SELINUS UNIVERSITY
OF SCIENCES AND LITERATURE

# THE INCORPORATION OF ICT AND GENDER IN THE TEACHING OF PHYSICS EDUCATION IN TEACHER TRAINING INSTITUTIONS IN EASTERN UGANDA

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## DECLARATION

This is to certify that this research titled **"The incorporation of ICT and Gender in the Teaching of Physics Education in Teacher Training Institutions in Eastern Uganda"** is my own original work and has never been presented anywhere for examination.

# DEDICATION

This research work is dedicated to my children Wilfred, Betty, Grace, Peninah, Mary, Emmanuel, Gift, Peter, Sarah, Joseph and Rachael.

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Waninga Willy

## LIST OF ABBREVIATIONS

| Abbreviation | Full Meaning |
|---|---|
| BTVET | Business Technical Vocational and Education Training |
| BUFHSERC | Busitema University Faculty of Health Science Ethics Committee |
| CLM | Collaborative Learning Community |
| CPD | Continuous Professional Development |
| DOI | Diffusion of Innovation |
| ERC | Ethical Research Committee |
| GDD | Gender Digital Divide |
| HOD | Head of Department |
| IBL | Inquiry Based Learning |
| ICC | International Communications Commission |
| ICT | Information Communication Technology |
| ISC | International Science Council |
| IT | Information Technology |
| ITU | International Technology Union |
| LDC | Low Developed Country |
| MOES | Ministry of Education and Sports |
| NTC | National Teachers College |
| NTC | National Teachers' Council |

| | |
|---|---|
| **NTP** | **National Teacher Policy** |
| **PBL** | **Project Based Learning** |
| **PTC** | **Primary Teachers' College** |
| **SDG** | **Sustainable Development Goal** |
| **SESEMAT** | **Secondary Science and Mathematics Teachers** |
| **SRL** | **Self Regulated Learning** |
| **STEM** | **Science Technology Engineering and Mathematics** |
| **TCK** | **Technological Content Knowledge** |
| **TISSA** | **Teacher Institute for Sub-Saharan Africa** |
| **TK** | **Technological Knowledge** |
| **TPCK** | **Technological Pedagogical Content Knowledge** |
| **TTI** | **Teacher Training Institutions** |
| **UNCST** | **Uganda National Council of Science and Technology** |
| **UNEB** | **Uganda National Examination Board** |
| **UNESCO** | **United Nations Education Scientific  Cultural Organization** |
| **UNITE** | **Uganda National Institute of Teacher Education** |
| **WB** | **World Bank** |
| **WHO** | **World Health Organization** |
| **ZPD** | **Zone of Proximal Development** |

# ABSTRACT

This research investigated the incorporation of ICT and gender in the teaching of physics education in Teacher Training Institutions (TTIs) in Eastern Uganda. The study aimed at assessing physics lecturers' ICT competence levels, identifying ICT applications used in teaching, examining factors impeding ICT use; evaluate ICT competences among physics student teachers, and comparing students' ability to use ICT to enhance their achievement by gender. Data was collected using a combination of interview guides, observation checklists, and document analysis sheets from a sample comprising 12 physics lecturers, 46 physics student teachers, and 12 administrators. The researcher adopted pragmatism paradigm that accommodated the use of case study and survey designs. The research employed both qualitative and quantitative methods to provide a comprehensive analysis. The findings reveal significant variation in ICT competence levels among physics lecturers, highlighting the need for comprehensive ICT training programs. A diverse range of ICT applications, including simulation software, learning management systems, and educational mobile applications, were identified as tools used by lecturers to enhance teaching. However, the study identified several barriers to effective ICT integration, including inadequate infrastructure, limited access to resources, lack of technical support, and insufficient training. Student teachers demonstrated varying levels of ICT competence, with a need for advanced training to ensure effective integration of technology into their teaching practices. Gender disparities were noted, with female students exhibiting lower confidence and proficiency in using ICT compared to their male counterparts. Based on these findings, the study recommends the implementation of mandatory ICT training for lecturers, the provision of adequate ICT resources, the development of gender-sensitive policies, and the encouragement of continuous professional development. Additionally, mentorship programs for lecturers and initiatives to promote equal access to ICT training for all students are suggested. This research contributes to the field by highlighting the critical role of ICT in enhancing physics education and promoting gender equity in TTIs. It offers practical recommendations for improving ICT use in educational practices, aiming to create more inclusive and effective learning environments that leverage technology to support student engagement and academic success in physics education.

