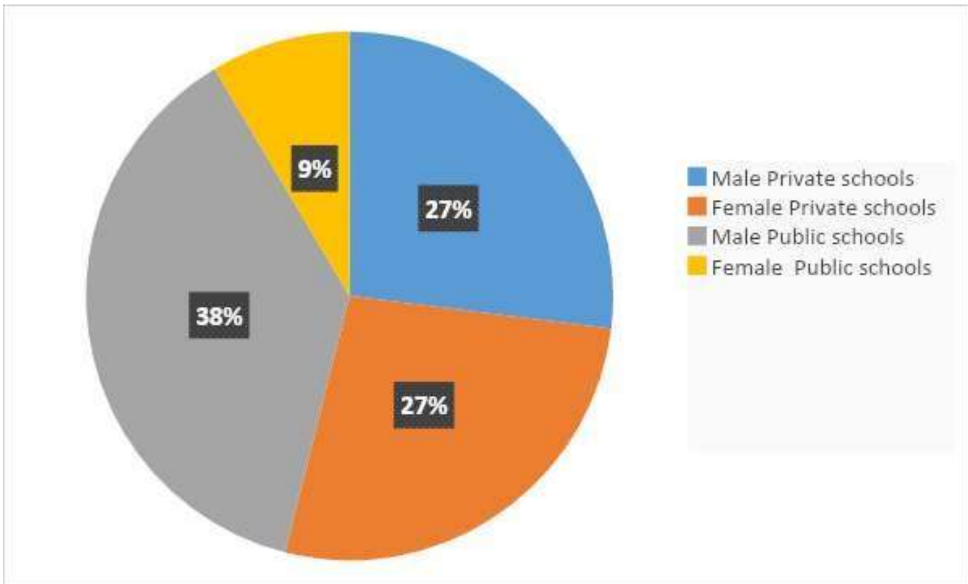

Fig4.1: Pie Chart Showing the Percentage of Respondents Based on Schools and Gender

Figure 4.1 shows a pie- chart descriptive of respondents based on schools and gender. Males of private school mathematics teachers is 41(27) % and females 41(27) % respectively. Furthermore, male respondents of public schools mathematics teachers is 57(38) % and female 13(9) % respectively.

4.2 Answering Research Questions

Research Question One: What is the level of availability of digital technologies for teaching Mathematics in secondary schools in Minna Metropolis, Niger State?

This research question was answered using mean ($\bar{x}$) and standard deviation (SD) and presented in Table 4. 2.

Table 4.2: Summary of Mean Scores on the level of Availability of Digital Technologies

Items	Not Available 1	Fairly Available 2	Adequately Available 3	Weighted Sum	Mean ($\bar{x}$)	Std. Dev (SD)	Decision
Personal computers	37(24.3)%	65(42.8)%	50(32.9)%	317	2.09	0.75	Available
Interactive whiteboards	33(21.7)%	52(34.2)%	67(44.1)%	338	2.22	0.78	Available
Video conferencing system	90(59.2)%	33(21.7)%	29(19.1)%	243	1.59	0.79	Fairly Available
Audio equipment	72(47.4)%	46(30.3)%	34(22.4)%	266	1.75	0.79	Fairly Available
Projector	58(38.2)%	65(42.8)%	29(19.1)%	275	1.81	0.73	Fairly Available
Laptop computers	35(23.0)%	56(36.8)%	61(40.1)%	330	2.17	0.78	Available
Internet cable	75(49.3)%	49(32.2)%	28(18.4)%	257	1.69	0.77	Fairly Available
Wireless internet	64(42.1)%	34(22.4)%	54(35.5)%	294	1.93	0.88	Fairly Available
Electronic visual resources	57(37.5)%	64(42.1)%	31(20.4)%	278	1.83	0.74	Fairly Available
Electronic books	75(49.3)%	29(19.1)%	48(31.6)%	277	1.82	0.89	Fairly Available
Desktop computers	28(18.4)%	50(32.9)%	74(48.7)%	350	2.30	0.76	Available
Audio visual (e.g television)	65(42.8)%	44(28.9)%	43(28.3)5	282	1.86	0.83	Fairly Available
Computer laboratory	20(13.2)%	52(34.2)%	80(52.6)%	364	2.39	0.71	Available
Mobile phones	54(35.5)%	64(42.1)%	34(22.4)%	284	1.87	0.75	Fairly Available
Audio media(radio etc)	67(44.1)%	58(38.2)%	27(17.8)%	264	1.74	0.74	Fairly Available
Overall Mean					**1.94**	0.78	

The result of Table 4.2 shows the respondents' views on the level of Availability of digital technologies for teaching mathematics in schools in Minna Metropolis, Niger State. From the Table, the result reveals that the level of availability of digital technologies for teaching mathematics in schools had an overall Mean ($\bar{x}$) score and standard deviation (SD) of 1.94

and 0.78 respectively. This result indicates that the level of availability of digital technologies for teaching mathematics in secondary schools is inadequate because the overall Mean score is less than the decision Mean of 2.0. This meant that there is inadequate supplies of digital resources for teaching mathematics in secondary schools in Minna Metropolis, Niger State.

Research Question Two: What is the level of mathematics teachers' accessibility to use digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger State?

This research question was answered using mean ($\bar{x}$) and standard deviation (SD) and presented in Table 4. 3.

Table 4.3: Summary of Mean Scores on the level of Accessibility to use Digital Technologies for teaching mathematics

S/N	Items	Not Accessible	Fairly Accessible	Adequately Accessible	Weighted Sum	Mean ($\bar{x}$)	Std. Dev (SD)	Decision
1	Personal computers	35(23.0)%	69(45)%	48(31.6)%	317	2.09	0.74	Accessible
2	Interactive whiteboards	35(23.0)%	57(33)%	60(39.5)%	329	2.16	0.78	Accessible
3	Video conferencing system	105(69.1)%	32(21.1)%	15(9.9)%	214	1.41	0.67	Fairly Accessible
4	Audio equipment	70(46.0)%	49(32.2)%	33(21.7)%	267	1.76	0.79	Fairly Accessible
5	Projector	56(37.2)%	68(44.7)%	28(18.4)%	276	1.82	0.72	Accessible
6	Laptop computers	46(30)%	55(36.2)%	51(33.6)%	309	2.03	0.80	Accessible
7	Internet cable	76(50)%	43(28.3)%	33(21.7)%	261	1.72	0.80	Fairly Accessible
8	Wireless internet	71(46.7)%	48(31.6)%	33(21.7)%	266	1.75	0.79	Fairly Accessible
9	Electronic visual resources	76(50.0)%	53(34.9)%	23(15.1)%	251	1.65	0.73	Fairly Accessible
10	Electronic books	84(55.3)%	33(21.7)%	35(23.0)%	255	1.68	0.83	Fairly Accessible
11	Desktop computers	46(30.3)%	48(31.6)%	58(38.2)%	316	2.08	0.83	Accessible
12	Audio visual (e.g television)	68(44.7)%	39(25.7)%	45(29.6)%	281	1.86	0.85	Accessible
13	Computer laboratory	26(17.1)%	64(42.1)%	62(40.8)%	340	2.24	0.73	Accessible
14	Mobile phones	65(42.8)%	50(32.9)%	37(24.3)%	276	1.82	0.80	Accessible
15	Audio media (radio etc)	57(37.5)%	67(44.1)%	28(18.4)%	275	1.81	0.73	Accessible
	Overall Mean					**1.86**	0.77	

The result of Table 4.3 shows the respondents' views on the level of accessibility of digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger State. The result reveals that the level of availability of digital technologies for teaching mathematics in secondary schools had an overall mean ($\bar{x}$) score and standard deviation (SD) of 1.86 and 0.77 respectively. This result indicates that the level of accessibility of digital technologies for teaching mathematics in secondary schools is inadequate since the overall mean score is less than the decision mean of 2.0. This indicated that there is an inadequate supply of digital technology tools for teaching mathematics in secondary schools in Minna Metropolis, Niger State.

Research Question Three: What is the extent of mathematics teachers' readiness to use digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger State?

Table 4.4: Summary of Mean Scores on the extent of mathematics Teachers' Readiness to Use Digital Technologies for teaching mathematics

Statements	Not Ready 1	Fairly Ready 2	Ready 3	Weighted Sum	Mean ($\bar{x}$)	Std. Deviation (SD)	Decision
I am not ready to use digital technologies because of insufficient knowledge of appropriate software and hardware.	18(11.8)%	48(31.6)%	86(56.6)%	372	2.44	0.69	Ready
I am no ready to use digital technologies due to the lack of knowledge on how to evaluate the use and role of digital technologies in teaching mathematics	25(16.4)%	56(36.8)%	71(46.7)%	350	2.30	0.74	Ready
I am discourage from using digital technologies because of fear of equipment failure	31(20.4)%	44(28.9)%	77(50.7)%	350	2.30	0.78	Ready
I am not ready to use digital technologies because of my limited experience	29(19.1)%	44(28.9)%	79(52.0)%	354	2.33	0.78	Ready
I am not ready to teach mathematics using digital technologies due to my level of qualification	24(15.8)%	46(30.3)%	82(53.9)%	362	2.38	0.75	Ready
I am discourage from using digital technologies to teach mathematics due to my limited training and professional development	29(19.1)%	55(36.2)%	68(44.7)%	343	2.26	0.76	Ready
I am not ready to use digital technologies to teach mathematics as a result of insufficient supply of electricity	35(23.0)%	57(37.5)%	60(39.5)%	329	2.16	0.78	Not Ready
I am not ready to use digital technologies to teach mathematics due to lack of technical support from the school management	27(17.8)%	56(36.8)%	69(45.4)%	346	2.28	0.75	Ready
I am discourage from using digital technologies to teach mathematics because of the unlimited time given to me in teaching mathematics in my school	22(14.5)%	68(44.7)%	62(40.8)%	344	2.26	0.69	Ready
I am not ready to use digital technologies because I am not given the freedom to design my own teaching with the help of digital technology in teaching mathematics in my school	29(19.1)%	60(39.5)%	63(41.4)%	338	2.22	0.75	Ready
Overall Mean					**2.29**	**0.75**	

The result Table 4.4 shows the respondents' views on Readiness of Mathematics teachers to use Digital Technologies in secondary schools in Minna Niger State. From the Table, the overall mean ($\bar{x}$) score and standard deviation (SD) for the entire items of Table 4.2.3 is 2.29 and 0.75 respectively. This result indicates that Mathematics teachers are ready to use Digital Technologies in teaching mathematics in secondary schools in Minna metropolis; Niger State because the overall mean score 0f 2.29 is greater than the decision mean of 2.0.

Research Question Four: What is the level of availability of digital technologies based on school type for teaching Mathematics in secondary schools in Minna Metropolis, Niger State?

This research question was answered using mean and standard deviation. Summary of the analysis is presented in Table 4.5.

