PRIMARY TEACHER EDUCATION TRAINEES' PREPARATION FOR INTEGRATION OF INFORMATION COMMUNICATION TECHNOLOGY IN THEIR PEDAGOGICAL PRACTICES IN UGANDA

Felix Besigomwe

A THESIS SUBMITTED TO THE DEPARTMENT OF CURRICULUM INSTRUCTION AND EDUCATIONAL MEDIA, SCHOOL OF EDUCATION IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN EDUCATIONAL COMMUNICATION AND TECHNOLOGY OF MOI UNIVERSITY

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DECLARATION

Declaration by the Candidate

I declare that this thesis titled "*Primary Teacher Education Trainees' Preparation for Integration of Information Communication Technology in their Pedagogical Practices in Uganda"* is my original work and to the best of my knowledge, it has never been submitted to any University or Institution for any academic award whatsoever. Wherever other resources have been used, they have been acknowledged.

Signature

20th July 2023

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Felix Besigomwe Date

EDU/D.PHIL.CM/1006/18

Declaration by Supervisors

This thesis has been submitted for examination with our approval as University Supervisors.

…… Date ……

Prof. Violet Nabwire Opata

Associate Professor of Educational Communication & Technology

Department of Curriculum Instruction and Educational Media,

Moi University, P.O. Box 3900 – 30100 Eldoret, Kenya

……. Date ……..

Prof. Anne Syomwene Kisilu

Associate Professor of Curriculum Studies

Department of Curriculum Instruction and Educational Media,

Moi University, P.O. Box 3900 – 30100 Eldoret, Kenya

DEDICATION

I dedicate this thesis to Mr. Mark Dickson, Mrs. Janet Giberson, Eng.Alex Turihohabwe, Dr Martin Mutambuka (Ph.D), Mr. & Mrs. Jonathan Beesigomwe, Ms.Eudiah M. and Uncle Elton Kamuhangyire, who were there for me from certificate level to Ph.D. You motivated and supported me in all ways possible. May your heart and home be filled with peace, joy and tranquility that only Jesus Christ can provide.

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ABSTRACT

Teacher Trainees' Information Communication Technology(ICT) competencies influence the application of educational technologies in teaching and learning. ICT has a significant impact on the changing scenario of education. It is a necessity for student teachers. The purpose of this study was to assess Primary Teacher Education (PTE) Trainees' preparation for the integration of ICT in their Pedagogical Practices in Uganda. The objectives of this study were; To assess PTE trainees' ICT competencies for ICT Integration in their pedagogical practices; To explore the quality of ICT Infrastructure in PTE for trainees preparation in ICT integration in their pedagogical practices; To determine instructional modes used by tutors in preparation of PTE trainees for ICT integration in their pedagogical practices; To establish the relationship between PTE Trainees' preparation for ICT integration, and integration of ICT in their pedagogical practices; Determine the moderating effect of ICT infrastructure in PTE and tutors' instructional modes on the relationship between PTE Trainees' preparation for ICT integration, and integration of ICT in their pedagogical practices. This study adapted pragmatism research paradigm and was guided by a non-experimental, concurrent embedded mixed methods design. To select colleges, disproportionate stratified sampling technique was used. To select students per selected college, convenient sampling was opted for. This study was guided by the UNESCO- ICT Competency Framework and TPACK models. Geographically, the study took place in Primary Teacher Training Colleges, sampled from Central, Southwestern, Western, Eastern and Northern regions of Uganda. Only second-year Primary Teacher Trainees (finalists) participated in this study. The study used both a questionnaire to collect quantitative data and an observation schedule to collect qualitative data from PTE trainees. These tools were first subjected to pilot test to establish validity. Reliability was run using SPSS to assess the internal consistency of questionnaire items. Collected data on self-administered questionnaires were edited, categorized or coded and entered into the computer using the IBM SPSS version 23.0 for the generation of descriptive and inferential statistics. Correlations were run to establish the relationships between the study variables, and moderation analysis was done using multiple regressions. Data from the observation schedule were coded and thematically analyzed. Results showed that PTE trainees' ICT competencies for ICT integration were low, slightly below average in terms of skills, but slightly above average in terms of ICT knowledge. However, results indicated that there is a positive significant relationship between PTE Trainees' preparation for ICT integration and integration of ICT in their pedagogical practices in Uganda ($\rho < .01$, two-tailed). This relationship was moderated by tutors' Instructional mode and the availability of ICT infrastructure. The ICT competencies, tutor's mode of instruction and ICT infrastructure predicted teacher trainees' ICT integration into pedagogical practices by 46.7%. Both Quantitative and qualitative findings showed that many colleges have free access to ICT laboratory but with limited internet. There was however a great need for 21st Century PTE teacher trainees and tutors to acquire ICT knowledge and skills for pedagogical practices. To improve PTE trainees' ICT competencies for pedagogical practices, Ministry of Education and Sports should make ICT in education a compulsory course unit; provide adequate and efficient ICT infrastructure to PTE institutions; and enhance PTE trainees' ICT trainings, guided by UNESCO ICTFT, TPACK models, and the new ICT competencies model that originated from this study. These study findings will provide important information to MoES, teacher education institutions, policymakers such as NCHE and researchers.

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ABBREVIATIONS AND ACRONYMS

COVID-19	:	Coronavirus Disease 2019
EFA	:	Education for All
ICT	:	Information and Communications Technology
LCD	:	Liquid Crystal Display
LMS	:	Learning Management Systems
MoES	:	Ministry of Education and Sports
MoICT	:	Ministry of ICT and National Guidance
PTCs	:	Primary Teachers Colleges
PTE	:	Primary Teacher Education
SaaS	:	Software as a Service
SDGs	:	Sustainable Development Goals
SOPs	:	Standard Operating Procedures
TPACK	:	Technological Pedagogical and Content Knowledge
UNESCO	:	United Nations Educational, Scientific and Cultural Organisation

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.0 Introduction

This chapter presents the background of the study, problem statement, objectives of the study, research hypotheses, scope of the study, and justification of the study, significance of the study, theoretical framework and conceptual framework.

The study sought to examine the Primary Teacher Education Trainees' preparation for integration of Information Communication Technology (ICT) in their pedagogical practices in Uganda. ICT aid the teacher trainees' pedagogical practices in terms of; planning for instruction, resource development, actual classroom interaction and assessment (Higgins & Packard, 2004). ICT provides a number of powerful tools that can help transform the currently divided, teacher-oriented and text-based classes into technology-enhanced, student-centered and collaborative interaction (Rastogi & Malhotra, 2013). However, for teacher trainees to acquire ICT competencies for pedagogical practices other variables such as ICT infrastructure and tutors' teaching strategies should also be taken into consideration. For teachers to embrace technology effectively into their classrooms, they need to receive sufficient training before starting the actual teaching (Brun & Hinostroza, 2014; Tondeur et al., 2016; Usun, 2009). Yet, in a study by Farrel (2007) found that many technological barriers related to inadequate infrastructure; high access costs; unreliable and poor quality of Internet connection and electrical services; weak policy; lack of access to appropriate software and course delivery platforms; shortage of skilled personnel to manage resources and maintain new service delivery systems; a group of uneducated users of technology is cutting back on modern learning in Uganda. UNESCO has documented 194 country-wide school closures, constituting a near-global shut down because of

COVID-19 prevention measures (UNESCO, 2020). Many countries have resorted to the development of radio and TV content and e-learning and supplying distance learning materials, resources, and platforms. In Uganda and Zambia for example, UNESCO's Capacity Development for Education (CapED) has been carrying out teacher assessments to determine the ICT competency levels of teachers. In the short term, this will determine the type of ICT-related interventions that will be developed for teachers as part of the current educational response to COVID-19. Over time, evaluation recommendations will form the basis for the development of teacher training materials using ICT as a teaching tool in the COVID-19 era and beyond (UNESCO, 2020). This present study is therefore in line with the global ICT agenda and is worth considering. However, according to the recent research, the education sector in Uganda has not fully utilized technology during tough season when schools were closed; they either lack ICT competencies or education institutions have no or limited ICT infrastructure (Nelson et al., 2020). Researchers (Higgins & Packard, 2004; Fox et al., 2012; CISCO, 2013) posit that a school's broadband bandwidth increasingly determines online content, functionality and application. The current study also evaluated the availability and quality of ICT infrastructure in primary teachers' colleges. When teacher trainees are digitally literate and trained to use ICT, these approaches can lead to higher order thinking skills, provide creative and individualised options for teacher trainees to express their understanding, and leave them better prepared to deal with ongoing technological change in society and the workplace in future. Experts of ICT in Education such as; Higgins and Packard (2004) suggested that a teacher trainee should be confident to use different softwares, which are designed to manage and manipulate text (such as Microsoft's Word in the Office suite). These experts further emphasize that; teacher trainees should be able to

undertake tasks for themselves (such as writing assignments) and to prepare materials for their actual teaching. Teacher trainees need to be aware of the potential of ICT for supporting their work in the preparation of teaching materials. Therefore, this current study targeted primary teacher trainees (finalists) who are using the revised curriculum that consists of ICT components (MoE, 2012) that would enable them to apply ICT in their pedagogical practices. Their level of ICT competencies will inform policy makers and curriculum developers what is lacking in training, content and instructional resources in Uganda.

1.1 Background of the Study

It's believed that primary teacher education preparation of trainees for ICT integration in their pedagogical practices would equip trainees with knowledge and skills for their future pedagogical practices which includes, learning resources development, lesson planning, classroom interaction and assessment of learning activities in schools. This is because Information and communication technology (ICT) is gaining importance in education since students have emerged as the most active ICT users of computers and cell phones with internet access (Hakoama & Hakoyama, 2011; Wentworth & Middleton, 2014).

UNESCO (2009) argues that ICT can help to enhance the quality of education with advanced teaching methods, improve learning outcomes, enable reform of education system hence achieving United Nation's sustainable development goal number 4 (SDG4) for quality education and promotion of lifelong learning opportunities for all. Worldwide, the utilization of ICT in education has been regarded as an essential factor for economic growth, although the educational practices and structures and the economic growth have a posh and reciprocal relationship, as Kozma (2005) describes them comparing Finland, Hong Kong and Egypt regarding their solutions to applying

technology in education. According to new research by Huawei (2017), support and investment in ICT directly affect an individual country's performance. This is aligned with the United Nation's sustainable development goals (SDGs), through education, skill development and new service creation.

Computers like mindtools (Jonassen, 1999) allow students to perform a variety of critical thinking activities. The acquisition of ICT competencies by teacher trainees is therefore important to teachers, learners and economic development of any nation. These ICT Competencies in education are a set of technology standards that define proficiency in using computer technology in the classroom (Lawrence & Veena, 2013). According to Uerz et al. (2018) teachers got to be provided with the newest technologies because they bear responsibility for preparing technologically literate citizens during a 21st-century society where technological developments are constantly in flux. As a result, understanding and developing pre-service teachers' competency in technology use is the cornerstone in integrating technology into teaching. Knowledge and skills containing computer-related skills are grouped into four common areas: (1) Basic Technology Operation, (2) Personal and Professional Use of Technology Tools, (3) Social, Ethical, and Human Issues, and (4) Application of Teaching Technology (Lawrence & Veena, 2013).

Evidence is increasing that bypassing teachers and not engaging them with technology does not lead to improved student learning (World Bank, 2021). With regard to teacher education, prioritization of ICT skills and knowledge for teacher trainees and how they can be applied to specific learning units is important (Admiraal et al., 2017). Admiraal and colleagues think this teaching approach equips pre-service

students/teacher trainees with a set of basic knowledge and skills that they can pass on to their future classroom activities.

According to a review of 19 Asian countries surveyed by UNESCO in 2013, in-service teacher development in most researched countries has a vague path to improving teachers' ICT competencies than pre-service teachers (UNESCO, 2015). About half of the countries surveyed had not yet had CT competency standards for teachers to guide teacher development. This means that ICT in teacher education and training is not yet formal. In the Australian Curriculum, students develop ICT skills as they learn to use ICT effectively and efficiently as they investigate, create and transmit ideas and information at home, at school, at work and in their communities (ACARA, 2018).

In August 2001, the Ministry of Education of the People's Republic of China proposed that the proportion of use of multimedia teaching in colleges and universities should not be less than 30%. This policy has effectively promoted the development of pre-service teachers' ICT skills (Zhao et al., 2016). In 2012, the Ministry of Education of the People's Republic of China released the National ICT Education Development Plan (2011–2020). This program has been routinely designed and fully rolled out for the next 10 years of ICT-based educational work (MOE of P.R.C, 2012). Its main objective was to create an ICT-based education system that would encompass all levels of urban and rural schools, to promote a comprehensive integration of ICT with guidelines for implementing new ideas, concepts, methods, and strategies to improve education, promote education equity and build a learning society. By the end of 2014, 80.6% of primary and secondary schools in China had access to the Internet, while 59.6% of ordinary classrooms were equipped with

multimedia teaching equipment nationwide. This makes it easier for teachers to develop new teaching methods at the primary school level. ICT in education as a point of success and an important support for modern education is the strategy of choice to improve the quality of education, promote education equity, and achieve education reformation (Wu et al., 2016).

The first national education technological plan issued in the United States of America was getting America's students ready for the twenty-first century by meeting the Technology Literacy Challenge through provision of specific hardware devices as multi-media environment and classroom network access (U.S. Department of Education, 1996). In 1999, the Federal Department of Education launched Preparing Tomorrow's Teachers to Use Technology—a big founded project for pre-service teachers to use technology in teaching practice (U.S. Department of Education, 1999). Also in 2000, the United States of America emphasized the wide application of information technologies from the perspective of e-learning by putting a World – Class Education at the fingertips of all children. In 2010, the USA established comprehensive infrastructure to enable all students and education practitioners to use it at any place and any time; proposed to build comprehensive infrastructure to serve for study from five areas including study, assessment, teaching, infrastructure and productivity (U.S. Department of Education, 2010). According to the data released by National Center for Education Statistics, 100 % of the public schools in America had access to broadband in 2003, an increase from 35 to 100 % in a decade (Wu et al., 2016). According to the official report of National Center for Education Statistics, 99 % American teachers had their own computers in 2009, nearly up to 100 % (Gray et al. 2010). While by the end of 2012, the average ratio of teachers to PCs in China was 1.86:1 (Educational Informationization Strategy Research Base, 2013).

In 2008, the Australian Federal government introduced the Digital Education Revolution, which aims to provide sustainable and effective transformation in Australian schools to help students prepare for future education, training, life, and work in the digital world (Wang, 2012). One of the components of Australia's digital education transformation policy was to apply teachers' ICT competency standards to pre-service training and professional development in the workplace; communication and practical information in school and departmental management (Tang, 2009). This policy encourages teachers to develop a student-centered learning program, and to make good use of modern learning resources and activities (Zhao et al., 2016).

In 1998, the British government introduced the ‘National Grid for Learning’, and according to the program, until 2002, all teachers could use information technology in teaching, and library staff should also do the same. In the meantime, it is clear that pre-service teachers (graduates) need to have good instructional information technology (Zhao et al., 2016). Further steps were taken to assess pre-service teachers' ICT competencies (Zhao et al., 2016), in line with the definition of ICT teacher competency standards, set by UNESCO (UNESCO, 2011).

In Africa, a study conducted (Farrel & Isaacs, 2007) on ICT and education in 53 African countries in 2007 revealed that there were significant differences in ICT education policies in African countries. It was found that the capacity of African universities and teacher education institutions, the integration of ICT in education, was limited. The UNESCO International Institute for Capacity Building in Africa (IICBA) recently released advanced African ICT teacher standards (ICTeTSA), which is the result of extensive research and consultation with 29 countries across the continent. A UNESCO-IICBA (2008) study found that most universities and teacher

training institutions (TTIs) in 18 African countries have begun to address ICT infrastructure problems and have introduced ICT courses. However, few have ever talked about ICT educational issues or were familiar with UNESCO's work in the area. Teacher standards incorporating ICT may or may not be well developed to meet the needs and conditions of African countries. The IICBA has noted that the teacher education and development program will not be complete if it does not address the use of ICT by teachers, now and in the future (Trucano, 2012).

A survey was conducted in Tanzania and Nigeria by Teacher Development for 21st Century (TDev21), a joint venture between the World Bank (WB) and the Global e-Schools and Communities Initiative (GeSCI) and the Tanzania Department of Education and Vocational Training (MoEVT) and the National College Commission Education (NCCE) in Nigeria (Hooker et al., 2011). Research findings show that the government has prioritized teacher training as a focus area. Implementation of ICT in Teachers' Colleges was started in 2005 as a joint venture of MoEVT and the Swedish International Development Agency (Sida). The main goal of the project was to improve the quality of pre-service education and in-service teacher education through ICT. All Tanzanian tutors were trained in the use of ICT in teaching and learning which through a study interview translated into basic literacy skills (Hooker et al., 2011). Government has made efforts to define the integration of ICT integration into teacher training. Teacher Colleges, which have advanced ICT infrastructure, provide ICT training to trainee teachers. But many accounts suggest that the training is for basic ICT skills. Tanzania recognizes UNESCO ICT-CFT as the official framework governing their curriculum development for pre-service and in-service teachers at all levels (UNESCO, 2015). In the Nigerian education certificate curriculum, acquisition

of basic ICT competencies for teaching is compulsory for teacher trainees (NCCE, 2012).

Based on ICT in the education policy review of the USA, Britain, Australia, China, Nigeria and Tanzania, it has been shown that there is an investment in developing teachers in ICT competencies at various levels. Technology literacy, deepening of knowledge, and knowledge creation should be regarded as key policy objectives at various stages of gradually developing the teachers' ICT competencies and promoting the development of ICT in education. Developing and least developed countries should take a leaf in these countries.

1.2 The Ugandan Context

Uganda currently has 47 Primary Teachers Colleges (PTCs) of which 45 are owned and funded by the government and 2 religious-based private colleges (Kagoda & Ezati, 2013). All Primary Teachers Colleges (PTCs) provide residential training leading to the Primary Teaching Certificate (Grade III), which has been the minimum required qualification for teaching in primary schools of Uganda. This level is the first level of Primary Teacher Education in Uganda. The PTCs have a standard curriculum, prepared by Kyambogo University which has the mandate for primary teacher education. The minimum entry requirement to Primary Teachers College is an Ordinary Level certificate with a pass in 6 subjects including mathematics, English and at least two sciences (MoES, 2012). Applicants can join only within 2 years after taking their Ordinary Level national examinations. PTC graduates with a grade three certificate teach in primary schools of Uganda. However, Primary teacher training colleges are soon phasing out grade III certificates and start awarding degrees only according to the National Teacher Policy (MoES, 2019; p.39-41). The policy dictates

that teachers must embrace new pedagogies and transform pedagogical practices through technology.

Ministry of Education and Sports developed ICT policy in education to help guide the integration of ICT in education (MoES, 2006). Uganda's ICT policy in education recognizes the crucial role of teachers in implementing any education reform initiative, hence considered to focus on teachers, tutors and lecturers and the curriculum they are supposed to follow. Consequently, the policy action plan was to include ICT education in curricula from primary to university level. This policy stressed the need to introduce computer awareness and sensitization into the training of primary teachers on a phased basis so that newly qualified teachers are equipped to make use of ICT as it becomes available in all primary schools (MoES, 2006; p.19). It was anticipated that ICT will equip future teachers with competencies to use ICT in making teaching materials and communication for use in classrooms. Teacher education is considered key in achieving both Education Sector Strategic Plans (ESSP) and Education For All (EFA) and Sustainable Development Goals (SDGs). According to the Government White Paper on Education (1992: 152), "no education system can be better than the quality of its teachers, nor can a country be better than the quality of its education. In the Uganda Lower Secondary school competency-based curriculum, Information and Communication Technology proficiency is among the major generic skills emphasized (MoES, 2012), hence providing an ICT foundation for students who join Primary Teachers' College.

In line with the digital age, the National Curriculum Development Centre (NCDC) commended ICT integration in all subjects in the delivery of the new Lower Secondary Curriculum in Uganda. Teachers need to incorporate ICT into their daily teaching and change their traditional methods with modern tools and resources. They

are expected to always be ready and well equipped in terms of ICT knowledge and skills, tools and a positive attitude to provide ICT-based learning opportunities for students to improve their learning quality. These students from lower secondary are the ones enrolling in teacher training colleges, which would give rise to ‘digital native’ teachers when the basics of ICT meets professionalism during teacher training. However, some researchers have noted that some teachers are not comfortable with even the very basic applications of computers. Luwangula (2013) noted that teachers still yearn to learn packages like Microsoft (MS) Word, Excel, Powerpoint and internet surfing. Luwangula projected that most Ugandan teachers have less knowledge of how even the basic ICT skills they seek to learn can be used to enhance the teaching-learning process. However, the absence of studies establishing the current ICT competencies of primary teacher trainees in Uganda called for this study.

For this current study, Primary Teacher Education Preparation is aimed to help trainees obtain the academic abilities needed to progress to future levels in education. Trainee teachers gain competences (knowledge and skills) in this program that will enable them get ready for a career in teaching in Uganda. Among these knowledge and skills is integration of information communication technology in their pedagogical practices. Pedagogical Practices here refers to teacher trainees’ activities which they do during their training to become professional teachers, for example; learning how to develop different learning aids, lesson planning for different subjects by searching own notes and how to assess learners. Primary teacher trainees’ ICT competencies and pedagogical practices are moderated by accessibility and availability of ICT infrastructure and tutors’ modes of instruction.

1.3 Statement of the Problem

ICT is used to transmit a lot of information; thus teacher candidates need to be ICT-savvy. Blurton (2000) emphasized that educational institutions use a wide range of ICT tools to communicate, create, transmit, store, and manage information. However, there has been a concern about teachers not being able to apply ICT in their daily activities in Uganda. Most teachers already in the field of teaching in Uganda are not comfortable with the very basic application of computers, and they have less knowledge of how even the basic ICT skills can be used to enhance the teaching-learning process (Luwangula, 2013). Teacher trainees need to be digitally literate and trained in advance to use ICT to be able to deal with technological change in the society, in their pedagogical practices and future workplace. During COVID-19 lockdown of schools, most teacher training institutions in Uganda failed to coordinate e-learning probably due to numerous factors including; limited ICT infrastructures whereby some institutions are in areas not covered by telecom services and others lack computer laboratories and competent staff (Nakayiwa, 2020), all these can also suffocate the imparting of ICT knowledge and skills to teacher trainees and their pedagogical practices.

According to a report by the Jinja district education officials in Uganda, 90% of the primary school teachers lacked computer literacy (Monitor, 2016). Even though these teachers were trained in the same primary teacher education system as the rest of the country, just one out of ten primary school teachers in the district was fairly competent in using a computer. This problem might exist in all other districts, but it can be ascribed to the teacher training programs, which is the basis for this study. Also, a study by Liew (2007) found out that most teachers may not be in favour of the ICT program because they lack competence in dealing with ICT which might be the

case to Ugandan teachers. Majority of educational research has focused on primary teachers' ICT competencies for educational purposes, but the question remains: Are teacher trainees' ICT knowledge and skills related to ICT training provided at teacher training colleges? How are colleges equipped to produce 21st century teachers, since there are limited opportunities for training after colleges? Therefore, this study sought to establish Primary Teacher Trainees' ICT Competencies for their pedagogical practices in Uganda to cover the aforementioned gaps.

1.4 Purpose of the study

The purpose of this study was to assess Primary Teacher Education (PTE) trainees' preparation for integration of ICT into their pedagogical practices in Uganda.

1.5 Objectives of the study

The specific objectives of this study were;

1) To assess PTE trainees' ICT competences for ICT Integration in their pedagogical practices;
2) To explore the quality of ICT Infrastructure in PTE for trainees' preparation in ICT integration in their pedagogical practices;
3) To determine instructional modes used by tutors in preparation of PTE trainees for ICT integration in their pedagogical practices in Uganda;
4) To establish the relationship between PTE Trainees' preparation for ICT integration, and integration of ICT in their professional learning for pedagogical practices in Uganda
5) To determine the moderating effect of ICT infrastructure in PTE and tutors' instructional mode on the relationship between PTE Trainees' preparation for ICT integration, and integration of ICT in their professional learning for pedagogical practices in Uganda.

1.6 Research Hypotheses

This study was guided by the following hypotheses:

H_o1: There is no statistical significant relationship between PTE Trainees' preparation for ICT integration, and integration of ICT in their professional learning for pedagogical practices in Uganda

H_o2**:** There is no statistical significant moderating effect of quality of ICT infrastructure in PTE and tutors' instructional mode of instruction on the relationship between PTE Trainees' preparation for ICT integration, and integration of ICT in their professional learning for pedagogical practices in Uganda.

1.7 Research Questions

1) What is the level of PTE trainees' ICT competences in preparation for ICT Integration in their pedagogical practices in Uganda?
2) What are the availability and quality of ICT Infrastructures in Primary Teachers' Colleges in Uganda?

1.8 Justification of the study

Teachers in the field and those upgrading their studies in different institutions of higher learning are seen struggling with ICT in Uganda. More so, during COVID-19 lockdown of schools, ICT has not helped teachers and higher institutions to continue their educational activities. This keeps one wondering whether they had an encounter with ICT training during their initial teacher education in Primary teacher training colleges. In a study by Farrel (2007) found that many technological barriers related to inadequate infrastructure; high access costs; unreliable and poor quality of Internet connection and electrical services; weak policy; lack of access to appropriate software and course delivery platforms; shortage of skilled personnel to manage resources and

maintain new service delivery systems; a group of uneducated users of technology is cutting back on modern learning in Uganda. According to the recent research, the education sector in Uganda has not fully utilized technology during tough season when schools were closed; they either lack ICT competencies or education institutions have no or limited ICT infrastructure (Nelson et al., 2020; Nakayiwa, 2020). In addition, none of the studies has considered primary teacher trainees' ICT competencies, but most of them deal with qualified teachers already in service. This study, therefore, aimed at establishing the level of teacher trainees' ICT competencies for pedagogical practices in Uganda. This would help in evaluating the achievement of SDG number 4; for quality education and promotion of lifelong learning opportunities for all, and also revision of teacher education curriculum.

1.9 Significance of the Study

Effective integration of ICT in schools and classrooms can transform teaching and empower students. In this context, it is important for teachers to have the skills to integrate ICT into their professional work to ensure equity and quality of learning. Therefore, establishing the level of Primary Teacher Education Trainees' ICT competencies provides great significance in education sector in the following ways.

1. The study could provide vital information to the Ministry of Education and Sports (MoES), educational partners, and management of teacher training institutions in Uganda to establish how teacher trainees' knowledge and skills development in ICT may be positively or otherwise affecting the quality of teacher education, and hence be in a position to adjust appropriately.
2. Ministry of Education and Management of teacher training institutions in Uganda should be able to identify technical bottlenecks and measures of dealing with them in prompting ICT experiences among their students for

quality teacher education. Hence, this study may be an eye-opener to the Ministry of Education and Sports and Ministry of ICT and national guidance, to know where to invest, to improve in order to achieve sustainable development goals number 4.

3. Knowledge gained from this research study should be useful to educators and policymakers like the National Council for Higher Education (NCHE) in making a wise decision concerning their ICT investment.
4. Furthermore, these results can guide the preparation of pre-service teachers for 21st-century learning environments with new technologies. Important suggestions have been provided throughout the discussion of findings and recommendations.
5. Theoretically, these study findings should also prompt more researchers in the area having contributed to literature for future studies. For instance, they will use the findings from this study to advance further in other variables related to this study.
6. A model has been established and it can guide educational planners alongside the UNESCO ICT-Competency Framework for teachers.

1.10 Scope and Limitations of the Study

1.10.1 Scope

Geographically, the study took place in Primary Teacher Training Colleges, sampled from Central, Southwestern, Western, Eastern and Northern regions of Uganda using disproportionate stratified sampling. By content, it dealt with ICT infrastructures, Tutors' mode of Instruction, ICT Competencies and Teacher Trainees' Pedagogical practices, to establish Primary Teacher Trainees' information and communications technology (ICT) competencies and their Pedagogical Practices in Uganda. Only

Teacher trainees (finalists) were involved in the study with a sample size of 627 using convenient sampling, whereas colleges were selected using a stratified sampling technique. A pragmatism paradigm and concurrent embedded mixed methods design was followed. This allowed the collection of quantitative data using a questionnaire and observational data using an observation schedule, all done at once.

Theoretically, the study was guided by UNESCO ICT Competency Standards for Teachers and TPACK models. Data was analyzed using IBM SPSS software to produce descriptive statistics (mean, frequency and percentages and inferential statistics (correlations and regression analysis), and thematic analysis was done for qualitative data collected on quality and accessibility of ICT infrastructures in colleges.

1.10.2 Limitations and Delimitations of the Study

The study faced several limitations, which include;

i) Hard to reach areas especially where colleges are located. Some colleges were far from towns and off tarmac roads. Extra resources and time was considered in budgeting.

ii) Respondents were dispersed in most classrooms as a result of COVID-19 standard operating procedures (SOPs), which took a long time for the investigator collecting data because no research assistant was allowed to risk the health of the respondents. Therefore, enough time (two days) was allocated to every college.

1.11 Theoretical Framework

Teacher trainees in the 21st Century must not only be prepared to use technology but they must also know how to use technology to support student learning. For this to be a reality, institutions of higher learning should invest heavily in ICT infrastructures

and re-engineering of teacher educators (tutors and lecturers) to model ICT to their students.

This study was guided by the UNESCO- ICT Competency Framework (2011) backed by the TPACK model by Mishra & Koehler (2006). The Teachers' ICT Competency Framework (UNESCO ICT-CFT) was established in 2008 and improved in 2011 by a UNESCO multi-disciplinary team in consultation with experts from the field from all regions of the world (Tsvetkova, 2016). This UNESCO ICT Competency Framework for Teachers (ICT CFT) is suitable for this study because it guides pre- and in-service teacher training on the use of ICTs across the education system. Its target audience is teacher-training personnel, educational experts, policy-makers, teacher support personnel and other professional development providers (UNESCO, 2018), who are the beneficiaries of the current study findings. The ICT CFT framework requires an enabling strong environment, including a determined leadership from government, from those responsible for teacher education and professional development of in-service teachers, and headteachers and principals. Therefore, this study was interested in Teacher trainees and their enabling environment which is infrastructure and tutors' modes of instruction in their teacher training classroom.

The ICT competency standard framework for teachers further defines the competency outcomes and the supporting knowledge and skills that are needed to utilize ICT in performing the job roles related to teaching. It provides performance indicators to evaluate the level of knowledge and competence of teachers to apply ICT in educational settings. These indicators guided this study in the development of the conceptual framework and choosing the right questionnaire and its development. The structure of the framework encourages teachers to return to each theme as they go from one set of competencies to the next and as their proficiency levels increase. The

first set, called Technology Literacy, promotes basic understanding and skills, particularly a grasp of how ICT can be beneficial in a learning environment. The second set of competencies, Knowledge Deepening, supports integrating ICT knowledge and skills into the educational process. The third and final set, Knowledge Creation, demands teachers to use ICT in innovative and creative manners.

Technological literacy, deepening of knowledge and knowledge creation are defined by UNESCO as the intersection of three approaches with six aspects of a teacher's work, namely, understanding ICT in education, curriculum assessment, pedagogy, ICT, institution and administration and teacher professional learning with 18 modules defined, as indicated in Figure 1 (UNESCO, 2011).

Figure 1

UNESCO ICT-CFT (2011)

Approach: / Component:	*Technology Literacy*	*Knowledge Deepening*	*Knowledge Creation*
Understanding ICT in the Classroom	Policy awareness	Policy awareness	Policy innovation
Curriculum and Assessment	Basic knowledge	Knowledge application	Knowledge society skills
Pedagogy	Integrate technology	Complex problem solving	Self management
ICT	Basic tools	Complex tools	Pervasive tools
Organisation and Administration	Standard classroom	Collaborative groups	Learning organizations
Teacher Professional Development	Digital literacy	Manage and guide	Teacher as model learner

The ICT Competency Framework for Teachers aimed at helping countries to develop comprehensive national teacher ICT competency policies and standards, and should be seen as an important component of an overall ICT in Education Master Plan.

The UNESCO ICT-Competency Framework for Teachers has the potential to play a unified and really important role within the professional development of the teacher, and may be applied in several economies and different aspects of everyday teaching practice. For example, teacher trainees can apply it in learning material development, delivering their lessons, and also assessment of learners. Also Ministry of Education and Sports in Uganda can choose to leverage different aspects, according to each time to its own educational conditions, i.e. curriculum, pedagogy, assessment. ICT policy in education in Uganda can follow this framework towards educational reform, based on its economic and social development goals and the educational priorities.

The UNESCO ICT-CFT may be a powerful framework which will be used not just for surveys to match the teachers' competencies in several countries but most significantly, to research and develop educational programs and training courses of

teacher professional development (Salmilah, 2017). Pribadi (2014) cited in Salmilah (2017) explains that training is one of the most important components in developing human resources (HR) in an institution. It is important not to forget that the quality of teachers and their continuing professional development plays a critical role in the achievement of quality education (Barber & Mourshed, 2007) and sustainable development. Therefore, UNESCO ICT Framework for Teachers has enabled many countries to have established ICT standards for teachers in the form of a framework or set of guidelines.

These countries describe desired teacher outcomes or competencies that may be recommended or mandatory. ICT CFT Version 3 adopted by the UN General Assembly responds to the 2030 Agenda for Sustainable Development, it underscores the global shift in the formation of inclusive knowledge societies (UNESCO, 2018). It addresses recent technological and pedagogical developments within the field of ICT and Education. This UNESCO ICT-CFT operates on the principles that includes; knowledge societies, Universal Design for Learning, and Inclusive Education (UNESCO, 2018). These principles are recommended when implementing ICT-CFT, which includes the development of ICT policy on Education, teacher standards, assessment terms, curriculum design, and teacher training courseware. Therefore, these principles guided the setting of objectives for this study. This framework was complemented by TPACK model all which inspired the current study that was concerned with teacher trainees' ICT competencies.

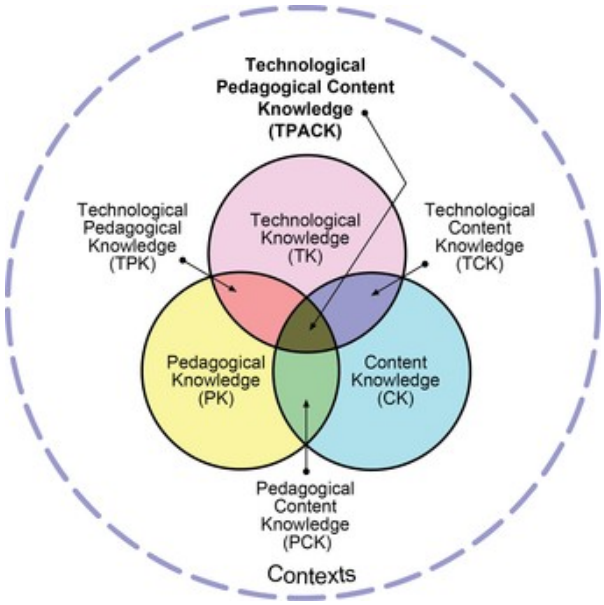
TPACK Model

Teachers' TPACK originated from PCK by Shulman (1986). PCK was modified by Mishra & Koehler (2006) who proposes a set of general knowledge domains (e.g. content knowledge (CK), pedagogical knowledge (PK), and pedagogical content

knowledge (PCK) and technological knowledge domains (i.e., technological knowledge (TK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPCK). Figure 2 represents TPACK (2006) components.

Figure 2

TPACK Model



TPACK Model (Mishra & Koehler,2006).

TPACK provides a productive approach to the many difficulties teachers face in implementing Educational Technology in their classrooms. By distinguishing these three types of knowledge, the TPACK framework outlines how content (what is taught) and teaching (how the author presents that content) should form the basis for any effective educational technology integration. This order is important because the technology implemented to enhance students' learning experience must support attribution in relation to content. This applies to pedagogical practices that this current study explored.