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# CHAPTER ONE
# INTRODUCTION

## 1.0 Introduction

In Eastern Uganda's Teacher Training Institutions, the convergence of Information Communication Technology and gender considerations profoundly shapes Science Education. This chapter introduces the research's objectives, which aim to dissect the intricate relationship between Information Communication Technology (ICT) integration and gender-responsive pedagogy in teaching physics. Firstly, the study scrutinizes physics lecturers' ICT competence levels, focusing on their technological proficiency. Secondly, it delves into the array of ICT applications utilized by lecturers in Physics Education, considering gender-responsive approaches. Additionally, the research identifies impediments to seamless ICT integration and explores gender disparities in ICT competences among student teachers. Finally, the study examines how ICT usage impacts academic achievement in physics, differentiated by gender. Through this investigation, the research seeks to inform interventions and policies promoting inclusive and equitable physics education in Eastern Ugandan Teacher Training Institutions (TTIs). This chapter comprised of background, statement of the problem, purpose of the study, objectives of the study, research questions significance, scope and definition of terms about the study**.**

## 1.1 Background of the Study

Costa et al (2020) notes that areas of Science, Technology, Engineering and Mathematics (STEM) are fundamental for the future of work based on technological advancements. They are crucial for the development of countries through the boosting economic growth which acts as a way of reducing poverty (Kiconco & Karyarugokwo, 2022). As a result, governments and industry leaders have taken physics as the gate way to careers in Science ,Technology, Engineering and Mathematics (STEM), which are critical for the future prosperity and economic competitiveness of countries (Maera,2016). This means that efforts should be in place to ensure that quality education is provided at all levels of the education system. Bogere et al (2013) noted that quality education is highly dependent on how well the students are taught and how much they learn. (Irwin (1967) quoted by Kiconco (2022)describes quality education as the maximization of the school's system performance and ability to prepare students for adult roles as citizens ,train them to fill appropriate adult roles and develop personality especially interpersonal skills and remove the recipients from an unemployment status. Uganda has focused on the science led strategy to promote growth and development. A number of policies have been adopted for this achievement such as science promotion policy. Since 2005, sciences like Mathematics, Chemistry, Biology and Physics have been compulsory at Ordinary level where all students enroll and learn them.

Physics is that part of science that deals with the interaction of matter in relation to energy. It is the acquisition of knowledge on our physical environment and creation of a worldwide view which provides framework for understanding the significance of this information (Maera, 2016). Physics Education is the adequate mastery of scientific concepts, skills and provision of an orientation on the use of scientific knowledge in different societal sectors and types of further education.

For decades, Uganda has been advised by global social economic agencies to invest in science education and scientific innovations necessary to acquire lasting and sustainable national social and economic developments (Uganda-UNESCO, 2010, Wedgwood, 2005). With support from the Belgian Development Cooperation and the World Bank (WB), Uganda in 2011 designed a new strategy for Secondary Education and Business Technical Vocational Education and Training (BTVET) under the theme skilling Uganda. This was intended to raise the standards and expand coverage of training to create employable skills and competences relevant to the labor market. Additionally, it also aimed at reducing failure rates among students in science subjects which has continued persisting (Kiconco, 2022). The government also launched a new project for Secondary Science and Mathematics Teachers (SESEMAT) in secondary schools and colleges (Markon, 2013).