Table 4.5: Summary of Mean scores on the Level of Availability of Digital Technologies based on school type

Items	Availability of digital technologies in Private Schools			Availability of digital technologies in Public Schools		
	N	**Mean ($\bar{x}$)**	**Std. Deviation (SD)**	**N**	**Mean ($\bar{x}$)**	**Std. Deviation (SD)**
Personal computers	70	2.14	0.85	82	2.04	0.66
Interactive whiteboards	70	2.42	0.84	82	2.05	0.69
Video conferencing system	70	1.76	0.89	82	1.46	0.67
Audio equipment	70	1.76	0.89	82	1.74	0.72
Projector	70	1.97	0.86	82	1.67	0.57
Laptop computers	70	2.24	0.87	82	2.11	0.69
Internet cable	70	1.90	0.83	82	1.51	0.65
Wireless internet	70	1.96	0.84	82	1.91	0.92
Electronic visual resources	70	1.80	0.77	82	1.85	0.73
Electronic books	70	1.70	0.83	82	1.93	0.92
Desktop computers	70	2.38	0.79	82	2.23	0.73
Audio visual (e.g television)	70	1.94	0.83	82	1.78	0.84
Computer laboratory	70	2.47	0.73	82	2.32	0.69
Mobile phones	70	2.03	0.81	82	1.73	0.67
Audio media(radio etc)	70	1.87	0.81	82	1.62	0.66
Overall Mean and Std deviation		**30.29**	**12.44**		**27.95**	**10.81**
Overall Mean Difference			**(30.29 - 27.95) = 2.34**			

Table 4.5 shows the mean scores and Standard Deviations on the availability of digital technologies for teaching mathematics in secondary schools in Minna Metropolis. From the result, the total Mean ($\bar{x}$) score of the Public Schools is 27.95 with total Standard Deviation (SD) of 10.81 compared to private schools with Mean ($\bar{x}$) score of 30.29 with Standard Deviation (SD) of 12.44. This indicated that digital technologies were fairly available in Public schools compared to Private Schools in Minna Metropolis. Therefore, private schools have more digital resources for teaching mathematics compared to Public Schools with a total mean difference of 2.34

Research Question Five: What is the level of mathematics teachers' accessibility to digital technologies based on school type for teaching Mathematics in secondary schools in Minna Metropolis, Niger State?

This research question was answered using mean and standard deviation. Summary of the analysis was presented in Table 4.6.

Table 4.6: Summary of Mean scores on the level of mathematics teachers' accessibility to digital technologies based on school type

Items	Level of Mathematics Teachers' Accessibility to Digital Technologies in Private Schools			Level of Mathematics Teachers' Accessibility to Digital Technologies in Public Schools		
	N	Mean ($\bar{x}$)	Std. Deviation	N	Mean ($\bar{x}$)	Std. Deviation
Personal computers	70	2.07	0.87	82	2.09	0.60
Interactive whiteboards	70	2.24	0.84	82	2.09	0.72
Video conferencing system	70	1.61	0.78	82	1.23	0.48
Audio equipment	70	2.03	0.91	82	1.52	0.57
Projector	70	1.87	0.84	82	1.77	0.59
Laptop computers	70	2.15	0.87	82	1.93	0.72
Internet cable	70	1.84	0.86	82	1.60	0.74
Wireless internet	70	1.76	0.76	82	1.74	0.82
Electronic visual resources	70	1.77	0.78	82	1.54	0.67
Electronic books	70	1.75	0.82	82	1.62	0.83
Desktop computers	70	2.19	0.86	82	1.98	0.79
Audio visual (e.g television)	70	2.04	0.90	82	1.68	0.78
Computer laboratory	70	2.31	0.84	82	2.17	0.60
Mobile phones	70	2.01	0.80	82	1.64	0.76
Audio media(radio etc)	70	1.86	0.78	82	1.77	0.68
Overall Mean and Standard deviation		**29.52**	**12.51**		**26.37**	**10.36**
Overall Mean Difference			**(29.52 - 26.37) = 3.14**			

Table 4.6 shows the mean scores and standard deviations of digital technologies accessibility by mathematics teachers based on school type. It revealed that mathematics teachers' in public schools have total mean ($\bar{x}$) score of 26.37 with standard Deviation (SD) of 10.36 and private schools have total mean ($\bar{x}$) score of 29.52 with standard Deviation (SD) of 12.51 on the accessibility of digital technologies in teaching mathematics . The result demonstrated that mathematics teachers' in public schools have less access to digital technologies in teaching mathematics while mathematics teachers in private schools have more access to digital technologies in teaching mathematics compared to Public Schools with total mean difference of 3.14

Research Question Six: What is the extent of mathematics teachers readiness to use digital technologies based on school type for teaching Mathematics in secondary schools in Minna Metropolis, Niger State?

This research question was answered using mean and standard deviation. Summary of the analysis was presented in Table 4.7.

Table 4.7: Summary of Mean scores on extent of mathematic teachers' readiness to use digital technologies based on school type

	Extent of Mathematics Teachers' Readiness to use Digital Technologies in Private Schools			Extent of Mathematics Teachers' Readiness to use Digital Technologies in Public Schools		
Statements	**N**	**Mean ($\bar{x}$)**	**Std. Dev (SD)**	**N**	**Mean ($\bar{x}$)**	**Std. Dev (SD)**
I am not ready to use digital technologies because of insufficient knowledge of appropriate software and hardware.	70	2.51	0.75	82	2.39	0.65
I am no ready to use digital technologies due to the lack of knowledge on how to evaluate the use and role of digital technologies in teaching mathematics	70	2.41	0.71	82	2.21	0.75
I am discourage from using digital technologies because of fear of equipment failure	70	2.42	0.77	82	2.19	0.79
I am not ready to use digital technologies because of my limited experience	70	2.49	0.73	82	2.19	0.79
I am not ready to teach mathematics using digital technologies due to my level of qualification	70	2.49	0.69	82	2.28	0.79
I am discourage from using digital technologies to teach mathematics due to my limited training and professional development	70	2.28	0.78	82	2.23	0.75
I am not ready to use digital technologies to teach mathematics as a result of insufficient supply of electricity	70	2.28	0.79	82	2.07	0.75
I am not ready to use digital technologies to teach mathematics due to lack of technical support from the school management	70	2.52	0.69	82	2.06	0.73
I am discourage from using digital technologies to teach mathematics because of the unlimited time given to me in teaching mathematics in my school	70	2.34	0.69	82	2.19	0.69
I am not ready to use digital technologies because I am not given the freedom to design my own teaching with the help of digital technology in teaching mathematics in my school	70	2.38	0.79	82	2.09	0.67
Overall Mean and Standard Deviation		**24.09**	**7.42**		**21.93**	**7.37**
Overall Mean Difference				**(24.09 - 21.93) = 2.16**		

Table 4.7 shows the mean scores and standard deviations of mathematics teachers readiness to use digital technologies for teaching mathematics in secondary schools in Minna Metropolis. The result indicated that mathematics teachers in public schools have total (*M* = 21.93, *SD* = 7.37) and private schools mathematics teachers have a total (*M* =24.09, *SD* = 7.42) on readiness in using digital technologies for teaching mathematics in secondary schools in Minna Metropolis. However, the result showed that mathematics teachers in both (Public and Private) schools were ready to use digital technologies for teaching mathematics in secondary schools. Hence, private schools mathematics teachers' shows more readiness to use digital technologies as compared to public schools mathematics teachers with total mean difference of 2.16.

Research Question Seven: What is the level of mathematics teachers accessibility to digital technologies based on gender for teaching Mathematics in public secondary schools in Minna Metropolis, Niger State?

This research question was answered using mean and standard deviation. Summary of the analyses was presented in Table 4.8.

Table 4.8: Summary of Mean scores on the level of mathematics teachers' accessibility to digital technologies based on gender

Items	Level of Male Mathematics Teachers' Accessibility to Digital Technologies Public			Level of Female Mathematics Teachers' Accessibility to Digital Technologies public		
	N	Mean ($\bar{x}$)	Std. Deviation (SD)	N	Mean ($\bar{x}$)	Std. Deviation (SD)
Personal computers	57	2.27	0.73	13	1.87	0.67
Interactive whiteboards	57	2.19	0.76	13	2.13	0.79
Video conferencing system	57	1.57	0.74	13	1.21	0.50
Audio equipment	57	1.91	0.79	13	1.56	0.75
Projector	57	1.93	0.78	13	1.68	0.62
Laptop computers	57	2.24	0.75	13	1.79	0.79
Internet cable	57	1.73	0.79	13	1.72	0.83
Wireless internet	57	1.87	0.81	13	1.63	0.76
Electronic visual resources	57	1.78	0.78	13	1.51	0.62
Electronic books	57	1.88	0.87	13	1.46	0.73
Desktop computers	57	2.26	0.78	13	1.89	0.83
Audio visual (e.g television)	57	2.07	0.89	13	1.59	0.71
Computer laboratory	57	2.48	0.67	13	1.97	0.69
Mobile phones	57	1.98	0.80	13	1.63	0.76
Audio media(radio etc)	57	1.96	0.71	13	1.62	0.70
Overall Mean and Standard deviation		**30.12**	**11.66**		**25.26**	**10.80**
Overall Mean Difference	**(30.12 - 25.26) = 4.86**					

Table 4.8 shows the gender mean scores standard deviations on the accessibility of digital technologies for teaching mathematics in public secondary schools in Minna Metropolis. The result indicated that male mathematics teachers have a total (*M* = 30.12, *SD* = 11.66) while female mathematics teachers got a total (*M* =25.26, *SD* = 10.80) on the accessibility of digital technologies for teaching mathematics in public secondary schools in Minna Metropolis. Therefore, the result showed that male mathematics teachers have more access to digital technologies compared to female mathematics teachers' in secondary schools in Minna Metropolis with the total mean difference of 4.86.

Research Question Eight: What is the level of mathematics teachers readiness to use digital technologies based on gender for teaching Mathematics in public secondary schools in Minna Metropolis, Niger State?

This research question was answered using mean and standard deviation. Summary of the analyses was presented in Table 4.9.

Table 4.9: summary of Mean scores on the level of mathematics teachers' readiness to use digital technologies based on gender

STATEMENT	Level of Male Mathematics Teachers' Readiness to Use Digital Technologies			Level of Female Mathematics Teachers' Readiness to Use Digital Technologies		
	N	Mean ($\bar{x}$)	Std. Deviation (SD)	N	Mean ($\bar{x}$)	Std. Deviation (SD)
I am not ready to use digital technologies because of insufficient knowledge of appropriate software and hardware.	57	2.40	0.700	13	2.49	0.69
I am no ready to use digital technologies due to the lack of knowledge on how to evaluate the use and role of digital technologies in teaching mathematics	57	2.23	0.77	13	2.38	0.68
I am discourage from using digital technologies because of fear of equipment failure	57	2.35	0.79	13	2.25	0.78
I am not ready to use digital technologies because of my limited experience	57	2.31	0.783	13	2.35	0.77
I am not ready to teach mathematics using digital technologies due to my level of qualification	57	2.30	0.76	13	2.45	0.732
I am discourage from using digital technologies to teach mathematics due to my limited training and professional development	57	2.18	0.77	13	2.32	0.751
I am not ready to use digital technologies to teach mathematics as a result of insufficient supply of electricity	57	2.10	0.81	13	2.23	0.72
I am not ready to use digital technologies to teach mathematics due to lack of technical support from the school management	57	2.20	0.781	13	2.35	0.69
I am discourage from using digital technologies to teach mathematics because of the unlimited time given to me in teaching mathematics in my school	57	2.25	0.69	13	2.28	0.700
I am not ready to use digital technologies because I am not given the freedom to design my own teaching with the help of digital technology in teaching mathematics in my school	57	2.25	0.76	13	2.18	0.72
Overall Mean and Standard deviation		**22.62**	**7.65**		**23.30**	**7.27**
Overall Mean Difference			**(23.30 - 22.62) = 0.68**			

Table 4.9 shows the gender mean scores and standard deviations of mathematics teachers' readiness to use digital technologies for teaching mathematics in public secondary schools in Minna Metropolis. The result indicated that male mathematics teachers' have a total (*M* = 22.62, *SD* = 7.65) while female mathematics teachers got total (*M* =23.30, *SD* = 7.27) on their readiness to use digital technologies for teaching mathematics in public secondary schools in Minna Metropolis. Therefore, the result showed that both male and female mathematics teachers' were ready to use digital technologies for teaching mathematics in public secondary schools in Minna Metropolis. Hence, female mathematics teachers' show more readiness to use digital technologies as compare to their male counterpart with total mean difference of 0.68

4.3. Analysis of Null Hypotheses

Hypothesis One: There is no significant difference in mean score ranking on the level of availability of digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State.