According to the TPACK framework, specific technological tools (hardware, software, applications, related information literacy practices, etc.) are ideal for instructing and guiding students towards a better, stronger understanding of the subject content (Kurt, 2018). Three types of knowledge - TK, PK and CK - are thus integrated and reconnected in different ways within the TPACK framework. Technology Pedagogical Knowledge (TPK) describes the relationships between technology tools and specific teaching practices, while Pedagogical Content Knowledge (PCK) describes the relationship between teaching practices and specific learning objectives. Finally, Technological Content Knowledge (TCK) describes the relationships and intersections between technologies and learning objectives. These triangular areas then form the TPACK, which considers the relationships between the three areas and agrees that teachers operate within this complex space. Therefore, TPACK guided this study on measuring the skills and knowledge that teacher trainees possess. This is because TPACK is a useful conceptual framework to explicate the kind of knowledge teachers need to integrate technology into their teaching practices (Voogt & McKenney, 2017). Most teacher education programmes equip trainee teachers with the mixing of technology within the lessons and introduce them to instructional design that might align to the curriculum and make their teaching attractive and effective (Khine et al., 2019).

Therefore, these two models (ICT CFT and TPACK) complement each other to guide the evaluation of teachers' ICT competencies and application of ICT in teaching and learning processes.

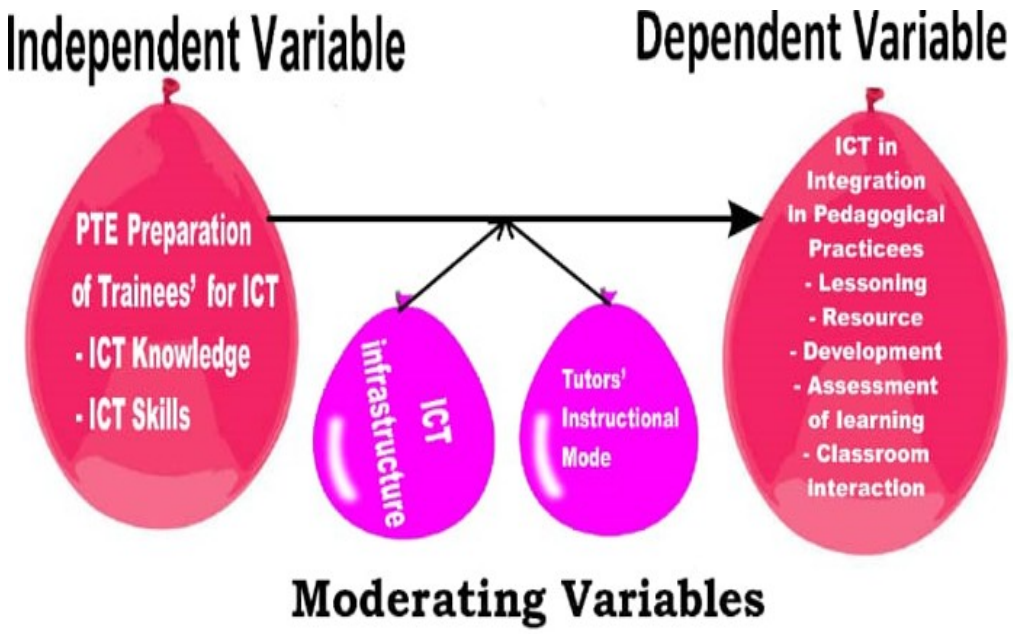
1.12 Conceptual Framework

Miles and Hubermann (1994) noted that a conceptual framework, in graphical or narrative form, describes the most factors, constructs or variables and the hypothetical

relationships between them" (p. 18). Maxwell (2012) defines the conceptual framework as "the set of ideas, assumptions, expectations, beliefs, and theories that support and express your research" (p. 39). Therefore, the framework in Figure 3 illustrates that the independent variable in this study is conceptualized as Primary Teacher Education Trainees' ICT competencies, dependent variable as Primary Teacher Education Trainees' Integration of ICT in pedagogical practices and the moderating variables as ICT infrastructures and tutor's modes of instruction, and infrastructure in PTE.

Figure 3

The conceptual framework



Source: *Developed by the investigator (*Besigomwe, 2021*)*

From Figure 3, PTE Trainees' preparation for ICT are conceptualized as, ICT knowledge and skills. ICT knowledge and skills as independent variables include; basic digital literacy skills and digital citizenship, along with the ability to select and use appropriate off-the-shelf educational tutorials, games, drill-and-practice software, and web content. These skills should be used in computer labs or limited classroom

facilities using standard curriculum objectives, assessment approaches, unit programs, and didactics teaching methods. Teachers must also be able to use ICTs to manage classroom data and support their professional learning. These competencies should be utilized in support of students' in-depth understanding of key concepts and their application to complex, real-world problems. To support collaboration projects, teachers should help students use network and web-based resources to collaborate, access information, analyze and resolve issues of their choice, and interact with outside experts. Teachers should even be ready to use ICTs to make and monitor students' individual and group project plans, also on access information, consult experts, and collaborate with other teachers to support their professional learning. Teachers are model learners and knowledge producers who are constantly engaged in educational experimentation and innovation. Teachers collaborate with colleagues and external experts to develop new knowledge about learning and their teaching practice.

Infrastructures as a moderating variable include; a variety of networked devices, digital resources, and electronic environments are used to create and support this community in its production of knowledge and its collaborative learning. Adequate exposure to computer assisted instruction (CAI) requires substantial computer and Internet resources. If a sufficient number of computers are available, each learner can access the computer for a longer period of time (UNESCO, 2014).

Tutor's modes of Instruction include; teacher-centred instruction to student-centred interactive learning environments, Computer Assisted Instruction and e-learning. Teacher Trainees' ICT competencies are influenced by many variables, such as objectives, pedagogical activities, participants and learning environment (Kennewell, 2001; Lim & Tay 2003; Lim & Khine, 2006; McFarlane, 2000; Zhao & Frank, 2003).

In particular, it plays an important role in preparing teacher trainers with the ICT and academic skills needed to integrate ICT for teaching and learning during their training phase (Mims et al., 2006).

ICT integration in PTE Trainees' Pedagogical Practices as a dependent variable in this context is limited to; planning instruction, resource development, learners' engagement using ICT and Assessment of learning activities using ICT. Teachers need to help students be collaborative, problem-solving and creative learners through ICT. Interactive computer simulations, digital and open educational resources, and sophisticated data gathering and analysis tools are only a few of the resources that facilitate teachers to afford previously unimaginable prospects for conceptual understanding (Beaula & Raja, 2012).

1.13 Operational Definition of Terms

Assessment refers to the measurement of learners' capabilities, progress and academic outcome; using digitalized tests, or manual work created through the use of a computer, for example, printed worksheets.

ICT Competency Framework for Teachers (CFT) is a framework that outlines the ICT competencies (knowledge and skills) that teachers need to integrate into their professional practice.

ICT Infrastructure include computer labs, computers, Internet, digital libraries, e-learning initiatives, projectors, computer softwares, audio equipments, printers, Tvs, websites, smart phones, online assessment tools, and student management and learning systems.

Lesson Planning means planning for learning/teaching process in advance by making learning materials ready, searching the relevant notes and activities online, methods to use, and consulting subject experts through

online collaboration before the teacher trainees go for field teaching practices.

Pedagogical Practices refers to teacher trainees' activities which they do during their training to become professional teachers, for example; learning how to develop different learning aids, lesson planning for different subjects by searching own notes and how to assess learners.

Primary Teacher Trainees refers to students undergoing training to qualify as primary teachers in Uganda, and for this case these are finalists (2nd year students) in PTCs.

Resource development refers to creating or preparing audio and videos, textbooks, notes, maps, charts, posters, models, PowerPoint slides, computers and other reading materials

Teacher education: For purposes of this study, teacher education is conceptualized as all pre-service and in-service training received by primary school teachers in primary teachers' colleges in preparation for the teaching job.

Teacher Trainees ICT Competencies refers to a combination of professional behaviour, skills and knowledge of ICT that a teacher trainee possesses for pedagogical practices. Skills such as when they use a computer, tablet or mobile phone, send an email, browse the internet, make a video call, design learning activities on a computer, draw graphics tailored to lesson notes, and research and knowing what and where to use ICTs. Teacher Trainees ICT Competencies were scored based on basic ICT tools, Complex ICT tools,

professional learning, curriculum and assessment and ICT knowledge.

TPACK in full is Technological pedagogical content knowledge, which is a framework for understanding and describing the knowledge a teacher needs for effective teaching practice in a technology-enhanced learning environment.

Tutors' mode of instruction refers to how tutors teach teacher trainees and demonstrate skills, using computer technology, combining content and teaching approaches in teacher training colleges.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter discusses the literature related to the objectives and variables of the study. These variables are; Information and Communication Technology (ICT), PTE

Trainees' ICT Competencies for integration of technology, ICT Infrastructures and Tutors' mode of Instruction, and the relationship between these variables.

Several studies conducted in Uganda are to assess the extent of ICT integration within the classroom (Guma et al., 2013; Glen, 2007; Namae, 2020; Andema, 2014). These studies report that the extent of ICT integration in classroom is low or moderate, and therefore the integration of ICT into the classrooms may be a dynamic process connecting various factors such as teachers' skills, experience with ICT, type of training, computer and peripheral available at schools. However, these studies have not assessed the teacher trainees' basic ICT knowledge and skills needed for the future integration of ICT in the classroom, a gap this study sought to fill.

Studies have revealed that whether beginner or experienced, ICT-related training programs develop teachers' competences in computer use (Franklin, 2007), influence teachers' attitudes towards computers (Keengwe et al., 2008) as well as assisting teachers reorganize the task of technology and the way new technology tools are significant in student learning (Plair, 2008). A study by Suárez-Rodrguez and colleagues (2018) found that technological competences influence pedagogical competences and personal-professional use of ICT. These teacher competencies begin from teacher training colleges and later to real teaching after graduating from college. Research studies revealed that quality professional educational program helps teachers implement technology and transform teaching practices. ICT Competencies in education are a set of technology standards that define proficiency in using computer technology in the classroom (Lawrence & Veena, 2013). The UNESCO ICT Competency Framework for Teachers (2018, p. 13) states that the ability of teachers to structure learning in new ways, to merge technology appropriately with a pedagogy, to develop socially active classrooms, and to encourage cooperative

interaction and collaborative learning and group work, is what will determine the success of the integration of ICT into the learning environment. Backfisch et al. (2020) reported a correlation between the teachers' Pedagogical Content Knowledge (PCK) and their skill to provide instructional quality (r = .21, ρ < .05) and quality of technology exploitation (r = .22, ρ < .05) in lesson plans. These claims form the basis for this study.

2.1 The Concept of ICT (Information and Communications Technology, or Technologies)

Hsu and Wang (2019) define information and communication technology, as the technology that helps to communicate, disseminate and produce information. Allison and Hoseth (2008) describe ICT, a broad term used to describe an exchange of ideas using equipment, tools, or networks. Examples of ICTs include the Internet, cell phones, and personal digital assistants (PDAs). UNESCO (2011) describes computers, mobile phones, digital cameras, satellite navigation systems, electronic devices and data recorders, radio, television, computer networks, and satellite systems as ICT. Almost anything that handles and communicates information electronically is ICT. According to Ajay (2009), information and communication technology can be defined as the technological means of collecting (input / collecting), integrating (processing / analyzing) and providing information (output / transmitting) through technology. Information and Communication Technology (ICT) refers to all technologies used for telecommunications management, broadcast media, intelligent management systems, audio-visual processing and transmission systems, and network-based control and monitoring functions. DaCosta et al. (2011) define ICT as the general processing and communication of information through technology. In this study, several technologies such as mobile technology are included; Email; Two-way instant messaging; Chat

rooms; Blogs; Personal webpages; Online shopping rating systems; Download images, audio and video and video games. ICT is defined as those devices that are integrated or used to address educational needs and issues, and are facilitated by older technologies such as radio, telephone, television and audio tapes; New digital forms, including computers, the Internet, mobile phones and other mobile devices. ICT refers to the range of technologies used in the collection, storage, editing, retrieval and transfer of information in various formats (Olakulehin, 2007). ICT is defined as the integration of information technology with other related technologies, especially communication technology. This definition sees ICT as a combination of two parts; "Informatics" and "Information Technology" (UNESCO, 2002a). Informatics (or computer science) is defined as the science that deals with the design, realization, evaluation, application, and maintenance of information processing systems, including hardware, software, organizational and human aspects and information, industrial, business, government and political influences. Information technology, on the other hand, is described as the technical applications (artifacts) of communication in society.

In this context, communication technology includes the Internet, wireless networks, cell phones and other means of communication. ICT refers to information and communication technologies and is defined as a diverse set of technological tools and resources used to create, disseminate, store and manage information and communication.

The Federal Ministry of Education, Nigeria (2010) states that ICT covers all equipment and tools (including traditional technologies of radio, video and television, including new technologies such as computers, hardware, firmware, etc.) and

methods, procedures, processes, concepts and policies applicable in conducting information and communication activities.

The Ugandan Ministry of Education and Sports (MoES, 2006) defines Information and Communication Technology (ICT) as ‘the electronic means of capturing, processing, storing, transmitting information, manufacturing and assembly’. ICTs are based on digital information and include computer hardware, software, and networks. When these technologies are used in the field of education, it is called ICT in education. The term can also be used as a synonym for the term education technology because it uses any hardware and software approaches that will result in better learning outcomes. In the age of computer technology, the term ICT mainly focuses on infrastructure, devices and resources of computer technology, so it is necessary to discuss the use of ICT in education by focusing mainly on computer based technology.

According to Way (2009), ICT integration is the degree to which information and communication technologies have been included into the educational setting and the degree to which they have impacted the structure and pedagogies of the institution. She goes on to say that this relationship between infrastructure, teacher motivation, innovations, and the development of e-pedagogies determines the degree of integration. Additionally, Jimoyiannis (2009) explains that the integration of ICT in schools is not just about making traditional instruction better; rather, it is about adopting a completely new pedagogy that moves away from the traditional model of knowledge transmission and onto autonomous, active, and collaborative learning through students' engagement in ICT-based learning environments and shared learning resources.

These claims are in line with the current study's hypothesis that the ICT infrastructure and the tutors' modes of instruction, which combine content, approaches, and technology, have an effect on the relationship between primary teacher education trainees' preparation for ICT integration and ICT integration in pedagogical practices.

2.1.1 Components of an Information and Communication Technology (ICT) system

The ICT system is a setup that includes hardware, software, data and users (BBC, n.d). They often include communication technologies, such as the Internet. ICT and computers are not the same thing. Computers are hardware that's often a part of the ICT system. ICT Systems are used in many places, such as offices, shops, factories, airlines, and ships (BBC, nd). They're also used in fields such as communications, medicine, and farming. ICT encompasses both the Internet-enabled and the mobile ones powered by wireless networks including older technologies, such as home telephones, radio, and television broadcasts, all of which are still widely used today in addition to cutting-edge ICT pieces such as artificial intelligence and robots (Pratt, 2019). ICT is usually used synonymously with IT (for information technology); however, ICT is usually used to represent a broader, more comprehensive list of all components associated with computer and digital technologies than IT. The list of ICT components is exhaustive, and it continues to grow. Some components, like computers and telephones, have existed for many years. Others, such as smartphones, digital Televisions and robots, are more recent entries. ICT commonly means more than its list of components, though. It also encompasses the appliance of all those various components. It's here that the important potential, power and danger of ICT are often found. There are three main types of ICT systems, namely; Information systems (are focused on managing data and information) (Laudon & Laudon, 2014),

Control systems (mainly control machines) (Electrical4U, 2020), and Communications systems (transport data from one place to another) (Schwartz et al., 1995). Information and communication technologies (ICT) are described from a pedagogical perspective as a set of technologies designed for short-term communication, such as social networks and smartphones, and a set of technologies that contain, store, and disseminate information (such as e-books, videos, or databases) (Valverde-Berrocoso, et al., 2022).

Input, output and system diagrams

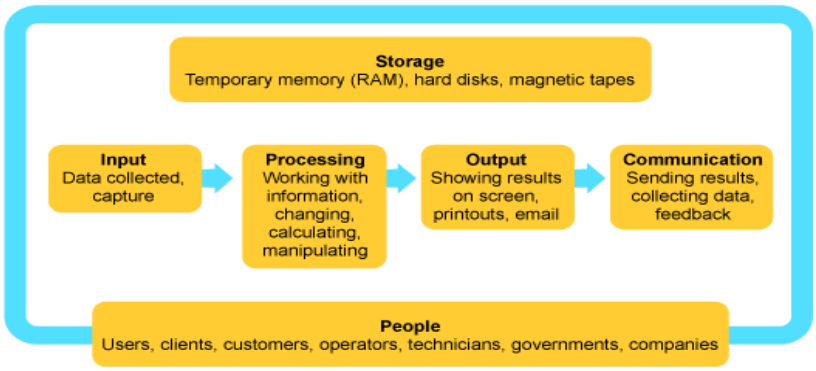
What comes out of an ICT system is essentially hooked in to what you set into the system, to start with. ICT systems work by taking inputs (instructions and data), processing them and producing outputs that are stored or communicated in some way.

An ICT system diagram

A system is an assembly of parts that together make a whole. ICT systems are made from some or all of the parts shown within the diagram. Various devices are used for input, processing, output, and communication.

Figure 4

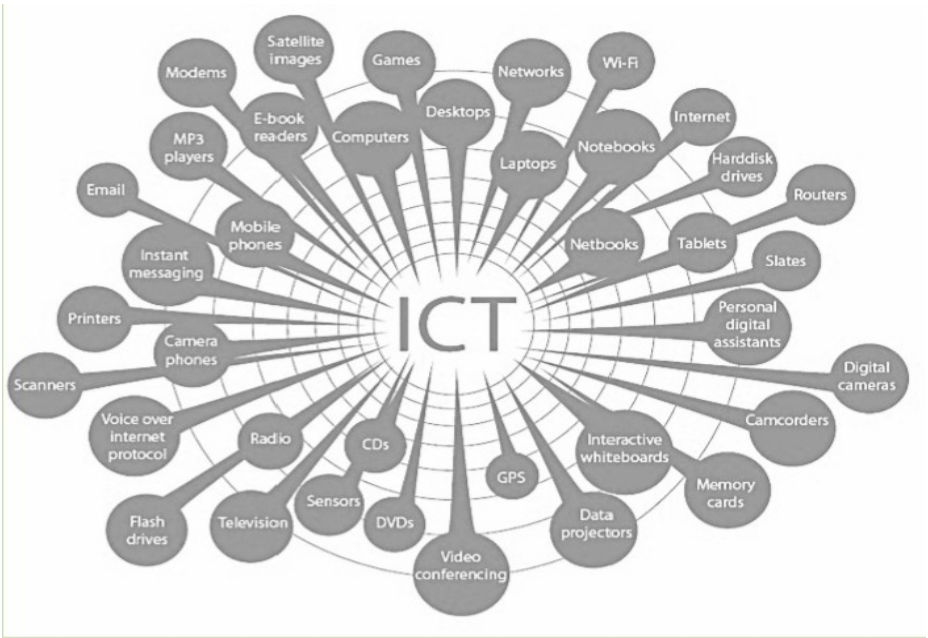
An ICT System



For simplicity, the components of Information and Communication Technology were summarized by UNESCO (2012) as shown in Figure 5.

Figure 5

Components of ICT system summarized by UNESCO



(UNESCO Bangkok, 2012)

2.1.2 Characteristics of ICT in Education

The widespread use of information and communication technology (ICT) has so far impacted all aspects of life, including education. Many countries see ICT as a

potential tool for innovation and change in the education sector (Erdogan, 2009, based on Eurydice, 2001; Papanastasiou & Angeli, 2008) and, as a result, make heavy investment in ICT integration in schools. For example, Europe and Central Asia allocate 22% of their budget to ICT (Erdogan, 2009, modified from, 2007).

According to Pelgrum and Law (2003), ICT in education became popular in the form of education policies in the early 1980's when the consumer market began to sell cheap microcomputers. These students also realized that with the introduction of microcomputers in education in the 1980s, education was expected to be more efficient and motivated. Hepp et al. (2004) argue in their paper “Technology in Schools: Education, ICT and the Knowledge Society” that since the introduction of ICTs in education, they have been used but not at a high level.

Although in the early 1980s computers were not fully integrated into the study of traditional subjects, the widely accepted view that the education system should provide students with an informed society increased interest in ICTs (Pelgrum & Law, 2003). In addition, Kozma and Anderson (2002) wrote in their paper that “ICT and the Reform in developed and developing countries” that for the economy to have a knowledgeable education must be its main need. At the same time, school teaching strategies are geared towards ICT. This shift in ICT has been dramatic. Similarly, Kozma and Wagner (2005) agree on the idea that ICT will enhance important education and can be a very challenging field for development work these days, in poor and rich countries (Wagner & Kozma, 2005). Furthermore, within the field of ICT in education, Ezer (2005) points out that ICT for development literature often treats education 'in transit'.

ICT in education is any hardware and technology that contributes to the information processing in education. In the current context, ICT in particular has computer and

hardware technologies, such as, Personal Computer, infrastructure required to set up Internet space and software such as CD ROM including various software packages, E-learning strategies, etc. ICT in education is any Information Technology that focuses on the acquisition, storage, manipulation, management, transfer or acceptance of information required for educational purposes. For example, information relating to student records, admissions, renewal of their core and co-curricular activities (UGWU & Nnaekwe, 2019).

ICT in education is any technology related to the exchange of information or in other words communication in a defined process. The use of electronic learning technologies such as, Teleconferencing, PowerPoint presentations, CD ROM by Communication Technology is part of ICT. ICT in education is an educational technology used in the education system. It includes hardware approaches such as the use of machinery and materials, software approaches such as using teaching and learning methods and systems approaches that use management technologies that deal with organized hardware and therefore software. Different software packages for use in different departments of education; e.g. library software, administration software, software associated with managing the entire teaching and learning process. ICT in education is the support material in the hands of staff involved in the education process to improve the quality of education. ICT in education contains the use of On-line science, offline learning with the help of computer technology.

In reports, government and policy documents of higher educational institutions and statements by academics and IT professionals, technology is often discussed with reference to their many uses (Mlitwa, 2005). In higher education, reference is made to ‘educational technologies’ (University of Cape Town (UCT), 2003), ‘technology and

eLearning technologies (Badenhorst & de Beer, 2004), online teaching and learning technologies (Van de Merwe & Moller, 2004).

2.1.3 Uses of ICT in Education

ICT is used in all areas of life. Due to the increasing importance of the computer, future student-citizens cannot keep themselves away from this potentially powerful medium. In education, the use of ICT has become increasingly important to improve efficiency and effectiveness at all levels and in both formal and non-formal settings. Education even at school level should provide computer education. Extensive technical knowledge and a positive attitude towards these technologies are a necessary requirement for successful citizens for decades to come.

It may be used for the following purposes:

Information and Communications Technology (ICT) can have an impact on student learning if teachers are digitally literate and understand how to incorporate them into the curriculum (UNESCO, 2019). ICT can be used in three ways in schools: for teachers to present, evaluate and monitor knowledge; facilitate administrative work; as “learning content related to students’ information knowledge”(Kang et al., 2011).

1) Schools use a different set of ICT tools to communicate, create, disseminate, store and manage information (Blurton, 2000). In some cases, ICT is also part of the teaching and learning network, using approaches such as switching from traditional chalkboards to digital whiteboards, using student smartphones or other learning devices during class, and the “flipped classroom” model where students watch lectures using computers at home and use class time to do more interactive exercises.
2) When teachers are digitally educated and trained to use ICT, these approaches can lead to higher thinking skills, provide creative and tailored options for

students to express their understanding, and leave students better prepared to face ongoing technological change in society and the workplace (Goodwin, 2012)

3) ICT planners should consider issues such as: the cost- benefit equation, providing and maintaining the required infrastructure, and ensuring that investment is aligned with teacher support and other policies aimed at the effective use of ICT (Enyedy, 2014)
4) Digital culture and digital learning: Computer technology and other aspects of digital culture have changed the way people live, work, play, and learn, which contributes to the creation and dissemination of knowledge and energy around the world (Deuze, 2006). Graduates who are unfamiliar with the digital culture are increasingly at risk in the national and global economies. Digital skills - the skills of searching, understanding, and producing information, and critical use of new media for full public participation has become increasingly important in the field of study (Buckingham, 2008).
5) ICT tools can also help to develop the skills of minority language learners especially in learning the official language of instruction through features such as automatic speech recognition, authentic audiovisuals, and chat functions (Alsied, & Pathan, 2015; Golonka et al., 2014)
6) Students with different learning styles: ICT can provide a variety of options for introducing and processing information, making sense of ideas, and expressing learning. More than 87% of students study better visually and tactilely, and ICT can help these students 'feel' information rather than just read and hear it (Kenney, 2011; Tileston, 2003). Mobile devices can also offer programs ("apps") that provide additional support to students with special

needs, with features such as simplified screens and commands, consistent menu layouts and control features, text-based graphics, audio feedback, speed and difficulty setting, appropriate and unobtrusive feedback, and editing of simple errors (Newton & Dell, 2011; Rodriquez et al., 2013).

7) Broadcast material, online site or CD-ROM can be used as sources of information in various subjects
8) Facilitate communication for students with special needs (Talent Guide, 2008; Rigby, 2009).
9) Use of electronic toys to improve spatial awareness and psycho-motor control
10) Through ICT, students develop an appropriate level of competence, become more involved in their learning, and achieve learning outcomes across the curriculum at a higher level.
11) Using an online service such as email, chat, chat forum to support collaborative writing and information sharing.
12) Conducting video conferencing or other form of Teleconferencing to engage various students from remote Geographic locations.
13) Blended learning by combining conventional classroom learning with E-learning programs
14) Process administrative and assessment data.
15) Exchange and share ideas - among educators on professional growth. Doing online-based research to improve, an educational process
16) Current research has shown that ICT helps to transform a teaching environment into a student-centered environment (Castro Sánchez & Alemán, 2011). As students become more involved in learning programs in ICT classes, they are authorized by the teacher to make decisions, plans, and so on

(Lu et al., 2010). ICT, therefore, provides both students and educators with a wide range of educational possibilities and opportunities (Fu, 2013).

17) ICT facilitates the acquisition of high-level thinking skills by providing students with cognitive scaffoldings as they have a sense of information; allowing professionals, teachers, and students to interact with their ideas and interests in academic matters and to simulate real students' situations and problems as they explore the connection between concepts and ideas (Lim & Hang, 2003; Wenglinsky, 1998).

18) Research studies have highlighted the fact that the use of ICT, along with other teaching strategies, has helped students move to higher order thinking (Jonassen & Carr, 2020; Kearney & Treagust, 2001; Oliver & Hannafin, 2000). As a result, students develop constructive thinking skills. Thus, students learn to prepare for the future information age (Salomon, 2002). According to Kozma (2005), ICT can be used to improve students' understanding thereby increasing the quality of Education.

19) Some theorists agree that ICT can help students gain knowledge, reduce the level of specific instruction they receive, and give teachers the opportunity to help those students with special educational needs (Iding et al., 2002; Shamatha et al., 2004).

20) The integration of technology in schools has brought about changes in the roles of teachers in the classroom. Classes in which technology is used by their teachers are often compared to that of a facilitator or trainer rather than a lecturer (Henriquez & Riconscente, 1998).

21) As teachers use ICT in the classroom, their teaching is shown to be very fruitful. Therefore, to be at this level of training is a requirement for all

teachers to acquire sufficient expertise to teach effectively. As a teaching tool ICT can provide a new framework for teaching effectively. Therefore, learning will be done collaboratively, project-based and independent.

22) As students become more independent, teachers who are not accustomed to working as facilitators or trainers may not understand how technology can be used as part of teacher-directed activities. This is a situation where the teacher gets a great opportunity to learn from the students and to model to be a person who is knowledgeable, lifelong learner, and at risk.

23) As part of their job requirements, teachers are expected to use technical tools in most cases. As technology continues to have an impact on teaching and learning, teachers' expectations of using the benefits of technology will arise, leading to teachers being pressured to switch between pedagogy and technology seamlessly (Teo, 2011).

24) High level of assessment.

25) With an ICT learning solution student work can be tracked to the highest level. Every student's response to questions, simulations, and tests can be tracked and included in customized reports.

26) In fact, educational institutions often drop businesses for almost a decade in the adoption of new technologies (Leidner & Jarvenpaa, 1995). This is true in terms of the use of ICT in the learning process: blackboard and chalks remain a key teaching technology in many schools even though the effectiveness of ICT to improve communication, efficiency, and decision-making in organizations is well known and focused on researchers.

27) ICT is important because of the widespread use of automated systems in all operations. ICT is very important in research, library, documentations, etc. Technology has opened a new door to human activity.
28) According to Hepp et al.(2004) due to increased productivity, ICT should be considered as the most important educational tool from the classroom to the senior management team. ICT plays a role in reducing the burden of school management, which is why there will be an increase in the flow of effective and integrated information between teachers, students, and non-teaching staff.
29) ICT has the potential to improve access, quality and effectiveness in general education and is able to develop more and better teachers in particular.
30) In conclusion, we can say that ICT helps to improve the teaching and learning and the people who participate in teacher education programs. It can be incorporated into a learning process to acquire knowledge and skills well. ICT provides access to resources so that teachers can apply the new knowledge and skills they have learned. Communication technology will be able to improve the capacity of teachers and instructors and at the same time, strengthen the capacity of instructors, which is a fundamental requirement of effective transactional strategy.

2.1.4 Advantages of the Use of ICT in Education

ICT integrates all those gadgets that work by processing data for better and more efficient communication. In education, a process of communication takes place between teachers, students, administrators and administrative staff that requires a lot of data that will be stored to retrieve it where it is needed, to be distributed or transmitted in the desired manner (Ugwu & Nnaekwe, 2019). Computer hardware and software such as advanced projector (OHP), Television, Radio, Computers and related

software are used in the educational process. However, ICT today focuses on the use of computer technology for data processing. In this case, the benefits of ICT in education can be documented as follows:

Quick access to information:

Information can be accessed in seconds by connecting to the Internet and browsing Web pages.

Learning Management Systems

Learning management systems (LMS) also are mentioned as Virtual Learning Environments, Digital Learning Environments, Course Management Systems, and Electronic Learning Environments (De Smet et al., 2012). A LMS is a web-based program designed to support online training, teaching and learning (Valamis, 2019). It allows students to perform learning activities such as reading materials, completing assignments, doing tests and tests, doing research online, participating in class discussions, and working on group online projects (Pituch & Lee, 2006; Sun, et al,. 2008). Learning Management System has therefore become an integral part of modern academe.

Easy availability of updated data:

Sitting reception or at any comfortable place the specified information are often accessed easily. This helps students to study updated content. Teachers can also keep abreast of the latest teaching and learning techniques and related technologies. In addition, Papert (1997) noted the benefits of ICT for students and may be: students are more motivated and, as a result, become more creative when faced with new learning environments. Also, they tend to associate in a ordered way by working in partnership with their peers. As a result, they're ready to generate knowledge. They will have the power to manage rapid changes in any type of environment.

Connecting Geographically dispersed regions:

With the advancement of ICT, education is not always restricted within the four walls of educational institutions. Students from different parts of the world can learn together through online, offline. According to Ugwu and Nnaekwe (2019), this would result in an enriching learning experience. Such collaborative learning can result in developing;

- divergent thinking ability in students,
- Global perspectives
- Respect for the diverse nature of human life and acculturation.
- Facilitation of learning

ICT has played a role in transforming the focus on learning rather than teaching. ICT helps students to explore knowledge for content through self-study. The teacher can help learners by ensuring the right guide to effective learning. Situational learning, Programmed learning, many online courses are just some of the examples of self-study strategies used with the help of ICT.

Catering to the Individual differences:

ICT can contribute to catering to the individual needs of the students as per their capabilities and interest. Crowded classrooms have always been a challenge for the teacher to think about the requirements of each student within the class.

Blind and Visually Impaired Students:

Blind and Visually Impaired students lack the sight necessary to see information presented on a computer screen. They cannot operate a mouse. They rely predominantly on text-to-speech software called screen readers (SR) to interact with

computers and the Internet (Lazar et al., 2007). They use key commands (including keyboard shortcuts afforded by the operating system and specialized keystrokes afforded by the screen-reading technology) to operate the screen readers. The Screen readers identify and interpret text content on the computer screen and present this aurally through a synthetic voice (Di Blas et al., 2004). Jaws, WindowEyes, Voice Over, and NVDA are commonly used, screen readers.

A wider range of communication media:

With the advent of ICT, various forms of communication were introduced in the teaching and learning process. Offline learning, online learning, blended learning are a number of the resources which will be utilized in educational institutions. Collaborative learning, individualized learning strategies can enhance the quality of the group as well as individual learning with the real society. This can ensure the applicability of knowledge.

Wider learning opportunities for pupils

Application of the latest ICT in education has provided many options for the learners to opt for the course of their choices. Many Online courses are available for them to pick any as per their aptitude and interest. Students can evaluate their own progress through different quizzes, able to use online tests (Hisgrace Cablesat Technologies, 2015). This can ensure fulfillment of the utilization required within the job market thus minimizing the matter of unemployment. It can also provide more efficient and effective citizens to society as per the changing needs.

2.2 Perspectives of ICT in different countries

A study by Shahid & Kulhudhuffushi (2015) shows that the ability to use ICT among Asian school teachers is low compared to the level of training they receive and the positive attitude they have toward ICT. An ICT application is a common requirement

in all learning environments at present, as traditional teaching methods in which the teacher continues to speak and students memorize, listen, make notes and even sleep are not at all acceptable. It is necessary to increase student participation in the learning process to make learning more appealing to learners and to make teaching based on outcomes. Computer integration in education was needed that way; to make new technologies friendlier to students, and to improve the teaching and learning process (Alev, 2003) through its implementation.

In the Philippines, a study by Caluza et al (2017) that aimed to assess the level of ICT skills of public school teachers found that most teachers have a basic knowledge of ICT but need to be improved. They recommended that additional training be needed for teachers to integrate ICT into teaching and other related activities to improve and enhance the quality of education of their public primary school.

Rivera et al (2017) conducted a study of the media skills of Colombian (Medellin) and Ecuadorian (Loja and Zamora) teachers using a tax conversion program from a media skills model, consisting of 6 aspects and 12 indicators in total. The data collection tool was used for the purpose of determining their level of media capabilities from each aspect. The results revealed a low to moderate level of media knowledge, highlighting the need for priority interventions based on domestic, regional and international activities, namely those involving scientific, educational and political partnerships to improve demographic performance that should lead to citizen-centered media skills. Rivera et al., (2017) states that the problems of illiteracy in the media, of social groups such as teachers, which should lead to general human training, should not be added to the current social and economic problems in countries such as Colombia and Ecuador. Those people have accepted social and social responsibility as educators, and therefore have no excuse: "a teacher who thinks of his or her speech and uses a

competency model should be competent in their knowledge. Therefore, according to the above, one cannot make skills based on one's incompetence" (Sánchez & Aguaded, 2013).

Twidle et al. (2006) found that student teachers in the United Kingdom felt unfit to use ICT to practice learning. One of the reasons for this was the lack of student performance skills. In a review of research on science, technology and education (Parker et al., 2007) the authors argued that teachers need time to develop their knowledge in the field, and practical experience is important. Teachers need to know how computers or other technology devices work to be able to use them, but workshops or private conferences are not enough to make a real difference in terms of ICT integration in classrooms (Enochsson & Rizza, 2009).

In Europe, Gerick et al. (2017) pointed out that the need for students to develop new types of skills such as digital or computer literacy and learning skills is always important.

In Belgium, Tondeur et al. (2018) conducted a study on the ICT capabilities of pre-service teachers and the results showed a positive effect on the ease of use by pre-service teachers in their ICT skills and knowledge for educational practice. Their results could provide a guide to the preparation of pre-service teachers for 21st-century learning environments with new technologies.