Bakimedeedeniya (2024) takes teaching as a multifaceted and dynamic process involving the deliberate and systematic transfer of knowledge, skills, and information from a knowledgeable individual, known as the teacher or educator, to a receptive individual, referred to as the learner or student. Oxford (2021) defines teaching as an engagement with learners to enable their understanding and application of knowledge, concepts and processes. It encompasses lesson design, content selection, delivery, assessment and reflection on the given topic (Roland et al 1991). Related to the above, Learning is defined as a comprehensive process that does not only involve the acquisition of knowledge but also the development of skills, the ability to apply knowledge in various contexts, and the adaptive modification of behavior. This means that for learning to occur there is need to have good teaching (Bakimedeedeniya , 2024). This study intends to focus the analysis on how physics lecturers teach or help student teachers to construct their knowledge with the use of ICT.

Heng and Jing(2012) defines ICT as a diverse set of technological tools and resources used to communicate, create, disseminate, store and manage information. Narinderrit(2020) encourages teachers to be conversant with ICT tools as they transform teaching and learning in different forms. Abigail et al (2020) stressed that teachers need to possess requisite technological competence so as to teach effectively in this digital platform. Ellermeijer & Tran (2019) stress that ICTs should be integrated in the teaching of physics because of its ability to simplify abstract content, creates interest and improves learning outcomes. This can be seen in the teacher's Technological Knowledge (TK), Technological Content Knowledge (TCK) and Technological Pedagogical Content Knowledge.(TPCK) In the same reference, it was also put ICTs can make physics education less difficult, more applicable and can increase opportunities for own investigation. This therefore calls for the lecturers and students to develop a positive interest on the use of ICT so that it can be used to reduce gender disparities in physics.

Teacher Training Institutions (TTIs) in higher education are judged with the responsibility of producing the 21st century teachers who are needed to enhance these as in science and technology. Yucel & Kocak(2010) high light that in this century now, Technological competence is a skill that should be possessed by all teachers as it is how part of their professional competence (Kubrickya & Castkova, 2015). The implementation of science education reforms in Uganda is mostly left to classroom science teachers who products of varying schools of education and their faculties. This means that the professional effectiveness in handling assigned reform tasks depends on how effective the teachers were **(**UNESCO, 2011).This is an indication that successful enactment of proposed science education reforms hinges on the knowledge and competences posses by science teacher educators who are either lecturers or tutors in higher education institutions. This means that an understanding on the quality of knowledge, skills and professional practices of science teacher educators is vital in predicting the success of science reforms.

According to Dujanga, Saphina & Akoba(2019), the government of Uganda has promoted the teaching of physics under Universal Secondary Education (USE) through compulsory taking of all sciences (physics) inclusive and giving women additional 1.5 points to compete favourably for admission to Universities and other Tertiary Institutions. Nevertheless, women's participation at school and employment is very low (Onsongo, 2009). Majority of the students who take it end up performing poorly at all levels of education system (Adyemo, 2010). The trend of enrolment and performance of secondary school students in physics is threatening and frightening (Akambi, 2003). Bello (2002) in his study found out that one of the characteristics of gender difference was female under representation and under achievement in physics. This brings many questions as to why this is the case. According to International Science Council (ISC) (2021) the under representation of female members in academics is greater in engineering sciences by 10% & mathematics by 8%.

The 5$^{th}$ SDG aims at achieving gender equality and empowering all women and girls. It calls for enhanced use of enabling technology (Guterres, 2019) to narrow the gender gap. Gender refers to the characteristics of women, men, girls and boys that are socially constructed. These could be roles and behaviors associated with being a man, girl, boy, woman as well as relationship with each other (WHO, 2022). According to Plan International (2022), the Gender Digital Divide (GDD) which is the difference between men and women with access to technology and internet stands at 32.9%.this implies that a lot should be done to promote ICT use by women. For example International Technology Union (ITU) 2022 reveals that only 19% of women in Low Developed Countries (LDCs) used the internet in 2020 as compared to 86% in Developed Countries (DCs) in 2019. Additionally, UNESCO (2017) acknowledges that women represent 30% of the STEM student body in Higher Education and 25% of the STEM labor force. This means that those who pass physics which is the gate way to STEM are few compared to men. UNESCO (2021) acknowledges that of the researchers who were scientists as of 2018, only 30% were women researchers compared to men who were 70%. This calls for engagement of girls and women in exploring socio-scientific issues. This can be promoted through social support for women and girls, such as peer networking and mentoring by more experienced STEM researchers or professionals.