The data was analyzed using Mann Whitney test as illustrated in Table 4.10.

Table 4.10: Summary of Mann Whitney Test mean scores ranking on the level of Availability of digital technologies based on school type

Variable	**School Type**	**N**	**Mean ($\bar{x}$)**	**DF**	**U-Value**	**P-value**	**Decision**
Availability of digital technologies	Public	82	1.86	150	1.92	0.06	Accept HO_1
	Private	70	2.02				

Table 4.10 showed that a u-value of 1.92 was obtained from the p-value of 0.06 at 150 degrees of freedom. The Table shows that public schools have mean ($\bar{x}$) score of 1.86 and mean ($\bar{x}$) score of 2.02 for private schools on Availability of digital technologies. Therefore, the null hypothesis (HO_1) was accepted since P-Value of 0.06 is greater than 0.05 alpha level. This meant that there was no statistically significant difference in mean

score ranking on the level of availability of digital technologies based on school type for teaching Mathematics in secondary schools in Minna, metropolis, Niger State.

Hypothesis Two: There is no significant difference mean score ranking on the level of mathematics teachers' accessibility of digital technologies based on school type for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State.

The data was analyzed using Mann Whitney test as illustrated in Table 4.11.

Table 4.11: Summary of Mann Whitney Test mean scores ranking on the level of Accessibility of digital technologies based on school type

Variable	School Type	N	Mean ($\bar{x}$)	DF	U-Value	P-value	Decision
Accessibility of digital technologies	Private	70	1.96	150	2.56	0.01	Reject HO_2
	Public	82	1.75				

Significant at $p<0.05$

Table 4.11 demonstrates that a u-value of 2.56 was obtained from p-value of 0.01 at 150 degrees of freedom. The Table demonstrated that public schools in the study area have mean score of 1.75 and mean score of 1.096 for private schools on Accessibility of digital technologies. Therefore, the null hypothesis (HO_2) was rejected since P-Value of 0.01 is less than 0.05 alpha levels. This indicates that there was statistically significant difference in mean score ranking on the level of Accessibility of digital technologies based on school type for teaching Mathematics in secondary schools in Minna, metropolis, Niger State.

Hypothesis Three: There is no significant difference mean score ranking on the extent of mathematics teachers' readiness to use digital technologies for teaching Mathematics between public secondary schools in Minna Metropolis, Niger State.

The data was analyzed using Mann Whitney test as illustrated in Table 4.12

Table 4.12: Summary of Mann Whitney Test mean scores ranking on the level of Accessibility of digital technologies on the extent of mathematics teachers' readiness to use digital technologies for teaching Mathematics

Variable	**School Type**	**N**	**Mean ($\bar{x}$)**	**DF**	**u-Value**	**P-value.**	**Decision**
Readiness to use of digital technologies	Private	70	2.41	150	3.04	0.00	Reject HO_2
	Public	82	2.19				

Significant at $p<0.05$

Table 4.12 reveals that a u-value of 3.04 was obtained from p-value of 0.00 at 150 degrees of freedom. The Table revealed that public schools have mean ($\bar{x}$) score of 2.19 and mean score of 2.41 for private schools on extent of mathematics teachers' readiness to use digital technologies for teaching Mathematics. Therefore, the null hypothesis (HO_3) was rejected since P-Value of 0.00 is less than 0.05 alpha level. This indicates that there was statistically significant difference in mean score ranking on the extent mathematics teachers' of readiness to use digital technologies for teaching Mathematics in secondary schools in Minna, metropolis, Niger State.

Hypothesis Four: There is no significant difference mean score ranking on the level of mathematics teachers' accessibility of digital technologies based on gender for teaching Mathematics in public and private secondary schools in Minna Metropolis, Niger State.

The data was analyzed using Mann Whitney test as illustrated in Table 4.13

Table 4.13: Summary of Mann Whitney Test mean scores ranking on the level of Accessibility of digital technologies based on gender

Variable	**School Type**	**N**	**Mean ($\bar{x}$)**	**DF**	**u-Value**	**P-value.**	**Decision**
Accessibility of digital technologies based on gender	Male	57	2.00	150	4.27	0.00	Reject HO_4
	Female	13	1.68				

Significant at $p<0.05$

Table 4.13 reveals that a u-value of 4.27 was obtained from p-value of 0.00 at 150 degrees of freedom. The Table revealed that male mathematics teachers' have mean ($\bar{x}$) score of 2.00 and mean ($\bar{x}$) score of 1.68 for female mathematics teachers' on accessibility of digital technologies based on gender. Therefore, the null hypothesis (HO_4) was rejected since P-Value of 0.00 is less than 0.05 alpha levels. This implies that there was statistically significant difference in mean score ranking on the level of accessibility of digital technologies based on gender for teaching Mathematics in secondary schools in Minna, metropolis, Niger State.

Hypotheses Five (HO_5): There is no significant difference mean score ranking on the level of mathematics teachers' readiness to use digital technologies based on gender for teaching Mathematics in public secondary schools in Minna Metropolis, Niger State.

The data was analyzed using Mann Whitney test as illustrated in Table 4.14

Table 4.14: Summary of Mann Whitney Test mean scores ranking on mathematics teachers' Readiness to use digital technologies based on gender

Variable	School Type	N	Mean ($\bar{x}$)	DF	U-Value	P-value.	Decision
Readiness to use of digital technologies	Male	57	2.26	150	0.96	0.03	Rejected HO_5
	Female	13	2.33				

Significant at $p<0.05$

Table 4.14 reveals that a u-value of 0.96 was obtained from p-value of 0.03 at 150 degrees of freedom. The Table revealed that male mathematics teachers' have mean ($\bar{x}$) score of 2.26 and mean ($\bar{x}$) score of 2.33 for female mathematics teachers' on readiness to use of digital technologies based on gender**.** Therefore, the null hypothesis (HO_5) was rejected since P-Value of 0.03 is less than 0.05 alpha levels. This shows that there was statistically significant difference in mean score ranking on the level of mathematics teachers' readiness to use digital technologies based on gender for teaching Mathematics in secondary schools in Minna, metropolis, Niger State.

4.4 Summary of the Major Findings

The following are the major findings of the study.

1. There was no statistically significant difference in the mean score ranking on the level of availability of digital technologies for teaching mathematics based on school type. Thus, private schools in Minna Metropolis have more digital technologies available for teaching and learning mathematics than public schools.
2. There was a statistically significant difference in the mean score ranking on the level of mathematics teachers accessibility to digital technologies for teaching mathematics based on school type. Thus, teachers in private schools in Minna Metropolis have more access to digital technologies for teaching and learning mathematics compared to teachers in public schools.
3. There was a statistically significant difference in the mean score ranking on the level of mathematics teachers readiness to use digital technologies for teaching mathematics based on school type. From the study, private schools mathematics teachers demonstrated a high mean score over public schools mathematics teachers. Hence, the private schools mathematics teachers demonstrated high readiness over the public schools mathematics teachers' in using digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger state.
4. There was statistically significant difference in the mean scores ranking on the level of mathematics teachers accessibility to digital technologies for teaching mathematics based on gender. Thus, Male mathematics teachers have greater mean score over their female mathematics counterparts. Hence, this shows that the male mathematics teachers have more access to digital

technologies than female mathematics teachers for teaching mathematics in public secondary schools in Minna Metropolis, Niger state.

5. There was a statistically significant difference in the mean scores ranking of on the level of mathematics teachers' readiness to use digital technologies for teaching mathematics based on gender in public schools. Male mathematics teachers' possessed a high mean score over their female mathematics teachers counterpart. Hence, the male mathematics teachers show more readiness than female mathematics teachers to use digital technologies for teaching mathematics in public secondary schools in Minna Metropolis, Niger state. Thus, this shows that readiness is not gendered biased.

4.4 Discussion of Findings

The result of this study is discussed based on the following findings.

Table 2 revealed that the level of availability of digital technologies for teaching Mathematics is fairly available in both public and private secondary schools. The researcher observed the following in each case of the items; 37 respondents representing (24.3%) had, not Available response to personal computers, 65 representing (42.8%) are fairly Available, 50 representing (32.9%) are Adequately Available. 33 respondents representing (21.7%) had, not Available response to Interactive whiteboards, 52 representing (34.2%) Fairly Available, 67 representing (44.1%) are Adequately Available. 90 respondents representing (59.2%) had, not Available response to Video conferencing system, 33 representing (21.7%) are Fairly Available and 29 representing (19.1%) are Adequately Available. 72 respondents representing (47.4%) had, not Available response to Audio equipment, 46 representing (30.3%) are Fairly Available, 34 representing (22.4%) are Adequately Available.

While 58 respondents representing (38.2%) had not Available response to Projector, 65 representing (42.8%) are fairly Available and 29 representing (19.1%)are Adequately Available. 35 respondents representing (23.0%) had, not Available response to laptop computers, 56 representing (36.8 %) are fairly Available and 61 representing (40.1%) are Adequately Available. 75 respondents representing (49.3%) had, not Available response to internet cable, 49 representing (32.2%) are fairly Available, 28 representing (18.4%) are Adequately Available. 64 respondents representing (42.1%) had, not Available response to Wireless internet, 34 representing (22.4%) are fairly Available and 54 representing (35.5%) are Adequately Available. 57 respondents representing (37.5%) had, not Available response to Electronic visual resources, 64 representing (42.1%) are fairly Available and 31 representing (20.4%) are AdequatelyAvailable.75 respondents representing (49.3%) had, not Available response to Electronic books, 29 representing (19.1%) are fairly Available and 48 representing (31.6%) are Adequately Available.

Similarly, 28 respondents representing (18.4%) had, not available response to Desktop computer and 50 representing (32.9%) are fairly accessible, 74 representing (48.7%) are Adequately Available. While 65 respondents representing (42.8%) had, not available response to Audio visual (e.g. television), 44 representing (28.9%) are fairly Available and 43 representing (28.3%) are Adequately Available. 20 respondents representing (13.2%)had, not Available response to Computer laboratory, 52 representing (34.2%) are fairly Available and 80 representing (52.6%) are Adequately Available. 54 respondents representing (35.5%) had, not Available response to mobile phones, 64 representing (42.1%) are Available and 34 representing (22.4%) are Adequately Available. 67 respondents representing (44.1%) had, not Available response to Audio media (radio etc), 58 representing (38.2%) are fairly accessible and 27 representing (17.8%) are Adequately Available.

The finding agrees with Bitok (2014), which revealed that public and private secondary schools lack necessary information and communication technology resources for teaching and learning biology. This finding gains further support from the work of Nwana *et al*. (2017), on the Availability and Utilization of ICT Resources in Teaching Computer Education in Secondary Schools. The finding revealed that many of the ICT resources needed to teach computer education were not available. Contrary to this study, Onah *et al*. (2020) revealed little or less availability of Information and Communication Technology (ICT) in secondary schools for teaching and learning Cultural and Creative Arts.