Syahid et al. (2019) reported that having ICT literacy skills was required for primary school teachers in line with current development needs and Education in Indonesia. Syahid and his colleagues conducted a multi-year study that sought information on the types of ICT training materials tailored to the needs of primary school teachers and the development of an effective ICT training curriculum. The findings of this study showed an overview of the gap between ICT-capable teachers and teachers who need

to improve their skills in the use of ICT in practice. In an effort to bridge this gap, their research created an ICT training curriculum that was tailored to the needs of teachers in primary schools. Based on the results of the needs analysis and curriculum development, it was concluded that the ICT knowledge and skills of primary school teachers in learning activities need to be improved.

Danner & Pessu (2013) assessed the students ’self-assessment ICT knowledge and skills that students have in teacher training programs at the University of Benin, Nigeria. They found that the unavailability of computers and Internet connections within the education sector raised a sensitive issue affecting staff and student use of ICT applications. They, therefore, recommend that government make funding available for the provision of ICT infrastructure at tertiary institutions in the country. These findings inspired this current study to be conducted in Uganda.

Finger, et al, (2012) conducted a TPACK survey comprising 18690 participants in Australia and found that there was a modest increase in the confidence of first-time teachers to use ICT as a teacher and that there was a modest increase in their confidence to facilitate students' use of ICT as future teachers. These findings also inspired this study to be carried out in the Ugandan context using the TPACK Model.

In South Africa, Dlamini & Mbatha (2018) carried out an exploratory study within the framework of the South Africa teachers’ union to understand members’ preparedness to integrate ICT tools in their teaching practices. Their findings indicate the need for technological advancement activities in the use of ICT in teaching, multicultural education, and classroom management. Besides, the study provided clear evidence that without significant investment in ICT infrastructure by the government, inequalities in ICT skills among teachers still exist, which may be the case in Uganda.

In Rwanda, Byungura et al. (2018) pointed out that the more students have access to technology, the more they need higher education programs to adopt new teaching strategies that address different learning needs. Depending on the previous students' experience with computer-based tools, they may have different stages of adjusting to new technologies. In their study at the University of Rwanda (UR), they reported that the familiarity and knowledge of the technology of incoming students were not well known. Their research results show that most participants were unfamiliar with the technology and had no prior exposure to eLearning programs. Second, in terms of digital tools, while smartphones are available tools, held and used by respondents, they are rare or have never used for learning activities. They recommend that there be strategies to improve knowledge and confidence in technology, for first-year students. This will prepare new students for the acquisition and early technology while empowering them to develop relevant skills and competencies in the digital age (Byungura et al., 2018).

In Kenya, a report by the National Council for Science and Technology (2010) showed that the use of computers in Kenyan classrooms is still in its infancy, and concluded that the attitudes and experiences of teachers and administrators play an important role in computer use in Kenyan classrooms.

Uganda developed its National Information and Communication Technology Policy in 2003 with the ultimate goal of integrating ICT into academic and other literacy programs to provide equal access for all students regardless of education level (MoE&S, 2006). With the establishment of the ICT Ministry in Uganda in 2006, various policies were developed by the Ministry of Education and Sports (MoES), for example, the ICT policy on primary and secondary school education aimed at training teachers in ICT skills but the programme seems to be facing challenges to accomplish

this. The policy aims to improve the investment quality of educational ICT resources, software as well as broadband connectivity in primary, secondary and tertiary institutions. Establish educational networks for sharing educational resources; promoting growth and implementation of e-learning; creating opportunities and providing assistance to the disadvantaged, people with special needs, women and youth to acquire ICT skills. In recent years there have been many efforts and resources aimed at improving teachers' skills and confidence in the effective use of ICT in classroom teaching and learning (Magambo, 2007). Information and Communication Technology knowledge and skills develop the skills of teacher trainees to self-learn, develop teaching materials, seek information and teach. In Uganda Primary School Teachers, ICT is taught as a unit under Professional Education Studies (MOES, 2012) and as a teaching tool. In high schools, ICT is taught as a subject (NCDC, 2018) and is evaluated by the Uganda National Examinations Board (UNEB). ICT has become an important part of international education. ICT can do wonders in the classroom if used wisely by well-trained teachers.

Globally, there is awareness of the important role of new Information and Communication Technologies (ICTs) in the education sector. Globally, Information Communication Technology is drastically changing the way we live our lives. ICT abounds in our daily routines, study and personal life. Today's students grow up in a world that is experiencing technological change and innovation. Therefore, there is a need for teachers to be equipped with the necessary skills and experience that will enable them to become useful members of a global community. ICT can empower teachers and students to promote change and promote 21st-century skills development, but the knowledge to prove this belief is still untapped in Uganda. The

integration of technology into the teaching and learning process is being considered by many researchers and increasing the productivity of students and teachers and making more information available. It is clear that ICTs provide opportunities that were not previously available to teachers. Using tools such as email, the web, audio, video, computer conferencing, both asynchronously and synchronously, a richer and more personalized learning environment can be created that allows students to control their learning speed, learning environment and company they wish to keep (or not to keep) while studying. In line with the rapid development and use of ICT in the workplace, it is important that the current generation of teachers is well-prepared with the knowledge and skills of ICT so that they can ably tackle the world of work in the future. Teacher training colleges need to equip teachers with ICT skills to equip students with the critical skills needed if they, as members of the community, will make a significant contribution to the country's future development. All teachers need to become familiar with ICT and be able to use ICT applications. In fact, ICT is a way of life for many of us and we must be fully prepared to live in the world of ICT. ICT improves the learning and teaching process by increasing student motivation. The use of ICT in the classroom helps to explain complex concepts so that students can easily understand those concepts. ICT in education can take many forms such as information and computer networks, digital content, Internet sites, multimedia, and more. ICT competencies are a collection of knowledge, skills, and attitudes needed when using ICT to perform tasks and construct knowledge (Ferrari, 2012).

Education systems around the world are under increasing pressure to use Information and Communication Technology (ICT) to teach students the knowledge and skills needed in the 21st century (Omwenga, 2007). Kler (2014) has identified ICT as an effective resource with the potential to improve educational interaction between

teacher and student in a classroom provided with appropriate educational technology. The development and use of ICT in African institutions of higher learning are critical if the continent is to reduce its knowledge, technological and economic gaps between it and the rest of the world (Farrell et al., 2007).

Twinomujuni (2011) studied problems in the use of ICT in selected tertiary institutions in the Kabale district. There are not even a few studies conducted, related to the training of ICT Primary student teachers in Uganda, the gap this study is trying to close. Mugisha (2007) researched issues related to ICT implementation in the Core Primary Teachers 'College curriculum in Kabale district. The issues selected in the study were tutors' attitudes toward ICT, their use of ICT in teaching, and the availability of ICT. As these studies looked at issues related to ICT implementation, the study population was only tutors in the teacher's colleges and thus left a gap that would be closed by this current study by looking at teacher trainees in Ugandan teacher training colleges.

2.3 ICT Infrastructures and Trainees' Competences for Integration of Technology

The word "competence" first appeared in an article written by R. W. White in 1959 as a concept to promote performance. In 1970, Craig C. Lundberg described the concept in "Planning the Executive Development Program". The term came to the fore when in 1973, David McClelland wrote a seminal paper entitled, "Testing for Competence rather than for Intelligence". Since then it has been well known because of scholars such as, Richard Boyatzis the professor of Organizational behavior and others such as T.F. Gilbert (2013) who used this concept relating it to performance improvement. Its use varies greatly, leading to great ambiguity. Some scholars see "competence" as a combination of practical and theoretical knowledge, cognitive skills, behavior and

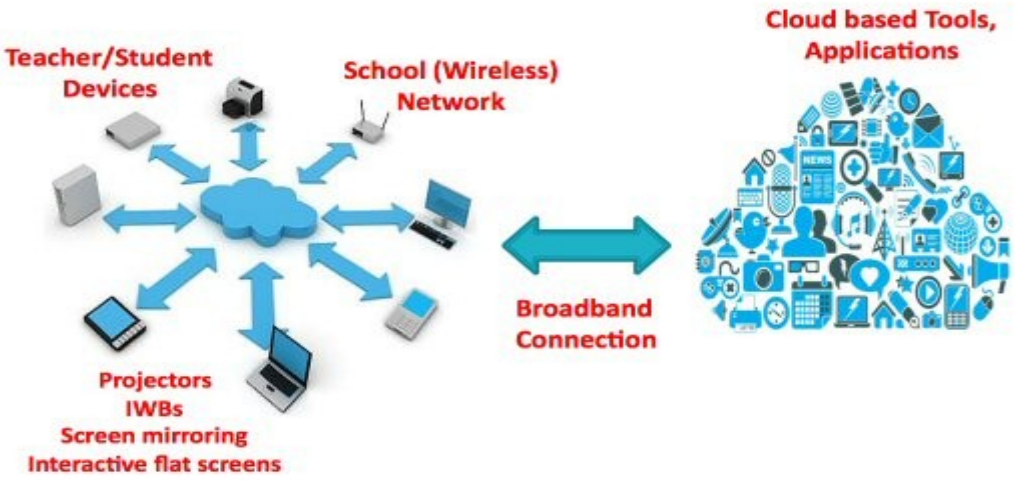
values used to improve performance; or as a condition or quality of sufficiency or suitability, capable of performing a particular role. International Organization for Industrial Development (UNIDO) (2002): Competence is can be explained as both knowledge and skills and specifications that can make one person do work better, regardless of his or her unique skills in the field. Therefore, Competence is the set of demonstrable characteristics and skills that enable and improve the efficiency or performance of a job.

This study hypothesized that for teacher trainees to have ICT competencies for their pedagogical practices, ICT infrastructure must be present. In some developing and underdeveloped countries, lack of infrastructure is a major problem for teachers' ICT use (Agyei & Voogt, 2011; Demmans Epp et al., 2017). However, ICT infrastructure is well suited to support teaching, learning, assessment and school management. ICT infrastructure includes digital television, global satellite calls, the Internet, websites, mobile phones, short messaging services, and multimedia equipment, such as video, audio, projectors and podcasts. Also, it includes digital media and communications, which are helped by transmission hardware and software, information sharing and distribution, especially in teacher education.

A Nigerian study has shown that the deficient of ICT resources and deprived infrastructure hamper the full realization of ICT in education (Adeosun, 2010). Improved types of ICT supported instruction including computers and Internet-assisted teaching require appropriate infrastructure including computers and Internet resources. Computers available for educational institutions must have computers for teaching and administration purposes. The development of a strong infrastructure that provides teacher trainees with the resources they need, when and where they are needed is a key factor in developing their ICT skills.

Figure 6

ICT infrastructures



Source: PDST Technology in Education (2015)

Overview of ICT infrastructure areas for schools

This image highlights some of the key areas of ICT in schools, including wireless school networks which connect teachers' and student mobile devices through broadband to cloud-based tools and applications. Although each school differs in size, location and location on the use of ICT, there are some common changes and trends in the way schools use ICT. These include:

1) Increased use of cloud-based tools and applications by schools
2) The importance of fast / reliable broadband connectivity to cloud-based applications
3) Use of mobile computer devices by teachers and students, including areas for special educational needs
4) The importance of appropriate wi-fi networks in schools to support mobile learning

5) Changes in how screens are displayed and alternatives to projectors in classrooms

In many countries, digital learning is being developed through the introduction of information and communication technology (ICT) in schools. Other common ICT education programs include:

One laptop per child: Cheap laptops are designed for 1: 1 use in school with features such as low power consumption, a low-cost operating system, and special reprogramming functions and mesh network functions (Zuker & Light, 2009). Despite cost-cutting efforts, however, providing one laptop per child can be costly in some developing countries (Warschauer & Ames, 2010).

Tablets: Tablets are small personal computers with a touch screen, allowing input without a keyboard or mouse. Inexpensive software ("apps") can be downloaded to tablets, making it a versatile learning tool (Bryant et al., 2015; Shah, 2011). The most effective applications develop high level of thinking skills and provide creative and tailored options for students to express their understanding (Goodwin, 2012).

Interactive White Boards or Smart Boards: White interactive boards allow customized computer graphics to be displayed, intelligently made, dragged, clicked, or copied (BBC.n.d). At the same time, handwritten notes can be taken from the board and saved for later use. Interactive white boards are associated with classroom instruction rather than student-centered activities (Turel & Johnson, 2012). Student involvement often peaks when ICT is available for use by students throughout the classroom (Beilefeldt, 2012).

E-readers: These are electronic devices that can hold hundreds of books in a digital way, and are widely used in the delivery of reading materials (Jung et al., 2011). Students - both skilled students and hesitant students - have positive responses to the

use of e-readers in independent reading (Miranda et al., 2011). These e-readers have features that motivate learners to use them for example; they are portable and have long life battery, text response, and the ability to define unfamiliar words (Miranda et al., 2011).

Flipped Classrooms: A flipped classroom model, which includes lecture and home practice with computer-guided instructions and interactive learning activities in the classroom, may allow for an extended curriculum. There is little research into student learning outcomes of flipped classes (Bishop & Verleger, 2013). Perceptions of students on the flipped classes are mixed, but positive, because they prefer cooperative learning activities in the classroom rather than the lecture (Bishop & Verleger, 2013; Strayer, 2012).

ICT and Teacher Professional Development: Teachers need specialized opportunities for professional development to increase their ability to use ICT in constructive learning, individualized teaching, access to online resources, and to facilitate students' interaction and collaboration (Dunleavy et al., 2007). Such training in ICT should have a positive impact on teachers' general attitudes towards ICT in the classroom, but should also provide direct guidance on ICT teaching and learning within each discipline. Without this support, teachers often use ICT in skills-based applications, limiting students' thinking (Smeets, 2005). Supporting teachers as they transform their teaching is also important for education managers, administrators, teacher trainers, and decision-makers to be trained in the use of ICT (Chapman, & Mählck, 2004).

Ensuring the benefits of ICT investment: To ensure that investments made in ICT for students are beneficial, additional conditions must be met. School policies need to provide schools with an acceptable ICT infrastructure, including stable and affordable internet connectivity and security measures such as filters and site blockers. Teacher

policies need to identify the basic skills of ICT learning, the use of ICT in teaching environments, and discipline specific uses (Kopcha, 2012). The effective use of ICT requires the integration of ICT into the curriculum. Finally, digital content needs to be produced in local languages and reflect local culture (Voogt et al., 2013). Continued technical, human and organizational support for all these issues is needed to ensure the effective access and use of ICT (Kopcha, 2012).

Contexts constrained by resources: The total cost of ICT ownership is important: teacher and management training, connectivity, technical support, and software, among others (Zuker & Light, 2009). When establishing ICT classrooms, policies should use an incremental pathway, establishing infrastructure and delivering sustainable and easily renewable ICT (Enyedy, 2014). Schools in some countries have begun allowing students to bring their mobile technologies (such as a laptop, tablet, or smartphone) to the classroom instead of providing such tools to all students – an initiative called Bring Your Own Device (Alberta Education, 2012; Project Tomorrow, 2012; Song, 2014). However, not all families can afford the devices or service plans for their children (Sangani, 2013). Schools must ensure that all learners have equal access to learning ICT devices.

The availability of ICT affects the teacher's ICT skills significantly (Oqunkola, 2008; Kumar et al., 2008; Wozney et al; 2006). Teacher trainees can increase their ICT knowledge and skills through the ICT resources available at their teacher's colleges.

In many countries, the improvement of ICT infrastructure has been considered a priority for the use of ICT. For example, Korea outlined its first Master Plan for ICT in education in 1996, with the ultimate goal of establishing the necessary ICT infrastructure in the country (Keris, 2014).

Similarly, Rwanda adopted the One Laptop per Child Initiative in 2007, to set up technology infrastructure and monitor children's engagements with laptops.

Similarly, in the late 1990s and early 2000s, many Latin American and Caribbean countries defined their ICTE policies and all included objectives related to computer provision and internet connectivity in schools and some form of teacher training strategy (Hinostroza et al., 2011). All of this aims to develop teachers' ICT skills and competencies, as well as the emerging practice of using mobile and / or home-based ICT infrastructure as tools to expand learning and learning opportunities.

Findings from a study by Omare et al. (2018) in Kenya revealed that the lack of electricity or generators, inadequate equipment and resources, inadequate knowledge in teaching and learning using ICT, individual perceptions and lack of internet connectivity were major barriers to learning and teaching via ICT. This not only affects the use of ICT in classrooms but also affects students negatively in gaining ICT knowledge and skills.

Kankam and Nsibirwa (2019) conducted research on internet availability and access to information for high school students in Ghana. Their findings revealed that students have limited Internet access at school and do not have the necessary skills to access online information effectively and efficiently. Their study underscores the need to improve Internet infrastructure and trains students with the necessary online search and retrieval skills.

With regard to infrastructure as a moderating variable in this study, the review notes that school broadband bandwidth is increasingly determining online content, performance and applications that students and teachers will be able to use effectively in the classroom (Fox et al., 2012). Therefore, all network and traffic applications, as well as bandwidth utilization technology, should be included in the design of school

networks (CISCO, 2013). While countries around the world continue to prioritize infrastructure development, simply investing in additional school technology does not lead to education reform. In fact, there is evidence to suggest that, in some cases, the emphasis on hardware may remove the focus on potential learning opportunities, and that it puts technology beyond teaching (Luckin et al., 2012). There is also important evidence that whether technology affects learning outcomes is determined by how it is used (Langworthy et al., 2010).

We therefore need to think critically about the type of infrastructure that needs to be built if we are to create schools where all students develop the knowledge, skills, and abilities for them to succeed in the 21st century. This is not a question that can be answered on its own but you should look at other aspects of the education system such as teacher trainees pedagogical practices and their ICT competencies.

2.4 PTE Trainees' ICT Competences for Integration of Technology

The concept of competence in pedagogy was introduced by Roth (1971), who described it as ripeness and maturity, productivity and critical ability; these are a prerequisite for responsible decision-making skills, as well as central general education goals. In his opinion, maturity is regarded as a competence for responsible action in three crucial areas: (1) self-competence, (2) expertise and (3) social skills. "Competence makes the connection between knowledge and skills and is seen because the ability to affect different situations". Competences can also be combinations of knowledge, assessment ability, communicational skills, and learning skills. "Competences are abilities of the person to unravel professional problems even in conditions of uncertainty, to simply accept critical decisions, creatively to figure, constantly to study". On the other hand, competences can be viewed as combinations of knowledge, skills, attitudes, and positions according to Špernjak and Šorgo (2018).

A competency is defined as a combination of skills, abilities, and knowledge needed to perform a specific task (Jones & Voorhees, 2002). Competence is defined because the ability to mix and apply relevant attributes to particular tasks especially contexts. These attributes include high levels of data, values, skill, personal dispositions, sensitivities and capabilities, and therefore the ability to place those combinations into practice in an appropriate way (Commonwealth Department of Education, Science, and Training, 2002).

UNESCO (2011) defines competency as; the skills, knowledge, and understanding needed to do something successfully. Competencies often serve as the basis for skills standards that specify the level knowledge, skills, and abilities required for success in the workplace as well as potential measurement criteria for assessing competency attainment. Competencies are the talents and knowledge that enable an educator to achieve success.

Teacher competency refers to the excellence capability including knowledge, skills, attitude, and experience to complete a definite task at a particular level to high excellence by a teacher (Paramanik, & Barman, 2019). Teacher competence is the capability, ability, and skills of the teachers to make the teaching-learning environment is effective (Sekar, 2016). Perera (2003) defines teacher competencies as, “a combination of professional behaviour, values, and attitudes, skills and knowledge that a teacher possesses in order to demonstrate quality teaching in relation to their context of teaching.

Teacher Trainees’ ICT Competencies are defined as a set of technology standards that define proficiency in using computer technology in the classroom. The competencies contain computer-related skills grouped into four general domains: (1) Basic Technology Operation, (2) Personal and Professional Use of Technology Tools, (3)

Social, Ethical, and Human Issues, and (4) Application of Technology in Instruction (Lawrence, & Veena, 2013). UNESCO (2011) looks at ICT competencies basing on three approaches; Technology Literacy, Knowledge Deepening, and Knowledge Creation. Most of the schools and educational systems started providing extensive computer networks for their students and these are increasingly becoming main components of the teaching and learning environment (Fraillon et al., 2014). Technology has become an increasingly important a part of students' lives beyond school, and even within the classroom. It can also help to deepen their understanding of complex concepts or to encourage peer learners collaboration. Because of these benefits, current educational practice suggests that teachers implement some sort of technology in their classrooms – but many teachers face difficulties in doing so.

For example, teachers lack knowledge on how technology can best be utilized to benefit students across diverse subject matter. Lack of adequate training and experience is one of the main factors why teachers do not use technology in their teaching (Danner & Pessu, 2013). This also results in teachers' negative attitudes toward computers and technology. Also, low self-esteem leads to refusal to use computers by teachers (Kumar & Kumar, 2003). To enhance student learning, teachers must be proficient in a variety of knowledge and skills in a highly complex environment where critical daily decisions are needed (Jackson, 1990). There are few jobs that require an a mixture of professional judgment and proficient use of evidence-based competencies as does the teaching.

In a study by Briones (2018) on the teachers' competence in the use of ICT in teaching Physics and the students' performance in Physics, the teachers perceived that the use of ICT; helped improve students' understanding of science ideas, increases students' motivation in learning science ideas, stimulates students' interest to

scientific ideas, facilitates the teaching and learning process, and gives teacher the opportunity to delivering the lesson in an innovative way. With ICT network programs, teaching materials can be more productive while teachers can provide more effective teaching approaches, and a variety of teaching and learning techniques can be used in the classroom (Donkor, 2011; Sarkar, 2012; El-Sayed & El-Sayed, 2012). Teaching and learning based on ICT and multimedia methods are often said to have a positive effect on these aspects: memory preservation (Oberfoell & Correia), comprehension, skills acquisition (Eital, 2016; Linder, Eital, Strobel & Kohler, 2016; Yasak & Alias, 2015; Leow & Neo, 2014), and student motivation (Kowitlawakul et al., 2017; Leow & Neo, 2014).

Fathivajargah (2003) recommends that when we are hiring teachers, we must hire those who have cognitive, emotional and practical competencies. Cognitive competency here means self-cognition, learners-cognition, and cognition of the teaching-learning process. Emotional competence is competence-based on interests, values, and attitudes. And practical competency refers to the teacher's competence in relation to the students, classrooms, schools, and society. Successful implementation of technology into the classroom is often dependent on the skill, knowledge, and commitment of the classroom teacher (Johnson et al., 2016). Teachers must also be able to use ICTs to manage classroom data and support their professional learning. Ability to handle information, plan problem tasks, and integrate open and specific subject applications and software tools with student-centred teaching methods and collaborative projects. These competencies should be used in support of students' in-depth understanding of key concepts and their application to complex, real-world problems. To support collaborative projects, teachers should use web-based resources to help students collaborate, access information, and communicate with external

experts to analyze and resolve their chosen issues. Teachers should also be able to use ICTs to create and monitor students' individual and group project plans, as well as to access information, consult with experts, and collaborate with other teachers to support their professional learning. Teachers are model students and producers of knowledge who are constantly involved in educational experiments and innovation. Teachers collaborate with colleagues and outside experts to produce new knowledge about learning and their teaching practice. A variety of network-connected devices, digital resources, and electronic environments are being used to create and support this community in its production of knowledge and learning collaboratively.

Bloom loosely divides teachers' competencies to emotional, cognitive and practical (quoting Seif, 2003). Aghaie (2006) thinks that the most important skills of a teacher are:

1) Getting acquainted with various ways of thinking and applying them.
2) Adapting to new learning and teaching methods and applying them
3) Classroom management and specific student communication skills
4) Familiarize yourself with communication and information technology, and is able to use them in teaching
5) Research skills
6) Skilled in evaluating academic achievements

Shabani (2006) also classifies teacher's competencies into characteristic and scientific. By characteristic competencies means student-oriented authoritarian, student-oriented and intimacy oriented, subject-oriented and intimacy oriented, subject-oriented authoritarian; By scientific competencies, means awareness of psychology, teaching methods, new communication methods, social psychology, teaching psychology and communicating.

Taghipour et al. (2010) divide teacher's skills into two categories; occupational and personal. Personal skills include: mental and physical health, adherence to the values, good mental skills, and occupational competencies include: general knowledge, job knowledge and communication skills. We can study teacher' professional competencies in two groups: a) General competencies, and b) specialized competencies (Perera, 2003). General competencies of a teacher include familiarity with development and learning psychology, awareness of the teaching-learning process, class management, teaching methods, controlling and evaluation. Specialized competencies of a teacher can also include: content mastery, providing the content in proper order, organizing the content, mastery in employing training tools in practice, keeping accurate records, giving feedback to the students (Ilanlou & Zand, 2011).

According to Ilanlou and Zand (2011), if teachers have professional competencies, they will regard the following points:

1) Emphasis on human relations and cooperation in improving the learning conditions

2) Emphasis on learning outcomes than on their products

3) Emphasis on students' self-assessment, as well as their learning and also their fellow students' learning

4) Making opportunities for internal motivation development

5) Increasing judgmental sources and data validity

6) Providing descriptive feedback to bring about improvements in performance

7) Modulation of evaluation system with a social system of schools

Basing on the clear definitions and description of competencies and teacher competencies, this study sought to analyze and determine teacher trainees' ICT competencies. Other authors have defined competencies in the following ways:

Hager and Gonczi (1996) define a competent professional as “one who has the attributes (knowledge, abilities, skills, and attitudes) necessary for job performance to the appropriate standards.” Competence involves a combination of characteristics (knowledge, skills, attitudes) that allow a person or group to perform a role or set of tasks at the appropriate level or level of quality or achievement (i.e. the right level), and thus make the right person or group in that role (Walker, 1993).

Teachers need to be competent in integrating ICT into education to support the learning and teaching process (Agyei & Voogt, 2011)).

The education systems require modern technologies, teacher trainees must be competent in integrating information and communication technology (ICT) into their future teaching and learning practices (Kihoza et al., 2016) teachers need to be competent in integrating ICT into education to support teaching and learning process (Aslan & Zhu, 2016). The influence of Information and Communication Technology (ICT) on creating ways to better deliver lessons is considered to be beneficial to education (Obillos Dela Rosa, 2016).

2.5 ICT Knowledge

Numerous studies have highlighted the importance of ICT Knowledge as a critical factor among teacher’s ICT competency. The use of ICT in teacher education has been extensively studied and documented especially the positive impact of ICT in teacher education (Kay, 2006; Murray et al., 2008), the use of ICT as an instructional tool (Murray et al., 2008; Ryan & Scott, 2008). The ICT knowledge teacher trainees acquire from colleges has an impact on their future use of pedagogical ICTs when they enter job markets as qualified teachers.

ICT Knowledge components (*UNESCO, 2011*):

1. Understanding of the hardware and software of computer systems and how these can be used to meet entertainment, personal and business needs.
2. Knowledge of a variety of software packages and programs, and how to choose the most appropriate program for a specific task.
3. Work with information data to meet specified business needs; this covers data structures, storage and how you can transfer data between different mediums.
4. Understand how ICT is used to support business working practices, such as how employees can communicate with each other remotely; diary management; and working collaboratively on documents.
5. Understand the risks of ICT and how to prevent these risks, by following sensible E-Safety guidance.

2.6 ICT Skills

Information and communications technology (ICT) skills refer to a person's ability to communicate with people through various technologies. Similar to information technology (IT), ICT refers to the use of technology to perform normal, everyday tasks: send an email, make a video call, search the internet, using a tablet or mobile phone, and more.

Surprisingly, ICT skills can also include the ability to use old communication technologies such as telephones, radios, and televisions. Often, ICT professionals are asked to integrate old communication technology with the new technologies. Almost every job requires some ICT skills, and many require hybrid skills, a set of skills mixed with technical and non-technical skills.

The success of educational plans in each country depends on the teachers armed with scientific competencies and professional skills (Maryam & Maryam, 2011). Oliver (2002) argues that the use of ICT in higher education promotes student-centred

learning. Lee (1997) found that a great number of students in teacher preparation programs were not equipped with basic computer operational skills.

Teacher development is required to prepare teachers with ICT skills to equip students with the kinds of critical skills needed if they, as members of the society, are to contribute meaningfully in the country's future development. All teachers need to be familiar with ICT applications and competent in the use of ICT applications (Danner & Pessu, 2013). White (2003) suggests that teachers need to experience online learning as part of their professional development. Lee (1997) found that a great number of students in teacher preparation programs were not equipped with basic computer operational skills. Ozoemelem's (2010) study has shown that there is a low level of expertise in the use of ICT among Nigerian university students. Similarly, Yusuf (2005) reported that teachers in Nigerian secondary schools lack proficiency in basic computer operations and in the use of generic software. If teachers are expected to integrate ICT into the school curriculum, training must be done at the pre-service teacher education level.

Teacher training programs should focus on the need for student-teachers to have ICT skills for their use, in the preparation of materials for teaching and learning activities; they need to facilitate the direct use of ICT in student learning activities within the classroom environment; and the need for teachers to develop in their students' critical awareness of ICT applications and the social impacts (Robbins, 1998).

Types of ICT Skills

According to Siddiquah and Salim (2017) teachers should be experts in simple skills such as MS Word, MS PowerPoint, searching and browsing at Internet, social networking, Email, File attachment, and computer games. Doyle (2020) on the

balance careers lists the top Information and Communications Technology (ICT) Skills, which include the following:

Email Management and Setting

Being able to communicate effectively and efficiently via email is essential for any job. Teachers will need to send emails to colleagues, employers, clients, and so on. Companies expect their employees (such as teachers) to write effective and well-written emails, and respond quickly to messages received in their inboxes. Depending on the level of professionalism required by their employer, they may also need to be able to manage settings or set up email accounts on various work devices. These emails help teachers when they are subscribing to different websites, blogs and teaching and learning channels like google, Google Classroom, Microsoft Teams, Online Coding Websites such as DataCamp, HackerRank, Coderbyte, YouTube, and videoconferencing platforms.

Online research

Almost every job requires at least some online research. Whether you are looking for new ideas in the article or looking for the latest news from your company's competition, you need to be able to filter out all the online information to find what you need, likewise to teachers researching about different topics and teaching. This includes basic online data management skills, including; Search Engine Optimization, Test Sources, Credit Sources, FAQs and Online Forums.

Social Media Management

Some jobs such as teaching require teachers to use social media. For example, many people who work in advertising tend to manage or update the company's social media

presence. While this is not a critical part of teachers' job, employers are increasingly looking for employees with basic communication skills. The more teachers know about the benefits and limitations of social media, the more they can begin to use that media in important ways at work. These sources of communication include; Facebook, LinkedIn, Pinterest, Instagram, YouTube, Twitter, Reddit and social media groups.

Internet Collaboration

Online collaboration is a broad section that focuses on any way to share information with your colleagues (or managers, or clients) online. These include meeting in a shared online calendar, providing documentary feedback with a web-based application, and hosting an online video conference with partners. Other online tools include; Software Conferencing Software, Skype, GoToMeeting, Instant Messaging, Google Docs, File Sharing, DropBox Pro, Slack and Google Hangouts. Teachers need this skill to communicate to their learners and their colleagues to share academic knowledge and experiences.

Data Management and Inquiries

From researchers to administrative assistants to primary school teachers, almost everyone needs to be able to develop and manage data using spreadsheets. In addition, they should be able to analyze that data and identify styles and patterns. Fluency in programs such as Microsoft Excel is essential for today's job market. Data Management and Inquiries include; MS Excel, Filters, MySQL and measurement analysis. All these tools can help teachers in management of data, grading and records for learners.

Desktop Publishing

Desktop publishing includes the production of materials that require printing and distribution. This could include feathers, brochures, newsletters, and more. Because you can create a lot using desktop publishing software, many tasks require you to have basic skills in this field. While people have a creative eye, this art is very good at desktop publishing, anyone can be better off with practice. Desktop publishing with; MS Publisher, MS PowerPoint, MS Word, print settings, Adobe Creative Suite and QuarkXPress. All these are needed by teachers for presentations and creating of classroom learning materials.

Smartphones and tablets

Many employers require their employees including teachers to use smartphones and tablets; they may issue certain calls to employees or state that employees should be available via email from time to time. For these reasons, it is important to know how to use the smartphone. Examples are; iPhone, Samsung Smartphones, Blackberry Devices, iPad, Samsung Tablets, CAT S41 and Panasonic Tough Pad. These are portable devices with different useful apps for communication.

Processing the Word

In this day and age, job seekers are expected to learn how to use word processing technology. Applicants must be able to produce written documents (including business letters, minutes of meetings, and more) using a computer processor such as Microsoft Word. Word processing can be done with; Microsoft Word, Libre Office Writer, Transcription, Typing and Note Taking. Teachers should have typing skills to produce professional documents and their own teaching notes.

2.7 PTE Trainees' Pedagogical Practices

Teacher pedagogical practices are operationally defined as teacher trainees' activities which they do during their training to become professional teachers, for example; learning how to develop different learning aids, lesson planning for different subjects by searching own notes, and how to assess learners. UNESCO ICT Framework (2011) encapsulates key aspects of a learning system, which include pedagogy, teacher practice and professional learning, curriculum and assessment.

Given that the relationship between teaching, learning, and assessment through the use of ICTs is very complex, one would not expect the inclusion of ICT in the learning environment could bring about a change in pedagogical practice itself. Rather, we would expect the use of ICTs in education to be inextricably linked with teacher understandings of teaching and learning (Becker, 2000; Becker and Riel, 1999; Bransford, Brown & Cocking, 2000; Cuban, 1993, Jones). Pedagogies associated with the effective use of ICT include those that emphasize high levels of understanding of key concepts within subject areas and the ability to use these concepts to solve complex real problems (Bransford, Brown & Cocking, 2000). Most recently, curriculum development initiatives have emphasised "21st century skills" (often referred to as "Key Skills" or "Key Competencies"), (ETA, 2010; OECD, 2005; NCCA, 2008a, 2008b, 2009), qualities that prepare students live and work in a digital society. These include skills such as critical thinking and problem solving, communication, collaboration, self-regulation and information management (Binkley et al., 2012).

However, both internationally (ESSIE, 2013) and nationally (e.g., Conway & Brennan, 2009), it has been found that teachers first and foremost use ICT to prepare their teaching and for teacher presentation during lessons to explain information and

concepts and consolidate learning. Few teachers use ICT to work with students during lessons and, when they do, student use of ICT is for beginners/basic. The majority of students use ICT to find information on the Internet, practice routine skills, or take tests. In this sense, ICT has been used to reinforce or automate traditional methods of teaching and learning (e.g., Campuzano et al., 2009; Plomp et al., 2009). This may reflect the fact that teachers' pedagogical orientations as well as the prevailing school, regional and national cultures, together with government current policy priorities, influence the shape and form of how digital tools are used in schools and classrooms. However, research suggests that, with careful planning, relevant teacher training, and buy-in from school leadership, teachers, students and parents can contribute to improving student outcomes through the use of ICT (Stansbury, 2010). Similar to teaching, it is envisaged that assessment using technology will, over time, move beyond replicating traditional summative assessments in electronic format, towards assessing such skills as complex problem solving, communication, team work, creativity and innovation. In this scenario, assessments will include modelling, video data, data processing, simulation and utilisation (Binkley et al., 2012).

The new national teacher policy of Uganda (MoES, 2019, p.35) also dictates that all teacher education programmes shall focus on a mix of content, pedagogy, technology and soft skills as part of the curricula. This shall include adapting to emerging trends and the 21st century learning competences. The new policy has been put in place to improve the quality of teacher education that had faced many challenges where most teachers were of low quality, lacking most of the important competencies such as technology competence. Accordingly, in line with international commitments, the provision of quality education remains a firm basis for achieving the Sustainable Development Goals (SDGs) especially SDG-4 "ensure inclusive and equitable quality

education and promote lifelong learning opportunities for all" and attaining the Middle-Income Status as endorsed in the country's National Development Plans (NDPs) and Vision 2040. However, with the provisions of Universal Primary Education (UPE) and Universal Secondary Education (USE) and government funded primary teacher education at certificate level in Uganda, currently the focus is not only access to education but also provision of quality education and lifelong learning. Information and Communication Technology (ICTs) are some of the key factors that can help improve the quality of education and improve lifelong learning.