Hains (2021) acknowledges that ICT changes the way students learn and teachers work. In a bid to achieve gender parity in Teacher Education and promotion of gender responsive pedagogy to promote improved access to information for teachers, the Ugandan Ministry of Education and Sports (MOES) introduced and passed the National Teacher Policy (NTP) in 2019. It was aimed at putting in place measures for supporting the integration of cross cutting issues like ICT and gender that affects the education sector. This can be achieved through the incorporation of ICT and gender into Teacher Development, Training and Management Practices (MOES, 2018). Among the duties of the NTP was the establishment of the National Institute of Teacher Education in Uganda called UNITE (Uganda National Institute of Teacher Education). UNITE would work with National Teachers' Council (NTC) to implement the Continuous Professional Development Frame Work for all teachers in Uganda (MOES, 2018).

In 2023, the Ministry of education phased out 23 Non Core PTCs and is working with 23 core Primary Teachers Colleges (PTCs) and 5 National Teachers Colleges (NTCs) in implementing the activities of the National Teachers Policy. One of the requirements of the NTP was that all teachers in Uganda should be graduates by the year 2030 (MOES, 2018). Accordingly, Primary Teachers Colleges (PTCs) were stopped from training Grade III teachers at Certificate level from 2021 intake and National Teachers' Colleges (NTCs) stopped for training the Grade V Diploma Teachers. From 2023 , all core PTCs and NTCs are now called Teacher Training Institutions (TTIs) acting as campuses of UNITE prepared for training Diploma holders who are upgrading from certificate level, Degree holders who are upgrading from Diploma level and Fresh Graduates who are going to be admitted from A 'level(MOES, 2018).

Following the recommendation of the Teacher Institution for Sub-Saharan Africa (TISSA, 2013) study, Uganda National Institute of Teacher Education (UNITE) & National Teachers' Council ( NTC) were advocated for improving the quality of Education in Uganda and Professionalization of the teaching profession. It is against this background that the researcher intended to investigate on the incorporation of ICT and Gender in the teaching of Physics Education in Teacher Training Institutions (TTIs) in Eastern Uganda. It was hoped that the use of ICT would provide opportunities for all sexes to Interact so that the technology is used in improving on students' achievement and enrolment hence elimination of gender disparity in physics achievement and enrolment (MOES, 2018).

### 1.2 Statement of the Problem

Physics is always perceived to be a difficult course stemming from its abstract nature (Mulhall &Daniel, 2019). Majority of the students who take it end up performing poorly at all levels of education system (Adyemo, 2010). The trend of enrolment and performance of secondary school students in physics is threatening and frightening (Odaga, 2020 & Akambi, 2003). Bello (2002) in his study found out that one of the characteristics of gender differences was female under representation and under achievement in physics. According to UNEB (2020), of the students (99.7%), who sat ordinary level in 2018, only 20.9% of the women went to Advanced level with only 6% taking sciences physics inclusive. Dujanga(2019) adds that the small number of female physic teachers in schools shows that female students lack models to stimulate them.