Table 3 revealed that, teachers' access to digital technologies for teaching mathematics is not accessible in public secondary schools. The researcher observed the following in each case of the items; 35 respondents representing (23%) had, not accessible response to personal computers, 69 representing (45.4%) are fairly Accessible, 48 representing (31.6%) are Adequately Accessible. 35 respondents representing (23%) had, not accessible response to Interactive whiteboards, 57 representing (37.5%) are fairly Accessible, 60 representing (39.5%) are Adequately Accessible. 105 respondents representing (69.1%) had, not accessible response to Video conferencing system, 32 representing (21.1%) are fairly Accessible and 15 representing (9.9%) are Adequately Accessible. 70 respondents representing (46.1%) had, not accessible response to Audio equipment, 49 representing (32.2%) are fairly Accessible, 33 representing (21.7%) are Adequately Accessible.

Also, 56 respondents representing (36.8%) had, not accessible response to Projector, 68 representing (44.7%) are fairly Accessible and 28 representing (18.4%) are Adequately

Accessible. 46 respondents representing (30.3%) had, not accessible response to laptop computers, 55 representing (36.2 %) are fairly Accessible and 51 representing (33.6%) are Adequately Accessible. 76 respondents representing (50.0%) had not accessible response to internet cable, 43 representing (28.3%) are fairly Accessible, 33 representing (21.7%) are Adequately Accessible. 71 respondents representing (46.7%) had, not accessible response to Wireless internet, 48 representing (31.6%) are fairly Accessible and 33 representing (21.7%) are Adequately Accessible. 76 respondents representing (50.0%) had not accessible response to Electronic visual resources.

Similarly, 53 representing (34.9%) are fairly Accessible and 23 representing (15.1%) are Adequately Accessible.84 respondents representing (55.3%) had, not accessible response to Electronic books, 33 representing (21.7%) are fairly accessible and 35 representing (23.0%) are Adequately Accessible. 46 respondents representing (30.3%) had, not accessible response to Desktop computer and 48 representing (31.6%) are fairly accessible, 58 representing (38.2%) are Adequately Accessible. While 68 respondents representing (44.7%) had, not accessible response to Audio visual (e.g. television), 39 representing (25.7%) are fairly accessible and 45 representing (29.6%) are Adequately Accessible. 26 respondents representing (17.1%) had, not accessible response to Computer laboratory, 64 representing (42.1%) are fairly accessible and 62 representing (40.8%) are Adequately Accessible. 65 respondents representing (42.8%) had, not accessible response to mobile phones, 50 representing (32.9%) are fairly accessible and 37 representing (24.3%) are Adequately Accessible. 57 respondents representing (37.5%) had, not accessible response to Audio media (radio etc), 67 representing (44.1%) are fairly accessible and 28 representing (18.4%) are Adequately Accessible.

The above finding is in harmony with Adelabu (2014). Their finding revealed that teachers in public secondary schools have less accessed ICT facilities. This study also agrees with the work of Nathaniel (2021), who disclosed that a considerable number of teachers have less access to Tablet PC and the internet; possess skills frequently, access and utilize their tablet PC for fun, entertainment, non-academic related functions. The above study is in total disagreement with Sofowora and Egbedokun (2010), findings, who observed that 55% of Geography teachers had access to computers but did not have the pre-requisite ICT skills. Out of the modern technologies available for teaching Geography, the most commonly used are: instructional television (54%), instruction radio (59%) and video (59%).

Table 4 revealed that teachers were ready to use Digital Technologies for teaching mathematics in public secondary schools. The researcher observed the following in each case of the items; 18 respondents representing (11.8%) of the response had, not ready to "*I am not ready to use digital technologies because of insufficient knowledge of appropriate software and hardware*" 48 representing (31.6%) are fairly ready, 86 representing (56.6%) are ready. 25 respondents representing (16.4%) had, not ready response to "*I am no ready to use digital technologies due to the lack of knowledge on how to evaluate the use and role of digital technologies in teaching mathematics*" 56 representing (36.8%) are fairly ready and 71 representing (46.7%) are ready. 31 respondents representing (20.4%) are not ready response, "*I am discouraged from using digital technologies because of fear of equipment failure*" 44 representing (28.9%) Fairly ready and 77 representing (50.7%) ready.

Also, 29 respondents representing (19.1%) had not ready response, "*I am not ready to use digital technologies because of my limited experience*" 44 representing (28.9%) Fairly ready, 79 representing (52.0%) ready. 24 respondents representing (15.8%) had not ready response, "*I am not ready to teach mathematics using digital technologies due to my level of qualification*" 46 representing (30.3%) Fairly ready and 82 representing

(53.9%) are ready. 29 respondents representing (19.1%) are not ready response, "*I am discouraged from using digital technologies to teach mathematics due to my limited training and professional development*" 55 representing (36.2 %) are fairly ready and 68 representing (44.7%) are ready. 35 respondents representing (23.0%) had not ready response, "*I am not ready to use digital technologies to teach mathematics as a result of insufficient supply of electricity*" 57 representing (37.5%) had Fairly ready, 60 representing (39.5%) are ready.

Similarly, 27 respondents representing (17.8%) had not ready response, "*I am not ready to use digital technologies to teach mathematics due to lack of technical support from the school management*" 56 representing (36.8%) are Fairly ready and 69 representing (45.4%) are ready. 22 respondents representing (14.5%) had not ready response, "*I am discouraged from using digital technologies to teach mathematics because of the unlimited time given to me in teaching mathematics in my school*" 68 representing (44.7%) are Fairly ready and 62 representing (40.8%) are ready.29 respondents representing (19.1%) had, not ready response, "*I am not ready to use digital technologies because, "I am not given the freedom to design my own teaching with the help of digital technology in teaching mathematics in my school*" 60 representing (39.5%) are fairly ready and 63 representing (41.4%) are ready.

This finding disagrees with that of Luis *et al*. (2021), who suggested that given the use of many digital resources and the high percentage of self-developed materials using educational software, secondary mathematics teachers reflected adequate digital competence and TPCK for teaching mathematics. The sudden transition to ERT forced teachers to slow down the pace of teaching and reduce the content taught. Significant differences were observed based on gender and age in teachers' perception of their adaptation to ERT. Despite the positive influence of previous training on their perception of ERT readiness, teachers generally recognized that they needed more training. This finding concurs with Naresh *et al*. (2015) in a study on Teachers Readiness to Use Technology in the Classroom. The finding revealed that the AUC among MSE secondary school teachers was moderate.

Meanwhile, the constructs of attitude, perceived usefulness, ease of use, job relevance, and computer compatibility showed a significant positive relationship with AUC. Furthermore, the finding is inconsistent with that of Lukman (2021) which revealed a high level of readiness among pre-service teachers to use digital storytelling for classroom instruction. Pre-service teachers' perceived relevance also played a significant role in their readiness to use digital storytelling for instructional delivery.

Tables 5 and 10 revealed a significant difference between public schools and private schools on the availability of digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger state. The significant difference favours private schools in terms of the availability of digital technologies, as revealed in their mean score and p-value. This finding agrees with Muhammad *et al*. (2020), who in their study on Inequities of Digital Skills and Innovation between Public and Private Schools in Punjab. The finding revealed that public and private institutes mainly vary regarding digital skills. This study also agreed with the findings of Onasanya *et al*. (2011), who in their separate studies on teacher awareness and extent of utilization of ICT for effective science and health education in Nigeria revealed that the level of utilization of ICT resources is shallow due to lack of availability of ICT resources in secondary schools in ten (10) local government area in Oyo state. In addition, Amuchie (2015) opines that the extent of utilization of ICT resources such as desktop computers, laptops, television, video players, radio, digital camera, printers, multimedia projectors, scanners, photocopying machines, satellite disc, Internet, Interactive whiteboard, and electronic notice board for teaching and learning in secondary schools in Nigeria is at a shallow extent, which is caused by the lack of ICT resources in the secondary schools. Furthermore, the finding of this study is also in disagreement with that of John and Shallimar (2020), who in their study disclosed that in terms of school readiness on distance learning, the schools were not yet ready to implement a distance learning scheme for teaching and learning process.

Tables 6 and 11 revealed a significant difference between public schools teachers and private school teachers' level of accessibility of digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger state. The significant difference is also in favour of private school teachers in terms of accessibility of digital technologies, as revealed in their mean score and p-value. The finding is also in line with the study of Muhammad *et al*. (2020), which showed that private school teachers were more innovative in accessing digital skills. Therefore, initiatives should be taken to develop an interest in public sector teachers regarding technology practice. Moreover, the government can also collaborate with the private sector to learn from their digital experiences and train teachers from the public sector. Furthermore, the finding is in harmony with Adenike *et al*. (2021) on Correlation Studies between Secondary School Teachers' Access to and Utilization of Internet Facilities for Instruction in Ilorin, Nigeria. The finding revealed a significant positive relationship between teachers' access to and utilization of Internet facilities for instruction. This implies that teachers who access Internet facilities use Internet facilities for classroom instruction more than their counterparts.

Tables 7 and 12 revealed a significant difference between public school teachers and private school teachers' readiness to use digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger. The finding supports Naresh *et al*. (2015), who, in his study on Teachers' Readiness to Use Technology in the Classroom, revealed that the AUC among MSE secondary school teachers was at a moderate level. Meanwhile, the constructs of attitude, perceived usefulness, ease of use, job relevance, and computer compatibility showed a significant positive relationship with AUC.

Tables 8 and 13 revealed a significant difference between male teachers and female teachers' accessibility of digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger state. The significant difference favours male teachers in terms of accessibility of digital technologies, as revealed in their mean score and p-value. Sometimes collateral cultural factors and other cultural attitudes based on gender bias and not the immediate gender identification of technology use prevent young girls and female teachers from accessing and using digital technologies in teaching and learning. Research shows disparities in education between genders, especially in Africa, where more emphasis is placed on boy-child than girl-child. The finding is in line with the EFA Global Monitoring Report (2012) in his study showed that girls face enormous obstacles to entering school than boys and that majority of 150 (68.2%) of respondents were males while 70 (31.8%) were females.

Further, it revealed that most of the teachers in Kenya involved in ICT in schools were males not females. Similarly, the finding supports Jimoyiannis and Komis (2017), who in his study revealed that male teachers are more optimistic about ICT in school while female teachers are neutral or negative. However, the finding is also inconsistent with that of Adenike *et al*. (2021), who studied Correlational Studies between Secondary School Teachers' Access to and Utilization of Internet Facilities for Instruction in Ilorin, Nigeria. The study findings revealed a significant positive relationship between teachers' access to and utilization of Internet facilities for instruction. This implies that teachers who access Internet facilities use Internet facilities for classroom instruction more than their counterparts.

Tables 9 and 14 revealed a significant difference between male teachers and female teachers' readiness to use digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger state. The finding is in agreement with Almanthari *et al*. (2020). The finding revealed that digital technologies facilities are a significant mediator between male and female teachers' readiness and digital technologies applications in mathematics teaching and learning. The study is also in line with that of Rahim and Shamsiah (2018), who researched on Teaching Using Information Communication Technology. The findings showed that male teachers are more confident than female teachers in using ICT integration in teaching.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The study investigated the availability, accessibility, and readiness to use digital technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger State, presented in five chapters.