Researchers have highlighted the decisive role of ICT in achieving quality education. Mikre (2011) emphasizes the importance of ICT by saying that ICTs have transformed the way people work today and are now transforming education systems. As a result, if schools train children with yesterday's skills and technologies they may not function properly and enter the world of the future. ICTs can be used in all fields of education to ensure high learning outcomes. According to the Irish Computer Society (ICS, 2021), classroom education is increasingly moving from lecturing or teach talk to a collaborative project-based model and digital technology is playing a key role in this. Also, ICT provides access to a general education curriculum and instruction that are specially designed to meet the needs of individual student. Students with disabilities can be taught together with peers in the same inclusive education classroom, where the teacher has expertise in technology that he or she can use in teaching and learning. This is the direction Ugandan teachers should be taking, to have ICT knowledge and skills for pedagogical practices (lesson planning, resource development, assessment of learning and classroom interaction). The relationship between these competencies and pedagogical practices has been discussed in the subsequent sections.

2.8 ICT Knowledge and Pedagogical Practices

Mukuna (2013) argue that teachers can only effectively integrate technology in their instruction if they are themselves knowledgeable about the technology. Dzogbenuku et al. (2019) studied the moderating role of ICT knowledge in the media and student performance of university students in Ghana and found that communication information, the establishment of social media and entertainment media have all had a positive impact on information systems. Also, research has shown that computer technology sets the relationship between human communication and student performance (Dzogbenuku et al., 2019). In a study by Arundhathi et al. (2018) on the impact of ICT on student academic performance found that the majority of respondents strongly agreed that the use of ICT by teachers encourages students to use ICT and ICT has changed the way they use the library. In the same study, respondents chose ICT to change the way they read books and write assignments and helped them improve learning.

However, Comi et al. (2017) points out that the effectiveness of ICT in school depends on the actual practice that teachers practice and their ability to integrate ICT into their teaching process.

In addition, Basri et al. (2018) examined the impact of gender mainstreaming, GPA, and student officials on the relationship between ICT and academic success at Saudi universities. Their findings revealed that there is a link between ICT acquisition and academic performance in a conservation environment. Other findings also revealed that the acquisition of ICT has led to better performance for female students than for male students.

However, computer literacy and information research is very limited and many studies focus mainly on internet access and internet use (Olafsson et al., 2014). There

is a need to assess how well students know, understand, and apply information and communication technology (ICT). This will determine how well students are ready to learn, work and live in the digital age.

Kazan & EL-Daou (2016) suggested that knowledge and beliefs could influence a teacher's goals of using technology in the classroom and his or her learning, finding that there is a positive correlation between teacher effort, knowledge, attitudes and students of specialized science outcomes. However, this study is of great interest in the relationship between ICT knowledge and teacher teaching practices in Uganda.

Furthermore, Churchill (2009) argues that ICT adds a new dimension to effective teaching by making teachers do things that may not be possible within the traditional classroom. However, teachers should be aware that introducing ICT tools in teaching changes not only the use of teaching tools but also what we teach and how we teach; which is an important and often overlooked part of many ICT integration interventions (Harris et al., 2009). When teachers are not aware or lack deeper knowledge about ICT for teaching, they may not embrace it in their daily pedagogical practices. Therefore, teachers need professional training in order to integrate technology into the syllabus (Karami et al., 2013). Karami and his colleagues argue that using only modern technology or without considering theories of learning will not work. Therefore, trainee teachers need deeper understanding of theories governing these new technologies to be able to use them in their classrooms efficiently and effectively. Also, Graham et al. (2009) argue that teaching ICT skills alone does not help pre-service teachers well, as they learn to use ICT-related tools without being able to use them effectively to promote student learning. Being an ICT-integrating teacher means going beyond ICT skills, and developing an understanding of the complex relationships between pedagogy, content, and ICT (Hughes, 2005). In

addition, Koehler and Mishra (2005) recommended that engaging teachers in real-world problem-solving activities through ICT is an effective way to learn about processes for integrating ICT and developing Technological Content Knowledge (TPACK), which they call 'learning technology by design'.

Also DeCoito and Richardson (2018) explain that technology cannot be effective in the classroom without teachers who are knowledgeable about both the technology itself and its implementation to meet educational goals. In a study by DeCoito and Richardson (2018) it was found that teachers were confident in content, pedagogy, and technology; however, most viewed technology as a tool rather than an embedded part of the learning process. Also, Baturay and colleagues (2017), in their exploration of teacher use of computer-assisted education and its relationship to gender, found Technology knowledge to be the biggest indicator of technology inclusion in practice, with males reporting higher Technology knowledge than females. All of these scholars emphasize the importance of teacher ICT knowledge in relation to pedagogy. Specific pedagogical practices have been discussed in the next sub-sections.

2.8.1 *ICT knowledge and lesson planning*

Teacher lesson planning is important when using ICT; where less planning has taken place, research shows that student work is often less focused and can lead to low attainment (Trucano, 2005). ICT can help the teacher to develop content for teaching and also making basic searches for information on internet. This is so important in environment where library resources are limited and also when the teacher wants to expand on his/her knowledge before he goes to class to teach. Looking at the TPACK model by Mishra and Koehler (2006), the teacher should also know about appropriate technologies he/she can use to help learners understand the content being taught.

2.8.2 *ICT knowledge and resource development*

ICT includes not only computer hardware and software, but also interactive digital content, the Internet and other satellite communications, radio and television services, web-based content repositories, interactive platforms, learning management systems, and information systems. The teacher's ability to explore these ICTs can be useful to the teacher in teaching and creating learning resources.

2.8.3 *ICT Knowledge and Assessment of learning*

Traditionally school systems were based on test methods and outcomes. Systems were entirely teacher-centred, but today the perspective has shifted from one-way teaching to a more participatory process; meaning students need personalized, engaging and useful real-time “feedback” that gives them and their teachers the opportunity to understand their learning graph. In a traditional education system, when students think of tests, pens, pencils and piles of paper come to their mind. Learning assessment is very helpful when it happens in real time, and this helps the teachers to respond to learners’ needs and planning their classrooms better, hence maximizing learning outcomes. This Technology can provide teachers with faster results, equipping them with real-time data about students which gives them and their teachers an opportunity to understand their learning graph (READ Alliance, 2017).

2.8.4 ICT knowledge and classroom interaction

Computer-based technologies can be powerful pedagogical tools--not just rich sources of information, but extensions of human capabilities and contexts for social interactions supporting learning (Sutherland, 2004). Also, plenty of research supports that ICT being used appropriately and in the right context in teaching practice, increases students’ motivation, encourages active participation and collaborative learning and positively affects the learning process (Karatza, 2019). Teachers

therefore need information about these technical tools including content during teaching.

2.9 ICT Skills and PTE Trainees' Pedagogical Practices

The aim of this study is to examine the extent to which teacher trainees consider themselves competent in the use of ICT tools, with an intention to teach and learn with technology. The building of ICT skills is often a goal of teacher training programmes and such skills are a necessary prerequisite for the implementation of ICT in the classroom (Unwin, 2005). A study by Leneway (2014) found out that teachers who possess both confidence and competence in their uses of technologies can have a positive impact on the students' analytical skills, such as thinking ability by comparing, contrasting, evaluating, synthesizing, and applying research.

However, studies have shown that most teachers do not have sufficient time, opportunities, and confidence to learn and practice teaching and learning technologies (Austin, 2004; Yigit & Oztuk, 2012). In a study by Danner & Pessu (2013) in Nigeria, found that computer training received by the student exerted a significant effect on perceived ICT competencies scores.

Effective technology integration by instructors in the college classroom is also often lacking so that pre-service teachers are not seeing the use of technology in education modelled for them (Cuban, 2001; Dawson, 2012, 2006; Koehler & Mishra, 2007; Swain, 2006). According to Crocco and Cramer (2005), what is lacking in teacher education programs, with respect to technology use, is using technology as added value for presenting content to pre-service teachers.

Hooper and Rieber (1999) identified the following five stages for teacher use of technology:

1) Familiarization,

2) utilization,
3) integration,
4) reorientation, and
5) evolution.

Noting that teachers typically do not progress past the utilization stage. For teachers to implement seamless technology instruction, teacher educators must examine ways to encourage the use of technology in instruction for pre-service teachers and to model this use for their pre-service teachers. In this way, teacher educators can help our nation's teacher's move beyond familiarity and utilization into full integration of technology into our classrooms so that we can offer our 21st-century students the full power of modern technologies.

Numerous research studies confirm that pre-service teachers gain new insights into planning and organization, pedagogical strategies, delivery, content knowledge, and classroom management by analyzing and reflecting on video during their field experience (Alger & Kopcha, 2009; Downey, 2008; Shepherd & Hannafin, 2008; Snoeyink, 2010; Yeh, 2007).

Bhatt (2017) investigated the impact of information and communication technology skills development program on technology integration beliefs and self-regulation of prospective teachers in Punjab. Statistically significant changes were found in prospective teacher's technology integrations beliefs and self-regulation. The results strongly supported the effectiveness of ICT skill development program in improving not only technology integration beliefs but also self-regulation. This is in line with Comi et al. (2017) who have studied Teacher ICT and student performance in various schools in England and whose findings have suggested that the success of ICT at school depends on the teachers' ability to integrate ICT into their teaching process.

These findings reveal that for the ICT skills to have an impact, teachers should be well prepared and trained.

Internet information skills have a positive impact on academic achievement. This effect is stronger for students with low academic performance or low family background (Pagani et al., 2016). In the study by Saruji et al. (2016), parents agreed that using ICT in schools can improve learning. Parents said that the benefits are, children would easily remember what they learnt, easier to answer examination questions, and in particular, easy to learn English.

Kitazawa et al. (2017) conducted research on teacher-training programs for elementary school teachers at the Japanese university in an effort to increase pre-service teachers' teaching skills that involve using information and communication technology (ICT). Pre-service teachers discussed the strengths and weaknesses of using ICT resources in practice. They then conducted a pilot study using ICT. The findings show that their teaching skills have been enhanced—not only in the use of ICT in researching teaching materials and preparing for instruction but also in-class teaching. Information and communication technology (ICT) plays a positive role in supporting students' learning and in helping teachers carry out teaching activities in many disciplines (Wasson et al., 2016). For example, ICT can help to improve the literacy of high school students who are at risk of social exclusion (Boulton, 2017), assist teachers to do foreign language teaching activities (Kukulska-Hulme et al., 2015), make abstract mathematical knowledge more visible and understandable (Samuelsson, 2006), and break the constraints of time and space (Kang, 2017).

Information and communication technology (ICT) plays an important role in supporting students' learning and in assisting teachers carry out teaching activities in many disciplines (Wasson et al., 2016). For example, ICT can help improve the

literacy of school students at risk of social exclusion (Boulton, 2017), assist teachers to do foreign language teaching activities (Kukulska-Hulme et al., 2015), make abstract mathematical knowledge more visible and understandable (Samuelsson, 2006), and then break time and space constraints (Kang, 2017). However, a study conducted in China by Li (2014) found that teachers' knowledge and skills in the use ICT are underdeveloped, not to mention their competence to integrate ICT and teaching practice. Teachers may have less knowledge about ICT and may not be able to use disciplinary software (Lin & Huang, 2009).

Several studies (Agyei & Voogt, 2011; Lim, 2007; Tondeur et al., 2017) found that technological inefficiencies, passive school support policy, different pedagogical beliefs and limited access to technology tools may prevent teachers from using ICT to develop high-quality teaching activities. This implies that if ICT is supported and teachers equipped with ICT skills, they can develop high-quality teaching activities.

According to Rosaen et al. (2010), video-based reflection helps with some specific comments about pre-service teachers' practice and shifts the focus from management to content and instruction. They also found that pre-service teachers analyzed and reflected on lesson strengths/weaknesses and gained a clearer vision of the role of the teacher in the classroom.

In a study conducted by Snoeyink (2010), eight elementary and secondary pre-service teachers showed a strong belief in the effectiveness of video self-analysis. Pre-service teachers saw themselves from the students' perspective, reduce their frustrating mannerisms, and improved their management skills. All these positive impacts are facilitated by ICT trained and skilled teachers.

Lastly, evidence shows that many students and teachers do not have the digital skills needed to effectively use ICT tools; which reduces their potential impact, can have

negative consequences on students' learning and can increase educational inequality, especially in developing countries (Hinostroza, 2018). Therefore, it is imperative that this study analyses the relationship between these ICT skills and their impact on teacher trainees' pedagogical practices in Uganda.

In general, according to Oliver (2002), ICT has its own influence on what is learned in two ways: the moves to competency and performance-based curricula and information literacy. Modern ICTs are able to provide strong support for the requirements of the performance-based curricula and therefore for many years, said Oliver, teachers who wish to adopt such curricula have been limited by their resources and tools but with the proliferation and widespread availability of contemporary ICTs, many of the restrictions and impediments of the past have been removed.

One way in which emerging ICTs influence the content of education curricula is according Oliver (2002), related to the need for educational institutions to ensure that graduates are able to demonstrate appropriate levels of information literacy. Institutions need to ensure that their qualifications reflect not only the skills and knowledge in their academic backgrounds but also the common characteristics and generic skills that include skills such as formal thinking ability; problem solving; effective communication; the ability to negotiate results; time management; project management; and collaboration and interpersonal skills.

Oliver (2002) makes a direct link between the impact of ICT on what and how students learn by arguing that the shift from content-based curricula to competency-based curricula is associated with moving away from teacher-centred forms of delivery to student-centred forms of teaching and learning. There are two ways of learning, related to the growing use of ICT, which are gaining prominence in universities and schools worldwide. The first form of learning is student-centred

learning. Technology has the potential to promote and encourage the transformation of education from a teacher-directed enterprise to one which supports more student-centred models. The second learning form described by Oliver (2002) and which is related to the growing use of ICT is work-based learning.

In terms of the impact of ICT on teaching and learning, teachers are an important part of the learning environment and therefore the impact of ICT on teachers and the strategies they employ to facilitate the environment are critical (Rai, 2006). Although Rai agrees that the impact of ICT on teachers is varied and idiosyncratic (peculiar to the individual), he summarizes this impact as being strategies that are: more learner-centred, more cooperative and collaborative, more active learning, and based on greater access to information and sources of information.

2.10 Tutors' Instructional mode and PTE Trainees' Preparation for ICT Integration

Teacher education institution tries to restructure their education programmes and classroom facilities in order to husband the potentials of ICT in improving the content of teacher education (Dixit & Kaur, 2015). Tutors are expected to teach their subject(s) and help their trainees develop effective teaching approaches founded on recognized and explicit educational theory, well-researched practice, current initiatives, and recent inspection evidence.

A variety of teaching methods are used: lectures, demonstrations, presentations, seminars, discussions, distance learning materials, tutorials, practical workshops. Tutors are expected to model good practice. Trainees are tested on their knowledge, skills, subject comprehension, teaching ability, and expertise. With all these approaches and methods if modeled with ICT, trainees will develop expertise in ICT application for their teaching practice and future job. Mahmud & Ismail (2010)

indicate that teachers lacking ICT skills are due to lack of pre-service and in-service training. Alazam et al. (2012) found out that teachers who did not attend any ICT course had lower ICT skill scores than those who attended ICT courses.

Students' achievement can be improved if the students are often exposed to attractive and interesting Teaching and Learning methods. Student willingness and motivation should also be improved (Dalilah et al., 2014) because they lack practical mastery is due to the perfunctory attitude, lack of interest and lack of guidance from instructors (Tee at al., 2016). The lack of interest and guidance will affect the students' learning outcomes (Azubuike, 2011; Shaari et al., 2014).

Technology should be used for more than just support of traditional teaching methods (Tezci, 2011a). According to Tezci (2011a), teachers should learn not only the way to use technology to reinforce traditional teaching or increase productivity, but also should learn from a student centered perspective how ICT are often integrated into classroom activities so as to improve student learning. This means that teachers got to use ICT in additional creative and productive ways so as to make more engaging and rewarding activities and simpler lessons (Birch and Irvine 2009; Honan, 2008). However, Yildirim (2007) found that teachers use ICT more frequently for the preparation of handouts and tests than to enhance critical thinking.

Similarly, Palak and Walls (2009) found that teachers mainly use technology to support their existing teaching approaches and infrequently to foster student-centered learning. According to the authors, one possible explanation may be a lack of models for a way to use technology to facilitate learning, and limitations associated with contextual factors like class size and student ability.

Brush et al. (2008) found that pre-service teacher preparation did not provide sufficient ICT information to support technology-based education, nor did it

effectively demonstrate appropriate ways to integrate technology into the curriculum. More training should be provided in pre-service teachers' curricula, and ICT skills must be applied within the classroom so as to integrate effective technology strategies (Supon & Ruffini, 2009). To help teachers deal with these difficulties, Chen (2008) suggested that instead of only providing education theories, ICT researchers should also document samples of how teachers achieve meaningful and effective integration of technology in their teaching to satisfy their pedagogical goals and wishes. This is why this study was necessary in a Ugandan context.

Nessipbayeva (2012) argued that the new education reforms in today's world are to find practical ways for trainee teachers and should be linked to the integration of ICT in teaching by the 21st- century teachers. The teacher training program should be designed to develop the knowledge, skills required to meet modern challenges (The American Association of Colleges for Teacher Education (AACTE) & the Partnership for 21st Century Skills, 2010; Pulist, 2010). Teacher Instructors (tutors) must have a high level of ability to use ICT and multimedia tools to train trainee teachers (Chandra, 2004). Teacher educators (tutors) must be highly skilful to use ICTs tools and multimedia for preparation of teacher trainees (Chandra, 2004). The use of teaching aids promotes students who will have the opportunity to use their skills to do challenging tasks, improve their self-study, build confidence to face their teachers, take on difficult tasks comfortably and work as an independent student (Kennewwell at al., 2000).

Tutors providing examples would be a crucial motivator for the development of digital competencies (Kaufman, 2015). Tutors should provide feedback to teacher trainees regarding their ICT competencies. Feedback should be continually provided through discussions, questionnaires, interviews, and observations in order to follow

how ICT competence develops, and what kind of problems pre-service teachers face in using ICT (Boulton, 2014).

Pre-service teacher assessments should be designed in terms of ICT skills, attitudes and beliefs regarding ICT, pedagogical reasoning and the use of classroom ICT (Haydn & Barton,2007).

In addition, various sorts of assessment tools got to be integrated and balanced to watch pre-service teachers' learning progress (e.g., pre-learning or post-learning questionnaire, learning portfolios, individual product rubrics, peer evaluation, reflections and blogging) (Liu & Zheng, 2011). The tools in authentic assessment tasks would help pre-service teachers to accumulate the required competencies and dispositions for the mixing of ICT in their teaching practices (Liu, 2011; Yin, 2012). All these are possible depending on the mode of instruction by the tutors and their skills and knowledge of how to go about it.

Gaible & Burns (2005) emphasize that, whether it is intended to bring teachers to basic, intermediate or advanced levels of skill—and whether ICTs are used or not, teacher education should be learner-centered, enabling teacher trainees to experience the types of instruction that they are asked to provide to their pupils. Within learner-centered teacher education, the voices and actions of teachers themselves, not of the tutors, should be the focus, and teacher trainees should engage interactively and collaboratively in activities that reflect their curricula. Like their pupils, teachers learn by doing by collaborating with peers, reflecting, planning classroom activities not by sitting and listening to a facilitator or following along in directed technology instruction (Gaible & Burns, 2005).

2.11 Knowledge Gaps

Review of literature has discovered that many studies done on ICT Competencies are among the graduate teachers, who are already serving, leaving out the fact that most of the basics should be learnt from teacher training colleges. The acquired knowledge and skills is what is taken to the field for implementation since most of Ugandan primary schools have no continuous professional development for practicing teachers, because of time, attitude of teachers and financial resource allocation by government to schools. Therefore, this study has unveiled the competencies of primary teacher trainees' ICT competencies and their pedagogical practices.

Furthermore, most of the studies have exhausted ICT competencies among students, but have left out the moderating effect of tutors (teacher educators) and infrastructure in the relationships between primary teacher trainees' preparation for ICT integration of primary teacher and integration in their pedagogical practices. Hence this study advocated for a moderation analysis.

Several studies done on the competencies of teacher trainees did not provide any model for guiding future practitioners. One that directs the integration of ICT in teaching practices has been established by this study.

2.12 Summary of Literature Review

Few studies analyze teacher trainees' ICT competencies in combination with the support they receive from their tutors on their ICT competencies. Therefore, this study aimed at analyzing these competencies amongst primary teacher trainees in Uganda. The more teacher trainees acquire ICT competencies, the more they become competent to use ICT for their learning processes and future application in teaching processes. It has been debated that the ICT Competencies are a set of technology standards that define proficiency in using computer technology in the classroom.

The competencies consist of computer-related skills grouped into four general domains: (1) Basic Technology Operation, (2) Personal and Professional Use of Technology Tools, (3) Social, Ethical, and Human Issues, and (4) Application of Technology in Instruction. Tutors should be exemplary in ICT competencies since this would be a crucial motivator for the development of digital competencies amongst teacher trainees.

Gaible & Burns (2005) emphasize that, whether it is intended to bring teachers to basic, intermediate or advanced levels of skill and whether ICTs are used or not, teacher education should be learner-centered, enabling teacher trainees to experience the types of instruction that they are asked to provide to their pupils. Literature cited suggest that teachers learn by doing, by collaborating with peers, reflecting, planning classroom activities not by sitting and listening to a facilitator or following along in directed technology instruction. Most of the literature has showed that in order to become a confident user of ICT in the classroom, teachers need to take part in ongoing training, understand the benefits of digital literacy. Training in ICT needs to be recognised as essential for teaching such skills, and as an enabler of other teaching and learning practices.

Teacher trainees require broad, on-going experience of ICTs to be able to evaluate and select the most appropriate resources. It has been noted that the digital skills that teacher trainees need have long moved on from just being able to use word processing and spreadsheets software. Digital skills that 21st Century teachers should have included cloud storage and sharing solutions, social media, web editing, image editing, presentation software, and general multimedia.

CHAPTER THREE

RESEARCH METHODOLOGY AND DESIGN

3.0 Introduction

This chapter focused on the study area, paradigm, design, population, sampling strategies, data collection methods and instruments, data quality control, data collection procedure and data analysis and ethical considerations to achieve the following objectives:

1) To assess PTE trainees' ICT competences for ICT Integration in their pedagogical practices;
2) To explore the quality of ICT Infrastructure in PTE for trainees' preparation in ICT integration in their pedagogical practices;
3) To determine instructional modes used by tutors in preparation of PTE trainees for ICT integration in their pedagogical practices;
4) To establish the relationship between PTE trainees' preparation for ICT integration and integration of ICT in their pedagogical practices in Uganda;
5) To determine the moderating effect of ICT infrastructure in PTE and tutors' instructional modes on the relationship between PTE trainees' preparation for ICT integration and integration of ICT in their pedagogical practices.

3.1 Study Site

This study took place in Primary Teachers Colleges in Uganda. There are 47 primary teachers' colleges (PTCs) in Uganda; 45 are owned and funded by the government and 2 are owned by faith-based bodies. These colleges are distributed in different districts and regions of Uganda as illustrated in the map (see Appendix F). These colleges train primary teacher trainees to become qualified teachers and these trainees were the target group for this study.

3.2 Research Paradigm

This study followed Pragmatism Research Paradigm because it advocates the use of mixed methods in research. Pragmatism is a paradigm that includes ideas, methods, approaches, principles, or a combination of these to define a solution to a research problem. In pragmatism there may not be one way to solve a problem but a combination of approaches can better help solve the problem and find the truth. This is the case with this study because it involved collection of quantitative and qualitative data simultaneously, which data was analyzed separately but concurred.

Research paradigm is associated with clarification of assumption about the nature and the source of knowledge (Saunders et al., 2012). Research paradigm deals with the source, nature and development of knowledge (Bajpai, 2011). In simple terms, a research paradigm is a belief about the ways in which data about a phenomenon should be collected, analysed and used. All the studies are based on some form of thinking and on how to understand the world. The Pragmatism research paradigm accepts ideas that are important only if they support action. Pragmatics believe that there are so many different ways to interpret and research the world, that no one point of view can give the whole picture and that there can be multiple realities (Saunders et al., 2012).

According to pragmatism research paradigm, the research question is the most important determinant of the research philosophy. Pragmatics combines both, positivism and interpretivism positions within the scope of single research according to the nature of the research question (Tashakkori & Teddlie, 2010). Pragmatism research paradigm can integrate more than one research approaches and research strategies within the same study. Additionally, studies with pragmatism research philosophy can amalgamate multiple research methods such as qualitative,

quantitative and action research methods. Positivists prefer quantitative methods such us structured questionnaires and official statistics because these have good reliability and representativeness, whereas interpretivism use methods such as participant observation, which all these methods are attributes to this current study based on the stated objectives.

3.3 Research Methods

This study was guided by mixed methods approach. According to Gay et al. (2012) mixed methods research combines quantitative and qualitative data in a single study. This approach was deemed suitable for this study because this integration provides a better understanding of the research problem than either of each alone.

This study had two hypotheses which were tested by statistical tools (correlations and regressions), and two research questions for teacher trainees level of ICT competencies and ICT infrastructure, that were answered by descriptive statistics (frequencies, means and standard deviations) and thematic analysis. Thus, the aspect of mixed methods research implies that both qualitative and quantitative data are to be blended in the desired manner in order to comprehend upon the concept accordingly which would be quite suitable for the research (McKim, 2017). Mixed methods research involves collecting, analyzing, and somehow integrating both quantitative and qualitative data in a single project (Leavy, 2017). For this study, both quantitative and qualitative data were collected concurrently.

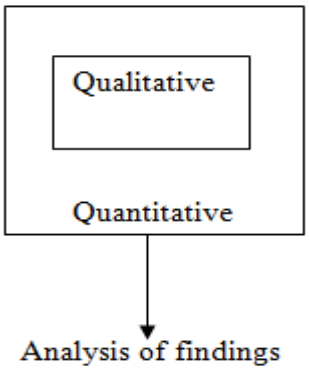
3.4 Research Design

This study was guided by a non-experimental, concurrent embedded/nested mixed methods design. Non-experimental design does not have the characteristics of experimental features, namely manipulation of independent variables and random assignment to conditions (Cook et al., 2002). This current study therefore never

involved experiments. Terrell (2012) describes concurrent embedded strategy as the one that uses two data collection methods; one is embedded (nested) within the other. Priority is given to the primary data collection approach with less emphasis placed on the nested approach. In concurrent nested designs, both qualitative and quantitative data are collected during the same stage, although one form of data is given more weight over the other (Creswell et al., 2003). The primary purpose of concurrent nested strategy is to obtain a broader perspective than can be obtained through a prominent data collection method. Its second purpose is the use of an embedded approach to deal with different research questions or collection data from different groups or levels in the organization (Terrell, 2012). Terrell further explains that the strength of this strategy is that the investigator is able to collect two types of data simultaneously; can collect both quantitative and qualitative data allowing for perspectives from each; provides advantages of both methods. For this current research, much of the data was quantitative and less data was qualitative hence adapted QUAN (Qual) model as shown in Figure 7.

Figure 7

QUAN (Qual.) model



Qualitative data was for only accessibility and quality of ICT infrastructures in the Primary teacher's colleges in Uganda, collected using observation schedule. Quantitative data was for all variables (ICT competencies, Pedagogical practices, ICT

infrastructures ascertained by teacher trainees and Teacher trainees' perceptions on their tutors' mode of instruction). Comparison of data was done based on observer's data from observation schedule for accessibility and quality of ICT infrastructures against quantitative data provided by respondents using the questionnaire, after data analysis. Both quantitative and qualitative data were collected at once but, quantitative data was given much weight than qualitative data in this study. Therefore, a research design is a general plan about what one will do to answer the research question (Saunders et al., 2012).

3.5 Target Population

The study population for this study was teacher trainees in forty-five (45) government-owned primary teachers' colleges in Uganda. These trainees are admitted using the same national criteria and they study using similar standard curriculum from Kyambogo University. The target population was 11,164 teacher trainees in their 2nd year (final year) that had experienced supervised teaching practice as one of the requirements for this course (MoES, 2010). The target population for a survey is a complete set of units for which survey data is to be used to create an index. Thus, the target population determines the units for which the survey findings are to be generalized (Lavrakas, 2008). The target population is "a complete aggregation of respondents who meet a set of designated criteria" (Burns & Grove, 1997). See Appendix H for teacher training colleges in Uganda.

3.6 Sample Size and Sampling procedure

3.6.1 Sample Size

The sample size comprised of all second years from the selected colleges.

Table 1

Sample size on college level

Strata	Populatio	Sample	Sampling technique

	n		
Southwestern	200	200	Convenient sampling
Western	120	120	Convenient sampling
Central	110	110	Convenient sampling
Eastern	176	176	Convenient sampling
Northern	80	80	Convenient sampling
Total	686	686	

Field data, 2020

3.6.2 Sampling Procedure

Disproportionate stratified sampling and convenient sampling techniques were used for this study. Stratified sampling for one college from every region (stratum) was used, considering all second year teacher trainees conveniently selected. These techniques are appropriate for this study because stratified sampling is a probability sampling method in which the population is divided into two or more groups (strata) according to one or more common attributes(Saunders et al., 2016). In disproportionate sampling technique the sampling fraction of each stratum varies. It is the type of probability sample in which it is possible that the unit selected in the stratum may not correspond to the number of units in the strata. This sampling method is used when there are strata in population of interest but they are very important and may not be adequately represented in the study when other sampling methods are used. Colleges per region had varying number of respondents (disproportionate), though all 2nd year (finalists) students in the selected colleges responded to the questionnaire. One college per region was selected using lottery method, after identifying the list of all colleges per region (Appendix H). Then, a simple random sample was generated. To generate the sample using lottery method, a researcher selects numbers at random, with each number representing a subject or item (Crossman, 2020). Before choosing the sample population, the researcher must make sure that the numbers are well mixed in order to create a sample in this manner (Crossman, 2020). One number was chosen to symbolize the one college that served

as the region's representative. Colleges in one region share the similar geography or terrain hence one college was assumed to be the true representative of the others in the same region (see Appendix H).

Second year students were preferred because they were in their final year to graduation, hence have prior pedagogical experience acquired during semi-final and final teaching practices. They were conveniently selected because of COVID-19 standard operating procedures, where only those available in their classroom setting participated. No other changes or arrangements could be allowed.

3.7 Data Collection Instruments

The research data collection instruments of this study were the ICT competencies questionnaire and ICT Infrastructure observation schedule.

3.7.1 Questionnaire

The questionnaire consisted of five sections. The first section deals with background information of teacher trainees and the second and third sections had to do with ICT competencies of teacher trainees (knowledge and skills), the fourth section had tutors' mode of instruction, the fifth section had ICT infrastructure for teacher trainees and the sixth section had pedagogical practices. All items on measuring Trainees ICT competencies and their perceptions on tutors' mode of instruction are adapted from the UNESCO ICT competency framework and TPACK, as models that guided this study. These models have question items that achieve the objectives set for this study. However, Teacher Trainees' pedagogical practices were measured with fifteen (16) items developed from a Guide to Teaching Practice by Cohen et al., 2010). The questionnaire items were on a Likert scale format except one item that is on Guttmann scale, and consists of 80 questions altogether. It was administered to 2nd year primary teacher trainees (see Appendix A). Questionnaires were preferred because they are

inexpensive, easy and fast way to collect data directly from sources and safer way in this COVID-19 pandemic where social distance is a norm.

3.7.2 Observation Schedule

The observation schedule was used to generate qualitative data that answered research question 2. The ICT Infrastructure observation schedule had predetermined 22 items. These items were adapted and modified from the School Infrastructure Survey (2013) by Ministry of Education, New Zealand, which captured almost all items that defined ICT infrastructure for this study. The observation schedule was filled by the investigator himself by observing ICT infrastructure available in their original setup at the teacher training colleges (See Appendix B). Observation schedule was preferred because it collects current data available hence reducing bias.

3.8 Pilot study

Pilot testing of the questionnaire and observation schedule were conducted in order to detect any deficiencies and difficulties that respondents are likely to face when responding to the items. Pilot testing of research instruments provides an opportunity to assess how long the study will take (and to identify potential concerns with participant fatigue) (Creswell &Creswell, 2018).

After approval of the proposal by the university research committee, the questionnaire was administered to Primary teacher trainees in their second year, in one of the teacher training colleges that did not participate in the final study. The respondents were encouraged to make comments and suggestions which were used to improve the items such as re-wording in the questionnaire. Pilot testing is a rehearsal of your research study, allowing you to test your research instruments with a small number of test participants before you conduct your main study (Wright & So, 2021). The

findings of the pilot study were used to determine the validity and reliability of the research instruments.

3.8.1 Validity of Research instruments

Participating pretest was done. Second year primary teacher trainees selected from one of the primary teacher training colleges were told that the pretest is a practice run; rather than asking them to simply fill out the questionnaire. This college did not participate in the final study. Participating pretests usually involve an interview setting where respondents are asked to explain reactions to question form, wording and order (Barribeau et al., 2012). Therefore, this pilot study aimed at three forms of validity; (a) content validity (Do the items measure the content they were intended to measure?), (b) predictive or concurrent validity (Do scores predict a criterion measure? Are the results consistent with other results?), and (c) construct validity (Do items measure the assumed constructs or concepts?). This kind of pretest helped to determine whether the questionnaire is understandable. Content validity was tested through calculating the Content Validity Index (CVI) using the formula;

$$\text{CVI} = \frac{\text{Number of items rated relevant}}{\text{Total number of items on tool}}$$

The items that were considered ambiguous by the experts and respondents during the pilot test were 5 out 80 items in the whole tool. Hence the calculated content validity index became;

$$\text{CVI} = \frac{80-5}{80} \quad \text{hence} \quad \text{CVI} = 0.94$$

The instrument was considered valid when it gave a content validity index of 0.94 which is above 0.7 that is recommended by many researchers. For predictive and concurrent validity, it was done through assessing other past or present studies with

the same questionnaire and looking for correlations between questionnaire responses. Construct validity for both the questionnaire and observation schedule was tested through experts' judgment from ICT field and supervisors who recommended the tool for use. Therefore, validity refers to how well an instrument measures what it is intended to measure.

3.8.2 Reliability of the research instruments

To establish reliability, Cronbach's alpha (α) for every variable was computed using IBM SPSS version 23.0. The most important form of reliability for multi-item instruments is the internal compatibility of the instrument, which is the degree at which the set of objects on an instrument behaves in the same way. This is important because instrument scale items must measure similar underlying constructs, so these items must have proper interrelationships. A scale's internal consistency is quantified by a Cronbach's alpha (α) value that ranges between 0 and 1, with optimal values ranging between .7 and .9 (Cresswell & Cresswell, 2018).

Table 2
Reliability Statistics for variables (n=20)

Variables	Cronbach's Alpha	N of Items
Basic ICT Tools	.896	8
Complex ICT Tools	.861	6
ICT for Professional Learning	.771	4
ICT for Assessment	.817	6
ICT Knowledge	.939	17
Tutor's Mode of Instruction	.949	8
Rate of Tutor's Modelling	.635	3
ICT Infrastructure	.549	12
ICT for Pedagogical Practices	.940	16

All items	.969	80

Field data, 2020

The reliability test for all variables using IBM SPSS gave Cronbach's alpha of .969, which indicates a high level of internal consistency for this current study scale with the sample of 20 respondents (10 males and 10 females). Cronbach's alpha is the most common measure of reliabilty (internal consistency). The scale interpretation for Cronbach's alpha is given in Table 3.

Table 3

Reliability Scale

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

The validity and reliability of the observation schedule was ascertained by ICT experts (lecturers) who checked the ICT infrastructure items to observe and recommended them as appropriate for the study.

Table 4
Summary of the scale used in the study

Variables	Scale	Author	Year	Items
Teacher Trainees ICT Competencies	UNESCO ICT CFT and TPACK	UNESCO, Mishra	2008 2006	24
Infrastructure	ICT Infrastructure observation schedule	MoE, NewZealand	2013	22
Pedagogical Practices	ICT on Teaching practice scale	Wyse et al	2010	16
Tutors' mode of instruction	TPACK	Mishra	2006	11

3.9 Research Procedure

After establishing the validity and reliability of the instruments, and approval of the proposal, an introductory letter was obtained from the Dean, School of Education, Moi University which introduced the researcher to the Ministry of Education and Sports and College Principals in Uganda (See Appendix C). The researcher approached Commissioners in charge of PTCs and Principals of PTCs to be permitted to carry out research therein (Appendix D). To observe strict COVID-19 SoPs and to save time and costs, the questionnaires were administered by the researcher himself on Primary teacher trainees. The filled questionnaires were collected from teacher trainees immediately after filling them; thereafter items edited, coded, and then entered into the computer SPSS version 23 software for analysis. Codes such as 1= strongly disagree to 5= strongly agree and 1= not at all and 4 = large were used. Data from observation schedule were recorded on a datasheet by the researcher and thereafter were coded and analyzed thematically. Quantitative and Qualitative data collection activities were done concurrently.

3.10 Data processing and analysis

Data analysis involves processing raw facts, figures and numerals into meaningful information by sorting, coding, cleaning and processing and interpreting data (Cohen, et al., 2007). The data collected were prepared or processed for analysis. Collected data on administered questionnaires were edited, categorized or coded and entered into the computer using the IBM SPSS version 23.0 for generation of frequency, percentages and inferential statistics. Data collected with observation schedule recorded on datasheet was thematically analyzed and described based on the availability and accessibility of ICT infrastructure items in the selected teacher training colleges in Uganda.

Table 5

***Summary Analysis Tools* according to research objectives**

Research Objective/question	Nature	Analysis Tools
To assess primary teacher trainees' ICT competences	Quantitative	Frequencies, means and percentages
To explore the quality of ICT infrastructure	Qualitative	Thematic Analysis
To determine tutors' instructional mode in preparation of teacher Trainees	Quantitative	Frequencies, means and percentages
To establish the relationship between teacher trainees' preparation for ICT integration and ICT integration		Pearson Product Moment Correlation Coefficient
To determine the moderating effect of ICT infrastructure and tutors' instructional mode on the relationship between teacher trainees' preparation for ICT integration and ICT integration	Quantitative	Multiple regression

At the bivariate level, ICT competencies were correlated with pedagogical practices using Pearson's Linear Correlation Coefficients to help rate the significance in influencing dependent variable. The quantitative data for the variables were on interval level on a Likert scale. Regression analysis was run to determine the

significance of the moderating effect of ICT infrastructure and tutors' instructional mode on the relationship between Teacher Trainees ICT preparation and ICT integration in their pedagogical practices, when all factors are combined. Both qualitative and quantitative findings were merged for the conclusion. Descriptive statistics; frequency counts and percentages on availability of infrastructure and tutor's mode of instruction, and frequencies and means were utilized to quantify the teacher trainees' level of ICT competencies. Availability and quality of ICT infrastructure data were thematically analysed.

3.11 Ethical considerations

The Oxford Advanced Learner's Dictionary (8th Edition) defines the word ethical as something morally correct or acceptable. In research, the researcher is imperatively expected to collect and use the data from the respondents in a morally acceptable way. Respondents were made aware of the purpose of the study, how the findings will be used, if there are any potential adverse impacts of their participation and who will have access to the findings. This was stated in the consent letter that was filled by every respondent. The respondents made an informed decision as to whether to participate in the study or not. Those willing to participate were given a consent form to fill first before questionnaire was administered (see Appendix E). Respondents were told to be free to withdraw their participation at any time without negative impact, if they felt so. For confidentiality, the researcher told respondents not to indicate their names, addresses, which could ultimately cause social damages to their personal lives or to their families. Colleges were given codes W, N, E, S, W and C. The researcher assured the respondents that the use of data collected will be in accordance with the intended purpose of this study but not personal interests. Data is kept in a safe and locked place, for a maximum of three years after research completion. This was also ensured by showing them an introductory letter from University and the research clearance. The investigator gave credit to all works of other scholars cited to avoid plagiarism (see plagiarism test report, Appendix G).

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION

4.0 Introduction

This chapter presents the results from data analyzed and discussion of the findings guided by the objectives, questions and hypotheses of the study. The discussion was guided by the ICT Competency Framework for Teachers (ICT CFT) Version 3 a tool to guide pre- and in- service teacher training on the use of ICTs across the education system, supplemented by TPACK model that gives us a new framework for the integration of technology in education and how teachers can structure their classrooms to provide the best educational experience for learners while incorporating technology. The purpose of this study was to establish Primary Teacher Trainees' Information and Communications Technology Competencies for Pedagogical practices in Uganda. Therefore, results have been produced to achieve the following study objectives:

1) To assess PTE trainees' ICT competences for ICT Integration in their pedagogical practices;
2) To explore the quality of ICT Infrastructure in PTE for trainees' preparation in ICT integration in their pedagogical practices;
3) To determine instructional modes used by tutors in preparation of PTE trainees for ICT integration in their pedagogical practices;
4) To establish the relationship between PTE trainees' preparation for ICT integration and integration of ICT in their pedagogical practices in Uganda;

5) To determine the moderating effect of ICT infrastructure in PTE and tutors' instructional modes on the relationship between PTE trainees' preparation for ICT integration and integration of ICT in their pedagogical practices.

Results were presented using tables, graphs and charts for both descriptive and inferential statistics. Qualitative data was also collected and analyzed thematically to backup quantitative data, especially on the availability and accessibility of ICT infrastructures in Primary Teacher Training Colleges in Uganda. Literature reviewed per objective of the study also supported the discussion of findings.

4.1 Questionnaire Return Rate

The total number of colleges that participated in this study was five (5), selected from five regions of Uganda. These five primary teacher's colleges had a total of 686 teacher trainees but only 627 teacher trainees returned the well-completed questionnaires, resulting in a return rate of 91.40%. According to Sarantakos (1998), some researchers are satisfied with the response rate of 10 %, while others a response rate of 75% is considered the best rate.

4.2 Demographics of Respondents

The demographic information presented in this section includes; sex, age of respondents and location of colleges where research data were collected.

4.2.1 Sex of the Respondents

The sample of the study comprised of 627 male and female primary teacher trainees from five (5) Primary Teacher Training Colleges considering all regions of Uganda. Results are presented in Table 6.

Table 6

Gender of Respondents

Gender	Frequency	Percent
Male	219	34.9
Female	408	65.1
Total	627	100.0

Field data, 2020

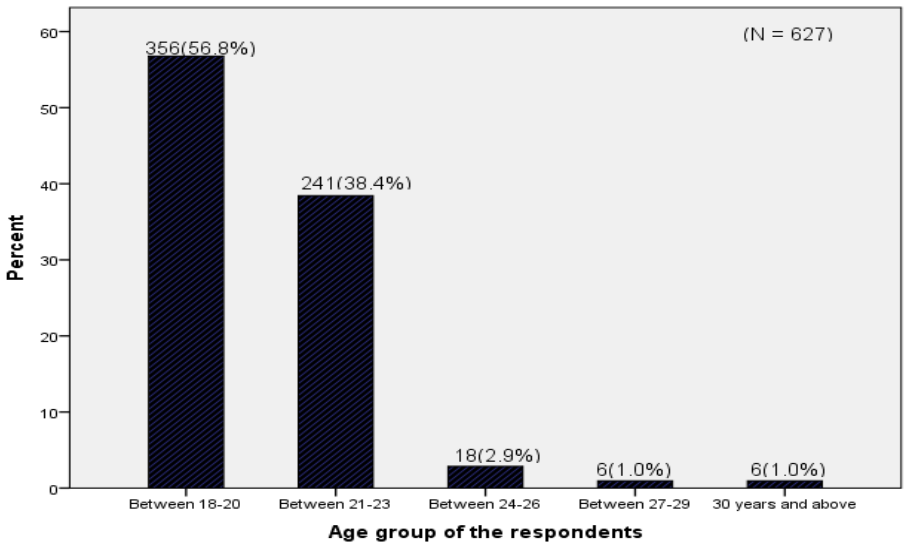
Results in Table 6 indicate that majority of the respondents 408 (65.1%) were females. This is because one of the sampled colleges was coincidently a single sex college, whereas other colleges were mixed (both males and females). Males were 219 representing 34.9%.

4.2.2 Age of the Respondents

Primary Teacher Education (PTE) Trainees were asked to indicate their age range. Results are presented using a bar graph as shown in Figure 8.

Figure 8

Age range of the Respondents



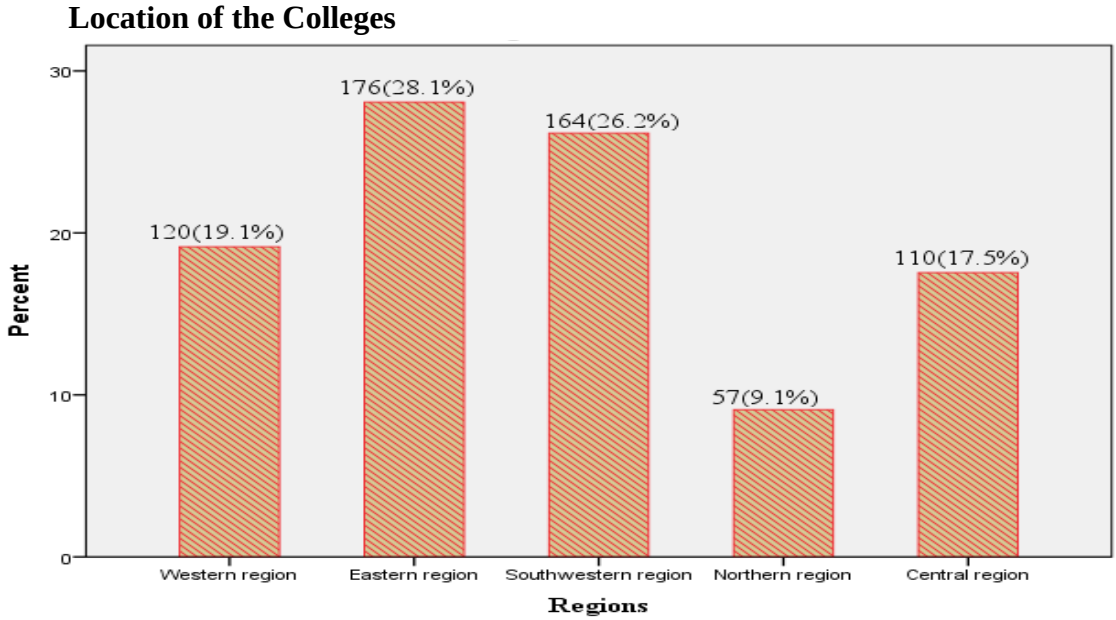
Results on Figure 8 indicate that majority of the respondents 356(56.8%) were between the ages 18-20, followed by 241(38.4%) who were between the ages 21-23 years. 18(2.9%) of the respondents were between ages 27-29 years, whereas 6(1.0%) were between the ages 27-29 years similarly 6(1.0%) were 30 years old and above.

Elli and Ricafort (2020) argue that young teachers may be better at computers and technology and more eager to learn more about teaching. Accordingly, the young age of these primary teacher trainees in Uganda would be a good stage to explore ICTs if infrastructure allows and also their tutors demonstrate for them.

4.2.3 Location of Colleges

To ensure representation of all Primary Teacher Training Colleges, all the five (5) regions of Uganda were considered since their geographical factors differ. The results were presented on a bar graph using frequencies and percentages as shown in Figure 9.

Figure 9



Results from Figure 9 indicate that majority of the respondents 176(28.1%) were from Eastern region followed by 164(26.2%) from Southwestern region and 120(19.1%) from Western region, then 110(17.5%) from Central region and finally 57(9.1%) from Northern region. All respondents were found in their classrooms and they all participated equally. Their differences in frequencies and percentage are attributed to core primary teachers' colleges and non-core teachers' colleges. Core primary teachers' colleges have a large enrollment capacity of minimum 450 students unlike non-core teachers' colleges whose enrolment is at 150 students (Daily Monitor, 2019).

4.3 The Levels of Primary Teacher Education Trainees' ICT Competencies for ICT Integration

Primary Teacher Education Trainees' ICT Competencies were scored based on basic ICT tools, Complex ICT tools, professional learning, curriculum and assessment and ICT knowledge. Items on the questionnaire were scored on a Likert scale of 1-5. Results were interpreted using the scoring guide adapted from Mailizar and Fan (2019) as shown in Table 7.

Table 7

Scoring guide

Means (*M*)	Percent (%)	Interpretation
1.0 ≤ x < 1.5	10 – 20	Very low
1.5 ≤ x < 2.0	21-30	Low
2.0 ≤ x < 2.5	31-40	Moderately low
2.5 ≤ x < 3.0	41-50	Slightly below average
3.0	51-60	Average
3.0 < x ≤ 3.5	61-70	Slightly above average
3.5 < x ≤ 4.0	71-80	Moderately high
4.0 < x ≤ 4.5	81-90	High
4.5 < x ≤ 5.0	91-100	Very high

Source*: Adapted from Mailizar and Fan (2019).*

4.3.1 Primary Teacher Education trainees' level of Skills on ICT Basic Tools

Primary Teacher Education Trainees were asked to indicate the extent to which they can use; a word processor, presentation software, a web browser, email address, search engine, a courseware, open educational resources, record and maintain pupil's grades and attendance using computer. Results are presented in Table 8 using mean (M) and standard deviation (SD).

Table 8

PTE trainees' level of Skills on ICT Basic Tools

Items	N	Mean	SD
To what extent can you use a word processor?	627	2.28	1.03
To what extent can you use presentation software?	627	2.16	1.04
To what extent can you use a web browser?	627	2.14	1.09
To what extent can you use an email address?	627	2.37	1.15
To what extent can you use a search engine?	627	1.94	1.08
To what extent can you use a courseware?	627	1.91	1.02
To what extent can you use open educational resources?	627	2.45	1.11
To what extent can you use the computer to record grades, maintain pupil's records, or take pupil's attendance?	627	2.53	1.14
Grand Mean		2.22	

Field data, 2020

Results in Table 8 indicate that the grand mean for ICT basic tools scored by teacher trainees was 2.22. According to the scoring scale, this puts teacher trainees' basic ICT skills at averagely low. Majority of the respondents reported that they can use a word processor a little (*M*=2.28, *SD* =1.03). Word processing is an important skill in modern society. As more technology is developed, teacher trainees are expected to understand the basics of typing and using word processing programs. As future teachers, they will use the word processing program to prepare worksheets and activities for their students for example typing notes, inserting pictures and links and creating forms. Almost everything becomes digital, in the future students need to print application letters or all departments will be digital. At that point you can't imagine

that applications are received as a handwritten letter on a physical paper. Teacher trainees need more time to practice computer basic typing skill.

Also, majority of the respondents reported that they can use presentation software a little (*M*=2.16, *SD* = 1.04) and majority can use a web browser a little (*M*=2.14, *SD* =1.09). UNESCO (2018) in their ICT Framework for Teachers Version 3, it specifies that teacher trainees need to have basics of presentation software because presentation software makes the ability to communicate messages to a group of people much easier than other delivery methods. Seeing a presentation while listening to it helps visual and audio learners absorb information. In today's education presentation software goes beyond the mere provision of facts to the facilitating of the higher order skills of creativity, problem-solving, analysis and evaluation. Teacher trainees should be able to utilize web browsers. A web browser (commonly alluded to as a browser) may be a program application for getting to data on the World Wide Web. Cases include google chrome, firefox, opera, torch and numerous others. When a client demands a web page from a specific site, the internet browser retrieves the necessary content from a web server and then displays the page on the user's gadget. Web browsers are utilized on a range of gadgets, including desktops, laptops, tablets, and smartphones. We use a web browser to get information resources from the internet on our gadgets. Therefore, teacher trainees should have fundamental skills for web browsers that are great for downloading, uploading information for teaching and learning.

Furthermore, email address can be used a little by respondents (*M*=2.37, *SD* = 1.15). Teacher trainees should be able to create and make good use of an email address. Email is used for many different purposes, including networking with friends, contacting experts and administrators, requesting information, and applying for jobs, apprenticeships and bursaries. Depending on your goals, the messages you send will

vary according to their style, the intended audience, and the results you want. All of these basic skills should be passed on to these teacher trainees during their teacher training.

Results in Table 8 further indicate that majority of the respondents can use search engine a little (M= 1.94, SD= 1.08) and a little of courseware (M=1.91, SD = 1.02). Primary teacher trainees should be equipped with the skills to search for peer-reviewed papers, theses, books, abstracts and articles from academic publishers, professional societies, preprint repositories, universities and other scholarly organizations. They should be able to explore various search engines, such as Google Scholar, Microsoft Academic, Educational Resources Information Center (ERIC), ResearchGate, Connecting Repositories (CORE), Semantic Scholar, Seek, Science.gov, infotopia, Google Books and more (Heinrich, 2017). Also, teacher trainees should also be introduced to educational coursewares and be able to use them (UNESCO, 2018). Courseware combines the words 'course' and 'software'. Originally it was used to describe additional educational materials intended such as teacher or trainer's kits or student tutorials, which are often integrated into computer use. The meaning of the term and its use are expanded and may refer to the whole lesson and additional material with reference to an online or 'computer-formatted classroom reference'. Examples are some of coursewares are Acrobatiq, Lumen learning, OpenStax, CogBooks, Cerego (House et al., 2018).

Respondents reported that they can use a little of open educational resources (*M* = 2.45, *SD*=1.11) and they can use the computer a little (*M*= 2.53, *SD*=1.14) to record grades, maintain pupil’s records or to take pupil’s attendance.

Though the current findings have shown primary teacher trainees in Uganda reported that they can use a little of open educational resources, Chiappe and Adame (2018)

argue that open educational practices have become a growing form of established education based on ICT. UNESCO (2019) also states that the intelligent use of open educational resources, combined with appropriate teaching methods, and well-designed learning materials, and diversity of learning activities, can provide a wide range of innovative educational options to engage teachers and students to become active participants in education processes and content creators as members of diverse and inclusive informed communities. For example, open educational resources can facilitate the learning and teaching processes during the educational disruption due to the COVID-19 outbreak (Huang et al., 2020). According to a research project conducted by Feldstein et al (2012), students who chose these courses, which were based on open educational resources, had better grades and lower failures, more often than their counterparts who did not take courses based on open educational resources. In addition, students acknowledged that open digital educational resources are more knowledgeable than standard textbooks and that they will always choose to study using digital technology or digital content. In terms of the level of functionality offered by the open educational resources website, there are three main categories of open educational resources:

(1) Directories – These provide a list of OER and links to resources which are available elsewhere on the Web. (2) Platforms – Specific digital tools designed to "do" something with the open educational resources for example, social networks (flickr, YouTube, Twitter, and facebook). (3) Repositories – Databases or collection of OER, usually ones developed by a particular institution.

Many international organizations, including the United Nations Educational, Scientific and Cultural Organization (UNESCO), Arab League for Education, Culture and Scientific Society (ALECSO) and The Commonwealth of Learning (COL) have

shared quality open educational resources and their tools on web pages for teachers and students to use during the learning process at home. Open educational resources are learning, teaching, and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license that permit no-cost access, reuse, repurpose, adaptation, retention and redistribution by others (Stracke et al., 2019; UNESCO, 2019). It is therefore more important than ever that the global community, Uganda inclusive, come together now to promote universal access to information and knowledge utilizing open educational resources.

Primary teacher trainees reported that they can use the computer a little to record grades, maintain pupil's records or to take pupil's attendance. Teacher trainees need computer skills to record marks, keep student records or take student's attendance. If you are a first-time teacher, you will have many different aspects of teaching management. In addition to designing lesson plans and actually teaching students, teachers need to come up with an effective classroom management system. Record keeping and ordering can be a time-consuming process for classroom management. Teachers need to set up systems that will help them keep track of all the different records they need to keep for each student. Once they have done this, they can focus on other aspects of their work. In addition to marks, they need to record the times they send notes home, when you have to report a student in the office, or when you have to contact a parent directly. One of the grades-keeping software has a place where they can easily enter this information and their existing records. Having a single system for managing teachers' documents will help them stay efficient and organized. Another very important aspect is to keep up with grading papers and making sure they are entering them correctly into the computer. This will help teachers avoid problems

down the road when it's time to submit grades. All of these skills need to be developed from college before they can join the teaching profession itself. Unfortunately, findings have shown that these basic ICT skills among primary teacher trainees in Uganda are still low.

4.3.2 PTE trainees' level of ICT Skills on Complex Tools

Primary Teacher Trainees were asked to indicate the extent to which they can use different ICT complex tools such as authoring environments, platforms, social networks, open educational resources and ICTs to collaborate with other schools. Using a scale of 1-5 from not at all to a large extent, the results are shown in Table 9.

Table 9

PTE trainees' level of ICT Skills on Complex Tools

Items	N	Mean	SD
To what extent can you use authoring environments to produce learning materials for your pupils?	627	2.79	1.15
To what extent can you use authoring environments to produce online materials for your pupils?	627	2.16	1.00
Can you use a platform to manage, monitor, or assess the progress of your pupils?	627	2.31	1.07
Can you use social networks to interact with your pupils and/or colleagues?	627	2.81	1.13
To what extent can you use open educational resources?	627	2.50	1.09
Can you use ICTs to collaborate with other schools?	627	2.50	1.12
Grand mean		2.51	

Field data, 2020

Results from Table 9 indicate that the grand mean for all items for ICT skills on complex tools is 2.51. This implies that it's slightly below average. Teacher trainees not only need to have basic ICT skills such as word processing, PowerPoint, and Internet access, but they also need to develop logical pedagogical skills to

successfully integrate ICT into their school curriculum into future teaching activities. The use of ICT in the classroom enables teachers to challenge students and develop higher thinking skills (BECTA, 2003) However, in order to become confident ICT users in the classroom, teacher trainers need to participate in ongoing training. Teacher trainers should understand the benefits of digital learning. ICT training needs to be seen as important in teaching such skills, and as empowering alternative teaching and learning methods. The digital skills needed by future teachers go beyond word processing and spreadsheets. The digital skills that 21st Century teachers should have include cloud storage and sharing solutions, social media, web editing, image editing, presentation software, and general multimedia (UNESCO, 2018).

Majority of the respondents reported that they can moderately (M = 2.79, SD = 1.15) use authoring environments to produce learning materials for pupils and also they can a little (M = 2.16, SD = 1.15) use authoring environments to produce online materials for their pupils. Advanced Distributed Learning (ADL) (2011), defines authoring tools as software applications used to create e-learning products. Authoring tools enable the production of interactive lessons or learning materials that can be in the form of hypermedia or multimedia by combining and embellishing objects such as text, image, animation and video (Dağ, Durdu & Gerdan, 2014). Users with a basic level of computer literacy are expected to use any educational authoring tool. The authoring tool has a graphical interface that enables the design of the e-learning material interface and content design.

Results in Table 9 further indicate that majority of the respondents reported that they can use a platform a little (M = 2.31, SD = 1.07) to manage, monitor, or assess the progress of their pupils and they can use social networks a little (M = 2.81, SD = 1.13) to interact with their pupils and/or colleagues. Teacher trainers should

emphasize tools such as Animoto, Padlet, Answer Pad, FreeOnlineSurvey, ProProfs, Quick Key, Quizalize, Quizizz, Zoho Survey, SurveyMonkey, Survey Hero and many others (Kathy,2019). These technology tools can be used for rapid assessment in a variety of ways, such as tracking students' progress over time, helping constructive assessment, helping to increase engagement, identifying knowledge gaps and supporting in-depth learning (Kathy, 2019). Teacher trainees should be equipped with the skills to use social bookmarks to share resources within and between students. They should also have the skills to use blogs and wikis to build online platforms for students (UNESCO, 2018; UNESCO, 2011). Both of these platforms allow students to interact effectively, practice literacy skills and writing, and publish work online.

Also, results indicate that respondents agreed that they can use open educational resources a little (M = 2.50, SD = 1.09) and they can also a little (M = 2.50, SD = 1.12) use ICTs to collaborate with other schools. Teacher trainers and ICT instructors should emphasize open educational resource exploration and utilization by teacher trainees. Open educational resources can provide access to high-quality resources while eliminating the cost of traditional textbooks. Also, teacher trainees should know how a teacher with a limited science lab can use open online videos to create demonstrations of classic experiments and also experiments in other subjects. Teacher trainees should also be able to demonstrate how teachers may use an open lesson plan online to add an enrichment activity for students or to provide additional practice for students struggling with a concept. Digital technology provides new learning opportunities in an interconnected society, where learning to work with others and interact has become a very important skill (García-Valcárcel et al., 2014). Teacher trainees should be equipped with adequate ICT skills for collaborating with other schools. Teachers, who do not have ICT skills to interact with other schools in

the area, especially those in a different category, may put their schools at risk of poor performance. If some schools do more wonderful and new innovations than others, they will not make a good name for those that have not innovated. Schools need to share information and teaching strategies and activities to keep up with the performance of other schools in the area. ICT's ability to host social networks like Twitter, WhatsApp and blogs is great for improving collaboration. It is even possible for students from schools that are miles (or even continents) away to work together using digital collaboration tools (Gallagher, & Magid, 2017). These ICT skills are still lacking among primary teacher trainees in Uganda which puts education of their future pupils at a disadvantage in a digital era.

4.3.3 PTE trainees' level of ICT Skills on Teacher Professional Learning

To ascertain the level of Teacher Trainees' ICT Skills for integration of ICT in pedagogical practices, respondents were asked to indicate whether they can use ICTs to share digital resources, collaborate with experts, be members of virtual community and also use internet for their professional learning. Results are presented in Table 10.

Table 10

PTE trainees' level of ICT skills for Teacher Professional learning

Items	N	Mean	SD
Can you share digital resources with your colleagues?	627	2.49	1.16
Can you collaborate with outside experts?	627	2.45	1.11
Are you a member of a teacher's virtual community of practice?	627	2.31	1.20
To what extent do you use the internet for your professional learning?	627	2.70	1.12
Grand mean		2.49	

Field data (2020)

Results in Table 10 indicate that the grand mean is 2.49 which imply that the respondents ICT skills for professional learning are moderately low. Yet, knowing how to use information and communication technology (ICT) is a very important set of skills for students, both during their time in College and beyond. Results indicate that majority of the respondents can share digital resources a little (M = 2.49, SD = 1.16) with their colleagues and they can collaborate a little (M = 2.45, SD = 1.11) with outside experts.

Digital communication tools allow students to share their creations - whether it's articles, videos, podcasts, or info-graphics - with people without their teachers (Gallagher, & Magid, 2017). If teacher trainees know that their final product will be viewed by a wider audience, they will strive hard to produce high quality work. Students feel a sense of purpose when they do something that may affect other people positively. Technology allows students to build and engage in this way and get valuable feedback from other students, professionals, and others who may be

interested in their work. Therefore, teacher trainees should familiarize themselves with this experience to acquire all the relevant skills while continuing the training.

Majority of respondents further reported that they are a little (M = 2.31, SD = 1.20) members of teacher's virtual community of practice. A virtual community of practice (VCoP), also known as an online community of Practice (OCoP), is a community that is formed, and maintained through the Internet. Virtual Communities of practice are informal networks, which exist outside any particular organization, that support professionals to develop shared ideas and participate in building knowledge among their members by providing opportunities to build relationships and connections through Internet-based ICT as alternatives (Rheingold, 2023; Zarb, 2006). Qualifying to be an Online Community of Practice, aspects of the Community of Practice (CoP) as defined by Lave and Wenger must be met (Wenger, 1998). To date, the Online Community of Practice must include active members of physicians, or "specialists," on a specific profit base (Wenger, 2011). Members must participate in the process of shared learning within their domain. The online community enables participants to read, post and receive advice and feedback from the community in the way they wish. Those who choose to participate in a well-received (read-only) way can still gain knowledge and skills from community resources, which is especially important for first-time professionals. Online Community of Practices give beginners, who may not feel comfortable sharing their knowledge, with the opportunity to learn from their experienced colleagues beyond their own space by observing and absorbing information and dialogue(see Bissessar, 2022). As new physicians gain understanding and expertise, they are more comfortable sharing their backgrounds and ideas with Online Community of Practices by further expanding the knowledge base (Gunawardena, et al., 2009). The asynchronous nature of many forums (e.g. blogs,

wikis) allows participants to participate voluntarily. Forums maintain a record of ideas, speeches and resources, creating an expert archive in the field of practice that can be accessed at almost any time (Gray, 2005).

Respondents further reported that they can use internet a little (M = 2.70, SD = 1.12) for the professional learning. According to UNESCO ICT CFT (2018) teachers should be able to use technology to interact with professional networks to support their own professional development. The Internet has changed the way professional development for teachers can be delivered. Internet technology allows professional development to be disseminated anywhere and anytime, as long as one has a working computer and an internet connection. Professional learning holds teachers at the highest level and encourages them to pursue their own independence while acquiring knowledge and skills. It also gives teachers the opportunity to exchange expertise to improve their learning community.

4.3.4 PTE trainees' level of ICT Skills for Curriculum and Assessment

Respondents were asked to indicate the level to which they can use ICTs for curriculum and learning assessment. The results are shown in Table 11.

Table 11

PTE trainees' level of ICT Skills on Curriculum and Assessment

Items	N	Mean	SD
Can you intentionally use ICTs to improve pupils' communication skills?	627	2.45	1.08
Can you intentionally use ICTs to help pupils find ideas and information?	627	2.61	1.08
Can you intentionally use ICTs to help pupils to collaborate?	627	2.38	1.07
Can you intentionally use ICTs to help pupils share knowledge?	627	2.58	1.10
Can you help pupils acquire information problem-solving skills?	627	2.62	1.11
Do you use web2.0 to assess higher order skills (creativity, problem-solving,etc)?	627	2.05	1.08
Grand mean		2.45	

Field data, 2020

Results in Table 11 indicate that the grand mean for all items is 2.45. This implies that respondents' ICT skills for curriculum and assessment are moderately low. These results are in agreement with UNESCO (2011) which found out that many teacher training institutions in developing countries lack the capacity to design and provide ICT training courses in education. Therefore, the formal development of the ICT-Teacher Framework under these circumstances remains a challenge. However, the inclusion of ICT in education seems to reinforce that level of teaching, making those technologies more relevant to the 21st century profile teaching (Larrosa, 2010). Also, the UNESCO ICT Competency Framework for Teachers recommends that teachers should have a good knowledge of curriculum standards in their subject, as well as knowledge of general assessment strategies. In addition, teachers need to be able to integrate the use of technology into the curriculum (UNESCO, 2011).

Majority of the respondents agreed that they can a little (*M* = 2.45, *SD* = 1.08) intentionally use ICTs to improve pupils' communication skills and also a little (*M* = 2.61, *SD* = 1.08) use ICTs to help pupils find ideas and information. Majority of the respondents further agreed that they can a little (*M* = 2.38, *SD* = 1.07) intentionally use ICTs to help pupils to collaborate and they can a little (*M* = 2.58, *SD* = 1.10) intentionally use ICTs to help pupils share knowledge. Though the findings in this study have shown that teacher trainees can a little intentionally use ICT to help pupils collaborate, Cox et al., (2004) argue that students working in pairs or groups using ICT-based resources are able to challenge each other's understanding and learn from these interactions. Therefore, more support for further professional development is needed for teacher trainees to integrate the use of ICT and improve pupils' communication skills using ICT. Also, majority of the respondents agreed that they can a little help pupils (*M* = 2.62, *SD* = 1.11) to acquire information problem-solving skills and they also agreed that they can a little (*M* = 2.05, *SD* = 1.08) use web2.0 to assess higher order skills (creativity, problem-solving etc).

Unfortunately, the findings from this current study have shown that the primary teacher trainees in Uganda are lacking these interesting skills, they are moderately low. ICT instructors in primary teacher training colleges in Uganda should model and emphasize ICT skills that will facilitate teacher trainees to help their future learners to communicate, find information and improve their communication skills. During lockdown when children were away from their teachers it was the time for learners to use different ICT gadgets to access information and ideas themselves, to share with their teachers through different media such as social media and telephones. This can happen when teachers have ICT skills which are imparted to learners. All these skills

are acquired at the college since there is no programme yet to train teachers who are already in service.

However, without a doubt digital technology can enhance learning by accessing information and improving communication, as well as providing opportunities for self-directed and collaborative learning. ICT skills can also help to develop capable-future citizens(pupils).

Danner and Pessu (2013) suggest that, if teachers are expected to integrate ICT into the school curriculum, preparations must be made at the pre-service teacher education level. Likewise to Uganda teacher trainees need to be prepared in ICT skills during their teacher training programme. Robbins (1998) too proposed that teacher preparation programmes should focus on the need for student-teachers to have ICT skills for their own use, in the preparation of materials for teaching and learning activities.

Mansbach (2015) posits that online instructors can utilize technology to create activities that help learners develop both lower-level and higher level critical thinking skills, for example discussion forums and digital storytelling. Porter (2004) recommends that Digital storytelling (DST) takes the old craftsmanship of oral storytelling and employs a palette of specialized devices to weave individual stories utilizing pictures, graphics, music, and sound blended alongside the author's own story voice. Several studies have shown that Digital storytelling goes past the capabilities of conventional narrating by generating student interest, concentration, and motivation, facilitating student collaboration and organization of ideas, helping students to comprehend complex learning content, and presenting knowledge in an adaptive and important way (Robin, 2016, 2008; Sadik, 2008; Van Gils, 2005).

4.3.5 PTE trainees' level of ICT Knowledge for ICT Integration in Pedagogical Practices

Primary Teacher Trainees were asked to indicate the level of knowledge they have about technologies that can be used in different subjects, enhancing their teaching approaches and enhance student's learning. Results are shown in Table 12 and discussed.

Table 12

PTE trainees' level of ICT Knowledge for ICT integration in Pedagogical Practices

Items	N	Mean	*SD*
I know about technologies that I can use for understanding and doing Mathematics	627	3.26	1.33
I know about technologies that I can use for understanding and doing literacy	627	3.32	1.26
I know about technologies that I can use for understanding and doing science	627	3.48	1.27
I know about technologies that I can use for understanding and doing social studies	627	3.51	1.26
I can choose technologies that enhance the teaching approaches for a lesson	627	3.39	1.28
I can choose technologies that enhance student's learning for a lesson	627	3.47	1.20
My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom	627	3.75	1.23
I am thinking critically about how to use technology in my classroom	627	3.80	1.22
I can adapt the use of the technologies that I am learning about to different teaching activities	627	3.65	1.21
I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn	627	3.59	1.22
I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom	627	3.49	1.20

I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district	627	3.49	1.24
I can choose technologies that enhance the content for a lesson	627	3.48	1.24
I can teach lessons that appropriately combine Mathematics, technologies and teaching approaches	627	3.35	1.29
I can teach lessons that appropriately combine literacy, technologies and teaching approaches	627	3.34	1.22
I can teach lessons that appropriately combine science, technologies and teaching approaches	627	3.48	1.23
I can teach lessons that appropriately combine social studies, technologies and teaching approaches	627	3.49	1.23
Grand mean		3.49	

Field data, 2020

Results in Table 12 indicate that the grand mean for Primary Teacher Trainees ICT knowledge is 3.49, which implies slightly above average. This is a good basis of good teaching with technology by primary teacher trainees in Uganda. Teacher knowledge has been reported as one of the key barriers for effective technology integration (Hew & Brush, 2007; Mishra & Koehler, 2006). According to the TPACK framework, certain technical tools (hardware, software, applications, learning-related methods, etc.) are best used to educate and guide students to a better, stronger understanding of the subject (Kurt, 2018).