Chapter one of the study presented the problem of the study. In the Background of the study, the researcher discussed availability, accessibility and readiness to use digital technologies for teaching mathematics in secondary schools. The study has eight objectives, one of which seeks to investigate the availability of digital technologies for teaching mathematics in public and private secondary schools in Minna Metropolis, Niger State. This is guided by eight research questions with corresponding eight research hypotheses. The study is limited to only mathematics teachers at the secondary level in Minna, Metropolis, Niger State using digital technologies in teaching mathematics in their classroom. The Purpose of the Study, Significance of the Study, and Operational definition of terms were also discussed.

This is followed by chapter two, where the related literature was reviewed under the following sub-headings: Conceptual Framework, Theoretical Framework, and Empirical Studies on the availability, accessibility and readiness to use digital technologies and summary of related literature. The review has pointed out that the level of digital technologies tools such as computers, projectors and among other accessories are inadequate and fairly accessible by mathematics teachers. This has resulted in limitation on the readiness to use them in their classroom for teaching and learning process, which have some implications to the present study as it pointed out the low level of availability, accessibility and readiness to use digital technologies in teaching mathematics. This gap has been filled by this study.

Chapter three presented the methodology employed in carrying out the study. The study adopted a descriptive survey design. A sample size of one hundred and fifty-two (152) mathematics teachers was drawn using Krejcie and Morgan's table for determining sample size (1970) from a population of two hundred and fifty-one (251) Mathematics teachers for the study. The research Instrument, namely, Digital Technologies Availability, Accessibility and Readiness to use questionnaire (DITAARQ) inventory scale, was developed and validated by two (2) expert lecturers in Science and Educational Technology Department of the Federal University of Technology, Minna, in order to access the items for clarity of purpose, relevance to the subject matter, appropriateness of language and relevance of the instrument to the study to guide in data collection. Cronbach Alpha Reliability Coefficients formula was used to justify the reliability of the instrument Digital Technologies Availability, Accessibility and Readiness to use questionnaire (DITAARQ) containing forty-two (42) items yielded an estimated value of 0.76. Finally, the procedure for data analysis was also presented in this chapter.

Chapter four of the study presented the result and discussion of findings. Eight research questions raised were answered using mean and standard deviation, while hypotheses were tested using Mann Whitney at 0.05 level of significance. Statistical Package for Social Science (SPSS) version 23 software was used to analyse the data obtained. Results from the findings had revealed that:

i. there was no statistically significant difference in the mean score ranking on the level of availability of digital technologies for teaching mathematics based on school type. Thus, private schools in Minna Metropolis have more digital technologies available for teaching and learning mathematics than public schools;

ii. there was a statistically significant difference in the mean score ranking on the level of mathematics teachers' accessibility to digital technologies for teaching mathematics based on school type. Thus, mathematics teachers in private schools in Minna Metropolis have more access to digital technologies for teaching and learning mathematics than mathematics teachers in public schools;

iii. there was a statistically significant difference in the mean score ranking on the level of mathematics teachers readiness to use digital technologies for teaching mathematics based on school type. From the study, private school mathematics teachers demonstrated a high mean score over public school teachers. Hence, the private schools mathematics teachers' demonstrated high readiness over the public schools teachers in using digital technologies to teach mathematics in secondary schools in Minna Metropolis, Niger state;

iv. there was statistically significant difference in the mean scores ranking on the level of mathematics teachers accessibility to digital technologies for teaching mathematics based on gender. Thus, male mathematics teachers have greater mean score than their female counterparts. This shows that the male mathematics teachers have more access to digital technologies than female of mathematics teachers in teaching mathematics in public secondary schools in Minna Metropolis, Niger state; and

v. there was a statistically significant difference in the mean scores ranking on the level of mathematics teachers readiness to use digital technologies for teaching mathematics based on gender in public schools. Male mathematics teachers possessed a high mean score over their female counterparts. Hence, the male mathematics teachers show more readiness than female mathematics teachers to use digital technologies in teaching mathematics in public secondary schools in Minna Metropolis, Niger state. Thus, this shows that readiness is not gender biased.

Finally, chapter five of the study presented the summary, drew conclusions, provided valuable and necessary recommendations and suggestions for further studies on the research work. The study concluded that using digital technologies as instructional tools such as computers, projectors, and video conferencing has made it possible to overcome barriers of space and time and has opened new possibilities for the teaching and learning process in the 21st century in secondary schools in Minna Metropolis, Niger State. Moreover, private and public secondary schools in Minna Metropolis, Niger State are now aware of the importance of incorporating digital technologies tools into teaching activities in their classrooms.

Hence, this study revealed generally that digital technologies have far-reaching implications in teaching and learning at the secondary schools level in Minna Metropolis, Niger State. This is because mathematics teachers have seen the usefulness of digital technologies. However, despite mathematics teachers' awareness and potential of digital technologies, yet only few of them make use of digital resources available and accessible for teaching mathematics in their classrooms. Therefore, the need for further development and use of digital resources amongst mathematics teacher, particularly at this level, is crucial. In the light of this, the study recommended, among others, that government should encourage both the mathematics teacher and students to incorporate digital technologies tools in teaching and learning of mathematics, as well as in organizing seminars, conferences and workshops for mathematics teachers to acquire the required skills, knowledge and professional development to use the latest instructional tools such as computer, projector etc.

5.2 Conclusions

Based on the study's findings, it is a truism to conclude that the level of digital technologies tools is inadequate and inaccessible for teaching and learning of mathematics in public secondary schools compared to private secondary schools in Minna Metropolis, Niger State. The level of inadequate availability and accessibility of digital technologies has been identified as poor in public schools. It is therefor, worthy of note that the availability, accessibility and readiness to use Digital Technologies for teaching mathematics in secondary schools in Minna Metropolis, Niger State are faced by many several challenges which include; Inadequate funding, inconsistency of power supply, Inadequate ICT facilities, Lack of sponsorship to both national and international conference, seminar, workshop, etc.; Over dependence on donor support; technophobia; inadequate ICT training of staff, low internet among others.

To curtail these challenges, some strategies were employed, some of which include; Independence on in-house funding by schools; provision of adequate funding by the government; constant power supply; adequate ICT training of staff; sponsorship of staff to both national and international conferences, seminar, workshop, etc. adequate ICT facilities in the schools, standard Internet infrastructure, among others. Conclusively, it will be valid to affirm that public secondary schools in Minna, Metropolis Niger State, lack adequate digital technologies facilities for teaching and learning Mathematics.

Hence, the level of use is inferior compared to private schools, though Digital Technologies have many perceived benefits to mathematics teachers and students.

5.3 Recommendations

Based on the findings and conclusion from this study, the following recommendations were made.

1. Niger State Government and proprietor of private schools should provide technology resources for teaching mathematics in secondary schools.
2. Niger State Government and proprietor of private schools should also improve mathematics teachers welfare so as to motivate and enable them discharge their functions effectively and efficiently on the use of technology resources for teaching mathematics in secondary schools.
3. There should be constant seminars, national and international conferences and workshops for mathematics teachers to provide them with the required skills, knowledge and professional development to enable them use the latest instructional tools such as computer, projector etc. This will be helpful on how to use the available digital technologies in secondary schools maximally.
4. Stakeholders in education, such as the Ministry of Education and non-governmental agencies, should formulate and implement specific information and communication technology (ICT) policies on digital technologies instructional tools for the Nigerian secondary educational system to meet up with the demand of on the socio-economic transformation of Nigeria as en-capsulated in the Vision 20:30 Document.
5. Public and private secondary schools authorities/administrations should conduct in-service teacher training to enhance digital technologies use among secondary school teachers to meet the standard of education in the 21st century.

6. Stakeholders and partners in education industries such as the Federal Ministry of Education, State Ministries of Education, Parent Teachers Association (PTA) among others, should encourage teachers in secondary schools to acquire personal computers purchased, through monthly contribution or loan at subsidized rate from their employers or bankers.

5.4 Implications of the Study

The following implications have been observed in the conduct of the study:

1. The use of digital technologies as instructional tools in education helps to develop critical scientific thinking, enhance teaching, and facilitate learning using multi-modal courseware among the teachers and the students.
2. It motivates the learners to participate in learning activities at any time and from anywhere.
3. It helps in exchanging and sharing ideas among mathematics teachers for professional growth and improves access on the use of digital technologies resources for teaching and learning process in their class room.

   Hence, ICT tools such as radio, T.V., Internet, computer, laptop, tablets, and many other hardware and software applications can be appropriated in the teaching-learning process. These tools can give benefits in the areas of content, curriculum, instruction, and assessment. In Nigeria, education has three main levels: primary, secondary, and tertiary. The quality of all these levels can be improved by using digital technologies instructional tools and techniques.

5.5 Contributions to Knowledge

This study, availability, accessibility and readiness to use digital technologies amongst secondary school mathematics teachers in Minna Metropolis, Niger State, has contributed to the existing body of knowledge in science education and other areas in the following ways:

1. The study has provided knowledge among mathematics teachers on the vital roles for using digital technologies resources in teaching and learning process specifically mathematics in secondary schools.
2. In addition, the study has also contributed to the existing literature and established a platform for future researchers on availability, accessibility and readiness to use digital technologies amongst secondary school mathematics teachers.

5.6 Suggestions for Further Studies

The research has established the availability, accessibility and readiness to use digital technologies amongst mathematics teachers in Minna Metropolis, Niger State. However, the following areas were suggested for further research study based on the research findings.

1. Replicate research on Availability, Accessibility and Readiness to use Digital Technologies amongst secondary schools' mathematics teachers in North central, Nigeria.
2. Availability, Accessibility and Readiness to use Digital Technologies amongst public and private secondary schools mathematics teachers in Zone A, Niger State.
3. Availability, Interest and Readiness to use Digital Technologies amongst secondary schools' mathematics teachers in Nigeria.
4. The related study should be conducted on Colleges of Education in Nigeria.
5. A similar study should also be carried out in Colleges of Education in Minna, Niger State.

REFERENCES

Abd Rahim, B. & Shamsiah, M. (2018). Teaching Using Information Communication Technology: Do trainee teachers have the confidence? *International Journal of Education and Development using ICT, 4*(1), 1-8.

Adebayo, O. (2007). Availability and utilization of material resources as correlates of student's learning outcome in Secondary school history: A case study of some selected secondary schools in Oluyole Local Government Area of Oyo State. Unpublished M.Ed. Project, University of Ibadan.

Adedokun, A. A. (2016). Nigeria secondary school teachers' demographics, perception, and level of technology integration: A correlational study (Doctoral dissertation). Retrieved from Nigeria secondary school teachers demographics_ perception and level of technology integration a correlational study.

Adelabu, O. (2014). Assessment of Accessibility and Utilization of Information and Communication Technology (ICT) for Effective Teaching of Biological Science in Secondary Schools. *Mediterranean Journal of Social Sciences*, 12(3),5-10..

Adenike, A. & Amos, O., & Charles, O. (2021). Correlational Studies between Secondary School Teachers' Access to and Utilization of Internet Facilities for Instruction. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 17(1),6-20.

Adomi, H. & Kpangban, C. (2010) Factors that influence elementary teachers use of computers. *Journal of Technology and Teacher Education,* 15(2), 267–293.

Afshari, M., Ghavifekr, S., Siraj, S., & Jing, D. (2013). Students' attitudes towards computer-assisted language learning. *Behavioral Sciences*, 103; 852-859.

Agbatogun, A. O. (2012). Investigating Nigerian primary school teachers' preparedness to adopt personal response system in ESL classroom. *International Electronic Journal of Elementary Education*, *4*(2), 377-394.

Aja, S. N. (2020). Educational leadership for social change: Positioning school administrators as agents of social change in Nigeria. *Management in Education,* 34(2), 84-87.

Aldon, G. (2010). Handheld calculators between instrument and document. *ZDM: The International Journal on Mathematics Education,* 42; 733–745.

Alison C.W., Ornella, R., & Mike, T. (2020). Teaching mathematics with digital technology. ZDM; *The International Journal on Mathematics Education,* 52;1223–1242.

Almanthari, A., Maulina, S., & Bruce, D. (2020). Secondary school mathematics teachers' view on e-learning implementation barriers during the COVID-19 pandemic: The case of Indonesia. *Eurasia J. Math.Sci. Technol,* 16; 1860.

Amanchukwu, R. N., Stanley, G. J., & Ololube, N. P. (2015). A review of leadership theories, principles, and styles and their relevance to educational management. *Management*, 5(1), 6-14.

Amazigbo, J.C. (2016). Mathematics phobia diagnosis and prescription National computers for teaching? A literature review. *Journal of Research on Computing in Education, 31* (2), 123-140

Ameen, K. S., Adeniji, S. M., & Abdullahi, K. (2019). Teachers' and students' level of utilization of ICT tools for teaching and learning mathematics in Ilorin, Nigeria. *African Journal of Educational Studies in Mathematics and Sciences*, *15*(1), 51-59.

Amuchie, A. A. (2015) Availability and Utilization of ICT Resources in Teaching and Learning in Secondary Schools in Ardo-Kola and Jalingo, Taraba State. Journal of Poverty, Investment and Development, 8, 94-100.

Apple Computer, Inc. (2015). *Apple software in depth*. Cupertino: Apple Computer, (Fall/Winter): 47, 56.

Ash, Katie. (2018). Projecting a better view. *Education Week* 's *Digital Directions* 2(3): 34–35.

Awofala, A. O. (2020). Assessing senior secondary school students' mathematical proficiency as related to gender and performance in mathematics in Nigeria. *International Journal of Research in Education and Science (IJRES)*, *3*(2), 488-502.

Bartsch, R. A. & K. M. Cobern (2013). Effectiveness of PowerPoint Presentation in Lectures. *Computers & Education*, 41; 77-86.

Bicer, A., & Capraro, R. M. (2017). Longitudinal effects of technology integration and teacher professional development on students' mathematics achievement. *EURASIA Journal of Mathematics Science and Technology Education*, *13*(3), 815-833.

Bingimlas, K. (2018). Investigating the level of teachers' knowledge in technology, pedagogy, and content (TPACK) in Saudi Arabia. *South African Journal of Education*, *38*(3), 1496-1508.

Bitok, E. B. (2014). Availability of Information and Communication Technology Resources in Teaching and Learning of Biology by Secondary Schools in Uasin Gishu County, Kenya. *International Journal of Science and Research*, 3(10), 2279-2285.

Bitzer, D., Peter, B. & Wayne, W. L. (2013). PLATO: An automatic teaching device. *IRE Transactions on Education* E-4(4), 157–161.

Blau, I., Peled, Y., & Nusan, A. (2016). Technological, pedagogical, and content knowledge in one-to-one classroom: teachers developing "digital wisdom". *Interactive Learning Environments*, 24(6), 1215-1230.

Buabeng-Andoh, C. (2012). An exploration of teachers' skills, perceptions and practices of ICT in teaching and learning in the Ghanaian second cycle schools. *Contemporary Educational Technology*, 3(1), 36-49.

Capaldo, C., Flanagan, K. & Littrell, D. (2014). Teacher Interview 7377 – Introduction to Technology in Schools. Retrieved October 23, 2017

Carlson, S., & Gadio, C.T. (2013). Teacher professional development in the use of technology. [Online].*Technologies for Education*. Available.

Carver, C. S. & Scheier, M. F. (2016). *Perspectives on personality*. Upper Saddle River, NJ: Pearson Education.

China Daily (2010). http://europe.chinadaily.com.cn/china/2010-12/31/content_ 11782006.htm Accessed Nov 13 2011.

Chonacky, N. & David, W. (2015). Maple, Mathematica, and Matlab: The 3M's without the tape. *Computing in Science and Engineering*, 7(1), 8–16.

Connor, M. I. & Wong, F. H. (2014). Working through PowerPoint: A Global Prism for Local Reflections. *Business Communication Quarterly*, 67(2), 228-231.

Dateba, S. (2015). Availability and use of Instructional Materials for Art Teaching in Four Colleges of Education in Kaduna and Plateau States, Nigeria. *Journal of education*, 4(3), 32-40.

Dele-Ajayi, O., Victor, A., Oluwafemi, A., Emma, A., Rebecca, S., & Itoro, E. (2019). Barriers and identified solutions to the integration of digital technologies in the classroom: A case study of teachers in Nigeria. In *2019 IEEE Global Engineering Education Conference (EDUCON)* (pp. 953-958).

Deng, F., Chai, C. S., So, H. J., Qian, Y., & Chen, L. (2017). Examining the validity of the technological pedagogical content knowledge (TPACK) framework for preservice chemistry teachers. *Australasian Journal of Educational Technology*, 33(3), 26-33.

DeTurck, D. (2013). Software Reviews. *College Mathematics Journal*, 24(4), 370–376.

Digital Technology (2015). Safe & Responsible use in Schools. Retrieved October 22, 2017.

Dusick, D.M. (2010). What social cognitive factors influence faculty members' use of *Education, 9*(3), 319-341.

Ergen, B., Yelken, T. Y., & Kanadli, S. (2019). A Meta-Analysis of Research on Technological Pedagogical Content Knowledge by Gender. *Contemporary Educational Technology*, *10*(4), 358-380.

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., andSendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. Computers and Education, 59(2), 423-435.

Etuk, E. D. & Bello, D. O. (2016).Challenges and prospects of mathematics Education in Nigeria.*J. Assertiveness*, 9684-9692.

Fakeye, D. (2010). Assessment of English language Teachers' Knowledge and use of Information Communication Technology (ICT) in Ibadan Southwest Local Government of Oyo State. American-Eurasian Journal of Scientific Research 5(4); 270-276.Marcelle, G. (2000). Gender Justice and ICTs.

Falade, A. A. & Samuel, Nathaniel (2016). College of Education Student Accessibility, Attitudes and Competence Towards the Use of Internet In Oyo State, Nigeria, Journal of Science, Technology, Mathematics and Education (JOSTMED), 12(1), 256-263.

Faw, R. (2015). [On-line] *Teachers and computers: The task ahead*.

Gadio C. (2014). *Exploring the Gender Impact of the World Links Program in someselected participating African countries: A qualitative approach*. World Links:Washington. Available at: http://www.world-links.org. (Accessed 10th October 2007.

George, A.S., McEwin, K., & Jenkins, J.M. (2010). *The exemplary high school*. New York: Harcourt

Getenet, S. T. (2017). Adapting technological pedagogical content knowledge framework to teach mathematics. *Education and Information Technologies*, *22*(5), 2629-2644

Gibbons, A.S. & Fairweather, P.G. (2010). Computer-based instruction: Design and development: New Jersey: Educational Technology Publications.

Goshit, T. (2016). Nigeria's need for ICT: SP. 259 technology and policy in Africa.

Guin, D., & Trouche, L. (2015). The complex process of converting tools into mathematical instruments. The case of calculators. *The International Journal of Computers for Mathematical Learning*, 3(3), 195-227.

Hafkin, N. (2012). Gender issues in ICT policy in developing countries: An overview.Paper presented at the *UN Division for the Advancement of Women Expert GroupMeeting on Information and Communication Technologies and Their Impact On andUse as an Instrument for the Advancement and Empowerment of Women*, Seoul,

Hennessy, S, Ruthven (2015). A practitioner model of the use of computer-based tools and resources to support mathematics teaching and learning. Educational Studies in Mathematics, 49(1), 47–88.

Herring, M. C., Koehler, M. J., & Mishra, P. (Eds.). (2016). *Handbook of technological pedagogical content knowledge (TPACK) for educators.* Milton Park, Abingdon, Oxfordshire USA Routledge Taylor & Francis NY.

Higgins, S., Xiao, Z., & Katsipataki, M. (2012). The Impact of Digital Technology onLearning: A Summary for the Education Endowment Foundation. Durham University.Retrieved October 22, 2017 .

Howard, S. K., Chan, A., & Caputi, P. (2015). More than beliefs: Subject areas and teachers' integration of laptops in secondary teaching. *British Journal of Educational Technology, 46*(2), 360-369.

Hu, P.J., Clark, T.H.K., & Ma, W.W. (2013). Examining technology acceptance by school teachers: A longitudinal study.*Information & Management, 41*, 227-241.

Ibrahim, C.F. (2015). An Exammination of Factors Affecting Students' Behaviour in Cultural andCreative Arts in Junior Secondary Schools in Nasarawa State, Nigeria. Unpublished Dissertationsubmitted to The School of Postgraduate Studies, Ahmadu Bello University, Zaria, Nigeria.

Imonivwerha, P. A., Obiunu, A. E., & Ogheneovo, P. (2014). Quality teacher preparation for climate change curriculum at the senior secondary school level.*Nigerian Journal of Curriculum Studies*, 21, 21-34.

Jimoyiannis, A. & Komis, v. (2017) Examining teachers‟ beliefs about ICT in education: implications of a teacher preparation program, Teacher Development, *An international journal of teachers' professional development*,11:2,149-173.

John, M.R. A. & Shallimar, A. B. (2020). Spearheading education during the COVID-19 rife: Administrators' level of digital competence and schools' readiness on distance learning. Journal of Pedagogical Sociology and Psychology, 3(1), 19-26.

Johnson, D. (2012). An overview of Cooperative Learning. Retrieved may 05, 2018 from www.co-operative.org/what-is-co-operative.

Kalagbor, L. D. (2016). An analysis of factors influencing students' academic performance in public and private secondary schools in Rivers State107 Nigeria.*Journal of Education and Practice, 7*(28), 96-101.

Kaleli-Yilmaz, G. (2015). The views of mathematics teachers on the factors affecting the integration of technology in mathematics courses.*Australian Journal of TeacherEducation*, *40*(8), 132-148.

Katamba, Z. L. (2009). Factors militating against the use of ICT in teaching and learning in public secondary schools in Kebbi State, Nigeria. *African Educational Research Journal*, 7(4): 168-173.

Kemeny, J. G. & Kurtz, T. E. (2012). *Back to BASIC*. Reading, Mass.: Addison-Wesley. Dartmouth's time-sharing computer and BASIC in this twenty-year retrospective

Kidwell, B., Hardesty, D.M., & Childers, T.L. (2018). Consumer emotional intelligence: conceptualization, measurement, and the prediction of consumer decision making. *Journal of Consumer Research*, (35), 154-166.

Koehler, M (2012). *TPACK explained*. Learning to teach in a post-modern world.[Online].*Educational Technology*.Available

Koh, J. H. L., Chai, C. S., Benjamin, W., & Hong, H. Y. (2015). Technological pedagogical content knowledge (TPACK) and design thinking: A framework to support ICT lesson design for 21st century learning. *The Asia-Pacific Education Researcher*, *24*(3), 535-543.

Kola, J., & Sunday, O. S. (2015). A review of teacher self-efficacy, pedagogical content knowledge (PCK), and out-of-field teaching: Focusing on Nigerian teachers. *International Journal of Elementary Education 4*(3) pp 80-85.