Majority of the respondents reported that they averagely know (M = 3.26, SD = 1.33) about the technologies they can use for understanding and doing Mathematics and they averagely know (M = 3.32, SD = 1.26) the technologies they can use for understanding and doing literacy. Teachers and curriculum developers must be knowledgeable decision makers, with the ability to determine when and how technology can improve learning skills effectively and efficiently (ISTE, 2008). All

schools and maths programs should provide students and teachers with access to teaching technology - including classroom hardware, handheld devices and labs with mathematical applications and resources, and Web-based resources - and adequate training to ensure its effective use (National Council of Teachers of Mathematics, 2015). In a balanced mathematics program, the use of technology techniques strengthens the teaching and learning of mathematics (Dick & Hollebrands, 2011). Teacher education programs and professional development should continue to update teacher trainees on the information and technology functionality in support of teaching and learning. The teacher trainees should be well equipped with the knowledge of mathematics education that take advantage of technology-enabled environments and the integration of digital tools into everyday teaching, incorporating gratitude for the power of technology and the impact it can have on students' understanding and use of mathematics. In addition to enriching students' knowledge as mathematics education students, the use of these tools enhances the opportunities offered by increasingly informed students about the convenience of information-driven communication and retrieval technologies (Gadanidis & Geiger, 2010; Project Tomorrow, 2011).

Also, research by Connor, Goldman, & Fishman (2014) indicates that technology-based professional development and specific software applications that support teachers' ability to individualize student instruction using assessment are generally effective in improving students' literacy. Huffstetter and colleagues (Huffstetter et al., 2011), examined whether Headsprout Early Reading supports preschoolers (n = 62) early learning skills. Headsprout uses a series of animated, collaborative lessons to help students learn the elements of sounds and visual words, in order to build their reading vocabulary. The results of this study, in which preschoolers were randomly

assigned, revealed that preschoolers who used Headsprout daily for 8 weeks had significantly greater benefit from early learning and oral language skills compared to preschoolers in the control group. Therefore, such technology enabled environments should be understood and embraced by primary teacher trainees in Uganda.

Results further indicate that majority of the respondents agreed that they averagely know (M = 3.48, SD = 1.27) about the technologies they can use for understanding and doing science and also they averagely know (M = 3.51, SD = 1.26) about the technologies they can use for understanding and doing social studies. Many teachers graduate from teacher training institutions with limited knowledge of how technology can be used in the classroom (Brush, 1998). Henriques (2002) suggested a method of introducing science teaching technology - stating that students will learn better when teaching technology is included in the science methodology. Many scholars have noted that teachers with limited subject matter preparation are more likely to insist on memorizing different facts and algorithms; rely on textbooks without using learners' understanding as a guide for planning lessons; they use low-level questions and formal classroom activities in addition, they use only limited questions of students or comments in the classroom, leading to poor student development of conceptual connections and misrepresentation of nature and structure of the subject (Carlsen, 1991; GessNewsome, 1999).

Also, many teachers strive to motivate students to learn (Heafner, 2004). Studies show that students tend to be less interested in social studies because they see it as a boring discipline (Schug et al., 1984; Shaughnessy & Haladyana, 1985). Students often measure it as uninteresting and insignificance; therefore, students are not encouraged to study the content of social studies due to lack of its content value. Educators suggest that students' lack of interest in social studies is related to teaching

methods used in dissemination of information (Martorella, 1997). It is because of this evidence that the focus should be on teacher trainees' learning to acquire knowledge and understanding of the technologies they can use in teaching science and social studies for the benefit of their students in future. Some of technologies for teaching and understanding science that are included in the school curriculum to support teaching and learning of science are electrical probes (sensors and software), dynamic modeling tools, interactive viewing tools, and integrated e-learning environments (Krajcik & Mun, 2014), Lego Mindstorms building kits (kits (features the RCX programmable brick, sensors, motors, and building piece) and Robolab software (Sullivan, 2008), Electric simulation ("EET electrical testing tool") (Jaakkola, Nurmi, & Veermans, (2011), Interactive powerful visualization from WISE in photosynthesis (energy [light to chemical] molecular modification) (Ryoo & Linn, 2014), Simulation-based inquiry used to learn about the greenhouse effect (Kukkonen, Kärkkäinen, Dillon, & Keinonen, 2014) Use microscope visual and remote electronics (Remote Microscopy Lab) in high school biology (Childers & Jones, 2015), Interactive dynamic and static visualizations to support the understanding of energy and matter transformation in life science (Ryoo & Bedell, 2017), use a virtual laboratory and a virtual lecture to help high school students improve their maritime literacy skills (Fauville). , 2017), The use of visual test (real labs) to teach machine concepts such as pulley systems (Sullivan, Gnesdilow, Puntambekar, & Kim, 2017), and those for teaching and understanding social studies include Newseum Digital Classroom, Google Expeditions, Kids Planet Discovery, Geo Walk, Barefoot World Atlas and Stack the Countries.

In addition, majority of the respondents agreed that they can averagely choose (M = 3.39, SD = 1.28) technologies that enhance the teaching approaches for a lesson and

they can averagely choose (*M* = 3. 47, *SD* = 1.20) technologies that enhance student's learning for a lesson. Teacher educators should skill teacher trainees with more technologies to integrate into their teaching approaches and enhance learning. The technology provides many tools that teachers can use inside and outside the classroom to improve student learning. Technologies such as flipped classroom, social media in the classroom and mobile learning all these can improve learning in the presence or absence of teacher, from anywhere and anytime.

Furthermore, respondents agreed that their teacher education program has caused them to averagely think more deeply (*M* = 3.75, SD = 1.23) about how technology could influence the teaching approaches they use in their classroom and the majority agreed that they are averagely thinking critically (*M* = 3.80, *SD* = 1.22) about how to use technology in their classroom. Since teacher trainees have this positive attitude towards technology and they are optimistic, they need to be supported to know how to use the available technologies for their future teaching. Teacher educators have a key role to play in preparing teacher trainees for active participation in a new era of global communication and new technological advances. Read current books about the technologies you want to introduce in your classroom and learn how to integrate these technologies.

Also, majority of respondents agreed that they can averagely adapt (M = 3.65, SD = 1.21) the use of technologies they are learning about to different teaching activities. Similarly, results in Table 12 indicate that majority of the respondents agreed that they can averagely select (M = 3.59, SD = 1.22) technologies to use in their classroom that enhance what they teach, how they teach and what students learn. These results are promising that teacher trainees can adapt the use of technologies to different teaching activities. Technology has become an important component of educating

students. It allows them to develop critical thinking skills, learn new ideas, and express themselves creatively. Technology helps teachers to embrace three main learning styles: visual, auditory, and kinesthetic. Even teachers who prefer a traditional teaching style can use a few technological tools to supplement the content. If a teacher has access to a computer, laptop, projector, or iPad, these tools can meet the specific needs of each type of student.

Additionally, results indicate that majority of respondents agreed that they can averagely use (M = 3.49, SD = 1.20) strategies that combine content, technologies and teaching approaches that I learned about in their coursework in their classrooms. With the increasing advancement of technology, some teacher trainees do not have the right knowledge and training yet to effectively integrate technology to improve their students' learning. So teacher trainees should spend a lot of time and effort learning how to use technology and make it a useful tool to increase students' learning ability and to make their classes enjoyable. Be creative and don't focus on one technological advancement like the internet. There are other ways to keep pace with technological advances, and you should try to explore these options. Some of the approaches teacher trainees should also explore include; problem-based learning, competency-based education, active learning, flipped learning, student-created content, collaborative learning and blended learning.

Results in Table 12 show that majority of the respondents agreed that they can averagely (M = 3.49, SD = 1.24) provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at their school and/or district and they can also averagely choose (M = 3.48, SD = 1.24) technologies that enhance the content for a lesson. This perceived basic knowledge and confidence of integrating technology and approaches in teaching is a good start for primary teacher

trainees. Teacher training colleges should put more efforts in developing and facilitating these teacher trainees in these competencies. According to the blog by Capella University (2017) integrating technologies in classroom promotes self-directed learning and creates active participants in the learning process, rather than passive learners being found in the learning environment. Combining technology with content for instance, interactive lesson plans can help turn "boring" conceptual topics in maths and science into fun, engaging and academic activities for learners (Capella University, 2017), which can benefit Ugandan pupils too to get motivated to learn, if their teachers combine content with technologies.

Respondents agreed that they can moderately teach (M = 3.35, SD = 1.29) lessons that appropriately combine Mathematics, technologies and teaching approaches, moderately teach lessons that appropriately combine literacy, technologies and teaching approaches (M= 3.34, SD = 1.22), science, technologies and teaching approaches (M = 3.48, SD = 1.23) and social studies, technologies and teaching approaches (M = 3.49, SD = 1.23). Several authors (e.g. Beauchamp & Parkinson, 2008; Keong, Horan & Daniel, 2005; Niess, 2005) find that the use of ICT improves the teaching of subjects related to science and Mathematics. ICTs introduce paradigm transformation from teacher-centred to learner-centred, from individual learning to collaboration learning (Collis & Moonen, 2001; Kafyulilo, Fisser & Voogt, 2011; Nieveen, Handelzalts, van den Akker & Homminga, 2005). The power of this linking ICT to classroom learning can have an impact on student engagement by creating multiple student options to connect technology with their course content (Kisalam & Kafyulilo, 2011).

A study by Nelson, Voithofer and Cheng (2019), from a sample of 806 teacher educators across the United States found that technology knowledge and institutional

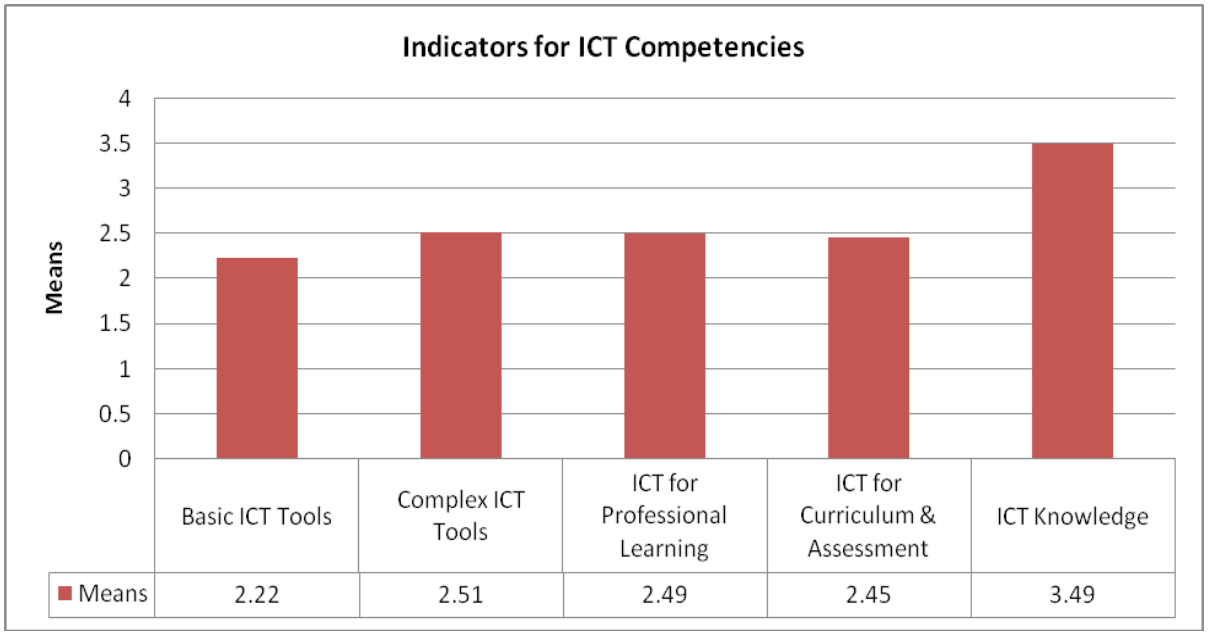
support mediate the variation of TPACK and ISTE standard alignment across all teacher educators' subject areas. Nelson and his colleagues recommended that institutions should provide targeted support to teacher educators in all disciplines and should adopt appropriate technology frameworks for their programs. The Ugandan government should take a stand on this recommendation.

4.3.6 *Comparison of PTE Trainees ICT Competencies for ICT Integration*

Primary Teacher Trainees ICT Competencies were compared to know the progress of teacher training as far as ICT is concerned in relationship to pedagogical practices. The results are displayed on the chart in Figure 10, using the grand means for all variables measured; Basic ICT tools with a grand mean of 2.22, complex ICT tools with a mean of 2.51, ICT for professional learning with a mean of 2.49, ICT for curriculum and assessment with a grand mean of 2.45 and ICT knowledge with a grand mean of 3.49.

Figure 10

Comparison for ICT Competencies for ICT Integration



Source:*Field data (2020)*

Figure 10 illustrate that Primary Teacher Education Trainees' ICT skills (Basic ICT tools, Complex ICT tools, ICT for professional learning and curriculum and assessment) are below average whereas Primary Teacher Trainees' ICT knowledge is slightly above average. The low score on basic ICT tools could be justified that probably instructors of ICT have been ignoring teaching these skills since they are offline (not connect to internet) and require much time for practice. Yet they would be the foundation for understanding complex tools. This difference in competence level can be justified by differentiating what is required for ICT skills and ICT knowledge. In most cases, ICT knowledge refers to theoretical information acquired about ICT whereas ICT skills refer to practical application of that ICT knowledge. ICT knowledge can be learned whereas ICT skills require practical exposure and discovery. However, both knowledge and skill are required to be ICT competent. From a philosophical perspective, knowledge is intangible but skills can be made tangible by applying those skills to a context and getting the desired result (Kumar, 2015). Skills therefore need much longer processes of practice than knowledge. This is because, in most cases, knowledge is something that you learn mentally and abstractly whereas skills include a certain amount of physical association, or real-life learning. In summary, Ugandan primary teacher trainees have averagely ICT knowledge with low ICT skills, implying that their ICT knowledge does not match with the ICT skills needed to perform their future teaching job better, in the current digital era.

4.4 Tutors' Instructional Mode for Primary Teacher Education Preparation

Primary teacher trainees were asked to indicate how they perceive their tutors in modeling combining content, technologies and teaching approaches in their teaching. Results are shown in Table 13.

Table 13

PTE trainees' perceived tutor's Instructional mode

Items	N	Mean	SD
My mathematics education tutors appropriately model combining content, technologies and teaching approaches in their teaching	627	3.51	1.33
My literacy education tutors appropriately model combining content, technologies and teaching approaches in their teaching	627	3.43	1.29
My science education tutors appropriately model combining content, technologies and teaching approaches in their teaching	627	3.63	1.26
My social studies education tutors appropriately model combining content, technologies and teaching approaches in their teaching	627	3.46	1.26
My instructional technology education tutors appropriately model combining content, technologies and teaching approaches in their teaching	627	3.53	1.25
My professional education studies tutors appropriately model combining content, technologies and teaching approaches in their teaching	627	3.61	1.27
My tutors outside of education appropriately model combining content, technologies and teaching approaches in their teaching	627	3.30	1.30
My tutors appropriately model combining content, technologies and teaching approaches in their teaching	627	3.63	1.22
Grand mean		3.51	

Field data, 2020

Results in Table 13 indicate that the grand mean for tutors appropriately modeling content, technologies and teaching approaches in their teaching is 3.51 as perceived by teacher trainees. This puts tutors' modeling at slightly above average. However, this is not sufficient in this digital era and since they are supposed to impart these competencies to teacher trainees.

Majority of Primary teacher trainees agreed that their Mathematics education tutors averagely model (M = 3.51, SD = 1.33) combining content, technologies and teaching

approaches in their teaching. Appropriate and integrated use of technology has an impact on all aspects of mathematics education: what is taught in mathematics, how to teach mathematics and how to assess Mathematics (National Council of Teachers of Mathematics (NCTM), 2000). Teacher trainees should be assigned a task that involves a specific task or situation and that they need to learn to use and apply the appropriate technology to complete the task. Rios said, *"If teaching was all about content, then the best mathematicians would be among the best teachers. However, if you can combine your understanding of the content and ability to effectively work with your colleagues, and the knowledge on how your students learn, you will achieve effective teaching"* (Rios, 2019). In this way, teacher trainees can not only teach using the types of technology tools available, but also learn them in the context of mathematical assessment, which helps to increase their content knowledge (Power & Blubaugh, 2005).

Majority of respondents also reported that averagely (M = 3.43, SD = 1.29) literacy education tutors appropriately model combining content, technologies and teaching approaches in their teaching. Watt (2010) discusses children's learning about language and literacy skills which are evolving through technological mediation. Watt argues that the available evidence suggests that communication technology has far-reaching effects on language and reading skills and may even encourage the development of new media reading skills, as long as children are supported with language acquisition and appropriate content through development. Technology can help students discuss their ideas by bringing readers and writers together in the same classroom, and it can help students work together at different times with google texts and blogging. So combining these two factors, the development of literacy and technology, makes a good impression on education, a skill teacher trainees to be equipped with.

Also, majority of teacher trainees reported that their science tutors averagely model (*M* = 3.63, *SD* = 1.26) combining content, technologies and teaching approaches in their teaching likewise Social studies tutors who averagely model (*M* = 3.46, *SD* = 1.26) combining content, technologies and teaching approaches in their teaching. Teachers are expected to bring academic ideas to life through visual and practical learning lessons, for example, you can have an interactive white board to display photos, videos, and other images and also let students participate in out-of-classroom experiments and local trips (Rios, 2019). This experience will help trainee teachers gain subject knowledge and technological integration into their future teaching.

Furthermore, results from Table 13 show that majority of teacher trainees reported that their instructional technology tutors averagely model (*M* = 3.53, *SD* = 1.25) combining content, technologies and teaching approaches in their teaching and also professional education tutors averagely model (M = 3.61, SD = 1.27) combining content, technologies and teaching approaches in their teaching. These tutors handle course units that are studied by all teacher trainees irrespective of area of specialization. Therefore, tutors should keep in mind that, Technology will not work in a classroom without teachers who are knowledgeable about both the technology itself and its functionality to meet educational goals. In order for teachers to incorporate digital technology into their practice, they need a constant understanding of existing technologies and their functionality (DeCoito & Richardson, 2018). In addition, teacher trainees reported that their tutors outside of education model averagely (M = 3.30, SD = 1.30) combining content, technologies and teaching approaches in their teaching. Tutors outside of education are those tutors out-of-field teaching, without the necessary qualifications, certification or specialization (Hobbs & Porsch, 2021). Generally, all tutors averagely model (M = 3.63, SD = 1.22)

combining content, technologies and teaching approaches in their teaching. Although teacher trainees have perceived that their tutors have been averagely using different educational technologies, these results are not satisfactory in institutions of higher learning.

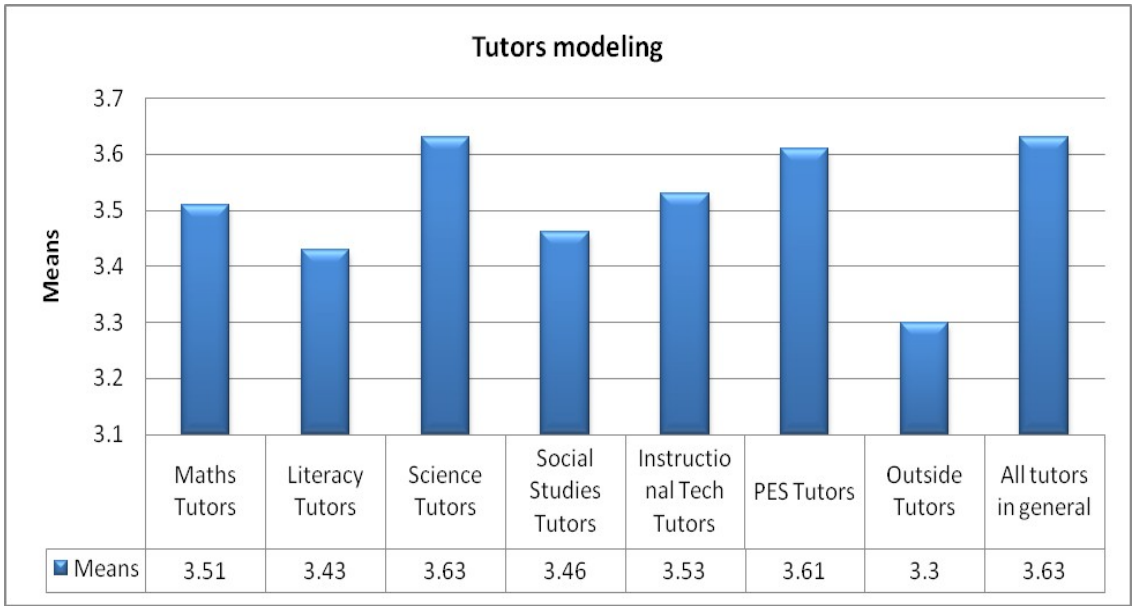
These findings are consistent with Balash's et al. (2011) assertion that even if educators were using different educational technologies, the use of technological tools was ineffective and ineffective in higher education institutions. In addition, Cuban (2001) found that teaching tools are less used in teaching while they are often used in research and management by lecturers. Future teachers need to be prepared to incorporate technology into their teaching and technical activities in appropriate ways by their tutors.

4.4.1 Summary Statistics for Tutors' Model combining Content, Technologies and Approaches

Perceptions of teacher trainees on their Mathematics, Literacy, Science education, professional education studies, instructional technology and outside of education tutors' mode of instruction modeling combining content, technologies and teaching approaches in their teaching were summarized on bar graph in Figure 11.

Figure 11

Tutor's Model combining Content, Technologies and Approaches



Source: *Field data (2020)*

The graph summary statistics show that the Mathematics education tutors, Science education tutors, Professional education tutors and Instructional technology tutors modeled above average compared to literacy, social studies and outside of education tutors. It seems literacy, social studies and other disciplines apart from science education professional education and instructional technology are not integrating technology in their teaching. This leaves a gap among teacher trainees who would acquire both knowledge and skills from these tutors, for their experiences of pedagogical practices.

4.4.2 Rate of Tutor's Mode of Instruction

Primary Teacher Trainees were asked to rate their tutors using percentages on how they effectively model combining content, technologies and teaching approaches in their teaching. Results are presented in Table 14.

Table 14

Rate of Tutor's Mode of Instruction

Items	25% or less		26%-50%		51%-75%		76%-100%	
	Count	%	Count	%	Count	%	Count	%
In general, approximately what percentage of your teacher education tutors have provided an effective model of combining content, technologies and teaching approaches in their teaching?	121	19.3%	165	26.3%	240	38.3%	101	16.1%
In general, approximately what percentage of your tutors outside of teacher education have provided an effective model of combining content, technologies and teaching approaches in their teaching?	182	29.0%	219	34.9%	155	24.7%	71	11.3%
In general, approximately what percentage of your tutors have provided an effective model of combining content, technologies and teaching approaches in their teaching?	114	18.2%	125	19.9%	229	36.5%	159	25.4%

Field data, 2020

Results in Table 14 indicate that majority of primary teacher trainees 240(38.3%) put their teacher education tutors at a percentage of 51%-75% for effective modeling combining content, technologies and teaching approaches in their teaching. Also, majority of teacher trainees 219(43.9%) rated their outside of education tutors to be at 26%-50% for effective modeling combining content, technologies and teaching approaches in their teaching. In general, majority of teacher trainees 229(36.5%) put all their tutors at a percentage of 51%-75% for effective modeling combining content,

technologies and teaching approaches in their teaching. These percentages are low depending on the current trend of teaching with technology.

Sprague (2004) noted that some teacher educators do not understand the type of teaching and learning technology supports, and they have developed a culture that does not include technology and are uncomfortable when that culture is challenged. On the other hand, some technology tutors are familiar with, or to a lesser extent, one area of educational content and are unaware of some of the problems teacher education needs to address (Sprague, 2004). Technology has not been part of their teacher education preparation (Norton & Sprague, 2002-2003).

Therefore, the technology skills tutors have developed were maybe self-taught, learned at professional development workshops, or learned from a technology proficient mentor. Most of tutors in primary teacher training colleges in Uganda were not trained to teach with technology during their teacher education times. Though they may have some technology skills, but their understanding of how to integrate technology effectively combining content and teaching approaches is limited. With a direct focus on the field of art and design education in Uganda, there are absolutely no written studies on how teacher trainers (TEs) develop digital skills (Tusiime et al., 2019). However, modeling has traditionally been used in teacher education around the world to enhance digital competence (Dorgu, 2015).

4.5 Evaluation of Availability and Accessibility of ICT Infrastructure

Primary Teacher Trainees were asked to show how easy or difficult it is to access ICT infrastructure at college. It was assumed that limited or no access to ICT infrastructure by teacher trainees will result into low ICT competencies of teacher trainees for pedagogical practices. Results are presented in Table 15.

Table 15

Availability and Accessibility of ICT Infrastructure

Items	Not accessible		Restricted access		Free access	
	Count	%	Count	%	Count	%
Are personal computers accessible for you as a student teacher at the college?	321	51.2%	90	14.4%	216	34.4%
Are college computers accessible for you as a student teacher at the college?	73	11.6%	188	30.0%	366	58.4%
Are videoconferencing systems accessible for you as a student teacher at the college?	368	58.7%	120	19.1%	139	22.2%
Are interactive whiteboards accessible for you as a student teacher at the college?	402	64.1%	117	18.7%	108	17.2%
Are Learning Management systems/VLE(WebCT, Moodle,padlet etc.) accessible for you as a student teacher at the college?	378	60.3%	115	18.3%	134	21.4%
Are Audio equipment (including software) accessible for you as a student teacher at the college?	262	41.8%	161	25.7%	204	32.5%
Are Digital photo cameras(including editing software) accessible for you as a student teacher at the college?	337	53.7%	151	24.1%	139	22.2%
Are mobile phones accessible for you as a student teacher at the college?	78	12.4%	118	18.8%	431	68.7%
Is projection system accessible for you as a student teacher at the college?	165	26.3%	211	33.7%	251	40.0%
Are Networked printers accessible for you as a student teacher at the college?	281	44.8%	174	27.8%	172	27.4%
Is college television accessible for you as a student teacher at the college?	137	21.9%	172	27.4%	318	50.7%
Is internet access accessible for you as a student teacher at the college?	155	24.7%	153	24.4%	319	50.9%

Field data, 2020

Results in Table 15 indicate that majority of respondents 321(51.2%) reported that personal computers are not accessible for them as student teachers at the college compared to majority of respondents 366(58.4%) that reported that college computers are freely accessible for them as student teachers at the college. Majority of teacher trainees cannot afford a personal computer and also some colleges do not have enough of computers and those with are restricted. College principals report that there is still a shortage of ICT facilities and laboratories, leaving the ICT skills that teachers demand, and PTCs remain divided over the use of ICT (Daily Monitor, 2019).

Also, majority of respondents 368(58.7%) reported that videoconferencing systems are not accessible for them as student teachers at the college. Though findings have indicated that videoconferencing has not been embraced in teacher education programmes in Uganda, videoconferencing systems can connect people together without traveling. This means that meetings can be set up between two or more people hence saving time and money. Tutors and teachers can coordinate activities and handle online lessons interacting with their learners. Some of the examples of videoconferencing systems are; Zoom, ezTalks, WhatsApp and Microsoft Teams. Typically, a videoconferencing system can be used to host video conferences, online training, webinars and video presentations in various industries such as education, training, business, government, health, legal, finance, military and more (ezTalks (n.d). Foronda and Lippincott (2014) examined the use of a videoconferencing system in a master's level nursing degree. Their relevant data in the study identified five emerging themes: fun, flexibility, ease of use, communication, and technical issues. Participants reported that using videoconferencing "makes learning comparable or better than face-to-face methods" (Foronda & Lippincott, 2014, p. 5). On the other hand, Lai and Pratt (2009) have identified technical difficulties and

implementation problems that come with the use of videoconferencing technology in online teaching and learning. They found that its use did not improve teacher-student or student communication and reported the need for teachers' knowledge of technology integration when using videoconferencing programs. Similarly, Rehn et al. (2016, p. 313) highlighted the need for teachers to “learn to adapt to teaching methods and techniques” when using complementary videoconferencing. A supportive online learning environment includes teachers who use effective pedagogical practices to meet the needs of their students and to build good relationships with teacher and student to encourage student motivation and engagement (Lai, 2017).

Findings further indicate that interactive whiteboards are not accessible as reported by majority of respondents 402 (64.1%). An Interactive Whiteboard (IWB) is a large, touch-sensitive (thus interactive) board that when used with a combination of a computer and digital projector facilitates interactive ICT engagement (NCTE, 2009). It can allow direct input via finger or stylus so that objects can be easily moved around the board or transformed by teacher or students (Mercer,et al., 2010). It’s unfortunate that most colleges, universities and other institutions of learning in Uganda miss out this technology. Beeland (2001) reports on a study showing an increase in student engagement due to the use of interactive white boards. Morgan (2008) researched the use of the interactive white board and found that the use of the interactive white board as a teaching tool has a positive effect on student participation in class and leads to improved student behavior.

In addition, majority of respondents 378 (60.3%) reported that learning management systems are not accessible for them as student teachers at the college. A learning management system is a software-based or SaaS platform that assists with the management, delivery, and evaluation of an e-learning programs (Mardinger, 2020).

In short, it helps to bring training materials to a wide audience - think of everything from online courses, to real-time teaching sessions. Using the LMS, teachers can assign work, share content, and post marks while students can students can turn in work, view content, and collaborate on forums and with social-like features (Mansfield, 2019). Examples of learning management systems are Schoology, moodle, Sakai, LearnDash and LearnPress. Miguel (2018) states that once the Learning Management System is set up, it can be accessed from anywhere with an internet connection, and this can provide flexibility for students and lecturers.

Similarly, audio equipment (including software) was reported by majority of the respondents 262(41.8%) that they are not accessible for them as student teachers at the college. Yet, teacher trainees should be exposed to practical training in learning studios that teach them how to use sound signals and electronic sound control systems and are presented in recording techniques, sound mixing techniques. Teacher trainees should also learn to use audio technology tools such as musical instrument sequences, digital audio workstations, audio processors and microphones. Audio provides another quick, inexpensive way to text to connect with your students and provide up-to-date content, interviews, discussions or tutorials. Middleton (2013) emphasizes that audio has a proven ability to facilitate real engagement, allowing students to interact in a variety of ways with the outside world as listeners and publishers. Audio can be easily created with many desktop tools and small digital recording devices such as smart phones, a skill teacher trainees should be guided on.

Further majority of respondents 337(53.7%) reported that digital photo cameras including editing software are not accessible for them as student teachers at the college. Digital cameras are one of the most effective technologies in information and communication you can do at school. They improve student-teacher interaction. In

Linda's article (2012), educators say that cameras can be used to record classroom projects and special events, and that children include pictures in their reports and in many media presentations. They can also edit photos to create all kinds of art. The skills a teacher trainee needs to make learning fun. However, mobile phones were reported by majority of respondents 431(68.7%) that they are freely accessible by them as student teachers at the college. Currently, most colleges allow teacher trainees to use mobile phones unlike in the past when mobile phones were not allowed in the college. However, in an interview by Daily Monitor (2019) to college principals, some PTC principals in the country continue to restrict students from using phones- the simplest device in ICT compared to their counterparts in other professions. At the primary level, where many teachers are lacking in initial training, the mobile devices will ensure that meaningful English language audio penetrates the classroom together with visual aids, and backed up by lesson plans assisting the teachers in their use of the resources (Trucano, 2009). Cell phones are popular in developing countries simply because there is no wireless infrastructure, making wireless infrastructure cheaper and faster to use (Qusay, 2009). In addition, Qusay said many people access the internet on their cell phones because they do not have access to home or school or because desktop communication is too expensive. The cell phone is thus a computer for students in developing nations (Qusay, 2009). Thus, recent research efforts are aimed at empowering students to access content on their mobile phones. The introduction of applications in the field of education has led to the introduction of new learning methods (Roy, 2017). Roy says that there are fun games available on mobile apps that make students think better and help them understand things with a different eye. Thanks to mobile phones and a variety of feature-focused

programs, students can learn at their own pace and take their time in understanding things, as it all clicks (Roy, 2017).

Similarly, projection system was reported by majority of respondents 251(40.0%) to be freely accessible by them as student teachers at the college. However, this is a small percentage that implies that most likely tutors may not be using them in their teaching or they are restricted. Many teachers find that chalkboards are almost a thing of the past with the arrival of projectors in the classroom (Csinan wordpress, 2013). Csinan posted that, instead of writing notes across the board, teachers can use PowerPoint presentations, pictures and even a film as a teaching tool using projectors. Through projectors, teachers can now use films, slides, and pictures to teach students a variety of subjects. Teachers will also find that the internet is very useful since projectors can display web content throughout the classroom, rather than students accessing information on individual computers, if any. Using LCD projectors gives teachers access to students in many ways. Students enjoy seeing, hearing, and communicating with technology rather than simply reading a book or listening to a talk. Ozaslan & Maden (2013) concluded in their study that students learn better when subject knowledge is presented with specific visual tools. They, in turn, reported that teachers believe PowerPoint presentations make content more appealing; therefore, they help them to draw the attention of the students. Therefore, projectors are one of the devices colleges should have for the benefit of teacher trainees in terms of learning and getting familiar to its use.

Results in Table 15 further shows that majority of respondents 281(44.8%) reported that networked printers are not accessible for them as student teachers at the college. A network printer is part of a work group or network of computers that can access all of the same printers simultaneously. The network printer does not need to have a

physical connection to the network. Instead, it can be connected wirelessly and given to a work group. In teachers college, network printers can best meet the needs of multiple users (students) with a single printer. Trained teachers need a printer, especially color printers, to make printouts from their desktops, laptops, phones, tablets, and so on. These printouts can be used for their teaching aids, to decorate their teaching practice files, colored letters and to appreciate their typed work practice and notes.

Moreover, majority of respondents 318(50.7%) reported that college television is freely accessible for them as student teachers at the college. Televisions are a source of news that trainee teachers need to be revitalized with the world around them. Television also broadcasts educational content for example politics, environment and social life that can be useful for teachers who are on training to plan their lessons. There are also stations that host experienced teachers to share their expertise with students, and this can encourage trainee teachers on how to manage television teaching and communication.

Also internet is freely accessible for student teachers at the college as reported by majority of the respondents 319(50.9%). This is a fair start for some colleges. Internet is a very useful modern technology that helps us not only in our daily lives but also in the professional lives. For educational purposes, it is widely used to collect data and to conduct research or to supplement knowledge of various subjects. The Internet has become a great tool for effective teaching and learning. Teachers can use it as a teaching tool by posting their teaching materials (notes and videos) on the school's website or forum. The learning process is attractive and unique with the use of instructional videos and notes. Teachers can teach using animations, powerpoint slides, and images to capture students' attention all powered by internet. The

importance of the internet as a learning tool is significant (Sharma, 2016). Sharma says the development of internet technology has improved the quality of education in all countries and changed the way students are taught in schools. This is why it is so important for the current generation to get internet education for their younger generations (Sharma, 2016). Students see Google as a new Teacher and the Internet as a school. The internet is vital to the transformation of our education system in various ways. Teachers can use the internet as a modern educational tool. The departments of education should provide the infrastructure that teachers and students can use to reap the benefits of technology in education. Opportunities to use the Internet in learning are high in Africa (Internetsociety, 2017).

According to the International Telecommunications Union (ITU), more than a quarter of Africa's population (341 million) have access to the Internet since 2016 and the ITU estimates that by the end of 2019, 51 percent of the world's population or four billion people, use the Internet (ITU, 2019). Countries also see improved broadband connectivity at the national level (through national spinal networks) and other countries through various underwater cables that reached the west and east coasts of the continent over the past decade (Internetsociety, 2017). There is a sufficient amount of broadband that can be used to facilitate international efforts to meet the goals of Sustainable Development in general, and to facilitate interactive and equitable learning in particular (Internetsociety, 2017).