Kravitz, C. (2013). Why math is important. Retrieved on 10th July 2013.

Luis J. R., Diego Burón, Álvaro, A. G., & Laura, M.R. (2021).Secondary Mathematics Teachers' Perception of Their Readiness for Emergency Remote Teaching during the COVID-19 Pandemic.Educ. Sci. 2021, 11, 228.

Lukuman, K. B., Amos, O. O., & Adetayo, A. A. (2021). The Impact of Perceived Relevance and Technology Anxiety on Readiness to Use Digital Storytelling. *International Journal of Teacher Education and Professional Development*, 6(3), 76-89.

Madan, C. R., & Kensinger, E. A. (2017). Test–Retest Reliability of Brain Morphology Estimates. Brain Informatics, 4, 107–121.

Malubay, J., & Daguplo, M. S. (2018). Characterizing mathematics teachers' technological pedagogical content knowledge. *European Journal of Education Studies*, *4*(1), 200.

Martin, G., & Ofori-Attah, K.D. (2015). [On-line] *Internet technology enhanced classroom*. Mathematics centre first annual lecture, Abuja, July.

McKenna, A (2019). The Editors of Encyclopedia Britannica. Ogun State, Nigeria.

Melchor, G.G., Hassan, H.M., Juan, M. T.T., Hossein, H.M., & Inmaculada, A.D. (2020). Technological Factors That Influence the Mathematics Performance of Secondary School Students. Mathematics 2020, 8, 1935,

Mereku, D. K., & Mereku, C. W. K. (2015). Congruence between the intended, implemented and attained ICT curricula in sub-Saharan Africa. *Canadian Journal of Science, Mathematics and Technology Education*, *15*(1), 1-14.

Miller, O. & Akume, B.S. (2009). The challenges of effective application of ICT aided learning in office technology education. A paper presented at the 21st annual national conference of association of business educators of Nigeria (ABEN) on the 13th – 17th October, 2009 at Abia State Polytechnic Aba, Abia State.

Mishra & Koehler (2018), Technological Pedagogical Content Knowledge: A framework for teacher knowledge. Teach. Coll. Rec.2008, 108, 1017–1054.

Mitra, S. (2011). Paper presented at the *USAID Conference on New Technologies for Development and Disaster Relief.* Washington, D.C: Government of Mozambique. ICT Implementation Strategy.

Morgan, S., Heeks, R. & Arun, S. (2014). *Researching ICT-based enterprise for womenin developing countries: A gender perspective women's ICT-based enterprise for development project.* Available at (Accessed:10th October 2007).

Msila, V. (2015). Teacher readiness and information and communications technology (ICT) use in classrooms: A South African case study. *Creative Education*, *6*(18), 1973.

Mugenda, M. (2013), Research methods, African centre for Technology studies, Nairobi Kenya.

Muhammad, S. A., Muhammad, N. A., & Anila,Y.(2020), Inequities of Digital Skills and Innovation between Public and Private Schools in Punjab. Bulletin of Education and ResearchAugust 2020, 2(2) 97-112.

Mumtaz, S (2011). Factors affecting teachers' use of information and communications technology: A review of the literature. *Journal of Information Technology for Teacher*

Naresh, K., Raduan, C., & Jeffrey, L. D (2015), Teachers' Readiness to Use Technology in the Classroom: An Empirical Study. European Journal of Scientific Research .ISSN 1450-216,21 (4).

Nathaniel, S. (2021). Nigerian Secondary Students' Accessibility, Utilization, Competence and Attitude towards the Use of Tablet PC for Pedagogic Experience. International Journal of Learning and Instruction (IJLI), 3 (1), 43-50.

Federal Republic of Nigeria (2014). National Policy on Education.

Ngwu, O.G, (2014) Assessment of availability and utilization of ICT resources in teaching in F.C.E Eha-Amufu Enugu Nigeria. ICELW.

Niess, M. (2006). Guest Editorial: Preparing teachers to teach mathematics with technology. Contemporary Issues in Technology and Teacher Education, 6(2). Available. http://www.citejournal.org/vol6/iss2/mathematics/article1.cfm (06/05/2011).

Niess, M., Ronau, R., Shafer, K., Driskell, S., Harper, S., Johnston, C., Browning, C., Özgün-Koca, S., & Kersaint, G. (2009). Mathematics Teacher TPACK Standards and Development Model. Contemporary Issues in Technology and Teacher Education, 9(1), 4-24.

North Central Regional Educational Laboratory. (2012). Breaking down the digital walls: Nigeria. *MOJES: Malaysian Online Journal of Educational Sciences*, *4*(3), 39-48.

Nwana, S.E., Ofoegbu, T.O. & Egbe, C.I. (2017). Availability and Utilization of ICT Resources in TeachingComputer Education In Secondary Schools in Anambra State, Nigeria. Mediterranean Journal of Social Sciences, 8(5):111-116

Nwosu, A, A. (2017). Integrating ICT into STM Classrooms: Status and Implications. STAN Proceedings of the 44th Annual Conference, 58 – 60.

Ogunlade, O. & Lukuman, B. (2021). Pre-Service Teachers' Perceived Relevance of Educational Technology Course, Digital Performance: Teacher Perceived of Educational Technology. *International Journal of Technology-Enabled Student Support Services*. 9; 41-54. 10.4018/IJTESSS.2019010103.

Okwudishu, C.H. (2015). Awareness and use of Information and Communication Technology (ICT) among village secondary school teachers in Aniocha South Local Government Area of Delta State. Abraka: Delta State University Unpublished B.Sc (LIS) Project.

Olafare, O.F., Akinoso, S. O., Adeyanju, L. O., & Olorundaisi T. F. (2020). Mathematics Teachers' Readiness Towards Utilization Of Multichoice Resource Centre For Teaching In Ogun State. International Journal For Innovative Technology Integration In Education.

Olokoba, A. A., Abdullahi, A. M., & Omosidi, S. A. (2014), Impact of Information Communication Technology (ICT) on The Management and Performance of Secondary School Teachers in Kwara State, Nigeria. International Journal of Education Learning and Development, vol. 2, no. 3, pp. 60-67.

Onah, J. C., Onyebuchi, G. U., Eke, C. C., & Adayi, I. O. (2020). Empirical evidence of availability and utilization of information and communication technology (ICT) in teaching and learning cultural and creative arts in Nsukka local government area. E-ISSN: 0975-8935 P-ISSN: 0253-1097

Onasanya, S. A., Shehu, R. A., Ogunlade, O.O. & Adefuye, A. L. (2011). Teacher's Awareness and Extent of Utilization of Information Communication Technologies for Effective Science and Health Education in Nigeria. *Singapore Journal of Scientific Research, 1: 49-58.*

Ozili, P (2020), COVID-19 Pandemic and Economic Crisis. The Nigerian Experience and Structural Causes. www.researchgate.net/publication.

Perry, S. M., Catapano, M., & Ramon, O. G. (2016). Teaching, academic achievement, and attitudes toward mathematics in the United States and Nigeria. *Journal for Leadership and Instruction*, *15*(2), 5-12.

Player-Koro, C. (2012). Factors influencing teachers use of ICT in education. Education Inquiry, 3(1), 93-108.

Puican, N. (2012). *Gender review in the InfoDev Project Information Systems for RuralDevelopment: A demonstration project in Cajamarca (Peru).* Unpublished studyprepared for *info*Dev.

Quaisie, G. (2013). Paving the way for girls to achieve excellent in Science and Math: Science, Technology and Math education (STME) clinic for girls. Papers from the *Eighth International Conference of the Gender and Science and Technology Association (GASAT8*). Available at: http://www.wigsat.org.gasat/42.txt. (Accessed22nd May 2006).

Rangel, D. M. C. (2019). *Analyzing teachers' technological pedagogical and content knowledge*. [Doctoral dissertation, The University of Texas at El Paso]. Retrieved from ProQuest Dissertations Publishing.

Rathore M. K. & Sonawat R. (2015). Integration of technology in education and its impact on learning of students. *International Journal of Applied Home Science*, 2(7&8): 235-246.

Rordin, M. N., Johnston, J., & Walshe, G. (2016). Making mathematics and science integration happen key aspects of practice. *International Journal of Mathematical Education in Science and Technology*, *47*(2), 233-255.

Rosenberg, J. M., & Koehler, M. J. (2015). Context and technological pedagogical content knowledge (TPACK): A systematic review. *Journal of Research on Technology in Education*, 47(3), 186-210.

Ruggiero, D., & Mong, C. J. (2015). The teacher technology integration experience: Practice and reflection in the classroom. Journal of Information Technology Education Research, 14, 161-178. Retrieved May 14, 2016 .

Sánchez, P. J., Trujillo, J.M., Gómez,G. M., & Gómez,G. G. (2020). Gender and digital teaching competence in dual Vocational education and training.Educ. Sci. 2020, 10, 84.

Sari, M. H. & Bostancioglu, A. (2018). Application of technological pedagogical content knowledge framework to elementary mathematics teaching: A scale adaptation study. *Journal of Theoretical Educational Science/Kuramsal Eğitimbilimergisi*, 11(2), 36-45.

Shittu, A. T., Gambari, A. I., Gimba, W. R., & Ahmed, H. (2018). Modeling technology preparedness as an antecedent of mathematic pre-service teachers' self-efficacy perceived usefulness, and intention toward the use of information technology.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1–22.

Singh, T. K. R., & Chan, S. (2014). Teacher readiness on ICT integration in teaching-learning: A Malaysian case study. International Journal of Asian Social Science, 4, 874-885.

Soetan, A. K., Ogunlade, O. O., Fakomogbon, M. A., & Bolaji, H. O. (2014), Availability and utilization of Information and Communication Technology (ICT) in early childhood education in Ilorin, Nigeria. Journal of Science, Technology, Mathematics and Education (JOSTMED), vol.10, no. 3, pp. 186-192.

Sofowora O. A. & Egbedokun A. (2010). An Empirical Survey of Technology Application in Teaching Geography in Nigerian Secondary Schools. *Ethiopian Journal of Environmental Studies and Management*, 3(1), 46-54.

Stoilescu, D. (2015). A critical examination of the technological pedagogical content knowledge framework: secondary school mathematics teachers integrating technology. *Journal of Educational Computing Research*, 52(4), 514-547.

Stryker, C. (2012). *Teaching successful telecourses.* Bozeman, MT, National Teachers Enhancement Network: Montana State University.

Suleiman, M. M., Yahya, A. T. & Tukur, M. (2020). Effective Utilization of ICT Tools in Higher Education. *development*, *2*, 5.

Sung, Y. T., Chang, K. E., & Liu, T. C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers and Education*, *94*, 252-275.

Tella A, Tella A, Toyobo OM, Adika LO, Adeyinka AA (2017). An assessment of secondary school teachers uses of ICTs: implications for further development of ICT's use in Nigerian secondary schools. The Turk. Online J. Educ. Technol. 6(3):5-17. Retrieved Sept. 28, 2011, from http://www.tojet.net.

Ten Technologies which would change Our Lives. Potential Impacts and Policy Implications. (2015). European Parliamentary Research Service. Retrieved October 22, 2017.

Ubulom, K. & Amaehule, U. (2011). Assessing the Extent of ICT usage by Extension Professional for Sustainable Agriculture and Society in Sub Himalayan Region. *Int.J.Curr.Microbiol.App.Sci.* 8(07): 142-151.

UNIFEM & United Nations University Institute for New Technologies (UNU/TECH). (2015). *Gender and telecommunications: An agenda for policy*.

UNESCO (2014). Learning to Live Together Educational Policies and Realities in the Asia-Pasific.

Voogt, J. & McKenney, S. (2017). TPACK in teacher education: are we preparing teachers to use technology for early literacy? *Technology, pedagogy, and education*, *26*(1), 69-83.

West African Examination Council. (WAEC, 2015-2020). Chief Examination Report on May/June General Mathematics, Niger, Academic press, Limited, retrieved from Google Search.

Willermark, S. (2017). Technological pedagogical and content knowledge: A review of empirical studies. *Journal of Educational Computing Research*, 12(3), 23-37.

Winzenried, A., Dalgarno, B., & Tinkler, J. (2010). The interactive whiteboard: A transitional technology supporting diverse teaching practices. *Australasian Journal of Educational Technology*, *26*(4), 534-552.

APPENDIX A

Table 1: Krejcie and Morgan Table

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

APPENDIX B

DISTRIBUTION OF SAMPLE BY SCHOOLS AND GENDER

S/N	NAME OF SCHOOLS	SCHOOL TYPE	MALE	FEMALE	TOTAL
1	Bosso secondary school, Minna	Public	4	4	8
2	Government army day secondary school	Public	4	4	8
3	Day secondary school, Chanchaga Minna'B'	Public	4	4	8
4	Day secondary school, Maikunkele 'A'	Public	5	4	9
5	Maryam babangida girls science college, Bosso	Public	4	4	8
6	Government technical college, minna	Public	4	4	8
7	Ahmadu Bahago secondary school, Minna	Public	4	5	9
8	Government girls secondary school (old airport) Minna	Public	4	4	8
9	Zarumai model school, Minna	Public	4	4	8
10	Government girls science college, Bosso road	Public	4	4	8
11	Aisha audi school, minna	Private	5	3	8
12	Brighter school, minna	Private	5	3	8
13	Al-fitrah islamic academy tunga, minna	Private	7	3	10
14	Faham international academy	Private	5	3	8
15	Galaxy international school	Private	5	1	6
16	Firdausi international school	Private	5	1	6
17	Hill-crest international school	Private	5	1	6
18	Himma international school	Private	5	1	6
19	Nasfah academy school	Private	5	1	6
20	Idea royal academy, tunga, minna	Private	5	1	6
	TOTAL		93	59	152

APPENDIX C
AVAILABILITY, ACCESSIBILITY AND READINESS TO USE DIGITAL TECHNOLOGIES QUESTIONNAIRE (DITAARQ).

Dear Respondent,

This questionnaire is designed to obtain data from you on the above subject matter, information made available to the research will be used and treated strictly with utmost confidentiality. I hereby solicit for your honest and kind response. Thank you.

Instruction: Tick the appropriate option for the following items below [√]

SECTION A: Demographic background of Respondents

1. Gender: Male [ ] Female [ ]

2. School type: Public [ ] Private [ ]

SECTION B: What is the level of availability of digital technologies for teaching mathematics in your school?

Items	**Adequately available**	**Fairly available**	**Not available**
Personal computers			
Interactive whiteboards			
Video conferencing system			
Audio equipment			
Projector			
Laptop computers			
Internet cable			
Wireless network			
Electronic visual resources			
Electronic books			
Desktop computers			
Audio visual (e.g television)			

Computer laboratory			
Mobile phones			
Audio media(radio etc)			
Other(please specify below)			

SECTION C: What is the level of accessibility to digital technologies for teaching mathematics in your school?

Items	**Adequately accessible**	**fairly accessible**	**Not accessible**
Personal computers			
Interactive whiteboards			
Video conferencing system			
Audio equipment			
Projector			
Laptop computers			
Internet cable			
Wireless internet			
Electronic visual resources			
Electronic books			
Desktop computers			
Audio visual (e.g television)			
Computer laboratory			
Mobile phones			
Audio media(radio etc)			
Other(please specify below)			

SECTION D: Readiness of Mathematics teachers to use Digital Technologies

NO	STATEMENT	R (3)	FR (2)	NR (1)
1.	I am not ready to use digital technologies because of insufficient knowledge of appropriate software and hardware.			
2.	I am no ready to use digital technologies due to the lack of knowledge on how to evaluate the use and role of digital technologies in teaching mathematics			
3.	I am discourage from using digital technologies because of fear of equipment failure			
4.	I am not ready to use digital technologies because of my limited experience			
5.	I am not ready to teach mathematics using digital technologies due to my level of qualification			
6.	I am discourage from using digital technologies to teach mathematics due to my limited training and professional development			
7.	I am not ready to use digital technologies to teach mathematics as a result of insufficient supply of electricity			
8.	I am not ready to use digital technologies to teach mathematics due to lack of technical support from the school management			
9.	I am discourage from using digital technologies to teach mathematics because of the unlimited time given to me in teaching mathematics in my school			
10.	I am not ready to use digital technologies because I am not given the freedom to design my own teaching with the help of digital technology in teaching mathematics in my school			

Key: R= Ready, FR = Fairly ready, NR = Not ready

APPENDIX D

Reliability test on Digital Technologies Availability, Accessibility and Readiness

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.758	44

APPENDIX E

NIGER STATE MINISTRY OF EDUCATION
LIST OF MATHEMATICS TEACHERS ACROSS PUBLIC SCHOOLS IN MINNA, METROPOLIS
PLANNING RESEARCH AND STATISTIC DEPARTMENT, MINISTRY OF EDUCATION, MINNA

S/NO	LGA	School Name	Male	Female	Total
1.	BOSSO LGA	GOVERNMENT SCIENCE COLLEGE, CHANCHAGA	0	1	1
2.	BOSSO LGA	SHEIKH MUHAMMAD SANBO CAIS, TUDUN FULANI MINNA	0	1	1
3.	BOSSO LGA	DAY SECONDARY SCHOOL, MAITUMBI MINNA	3	5	8
4.	BOSSO LGA	NIGER STATE SCHOOL FOR SPECIAL EDUCATION, MINNA	0	2	2
5.	BOSSO LGA	HILLTOP MODEL SECONDARY SCHOOL	2	3	5
6.	BOSSO LGA	BOSSO SECONDARY SCHOOL, MINNA	3	3	6
7.	BOSSO LGA	GOVERNMENT ARMY DAY SECONDARY SCHOOL	5	3	8
8.	BOSSO LGA	DAY SECONDARY SCHOOL, CHANCHAGA MINNA'B'	1	3	4
9.	BOSSO LGA	DAY SECONDARY SCHOOL, MAIKUNKELE 'A'	2	3	5
10.	BOSSO LGA	ABDULLAHI DADA SECONDARY SCHOOL, MAIKUNKELE	0	3	3
11.	BOSSO LGA	MARYAM BABANGIDA GIRLS SCIENCE COLLEGE, BOSSO	3	2	5
12.	BOSSO LGA	GOVERNMENT TECHNICAL COLLEGE, MINNA	2	1	3
13.	CHANCHAGA LGA	AHMADU BAHAGO SECONDARY SCHOOL, MINNA	2	3	5
14.	CHANCHAGA LGA	GOVERNMENT GIRLS SECONDARY SCHOOL (OLD AIRPORT) MINNA	1	5	6
15.	CHANCHAGA LGA	1270630006-ZARUMAI MODEL SCHOOL, MINNA	6	2	8
16.	CHANCHAGA LGA	WOMAN DAY COLLEGE	1	1	2
17.	CHANCHAGA LGA	GOVERNMENT GIRLS SCIENCE COLLEGE, BOSSO ROAD	2	3	5
18.	CHANCHAGA LGA	DAY SECONDARY SCHOOL, LIMAWA	3	2	5
19.	CHANCHAGA LGA	DAY SECONDARY SCHOOL, KWASAU	1	0	1

20.	CHANCHAGA LGA	GOVERNMENT VOCATIONAL TRAINING CENTER	3	0	3
21.	CHANCHAGA LGA	FR. O'CONNELL SCIENCE COLLEGE, MINNA	2	3	5
22.	CHANCHAGA LGA	GOVERNMENT DAY SCIENCE COLLEGE, TUNGA	2	7	9
23.	CHANCHAGA LGA	WOMAN EDUCATION CENTER	0	1	1
24.	CHANCHAGA LGA	JUNIOR SECONDARY SCHOOL, GBANGBAPI SAUKA KAHUTA	1	1	2
25.	CHANCHAGA LGA	JUNIOR SECONDARY SCHOOL, SHANU-MINNA	2	1	3
26.	CHANCHAGA LGA	POLICE SECONDARY SCHOOL, MINNA	19	3	22
27.	CHANCHAGA LGA	FEDERAL STAFF SCHOOL, MINNA	3	2	5
28.	BOSSO LGA	FEDERAL GOVERNMENT COLLEGE, MINNA	4	7	11
29.		Grand Total	73	71	144

SOURCE: ANNUAL SCHOOLS CENSUS 2018/2019

APPENDIX F

LIST OF MATHEMATICS TEACHERS ACROSS PRIVATE SECODARY SCHOOLS IN MINNA, METROPOLIS
PLANNING RESEARCH AND STATISTIC DEPARTMENT, MINISTRY OF EDUCATION, MINNA

NIGER STATE MINISTRY OF EDUCATION

NAMES OF SCHOOL	MALE	FEMALE	TOTAL
CHALLENGE INTERNATIONAL SCHOOL	2	1	3
AR-RAYYAN ACADEMY	2	0	2
ABU-TURAB ISLAMIC SCHOOL MINNA	3	1	4
DIVINE EXCELLENCE INTERNATIONAL SCHOOL	2	0	2
FEMA SCHOOLS	2	1	3
GARIMA STANDARD ACADEMY	2	0	2
HASHA INTERNATIONAL SCHOOL	2	0	2
MODEL SECONDARY SCHOOL FUT	3	0	3
NIGER BAPTIST	2	0	2
ST.CLEMENT’S SECONDARY SCHOOL GBAIKO	2	1	3
MYPA COLLEGE, MINNA	4	0	4
AISHA AUDI SCHOOL, MINNA	2	0	2
BRIGHTER SCHOOL, MINNA	2	1	3
AL-FITRAH ISLAMIC ACADEMY TUNGA, MINNA	2	0	2
FAHAM INTERNATIONAL ACADEMY	2	0	2
GALAXY INTERNATIONAL SCHOOL	3	1	4
FIRDAUSI INTERNATIONAL SCHOOL	1	1	2
HILL-CREST INTERNATIONAL SCHOOL	3	0	3
HIMMA INTERNATIONAL SCHOOL	6	1	7
NASFAH ACADEMY SCHOOL	3	0	3
IDEA ROYAL ACADEMY, TUNGA, MINNA	3	1	4
EL-AMIN INTERNATIONAL SCHOOL	6	3	9
NEW HORIZON COLLEGE	6	2	8
ELBETHEL INTERNATIONAL SCHOOL	3	0	3
Treasure international school	3	0	3
PLUS INTERNATIONAL	2	0	2
EPIC INTERNATIONAL SCHOOL	2	0	2
ONWARD SCHOOL	1	1	2
NEW GATE SCHOOL INTERNATIONAL	2	0	2
MAWO IINTERNATIONAL SCHOOL	3	1	4
KOWA INTERNATIONAL SCHOOL	1	2	3
CLIMAX ACADEMY	2	0	2
FAROUK BAHAGO INTERNATIONAL ACADEMY	3	2	5
GRAND TOTAL	87	20	107