However, Uganda is currently ranked 153rd in the world with uninterrupted internet access where only 3 out of 1000 residents have access to a stable internet (ITU Report, 2017). While shared mobile internet can be easily accessible to anyone with a mobile device / subscriber, it can only apply to limited (home) personal use such as communication, social networking and video access (MoICT, 2018). It cannot

empower high-bandwidth trading systems, which are in high demand for economic growth. Bandwidth costs are also very high in the country, compared to neighboring countries ((MoICT, 2018).

4.5.1 Summary of ICT Infrastructure Accessibility

Teacher trainees' accessibility of ICT infrastructure have been summarized and displayed on the graph in Figure 12 for easy comparisons.

Figure 12

PTE Trainees' ICT Infrastructure Accessibility graph

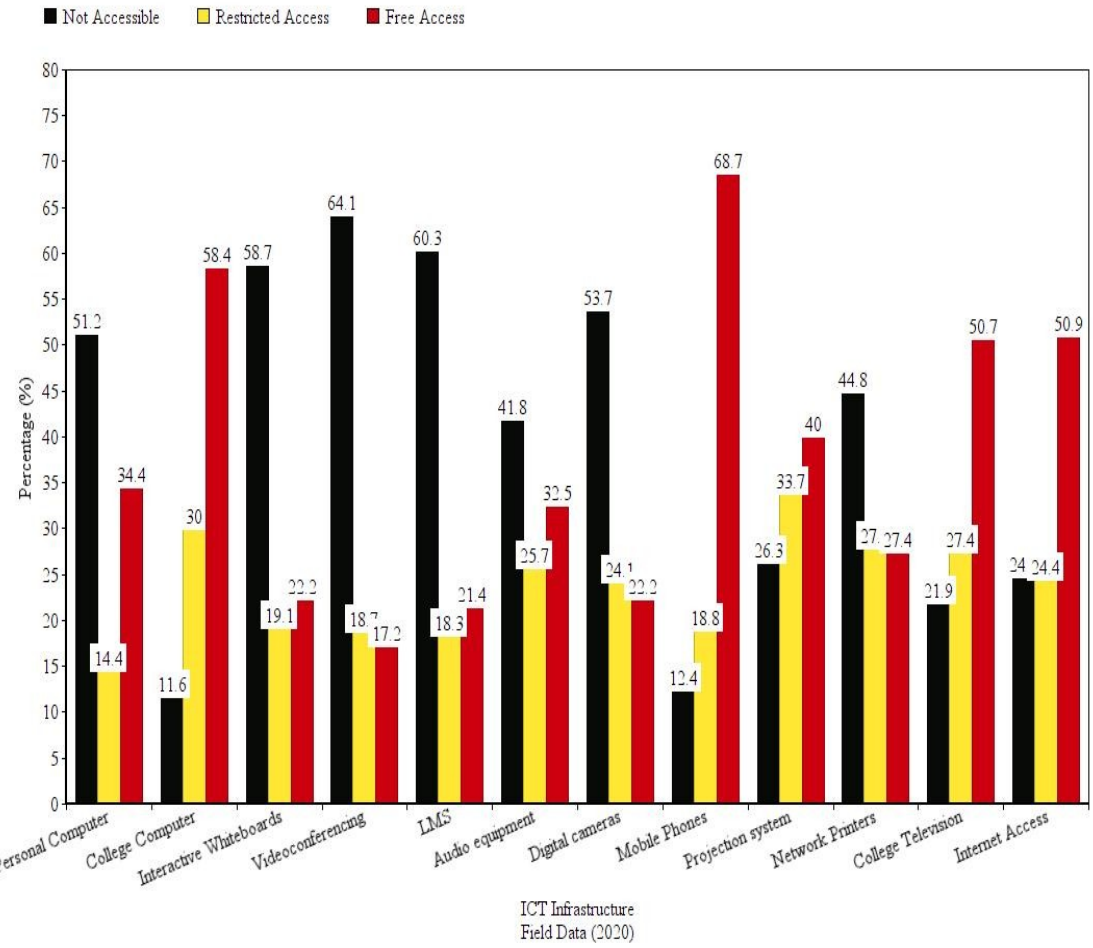


Figure 12 illustrate that only college computers, mobile phones, projection systems, college television and internet are freely accessible by student teachers at the college. Personal computers, interactive whiteboards, videoconferencing, learning

management systems, audio equipment and digital cameras are not accessible by teacher trainees. This implies that primary teacher trainees in Uganda have not been introduced to diverse technologies which they can recommend to their future workplaces if they know them. This affects their ICT skills and teaching confidence too if they are not familiar with the latest technological devices.

4.6 Qualitative data for ICT Infrastructure

Qualitative data for ICT infrastructure in Primary teacher training colleges were collected using an observation schedule. The observer visited college ICT laboratories to evaluate the quality of Infrastructure available and observations are recorded in Table 16. The colleges were coded as N, E, W, SW and C.

Table 16

Observations for ICT Infrastructure in Primary Teacher Training Colleges

No	**Infrastructure**	**Observations**
1.	College Computers' Lab	*College N, there is a small computer laboratory, with few number of functional computers and they are restricted accessible by students. In college E, there is enough of functional computer but with a small learning space/laboratory space. In college W, there is a big laboratory space, with a serious instructor and all computers are freely accessible by students, and computers are internet connect. SW laboratory had few computers, with enough learning space but with no internet and students have limited access. C laboratory had a small learning space, computers are enough but with limited access by students , internet limited*
2.	Personal Computers	*None of the students were seen having personal computers*
3.	WiFi campus/Internet access	*Only college W has free access internet for the computer laboratory and by students. College N, E, C and SW has no free internet for students.*
4.	Projection system	*All colleges visited have projectors for the lab*

5.	Digital library	*None of libraries have installed or subscribed digital library*
6.	Cloud-based E-learning Initiative	*None of the colleges*
7.	Audio equipment(including software)	*E and C have audio equipment, but the rest of laboratories don't have*
8.	Radio	*E and C have radios, the rest don't have*
9.	Digital Photo Camera	*E and W have digital photo camera, where as C, SW and N do not have*
10.	Printer accessible by students	*W, E, C have printer accessible by students. N and SW do not have*
11.	College Television	*All colleges have Television for students*
12.	Graphics Softwares installed	*Only W has graphics softwares installed. The rest do not have*
13.	Students email access	*W and E have student email addresses but the rest of other colleges do not have*
14.	College website or social platform	*None of the colleges have*
15.	Networked photocopiers/Multi-Function Devices(MFDs)	*W, C, E have local photocopier accessible by students. N and SW do not have photocopier accessible by students*
16.	Desktop conferencing applications (skype, zoom, iChat, etc.	*E and W have, whereas N, C and SW do not have desktop conferencing applications*
17.	Educational video streaming service (e.g. Youtube, etc.)	*E, and W have youtube service and google classroom. SW has Youtube. C and N do not have*
18.	Student Management system (SMS)	*E and C have , the rest do not have*
19.	Smartphones	*E, C,W, SW have except N*
20.	Software packages used for student emails(outlook, gmail, proxy)	*None of the colleges have*
21.	Blogs	*None has*
22.	Online assessment tools	*W and E have. The rest do not have*

Field data, 2020

1) *College computer's laboratory*

Observations from all colleges indicate that they have ICT laboratories stocked with computers. However, some college computers are not utilized well for the benefit of

all students. Only one college laboratory (W) has the required space, computers in use, reliable internet connection and freely accessible by all students. However, even those with internet they are faced with challenge of bandwidth.

These findings are in agreement with Ministry of ICT and National Guidance report (MoICT, 2018) which shows that there remains a shortage of ICT facilities and laboratories, which leaves the ICT skills of the teacher trainees wanting. Also, Agyei and Voogt (2011) found that lack of infrastructure is the key issue for teachers' ICT application. PTCs remain divided on the use of ICT. For instance, some PTC principals in the country continue to restrict students from using phones- the simplest device in ICT compared to their counterparts in other professions. Some colleges have been restricting the use of mobile phones because they distract students (Daily Monitor, 2019). However, lockdown experience has liberalized the use of mobile phones in most teacher training colleges. This will ease communication among students and their tutors and also self-study through internet access.

2) *Personal computers*

There were no personal computers seen, even to those students who were found in ICT lessons. Recently, the chairperson of the ICT Association of Uganda told parliament that the quality of Ugandan students will be greatly improved if they are exposed to the power of their own computers at an early age and are allowed to integrate them with their learning experiences (Kaheru, 2015). The argument was to reduce taxes on their computers so that students could buy them. However, no results have been observed for these personal computers among Ugandan primary teacher trainees. Students have not yet purchased personal computers and this affects their practice of ICT skills and convenience for personal professional learning and lesson planning as part of the pedagogical practices. Yet, experts such as Miranda et al.

(2011) said that personal computers such as e-readers enables independent reading by students. Also, Gaible and Burns (2005) stated that personal computers are designed to empower users such as students and teachers, to access or create information resources, and to communicate with anyone else who uses a computer as a communication tool. In a UNESCO (2020) interview with education and technology experts in the Netherlands during the COVID-19 pandemic, they reported that students with their laptops would connect with their laptops and follow lessons remotely, and teachers could provide additional instructions and direct feedback to individual students. This learning opportunity is missed in Uganda, where many students at all levels of education do not have their own computers and this limits their personal learning and acquiring of ICT competencies.

3) ***WiFi campus/Internet access***

Most teacher training colleges don't have free internet access by teacher trainees. Yet, wireless networks would help teacher trainees' mobile devices to speed up applications and also connect to cloud-based applications easily as suggested by Professional Development Service for Teachers (PDST Technology in Education, 2015) of Dublin.

4) ***Projection system***

All colleges visited have projectors in their computer laboratory. It has been assumed that these projectors are there for teacher trainees to present their discussions. This could build their confidence in presentation using ICT in future. By using projectors in the classroom, students can take advanced notes and have the ability to understand what data is useful and what is not. Projection is also engaging to the students during presentation in class (Messier, 2018), and this could be the good experience by teacher trainees.

5) ***Digital library***

Findings from this study have shown that none of the teacher training colleges has or has set up a digital library. However, digital libraries incorporate technologies and information resources to allow for remote access, breaking down physical barriers between learning resources (Marchionini & Maurer, 1995). According to Marchionini and Maurer, digital libraries allow teachers and students to use a wide range of materials and interact with people outside the formal learning environment.

6) ***Cloud-based E-learning Initiative***

The Cloud-based E-learning Initiative has not been recognized in any teacher training college in Uganda. Yet, the development of e-Learning services within the Cloud Computing environment is critical to the current learning and learning process. The status of Cloud Computing is emerging as a natural platform to provide support for e-Learning systems and the use of data mining techniques that allow exploring large data bases (Fernandez et al., 2012). Cloud computing technology can be embraced in all public spaces and academically cloud-based elearning solutions promote a new learning era, in which lectures and labs are based on the cloud platform through virtualization (Isaila, 2014). Isaila notes that a variety of information can be made available to teachers and students through cloud-based services and these services can be accessed at anytime, anywhere. On the other hand, providing educational services through cloud computing technology enables them to acquire the skills needed in the global information society (Isaila, 2014). This opportunity is missed by all teacher training colleges observed in this study hence limiting the platform for teacher trainees' acquisition of ICT competencies.

7) ***Audio equipment (including software)***

Few colleges have audio equipment and software. However, whether recording audio podcasts, video podcasts, video training, or webinars, one needs software to record audio / video and edit them. McLaughlin (2020) explains that loudspeakers that use digital beam steering enable users to take direct control of the sound input. McLaughlin also explains that these solutions are used to improve speech comprehension and create immersive audiences in theaters, museums, theaters and also schools. This audio experience can help teacher trainees to gain confidence of speaking to large audiences but mostly their large classes in their future teaching.

8) ***Radios***

Few teacher training colleges had radios. In the evening, AM radios can be heard over long distances because atmospheric conditions allow AM radio waves to fly between the atmosphere and the earth (Ninno, 1999). Teacher trainees may hear AM broadcasts from a few hundred miles if they listen to AM channels in the evening. Students will hear stories and cultural programs that will enhance the information available in books, encyclopedias and the Internet (Ninno, 1999). This technology should not be missed in teacher training colleges for the enhancement of pedagogical practices by teacher trainees.

9) ***Digital Photo Camera***

Few teacher training colleges had digital photo cameras. Digital camera increases student learning of process skills in laboratory activities (Tatar & Robinson, 2003) and for reflective practices by teacher trainees recording their own work. This skill should be acquired in college, and then transferred to their future teaching careers. For example, by making digital cameras an additional learning tool for students, you can help them embrace creativity and really change the way a subject is taught. Cameras can be part of the comprehension process as you ask students to think and plan what photos they will take and why. Cameras can also enhance your learners' visual skills

or purposeful observation, which can enhance their abilities and help them prepare for future projects.

10) ***Printer Accessible by students***

Some colleges have printers accessible by students. The lack of a working printer presents a real problem for teacher trainees whose tutors demand homework printed, or supporting research material be provided, and so forth and this affects teacher's pedagogical practices. Some students would wish to print out learning materials to use during their lessons especially for school practice and also for personal learning.

11) ***College Television***

All colleges had televisions. Reeves (1998) argues that forty years of research shows positive results in learning from television programs that are explicitly produced and used for educational purposes. However, Reeves (1998) also clarifies that television is less common in the classroom because teachers face difficulties in previewing videos, acquiring equipment, installing programs in the curriculum, and linking television programs and assessment activities. If teacher trainees make good use of this college television, there is hope for a better teaching experience and better learning experience gained from these televisions.

12) ***Graphics Softwares installed***

Most of the teacher training colleges have no graphics softwares installed on their computers. One of the biggest motivations for learning computer graphics is beauty and the visual communication it provides (Judice, 2019). Teacher training colleges seem unaware that computer graphics can be used for many projects, for a variety of purposes, such as training, treatment, learning aids, digital integration, simulation, among others. This can make teaching more interesting and appealing, and this skill should be imparted to teacher trainees to improve their teaching practices.

13) ***Students email access***

Few teacher trainees have email access in teacher training colleges. However, email is a great way for students to communicate (Adrian, 2019). Adrian says that if students have questions about assignments, they can email their peers for a quick response. They can also help with projects. It's a great way to give them details as well. One can send announcements to everyone in the class or provide individual feedback on the essays (Adrian, 2019). Tutors should teach teacher trainees how to set up accounts, properly write messages and maintain proper email behavior. It will help them learn a skill that will last them a lifetime!

14) ***College website or social platform***

Ridley (2017) explains that college websites and other social media platforms can be used to share their college culture with prospective students and their parents. Ridley adds that colleges can share college life as it happens, using Instagram photos, YouTube videos, tweets and more. These social media platforms can give students the opportunity to express themselves and to be published, which is great for building their resume and gaining a real writing experience (Ridley, 2017) as part of the pedagogical experiences. Colleges can also send games or educational activities in front of the site for teacher trainees to practice at home, and help tutors interact with teacher trainees using an online platform.

15) ***Networked photocopiers/Multi-Function Devices (MFDs)***

Though few colleges have local photocopiers accessible by students, none of the colleges has a networked photocopier. However, Chilton (2008) explains that digital photocopiers operate using an integrated scanner and laser printer to scan and print documents that require duplication. Chilton also explains that networked photocopiers include a hard drive that stores any scanned documents, which means they can accomplish much more than what is done with older analogue copiers, especially

since many of these devices can also fax and be connected to the Internet. Users can also scan copies of the documents in a photocopier and send them directly to their computer, meaning that any changes needed before printing can be easily done (Childon, 2008). The photocopier can be connected to your network, allowing every user in the company to print and scan wirelessly. These technologies can help teacher trainees to print their learning resources directly from their computers easily.

16) ***Desktop conferencing applications (skype, zoom, iChat, etc.)***

Many colleges have not yet embraced these applications. This is unfortunate in this digital era where learning has gone digital via zoom and other videoconferencing applications. Desktop video conference is a form of video teleconferencing in which all hardware and software platforms are contained on a desktop computer. Instead of looking for a conference room with dedicated video cameras and monitors, desktop systems provide the ability to fully integrate video into a package equivalent to a standard office workplace (Stewart, 2011). This is a modern technology that helps students connect with the world and learn. Trainee teachers need to get used to it because they are now part of daily life.

17) ***Educational video streaming service (e.g. Youtube, etc.)***

Some colleges have tried to have these educational streaming services such as Youtube and google classroom. This is a good initiative to teacher trainees since their future jobs will expect them to share their innovations through these technologies. Video is becoming increasingly popular in education. In universities, middle schools, businesses and online courses, video has become a very effective tool (Wilbert, 2018). This is the way to go for all teachers and this should begin from college during their training.

18) ***Student Management system (SMS)***

Most teacher training colleges do not have web-based student management systems. The student management system (also known as the student information system or SIS) helps the school or colleges to manage data, communication and scheduling. It is a technology all school students including teacher trainees should know and be familiar with. The development and management of accurate, up-to-date information regarding student work is of paramount importance to universities and colleges (Baramagoudar et al., 2013). The Student Information System handles all types of student information, academic-related reports, college details, course details, curriculum, batch details, placement information and other resources related (Brahmaragoudar et al., 2013). Teachers can easily enter, manage and access student data. The school management system can help teachers increase student engagement by providing features that allow them to be more easily accessible. For example, teachers can use online and video classes to communicate directly with their students, making sure they are familiar with everything that is discussed in class.

19) *Smart phones*

Most students were found with smart phones. This would ease communication among students and their tutors and also self-study through internet access. Previously, the learning process was limited to the classroom (Chopra, 2019). Chopra says that today, students can manage everything remotely using Internet-enabled devices. According to experts, several college students use a smartphone to access information online (Gerlich et al., 2010). Their smartphones help students browse the college curriculum, find books, and browse through everything (Chopra, 2019). Chopra goes on to say that learning never stops because students' mobile phone furthers their studies, making the process easier and comfortable. This could be an important learning tool if teacher trainees are taught how to use it in their pedagogical practices.

20) ***Software packages used for student emails (outlook, gmail, proxy)***

All colleges had no software packages used for student emails. This could also be the reason why majority of the teacher trainees had no email access at colleges, as earlier discussed.

21) ***Blogs***

None of the colleges has blogs. There are many types of blogs, such as LibLogs (library blogs) and EduBlogs (educational blogs) (Hong, 2008). According to Minaev (2021) a blog (an abbreviated form of "weblog") is an online journal or informative website that shows details in chronological order, the latest posts appearing first, at the top. It is a forum in which an author or group of writers share their views on each topic (Minaev, 2021). Hong (2008) explains that a blogger inserts a post into a blogging app and saves the post. According to Ray (2006), educational blogs or EduBlogs can be used for communication, such as teaching aids, as collaborative tools, and exhibitions for student projects. Blogging does not require programming languages or server knowledge from bloggers. Posts can include text, hyperlinks, images, or parts of multimedia. Content is available online and users who subscribe to the blog will be notified of new posts. Visitors can read posts and post comments. Most blogs are primarily text, but there are also audio blogs, video blogs, and photo blogs. Blogs engage people in sharing information and displaying them, and they often attract great readings. Instead of providing static information, blogs allow users and readers to respond, build, and connect (Hong, 2008). This is an important technology that can provide learning resources to support teaching practices for teacher trainees.

22) ***Online assessment tools***

Most of the colleges do not have online assessment tools. Wanasek (2020) explains that incorporating these online assessments into classrooms is a great tool to test

students' knowledge in a motivating way. Wanasek goes on to explain that many digital tools also track and record marks and answers for a complete breakdown of classroom learning. This automatic grading allows a teacher or tutor to free up most of their time for better use of what is most important (Wanasek, 2020). However, the biggest challenge now is to find new ways to teach, and using online education to maintain student-university connections which seems to be the best approach (Lima et al., 2020). It is a challenge, requiring the teacher to create a collaborative environment that creates meaningful learning and, at the same time, the commitment and dedication of the student (Evans et al., 2020). At the time of the devastating COVID-19 universities, colleges and other schools, many lecturers, tutors and teachers in Uganda have failed to continue teaching online, or testing students online due to a lack of these innovations and probably infrastructure, this stifles the entire education system.

Table 17

Comparing Quantitative and Qualitative Findings

Quantitative findings	**Qualitative findings**
Personal computers not accessible (51.2%)	No personal computers were seen
College computers are accessible (58.4%)	Computers are available though with limited access
Videoconferencing systems not accessible (58.7%)	$\frac{2}{5}$ colleges have videoconferencing applications but not in use by trainees
Interactive whiteboards not accessible (64.1%)	No interactive whiteboards seen in laboratory or class
Learning Management Systems not accessible (60.3%)	$\frac{2}{5}$ colleges have LMS but not in use
Audio equipment few available (32.5%)	$\frac{2}{5}$ colleges have simple audio equipments

Digital cameras not accessible (53.7%)	$\frac{2}{5}$ have digital cameras
Mobile phones are accessible (68.7%)	In $\frac{4}{5}$ of the colleges, trainees were seen with mobile phones
Projection system accessible (40%)	Sampled colleges have projectors though not used in classroom most times
Networked printers not accessible (72.6%)	$\frac{3}{5}$ of the colleges have printers in the laboratory
College television accessible (50.7%)	All sampled colleges have television
Internet accessible (50.9%)	One Core PTC has wireless internet, the rest do not have

Field data, 2020

Findings from the merged data Table 17 shows the consistency of most of quantitative data with qualitative data. Where inconsistencies have been noticed, it's because of respondents' perceptions, the gap that was filled by qualitative empirical data. However, there are facilities which were observed available in some colleges but not freely accessed by teacher trainees, such as computers, television and printers. This implies that some colleges are very restrictive or there is shortage of staff to manage and control these infrastructures.

4.7 Level of PTE Trainees' Pedagogical Practices Integrating Technology

Teacher trainees were asked to indicate the level of agreement or disagreement with the statements regarding their pedagogical practices. Pedagogical practices were measured based on the activities teacher trainees do during their training to become professional teachers. These activities include lesson planning, lesson material development and assessment of pupils' learning done during school practice. Results are presented in Table 18.

Table 18

Level of PTE Trainees' Pedagogical Practices Integrating Technology

Items	N	Mean	SD
I have used ICT in lesson planning	627	2.00	1.31
I have used ICT in evaluating learning	627	2.16	1.37
I have used ICT in recording and record keeping of information about how pupils are developing understanding of new material	627	2.56	1.49
I have used ICT for assessing pupils	627	2.27	1.36
I have shared resources online to enhance my reputation as a student teacher	627	2.78	1.44
The resources I develop using ICT are of good quality and I would be happy to share them	627	2.94	1.45
I have used school or personal computer to record marks using a spreadsheet	627	2.77	1.44
I have used school or personal computer typing exam or tests for my learners	627	2.64	1.49
I have used school or personal computer to find information and resources on the internet	627	3.12	1.50
I have used school or personal computer to access resources using online databases	627	2.90	1.45
I have used school or personal computer to develop teaching resources e.g games, letters etc	627	2.85	1.47
I have used school or personal computer to develop digital content for learner use	627	2.73	1.44
I have used ICTs to self-learning in my subject area	627	3.15	1.50
I have used ICT to learn how to teach e.g. seeing tutorials online experts teaching	627	2.93	1.50
I have used ICT to access NCDC Primary curriculum online and e-books	627	2.63	1.48
I have used ICT to teach my pupils complex concepts e.g. digestion, machinery, reproduction, geography etc	627	2.59	1.51
Grand mean		2.69	

Field data, 2020

Results in Table 18 show the grand mean of 2.69. This implies slightly below average for teacher trainees pedagogical practices. Majority of respondents reported that their use of ICT in lesson planning is low (M = 2.00, SD = 1.31). Yet, Lesson planning is

important when using ICTs; where less planning has taken place, research shows that student work is often less focused and can lead to lower gains (Trucano, 2005). New lesson plans can be developed and maintained effectively using ICT and teachers can access lesson plans developed by other teachers to assist them in their teaching (BECTA, 2002). Teachers need to understand which particular technology is best suited to address the different topics in their domains and how the content dictates or perhaps changes technology - or vice versa" (Koehler & Mishra, 2009), part of TPACK.

Similarly, to evaluating learning using ICT (is perceived low by teacher trainees *(M* = 2.16, *SD* = 1.37), yet in OECD countries, research consensus holds that the most effective use of ICT is when a teacher, assisted by ICTs, challenges students' understanding and thinking, either through whole-class discussions or individual / small group work using ICTs (Trucano, 2005). Trucano adds that ICTs can be used to strengthen existing pedagogical practices and change the way teachers and students communicate.

Respondents further reported that their use of ICT in recording and record keeping of information about how pupils are developing understanding of new material is lightly below average (*M* = 2.56, SD = 1.49). Teacher trainees need to know that, ICT can help teachers evaluate and monitor students' progress compared to benchmark data. It can automate some of the tasks associated with recording and reporting pupils' attainment, and can, through the use of projected performance data, enable target setting and feedback in order to improve practice (BECTA, 2002). Teachers can use computers to record marks, calculate ratings, manage attendance and access to data on student performance in online programs and assessments (Barroso, 2019).

Also assessment of pupils using ICT is low (*M* = 2.27, *SD* = 1.36). This is unfortunate to teacher trainees since assessment is one of their roles during teaching. However, the British Educational Communications and Technology Agency (BECTA) say ICT extends a variety of assessment methods available to teachers. Teachers should learn to use online education portfolios to assess students. Teachers can choose from a variety of online portfolio providers tailored to the needs of their class (Darrel & Bleiberg, 2013). Online testing works better than traditional paper tests because it allows for faster response/feedback and data (Barroso, 2019). Also, computer simulations can provide useful insights into learners' comprehension, and certain assessment software may allow teachers to assess learners (BECTA, 2002). When used properly, diagnostic tools are integrated into Integrated Learning Systems (ILS), enabling the teacher to support learners, for example, by identifying and challenging misconceptions (BECTA, 2002). BECTA emphasizes that ICT can be used to demonstrate student work where students can store work in their files, or on their web pages, or have their work included in a school website. This can have positive effects on motivating and challenging other learners to produce quality work.

In addition, results show that majority of the respondents reported that sharing of resources online to enhance their reputation as student teachers slightly below average (*M* = 2.78, *SD* = 1.44). Sharing what you know, or asking someone else to share what they know, may not seem like such a big deal, but sharing information with peers can be a powerful tool to help teachers teach effectively in an integrated classroom (Malone, 2015). Malone adds that this often overlooked strategy is one of the best ways to find problems, find better ways, and find new or better teaching resources (Malone, 2015). In this digital age, most, if not all, teachers are online, meaning they have an 'online' name (Janelle, 2019). Janelle advises that modern teachers need to be

able to manage their online reputation and which social media platforms are best for them. This implies that teachers should also have knowledge and skills to manage the privacy settings on their social networking accounts, by ensuring that their posts, pins, and pictures do not undermine their high standing or professional integrity.

It's important to realize that the term privacy can be misleading when LinkedIn is a social network that you work with, but some profiles of social networking sites, such as Instagram or Facebook, should remain confidential and separate from learners (Janelle, 2019).

Primary teacher trainees also reported that they are slightly below average (M = 2.94, SD = 1.45) in developing quality resources for sharing using ICT. These teacher trainees need more practice and exposure to educational technologies. An InfoDev report puts it: "Teachers need extensive, continuous exposure to ICTs in order to be able to evaluate and select the most appropriate resources (Trucano, 2005). However, the development of appropriate pedagogical practices appears to be more important than the technical capabilities of ICT" (Trucano, 2005). The digital skills that 21st Century teachers should include cloud storage and sharing solutions, social media, web editing, image editing, presentation software, and general multimedia (Kharbach, 2016).

Furthermore, results indicate that majority of respondents they were slightly below average (M = 2.77, SD = 1.44) in using school or personal computer to record marks using a spreadsheet and they were also slightly below average (M = 2.64, SD = 1.49) in using school or personal computer to type exam or tests for their learners. A survey of US teachers was conducted to obtain a summary of key technological skills in 2014. Some study participants reported that good typing skills are important as they are used every time a teacher sits down at a computer. They also report that the

effective use of word processor, presentation software and spreadsheets is important for classroom management and production (Thompson, 2014). Indeed these skills are needed by teacher trainees in Uganda since they are relevant in almost all schools in Uganda, for typing communiqué, tests, home works and examinations for learners.

Additionally, respondents reported that they have averagely used (M = 3.12, SD = 1.50) school or personal computer to find information and resources on the internet and also slightly below average (M = 2.90, SD = 1.45) used school or personal computer to access resources using online databases. Every teacher should know what is available on the web in their subject area (Poole, 2012). Poole says the Web is a great resource for teaching and learning - and getting better every day. In addition, the academic technology specialist, Poole, thinks that conscientious technology teachers take the time to research what is available to enrich their students' learning knowledge (Poole, 2012). Therefore, every teacher should have good Web research skills because Web search has become an important skill for all computer users. Almost anything you can think of is available on the web - if you only know how to find it (Poole, 2012). Electronic information resource databases are one of the most technologically innovative libraries and are the most important resources for teaching, learning, and research and community development in any subject. E-resources databases are a resource where information is stored electronically and can be accessed through online networks. Some of the online information databases that teachers need to know include; ERIC, Google Scholar, Jstor, and CORE. They can also include national curriculum development centre (NCDC) online resources like books, teacher’s guides and curriculum for different class levels.

Majority of respondents have used school or college computer slightly below average (M = 2.85, SD = 1.47) to develop teaching resources e.g. games, letters etc. Teacher

trainers should be able to use computer programs to create simple teaching aids such as games and characters to teach children. Some of the most common uses of computers in education today include the continued use of educational software and programs that facilitate online teaching of students (Barroso, 2019). Programs like iReady use computers to test students in reading and maths (Barroso, 2019). Educational software like iReady makes it easy to differentiate instruction so that courses meet the different learning needs of each student (Barroso, 2019).

Primary teacher trainees also have slightly below average (M = 2.73, SD = 1.44) developed digital content for learners' use using school or personal computer. With digital skills, trained Primary teachers should be able to make visual presentations, design websites for science projects and write book reviews as bloggers. Primary teacher trainees should have the same basic skills as filming a video using a digital video camera, and editing a movie using movie editing software. Darrel & Bleiberg (2013) stipulates that students who successfully create, shoot, edit, and complete a movie with title cards, music and sound recording will learn to use a variety of technologies. These skills can help trainee teachers build more resources for their teaching.

Results in Table 18 continue to show that majority of the respondents have averagely used (M = 3.15, SD = 1.50) ICTs to self-learn in their subject area. By providing access to updated and additional learning resources, ICTs can enhance a teacher's self-study in his or her subject (Trucano, 2005).

Primary teacher trainees further reported that slightly below average used ICT (*M* = 2.93, *SD* = 1.50) to learn how to teach e.g. seeing tutorials online experts teaching. Teacher trainees should develop the habit of professional self-improvement by looking at the teaching professionals/experts. These professionals can be found online

at the websites of other educational institutions and on social networking sites such as YouTube. It is believed that expert teachers perceive events in the classroom differently than novices (Fletcher-Wood, 2017). Thinking about lessons, expert teachers focus on the evidence students have learned, novice about their feelings (Borko & Livingston, 1989). In a study on pedagogical expertise, by Borko and Livingston (1989), they found that novice exhibited wasted time, inefficient planning, and encountered problems when student response efforts led them away from written study programs, less selective posts on display than experts. Experts also reverse problems by addressing the same situations they face, seeking to fully understand them and come up with practical solutions (Sternberg & Horvath, 1995).

Moreover, majority of the respondents reported that they have slightly below average (M = 2.63, SD = 1.48) used ICT to access NCDC primary school curriculum online and e-books. Primary teacher trainees need to know that almost all teaching resources and policy documents are sent online by various education ministries and stakeholders. For example, the teaching guides for primary school teachers and the Ugandan primary school curriculum are available on the NCDC website so that all schools and teachers can use them. Therefore, they should get used to explore ministry departmental websites for updates on what is happening in the field of education.

Also, primary teacher trainees slightly below average (M = 2.59, SD = 1.51) used ICT to teach their pupils complex concepts e.g. digestion, machinery, reproduction, geography etc. It is safe to say that almost all disciplines/subjects beginning with mathematics, science, languages, arts and humanities and other major fields can best be learned with technological tools and equipment (Ghavifekr, & Rosdy, 2015). According to Warwick and Kershner (2008) the importance and value of ICT should

be recognized by teachers in order to make a meaningful lesson with the use of ICT. According to Scientific World (2019), using educational software, teachers, and students can learn about life situations in a more powerful way than traditional textbooks allow. For example, students can use the Internet to make visual trips to planets.

Finally, pedagogical practices for teachers using ICT may range from only minor improvements in teaching practices, using traditional methods, to the most important changes in their teaching approaches. ICTs can be used to strengthen existing teaching methods and change the way teachers and students communicate. The types of ICT applications are significantly related to teachers' teaching philosophies.

4.8 Hypothesis One

Hypothesis one stated that there is no statistical significant relationship between PTE Trainees' preparation for ICT integration, and integration of ICT in their pedagogical practices in Uganda. Correlations were run to determine the relationship between ICT competencies (Knowledge and Skills) and Integration of ICT in Pedagogical Practices.

Results are shown in Tables 19 and 20.

Table 19

Correlations for ICT Knowledge and ICT Integration into Pedagogical Practices

Variables		ICT Knowledge	Pedagogical Practices
ICT Knowledge	Pearson Correlation	1	.514**
	Sig. (2-tailed)		.000
	N	627	627

Pedagogical Practices	Pearson Correlation	.514**	1
	Sig. (2-tailed)	.000	
	N	627	627

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

Results in Table 19 indicate that there is a strong positive statistical significant relationship between ICT Knowledge and Integration of ICT in Pedagogical Practices (r = .514, ρ < .01) at 0.01 level of significance. Therefore, the null hypothesis that stated that there is no significant relationship between Primary teacher education trainees' preparation for ICT integration and integration of ICT in their pedagogical practices is rejected. The relationship is positive implying that an increase in ICT knowledge increases ICT integration in their pedagogical practices.

These findings are consistent with Rahman and Rahman (2015) in their research findings that have shown a positive relationship between knowledge and practice. Drent and Meelissen (2008) also found that strong ICT knowledge and skills are critical to using ICT in teaching. This study was of the view that when teacher trainees acquire ICT knowledge, they will improve pedagogical practices. Kazan and ELDaou (2016) conducted a study examining the relationship between perceived teacher's self-efficacy related to ICT usefulness and attitudes post-training and the students' science education performance results in Lebanon. The results showed a positive correlation of Pearson r = .6 between teachers' self-efficacy, knowledge, attitudes, and science results for special education students. Kazan and ELDaou again found that the first group participants, who were trained, were able to better explain and apply technology in the science class than the second group that were not trained (Kazan & ELDaou, 2016). This implies that the level of knowledge acquired is

significant. Also, Felistas et al. (2016) investigated the impact of teacher's competency on ICT integration in teaching and learning in public high schools in Machakos County, Kenya. Their findings highlight a significant relationship between teacher knowledge and ICT integration. Some researchers also suggest that knowledge and beliefs may influence teachers' intention to use technology in the classroom, especially as evidenced by their lesson plans (Kazan, 2015; Cullen & Greene, 2011; Rehmat & Bailey, 2014). All of these findings support the current findings that there is a significant relationship between ICT knowledge and teaching practices. Globally, the lack of ICT-related knowledge and skills among new and experienced teachers has been identified as a major obstacle to achieving ICT-related goals for colleges and schools (Pelgrum & Anderson, 2001). Flanagan and Shoffner (2011) suggest that perhaps the most difficult challenge for teachers is the lack of training and preparation for the use of technology in improved ICT teaching. However, descriptive results have shown that primary teacher trainees have a moderate knowledge of ICT but little use in pedagogical activities. This can be explained by the insufficient exposure to ICT infrastructure and the type of training they receive that does not have a technical model. Therefore, the increase in ICT knowledge would encourage these trainees to apply it in their teaching practices. Cox and his colleagues while reviewing literature on ICT and pedagogy concluded that very few teachers have extensive knowledge of the various ICT resources available in education and this means that their students are not given every opportunity to learn the ICT can offer them (Cox et al, 2003). Varol (2013) also found that teachers had limited knowledge of ICTs and their level of ICT usage in teaching was low. Therefore, the significant correlation between teacher trainees' ICT knowledge and ICT Integration in their pedagogical practices gives an assumption that teacher

trainees' pedagogical practices are improved and modern, when other constructs such as ICT skills are developed.

Table 20

Correlations for ICT Skills and ICT integration in Pedagogical Practices

Variables		1	2	3	4	5
	Pearson Correlation	1	.639**	.538**	.662**	.475**
Basic ICT Tools	Sig. (2-tailed)		.000	.000	.000	.000
	N	627	627	627	627	627
	Pearson Correlation	.639**	1	.629**	.715**	.546**
Complex ICT Tools	Sig. (2-tailed)	.000		.000	.000	.000
	N	627	627	627	627	627
	Pearson Correlation	.538**	.629**	1	.649**	.471**
Professional Learning	Sig. (2-tailed)	.000	.000		.000	.000
	N	627	627	627	627	627
	Pearson Correlation	.662**	.715**	.649**	1	.563**
Assessment ICT Skills	Sig. (2-tailed)	.000	.000	.000		.000
	N	627	627	627	627	627
	Pearson Correlation	.475**	.546**	.471**	.563**	1
Pedagogical Practices	Sig. (2-tailed)	.000	.000	.000	.000	
	N	627	627	627	627	627

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

Results in Table 20 indicate that there is a statistical significant relationship between ICT skills and ICT integration in pedagogical practices ($\rho < .01$). All the constructs for ICT skills which measured basic ICT tools ($r = .475$, $\rho < .01$) complex ICT tools ($r = .546$, $\rho < .01$), professional learning ($r = .471$, $\rho < .01$), and assessment ICT skills ($r = .563$, $\rho < .01$) were found to be statistically significant and positively correlated with ICT integration in pedagogical practices. Therefore, the null hypothesis that stated that there is no significant relationship between PTE trainees' competencies

and ICT integration in their pedagogical practices is rejected. This implies that an increase in ICT skills increases the integration of ICT in pedagogical practices of primary teacher trainees.

The current findings are in agreement with those of Rastogi and Malhotra (2013) who found a strong relationship between ICT skills by teachers, their attitude towards ICT and the actual implementation of ICT in their teaching class in India. Rastogi and Malhotra explored the expertise of ICT skills, teachers' attitude towards ICT, and their experience with ICT and how to use ICT in their modern day of practice in India. Their assumption was that due to the existence of diversity and levels of ICT skills and attitudes of teachers or because of their diverse teaching practices, the real integration of ICT into teaching could be compromised. Also, in a study by Alazam et al. (2012) regarding the levels of ICT skills and the use of ICT in the classroom among technical and vocational educators in Malaysia, it was found that there is a strong correlation between ICT skills and ICT integration in the classroom.

Aslan and Zhu (2017) also found that pre-service teachers' perceived competence of ICT strongly predicts the integration of ICT into teaching practice. Aslan and Zhu were investigating the extent to which pre-service teachers were able to incorporate ICT into their teaching practices as part of their teaching program, as well as factors predicting the integration of pre-service ICT teachers into their teaching practices in Turkey. Scholars such as Zhou et al. (2010) suggest that pre-service teachers need to acquire the necessary skills to meet the needs of their students during their pre-service education. This shows that pre-service teacher training programs play an important role in enabling pre-service teachers to acquire and apply their ICT skills in their teaching practices. In this regard, Yıldırım (2000) emphasizes the importance of teachers having appropriate technical training during their pre-service education, if

they are to meet the needs of students for the next century. Pre-service teachers should acquire the skills and knowledge necessary for the use of ICT in their pre-service learning process, and apply it in their pre-service and professional life (Yapıcı & Hevedanlı, 2012). It has been reported in a study conducted by Jung (2005) that alternative approaches to ICT, in order to achieve broader teaching goals, are recommended at the first level of teacher training and at a higher level.

Additionally, for school teachers to play an emerging role in helping the student acquire the 21st century skills needed; Teachers themselves need to learn ICT and be competent and must learn to integrate their technical knowledge and teaching skills in teaching the content of their subjects with 21st century skills (Garba, 2014). There is evidence that ICT helps primary school teachers to be more effective in their teaching, especially when they have the resources to work (BECTA, 2001). Therefore, the level of ICT literacy and teacher skills is important in determining the success of ICT integration in schools (Mahmud & Ismail, 2010). However, the ability of teachers use ICT in their educational practices depends on teacher education and training, on the other hand; also, tutors who teach them (Garba, 2014). Therefore, the enhancement of primary teacher trainees' ICT skills would facilitate their pedagogical practices and future application of ICTs in their future real teaching. All of these findings attest to the remarkable interaction between teachers' ICT skills and pedagogical practices. The increase in ICT skills increases the effectiveness of teaching practices among teacher trainees.

4.9 Hypothesis Two

Hypothesis two stated that there is a moderating effect of availability and quality of ICT infrastructures in PTE and tutors' Instructional modes on the relationship between PTE trainees' preparation for ICT integration and Integration of ICT in

pedagogical practices in Uganda. To determine the moderating effect of availability and quality of ICT infrastructures in PTE and tutors' Instructional modes on the relationship between PTE trainees' preparation for ICT integration and Integration of ICT in pedagogical practices a multiple regression analysis was done. Most moderator analysis measure the causal relationship between X and Y by using a regression coefficient. Although classically, moderation implies a weakening of a causal effect, a moderator can amplify or even reverse that effect. The regression analysis was done with all variables combined as indicated in Table 21 and also when moderators are removed as indicated in Table 22. This was done to determine how much moderators contribute to the model.

Table 21
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.688[a]	.474	.467	12.48670

a. Predictors: (Constant), Infrastructure, Knowledge, Modelling, ICT Basics, Professional Learning, Tutor mode, ICT Complex Tools, Assessment

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	86668.202	8	10833.525	69.482	.000[b]
	Residual	96357.061	618	155.918		
	Total	183025.263	626			

a. Dependent Variable: Pedagogical practices
b. Predictors: (Constant), Infrast, Knowledge, Modeling, ICT Basics, Professional Learning, Tutor, Complex ICT, Assessment

Regression Coefficients for all variables combined

Model	Unstandardized Coefficients	Standardized Coefficients	T	Sig.

	B	Std. Error	Beta		
(Constant)	-12.384	2.605		-4.755	.000
ICT Basic Tools	.214	.116	.077	1.850	.065
ICT Complex Tools	.418	.167	.118	2.493	.013
Professional Learning	.210	.209	.041	1.004	.316
Assessment ICT skills	.562	.158	.173	3.550	.000
ICT Knowledge	.172	.048	.154	3.580	.000
Tutor's Mode	.231	.095	.104	2.432	.015
Modelling Rate	.348	.241	.050	1.441	.150
Infrastructure	.661	.104	.218	6.343	.000

a. Dependent Variable: ICT Integration in Pedagogical Practices

Note: The model is significant where $\rho = .000$ hence $\rho < .01$ (2-tailed)

The regression model was found to be significant ($\rho < .01$) with the combination of ICT competencies, ICT infrastructure and Tutor's mode of instruction predicted Integration of ICT in pedagogical practices of teacher trainees. Therefore, the alternative hypothesis which stated that there is a significant moderation effect of quality of ICT infrastructure and tutors' mode of instruction on the relationship between teacher trainees' ICT competencies and ICT integration in their pedagogical practices is retained. The model summary table gives the Adjusted R square (.467), thus this model is predicting 46.7% of the variance in pedagogical practices. According to Cohen (1988), this is a large effect.

The current findings are in line with those of Afutor (2020) in Ghana, who found that ICT infrastructure, ICT skills and other factors predict technological integration at 70.9%. Lau and Yuen (2014) have confirmed that ICT infrastructure and teacher ICT skills are closely linked to the successful implementation and integration of ICT in schools. Also, Baharuldin et al. (2019) concludes that Teacher's readiness to integrate

ICT in the classroom acts as a fully mediator through the use of teacher ICT infrastructure. Tutors are role models in training students to become teachers, so it is important to assess their level of ICT implementation in college courses (Avidov-Ungar & Iluz, 2014). The low or negative use of ICT by tutors has the potential to reduce students's motivation (Makura, 2014), hence tutor's mode of instruction becomes significant in the teacher training process. Tutors who initiate a process that focuses on learning and teaching are able to perform well and incorporate technology into their teaching (Ertmer & Ottenbreit-Leftwich, 2010). Numerous studies have shown that although tutors are aware of the potential benefits of teaching incorporating ICT into teaching, many of them still integrates ICT in traditional manner and practice, without bringing about fundamental changes in teaching and learning patterns (Bransford et al., 2000). Tondeur et al.(2013) reported that pre-service teachers often feel inadequate to use ICTs in teaching and learning. Tutors in training colleges are often reluctant to accept new technologies in teaching due to a lack of appropriate software and materials and a lack of hardware (Goktas et al., 2009) and this affects their instruction methods and also affects teacher trainees' acquisition of ICT competencies for their pedagogical practices. Studies report various barriers and difficulties encountered in teaching technology related to their beliefs and ideas, time management and resources, and a supporting technical and educational framework (Brzycki & Dudt, 2005; Goktas et al., 2009; Gomez et al., 2008; Maltz & DeBlois, 2005; Moser, 2007). All these findings support the assertion that ICT infrastructure and tutor's mode of instruction moderate the relationship between Teacher trainees' ICT competencies and their pedagogical practices.

To determine how much moderators contributed to the model, a regression analysis excluding the moderators was run. The results are displayed in Table 22.

Table 22

Regression Coefficients[a] without moderators

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Adj.R^2
	B	Std. Error	Beta			
(Constant)	-1.097	2.301		-.477	.634	.413
Basic ICT Tools	.265	.121	.095	2.191	.029	
ICT Complex Tools	.521	.174	.147	2.992	.003	
Professional Learning	.384	.217	.075	1.767	.078	
Assessment ICT	.705	.164	.217	4.296	.000	
ICT Knowledge	.293	.041	.262	7.129	.000	

a. Dependent Variable: Pedagogical Practices

The regression model was statistically significant ($\rho < .01$) with ICT complex tools, Assessment ICT and ICT knowledge, whereas Basic ICT tools and professional learning skills were insignificant. The Adjusted R square value was .413. This indicates that 41.3% of the variance in pedagogical practices was explained by the model. Therefore, the null hypothesis that stated that there is no statistically significant moderating effect of quality of ICT infrastructure and tutors' mode of instruction on the relationship between PTE preparation of trainees for ICT integration and Integration of ICT in their pedagogical practices is rejected. To get the effect of moderators, the Adjusted R square value for independent variables was subtracted from the moderators and independent variables combined (46.7% - 41.3%) giving 5.4% variance in pedagogical practices explained by the model. This implies that moderators; ICT infrastructure and tutor's mode of instruction contribute 5.4% of the variance in teacher trainees' ICT competencies for pedagogical practices of primary teacher trainees in Uganda (see output data Appendix I).

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the summary of findings, conclusions and recommendations based on the findings from the study and suggestions for the further study. It was guided by the following objectives:

1. To assess PTE trainees' ICT competences for ICT Integration in their pedagogical practices;
2. To explore the quality of ICT Infrastructure in PTE for trainees' preparation in ICT integration in their pedagogical practices;
3. To determine instructional modes used by tutors in preparation of PTE trainees for ICT integration in their pedagogical practices;
4. To establish the relationship between PTE trainees' preparation for ICT integration and integration of ICT in their pedagogical practices in Uganda;
5. To determine the moderating effect of ICT infrastructure in PTE and tutors' instructional modes on the relationship between PTE trainees' preparation for ICT integration and integration of ICT in their pedagogical practices.

5.1 Summary of the Study Findings

1) Concerning the level of PTE trainees' ICT competencies for ICT integration in pedagogical practices, primary teacher trainees' ICT competencies have been reported as generally low; slightly below average in terms of basic ICT skills with the grand mean of 2.22, complex ICT skills with the grand mean of 2.51, ICT skills for professional learning with the grand mean of 2.49, ICT skills on

curriculum and assessment with grand mean of 2.45, but slightly above average in terms of ICT knowledge with the mean of 3.49.

2) Findings further show that tutors are slightly above average in appropriately modeling combining content, technologies and teaching approaches with the grand mean of 3.51. However, only Mathematics education, science education, professional education and instructional technology tutors model above average compared to other subjects.
3) Both qualitative and quantitative findings indicate that all colleges have computers but with limited internet bandwidth and restricted access. Most teacher trainees have mobile phones access and televisions. However, other ICT infrastructures are still lacking.
4) PTE trainees' preparation for Integration of ICT in their pedagogical practices is still slightly below average with the grand mean of 2.69.
5) Findings have shown that there is a statistical significant relationship between PTE Trainees' preparation for ICT integration and integration of ICT in their pedagogical practices in Uganda, with all variables significant ($\rho < .01$). Findings have also shown that, primary teacher trainees ICT competencies, ICT infrastructure and tutor's mode of instruction predict the integration of ICT in pedagogical practices of teacher trainees by 46.7%.

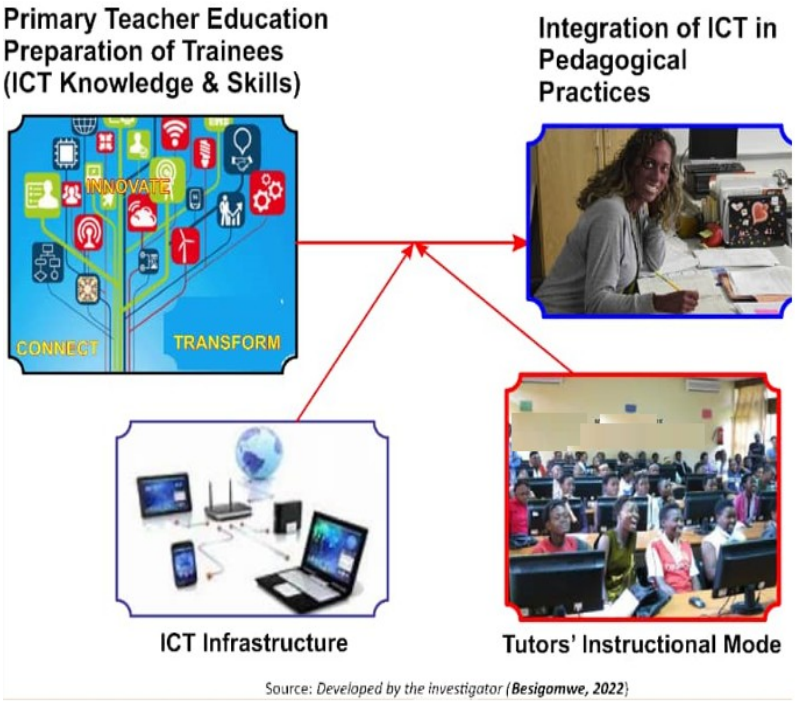
5.2 A New Model established

After running correlations and regression of PTE trainees' ICT competencies, Infrastructure and tutors' mode of instruction against teacher trainees' Integration of ICT in pedagogical practices, a new model has been established. This model has been called ICT Competencies Model for ICT integration in Pedagogical Practices, to

guide the rejuvenation of ICT competencies among primary teacher trainees in Uganda as shown in Figure 13.

Figure 13

A new ICT Competencies Model for ICT Integration in Pedagogical Practices



Source: *Developed by the investigator* (***Besigomwe, 2022***)

From Figure 13, it has been suggested that, in order for trainees to become proficient in ICT skills for teaching in the 21st century, they need exposure to technology and practical training. This is in line with Larrosa (2010) who argued that the integration of ICT into education seems to strengthen that teaching phase, making this technology particularly relevant to the 21st century teacher profile. Trainee teachers need to be well-prepared if they are to use ICT effectively in their teaching work. Their tutors/lecturers should integrate ICTs into the content and teaching methods of training teachers.

In Uganda's teacher education institutions, the knowledge and skills that teachers impart to trainees are what enable them to become qualified teachers. This is followed

by two-times trainees' school practice to assess the knowledge and skills the trainees have acquired during the course. Also, how these tutors/lecturers model ICTs in their teaching determine the ICT knowledge and skills that teacher trainees will acquire during training. Valencia-Molina et al. (2016) also suggest that the successful integration of ICT into teaching activities requires clarification of educational objectives; indicators of achievement; structure of teaching practices (instructions and procedures); testing methods; content features; motor and psychological needs of students to meet academic goals; and the relevant ICTs (Infrastructure) features to achieve those goals.

5.3 Conclusions

The study sought to establish PTE trainees' ICT competencies for ICT integration in their pedagogical practices in Uganda. The findings revealed that PTE trainees' ICT competencies for ICT integration in their pedagogical practices are low. Also, there is a statistical significant relationship between PTE trainees' ICT competencies and ICT Integration in their pedagogical practices moderated by tutors' instructional mode and ICT infrastructure. The conclusions made were based on UNESCO ICT Competency Framework for Teachers and TPACK model requirements. Specifically, the following conclusions have been made:

1) Though PTE trainees in Uganda have low ICT skills, they have slightly above average ICT knowledge for integration of ICT in their pedagogical practices. This is probably because most colleges have restricted access to computers, tutors not modeling and other factors. Therefore, there is still a need for 21st Century teacher trainees to acquire comprehensive ICT knowledge and skills that will guide the use and application of ICT tools in their profession.

2) Despite the perceived level of tutors' mode of instruction being slightly above average, it has not been helpful to the teacher trainees to acquire the ICT competencies. And tutors' modeling combining content, technologies and teaching approaches in their teaching seems not sufficient.
3) Regarding ICT infrastructures, most of the primary teacher trainees' colleges have free access to ICT laboratory, mobile phones and other equipment but they have no required skills of applying these gadgets in their pedagogical practices. Also the applications on these devices have not been explored for use by these primary teacher trainees in Uganda.
4) The findings have shown a positive statistical significant relationship between PTE trainees' ICT competencies and ICT integration in their pedagogical practices implying that if teacher trainees' ICT competencies increase even the pedagogical practices will improve.
5) The regression analysis results have indicated that primary teacher ICT competencies, tutors' mode of instruction and ICT infrastructure predict teacher trainees' pedagogical practices. This means that for primary teacher education trainees to be fully competent in their pedagogical practices, tutors must model to them or impart ICT skills and knowledge to them and also ICT infrastructure must be available as resources.

5.4 Recommendations

Based on the findings and conclusions of this study, the following recommendations are made:

(i) To improve PTE trainees' ICT competencies which have been found low, the Ministry of Education and Sports in the new national teacher policy should make ICT in education a compulsory course unit for all levels of teacher

education if they want teacher trainees to graduate with ICT competencies. They should emphasize both the theory and practical application.

(ii) For limited infrastructure, the government of Uganda through Ministry of Education and Sports should provide adequate and efficient computers and internet to teacher training colleges in the country, if they are to produce ICT competent teachers.

(iii) To solve the problem of low modeling of ICT by tutors, specialists in educational technology should be employed in all teacher training institutions because they can better plan and direct the proper use of technology in teaching and learning, rather than hiring non-teaching specialists to train teachers. Also, professional development of tutors in fields of ICT should be supported and fully funded.

(iv) On pedagogical practices (lesson planning and resource development), school practice management should also emphasize the role of the use of ICT by student teachers / teacher trainees in their planning and teaching.

(v) Teacher education institutions should be guided by the UNESCO ICT Competency Framework for teachers and the TPACK model, as these models propose a set of skills and knowledge aimed at preparing pre-service teachers to become ICT users to help students and themselves, to benefit from technology. Also, the new ICT competencies model which has originated from this study should be utilized, to guide the planning of ICT for pedagogy.

5.5 Suggestions for Further studies

There are issues that have not been resolved and discussed in this one study. Therefore, the following suggestions are made for further studies:

(i) An experimental study is recommended on both tutor's modes of Instruction and teacher trainees application of ICT in their pedagogical practices for more insights on low ICT competencies of teacher trainees.

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APPENDICES

Appendix A: Questionnaire

TEACHER TRAINEES' ICT COMPETENCIES QUESTIONNAIRE 497

Dear Teacher Trainee,

I am carrying out research on Teacher Trainees' ICT Competencies for Pedagogical Practices in Uganda. This questionnaire is intended to get your opinion. It is on this background that you have been randomly selected to participate in this research. It would thus be helpful if you assist by answering the questions as per the instructions at the beginning of each section. You should provide the most appropriate answer in your opinion. There is no wrong or right answer. Your responses are for academic purposes. Thank you. Yours sincerely,

Felix Besigomwe

SECTION A: Demographic Data
Please tick (✓) your answer in the space provided.

1. Gender: □Male □Female
2. In which age group do you belong?
    1. Between 18-20
    2. Between 21-23
    3. Between 24-26
    4. Between 27-29
    5. 30 years and above
3. Your college location
    1. Western region
    2. Eastern region
    3. Souwestern region
    4. Northern region
    5. Central region

SECTION B: TECHNOLOGY LITERACY SKILLS

ICTs: BASIC TOOLS

Scale: 1: Not at all 2: A little 3: Medium 4: Large

SN	Item	1	2	3	4
1	To what extent can you use a word processor?	1	2	3	4
2	To what extent can you use presentation software?	1	2	3	4
3	To what extent can you use a web browser?	1	2	3	4
4	To what extent can you use an email address?	1	2	3	4
5	To what extent can you use a search engine?	1	2	3	4
6	To what extent can you use a courseware?	1	2	3	4
7	To what extent can you use open educational resources?	1	2	3	4
8	To what extent do you use the computer to record grades, maintain pupil's records, or to take pupil's attendance?	1	2	3	4

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KNOWLEDGE DEEPENING

ICTs: COMPLEX TOOLS

Scale 1: Not at all 2: A little 3: Medium 4: Large

SN	Item	Response			
1	To what extent can you use authoring environments to produce learning materials for your pupilss?	1	2	3	4
2	To what extent can you use authoring environments to produce online material for your pupils?	1	2	3	4
3	Can you use a platform to manage, monitor, or assess the progress of your pupils?	1	2	3	4
4	Can you use social networks to interact with your pupils and /or colleagues?	1	2	3	4
5	To what extent can you use open educational resources?	1	2	3	4
6	Can you use ICTs to collaborate with other schools?	1	2	3	4

TEACHER PROFESSIONAL LEARNING: MANAGE AND GUIDE

Scale 1: Not at all 2: A little 3: Medium 4: Large

SN	Item	Response			
1	Can you share digital resources with your colleagues?	1	2	3	4
2	Can you collaborate with outside experts?				
3	Are you a member of a teacher's virtual community of practice?				
4	To what extent do you use the internet for your professional learning?				

KNOWLEDGE CREATION

CURRICULUM AND ASSESSMENT: KNOWLEDGE SOCIETY SKILLS

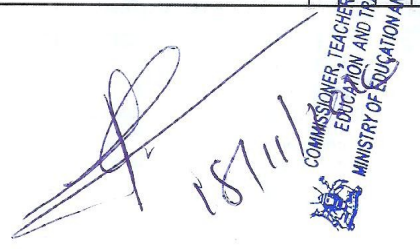
SN	Item	Response			
1	Can you intentionally use ICTs to improve pupils' communication skills?	1	2	3	4
2	Can you intentionally use ICTs to help pupils find ideas and information?	1	2	3	4
3	Can you intentionally use ICTs to help pupils to collaborate?	1	2	3	4
4	Can you intentionally use ICTs to help pupils share knowledge?	1	2	3	4
5	Can you help pupils acquire information problem-solving skills?	1	2	3	4
6	Do you use web 2.0 to assess higher order skills (creativity, problem-solving, etc.)?	1	2	3	4

SECTION C: ICT KNOWLEDGE

Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Neither Agree or Disagree"

SCALE: 1 = Strongly Disagree 2 = Disagree 3= Neither Agree nor Disagree 4 = Agree 5 = Strongly Agree

TCK (Technological Content Knowledge)					
1. I know about technologies that can use for understanding and doing mathematics	1	2	3	4	5
2. I know about technologies that I can use for understanding and doing literacy	1	2	3	4	5
3. I know about technologies that I can use for understanding and doing science	1	2	3	4	5
4. I know about technologies that I can use for understanding and doing social studies	1	2	3	4	5
TPK (Technological Pedagogical Knowledge)					
5. I can choose technologies that enhance the teaching approaches for a lesson	1	2	3	4	5
6. I can choose technologies that enhance student's learning for a lesson	1	2	3	4	5
7. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom	1	2	3	4	5
8. I am thinking critically about how to use technology in my classroom	1	2	3	4	5
9. I can adapt the use of the technologies that I am learning about to different teaching activities	1	2	3	4	5
10. I can select technologies to use in my classroom that enhance what I teach , how I teach and what students learn	1	2	3	4	5
11. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom	1	2	3	4	5
12. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.	1	2	3	4	5
13. I can choose technologies that enhance the content for a lesson	1	2	3	4	5
TPACK (Technology Pedagogy and Content Knowledge)					
14. I can teach lessons that appropriately combine mathematics, technologies and teaching approaches	1	2	3	4	5
15. I can teach lessons that appropriately combine literacy, technologies and teaching approaches	1	2	3	4	5
16. I can teach lessons that appropriately combine science, technologies and teaching approaches	1	2	3	4	5
17. I can teach lessons that appropriately combine social studies, technologies and teaching approaches	1	2	3	4	5
SECTION D: Models of TPACK (Tutor's mode of Instruction)					
1) My mathematics education tutors appropriately model combining content, technologies and teaching approaches in their teaching	1	2	3	4	5
2) My literacy education tutors appropriately model combining content, technologies and teaching approaches in their teaching	1	2	3	4	5
3) My science education tutors appropriately model combining content, technologies and teaching approaches in their teaching	1	2	3	4	5
4) My social studies education tutors appropriately model combining content, technologies and teaching approaches in their teaching	1	2	3	4	5
5) My instructional technology tutors appropriately model combining content, technologies and teaching approaches in their teaching	1	2	3	4	5
6) My professional education studies tutors appropriately model combining content, technologies and teaching approaches in their teaching	1	2	3	4	5
7) My tutors outside of education appropriately model combining content, technologies and teaching approaches in their teaching	1	2	3	4	5
8) My tutors appropriately model combining content, technologies and teaching approaches in their teaching	1	2	3	4	5



Appendix B: ICT Infrastructure Observation Schedule

ICT INFRASTRUCTURE IN PRIMARY TEACHER TRAINING COLLEGES IN UGANDA

College Code ☐

No	Infrastructure	Availability		Status
		Yes	No	Description
1.	College Computers' Lab			
2.	Personal Computers			
3.	WiFi campus/Internet access			
4.	Projection system			
5.	Digital library			
6.	Cloud-based E-learning Initiative			
7.	Audio equipment(including software)			
8.	Radio			
9.	Digital Photo Camera			
10.	Printer accessible by students			
11.	College Television			
12.	Graphics Softwares installed			
13.	students email access			
14.	College website or social platform			
15.	Networked photocopiers/Multi-Function Devices(MFDs)			
16.	Desktop conferencing applications (skype, zoom, iChat, etc.			
17.	Educational video streaming service (e.g. Youtube, etc.)			
18.	Student Management system (SMS)			
19.	Smartphones			
20.	Software packages used for student emails(outlook, gmail, proxy)			
21.	Blogs			
22.	Online assessment tools			

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18/11/2020

MOI UNIVERSITY
Office of the Dean School of Education
Tel: (053) 43001-8
(053) 43555
Fax: (053) 43555
P.O. Box 3900
Eldoret, Kenya

An ISO 9001: 2015 CERTIFIED INSTITUTION

REF: EDU/D.Phil.CM/1006/18 DATE: 3rd November, 2020

fxbshepherd@excite.com

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

RE: FELIX BESIGOMME ~ EDU/D.Phil.PGCM/1006/18

This is to confirm that the above mentioned is a bonafide Second year student undertaking a Doctor of Philosophy (PhD) Degree Programme in **(Educational Communication & Technology)** in the Department of Curriculum, Instruction & Technology, School of Education.

He has completed his course work and his PhD thesis titled **"Primary Teacher Trainees Information & Communication Technology Competencies for Pedagogical Practices in Uganda."**

Any assistance accorded to him will be highly appreciated.

Thank you.

05.11.2020

PROF. J. K. CHANG'ACH
DEAN, SCHOOL OF EDUCATION

COMMISSIONER, TEACHER, INSTRUCTOR EDUCATION AND TRAINING
MINISTRY OF EDUCATION AND SPORTS

Appendix D: Research Permit

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Application for Research Permit

Felix BESIGOMWE

Moi University
P.O Box 3900-30100
Eldoret, Kenya
18th November 2020

The Commissioner
Ministry of Education and Sports
Department of TIET
P.O Box 7063
Kampala, Uganda.

Dear sir/madam,

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I humbly submit my request to your office for the above subject.

I am a PhD Student in the College of Education, Moi University pursuing PhD in Educational and Communication Technology. I would like to conduct a field research titled: "***Primary Teacher Trainees' ICT Competencies for Pedagogical Practices in Uganda***". The study will contribute to the body of knowledge regarding the Integration of ICT in classrooms and also, concerning the importance of teachers' ICT knowledge and skills for educational purposes.

I am hereby seeking your consent to conduct this research in your Teacher Training Colleges. To assist you in reaching a decision, I have attached to this letter:

(a) A copy of recommendation issued by the University
(b) A copy of the research instruments which I intend to use in my research.

Should you require any further information, please do not hesitate to contact me on: *felix.besigomwe@chuss.mak.ac.ug* + *256783317548*

Your permission to conduct this study will be greatly appreciated.

Yours sincerely,

Felix Besigomwe

Cleared for the research

18/11/2020

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Appendix E: Consent form

2020/2021

PRIMARY TEACHER TRAINEES' ICT COMPTENCIES

Dear Teacher Trainee,

You have been selected to participate in this current research study about Primary Teacher Trainees' ICT Competencies for pedagogical practices in Uganda. This study is being conducted by Felix Besigomwe, a doctoral student, from the school of education at Moi University, Kenya. The study is being conducted as part of graduate student thesis. The questionnaire is intended to get your opinion.

There are no known risks if you decide to participate in this research study. There are no costs to you for participating in the study. The information you provide will be used for academic purposes only. The questionnaire will take about 10 minutes to complete. This survey is anonymous. Do not write your name on the survey. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study. Should the data be published, no individual information will be disclosed.

Your participation in this study is voluntary. By completing this consent form, you are voluntarily agreeing to participate. You are free to decline to answer any particular question you do not wish to answer for any reason.

If you have any questions about the study, please contact; Felix Besigomwe (+256783317548, fxbshepherd@excite.com or supervisor Prof. Nabwire Opata, Department of Curriculum Instruction and Educational Media, Moi University P.O. Box 3900 – 30100 Eldoret, Kenya

The Ministry of Education and Sports, Department of Teacher/Tutor, Instructor Education and Training (TIET) has reviewed my request to conduct this study. If you have any concerns about your rights in this study, please contact The Commissioner, Ministry of Education and Sports, Department of TIET P.o Box 7063 Kampala, Uganda Tel: 0417 893 600

Name_____Sign_____Date_____
____

Appendix F

A map of Uganda showing location of teacher training Colleges

Districts where colleges are located in all regions of Uganda

Appendix G

Plagiarism Report

SR158

THESIS WRITING COURSE

PLAGIARISM AWARENESS CERTIFICATE

This certificate is awarded to

FELEX BESIGOMWE

EDU/D.PHIL.CM/1006/18

In recognition for passing the University's plagiarism

Awareness test with a similarity index of 07% and

Striving to maintain academic integrity.

Awarded by:

Prof. Anne Syomwene Kisilu , CERM-ESA Project Leader

27th /02/2023

Appendix H

Primary Teacher's Colleges in Uganda

Name of College	**Location/ Region**	**District**
Kisoro PTC	South Western	Kisoro
Kabale-Bukinda PTC	South Western	Kabale
Kiyoora PTC	South Western	Ntungamo
Bishop Stuart PTC, Kibingo	South Western	Mbarara
Buhungiro PTC	South Western	Isingiro
Ibanda PTC	South Western	Ibanda
Bushenyi PTC	South Western	Bushenyi
Rukungiri PTC	SouthWestern	Rukungiri
Bulera PTC	Western	Hoima
Bundibugyo PTC	Western	Bundibugyo
Bwera PTC	Western	Bwera
Canon Apolo PTC	Western	Fort Portal
Kamurasi PTC	Western	Masindi
St.Augustine PTC, Butiiti	Western	Kyenjojo
Kibuli PTC	Central	Kampala
Busubizi PTC	Central	Mityana
Kabukunge PTC	Central	Masaka
Kabulasoke	Central	Gomba
Ndegeya PTC	Central	Masaka
Nakaseke PTC	Central	Nakaseke
Rakai PTC Bikira	Central	Rakai
Shimoni PTC	Central	Wakiso
Sancta Maria PTC Nkokonjeru	Central	Buikwe
Bishop Willis PTC	Eastern	Iganga
Busikho PTC	Eastern	Busia
Jinja PTC Wanyange	Eastern	Jinja
Kabwangasi PTC	Eastern	Butebo
Kaliro PTC	Eastern	Kaliro
St.Mary's PTC Bukedea	Eastern	Bukedea
St.Aloysius PTC Ngora	Eastern	Ngora
Mukuju PTC	Eastern	Tororo
St.Johnbosco PTC Nyondo	Eastern	Mbale

Soroti PTC	Eastern	Soroti
Moroto PTC	Eastern	Moroto
Kotido PTC	Eastern	Kotido
Kapchorwa PTC	Eastern	Kapchorwa
Arua PTC	Northern	Arua
Canon Lawrence PTC	Northern	Lira
Boroboro		
Christ The King PTC	Northern	Gulu
Gulu		
Gulu PTC	Northen	Gulu
Kitgum PTC	Northern	Kitgum
Loro PTC	Northen	Oyam
Moyo-Erepi PTC	Northern	Moyo
Paidha PTC	Northern	Zombo
St.Johnbosco PTC	Northern	Yumbe
Lodonga		
		Total

Source: MoE&S (2020)

Appendix I

Regression output

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.646[a]	.418	.413	13.10154	.418	89.054	5	621	.000
2	.663[b]	.439	.433	12.87630	.022	11.958	2	619	.000
3	.688[c]	.474	.467	12.48670	.034	40.230	1	618	.000

a. Predictors: (Constant), TotKnowledge, TotBasicTool, TotProfLearning, TotComplexTool, TotAssessment

b. Predictors: (Constant), TotKnowledge, TotBasicTool, TotProfLearning, TotComplexTool, TotAssessment, TotModelingRate, TotTutorMode

c. Predictors: (Constant), TotKnowledge, TotBasicTool, TotProfLearning, TotComplexTool, TotAssessment, TotModelingRate, TotTutorMode, TotInfrastructure

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	76430.418	5	15286.084	89.054	.000[b]
	Residual	106594.845	621	171.650		
	Total	183025.263	626			
2	Regression	80395.671	7	11485.096	69.271	.000[c]
	Residual	102629.593	619	165.799		
	Total	183025.263	626			
3	Regression	86668.202	8	10833.525	69.482	.000[d]
	Residual	96357.061	618	155.918		
	Total	183025.263	626			

a. Dependent Variable: TotPedagogy

b. Predictors: (Constant), TotKnowledge, TotBasicTool, TotProfLearning, TotComplexTool, TotAssessment

c. Predictors: (Constant), TotKnowledge, TotBasicTool, TotProfLearning,