In Uganda, the enrolment of female teacher trainees who are recruited for Physics in Teacher Training Institutions is always low compared to their counter parts the male (Dujanga,2019). This makes the students to think that physics is hard and should only be taught by male teachers which continues widening the gender disparity gap. Universities promote the utilization of various ICT tools in supporting teaching and learning (Chaman &Sangay, 2016). Teacher trainers are supposed to prepare teachers to fit into society where there are developments in science and technology. This can be achieved through modeling lecturers in the use of ICT to manage the instruction , provision of equal access to students irrespective of gender and preparation of activities that challenge students to collaborate as they use ICT in learning physics concepts and skills using different applications and tools. This in the long run helps us to produce student teachers who scientifically literate, possess the 21st century skills, gender sensitive and knowledgeable

However, so as to achieve quality education in Uganda, human capital development has been promoted by the government and donors through heavy investment in STEM with emphasis to the use of ICT in teaching and learning. This is based on the practical and academic competences which are relative to students' potential(MOES, 2018).Nonetheless, little literature is available to confirm that lecturers are incorporating ICT and Gender in the teaching of physics in Teacher Training Institutions in Eastern Uganda. This study therefore intended to investigate the extent to which lecturers are incorporating ICT and Gender in the teaching of physics in TTIs in Eastern Uganda.

### 1.3 Purpose of the Study

The purpose of the study was to find out how physics lecturers are incorporating ICT and Gender in the teaching of Science (Physics) Education in TTIs in Eastern Uganda**.**

### 1.4 Objectives of the study

The conduct of this study was based on the following study objectives:-

1. To investigate physics lectures' ICT competence levels (Technological content knowledge) in TTIs in Eastern Uganda.
2. To find out ICT application or tools used by physics lecturers in teaching Physics Education in TTIs in Eastern Uganda.
3. To examine the different factors which impede the lecturer's use of ICT in the teaching of physics in TTIs in Eastern Uganda.
4. To find out ICT competences possessed by physics student teachers by gender in TTIs in Eastern Uganda
5. To compare the ability of students in using ICT to enhance their achievement in physics by gender in TTIs in Eastern Uganda

### 1.5 Research Questions

This study was guided by the following research objectives:-

1. What ICT competences are possessed by physics lecturers in TTIs in Eastern Uganda?
2. How do physics lecturers use ICT applications in promoting students' achievement in physics in TTIs in Eastern Uganda?
3. What factors impede the use of ICT in teaching physics in TTIs in Eastern Uganda?
4. Which ICT competences are possessed by student teachers in TTIs in Eastern Uganda by gender?

5. How do students use their ICT competences to enhance their achievement in physics in TTIs in Eastern Uganda?

## 1.6 Scope of the Study

### 1.6.1 Geographical Scope

The study was carried out in Three Teacher Training Institutions (TTIs) in Eastern Uganda.

### 1.6.2 Time Scope

The study was focused on experiences from 2022 to 2024. This period was selected so as to critically analyze the extent to which lecturers were Integrating ICT and Gender in teaching physics since the emergency of Covid 19.This would enable the researcher in following the trend of post Covid 19 intervention with focus to gender disparity..

### 1.6.3 Content Scope

The research study was restricted to only five research questions for guidance .The study was restricted to only three Teacher Training Institutions under UNITE in Eastern Uganda. This place was chosen because the researcher originates from the same locality which made it easy for him to access the research sites. The investigation also concentrated on physics lectures' ICT competences, ICT applications used in teaching, challenges impeding the incorporation of ICT and gender in teaching, students ICT competences and their use in enhancing their academic achievement. .

## 1.7 Significance of the Study

The findings of this study would be of value to different t stakeholders. The study may support different stakeholders engaged in policy making like education officials, politicians and donors to come up with policies that can improve teachers' skills, knowledge, interest and values in teaching physics with focus to ICT and gender. This study would enable Teacher Training Institutions (TTIs) administrators to identify the gaps in classroom instruction of their physics lecturers especially in incorporating ICT and gender in teaching physics and plan for internal CPDs. This study would help physics lecturers to reflect on their instructional practices in handling student teachers using gender friendly information and communication technologies. The findings might also help the research to improve his instructional practices in handling the teaching of physics based on research experiences. Additionally, this study might enable physics student teachers to access the necessary support given to them by lecturers after the intervention. More importantly, the findings would act as appoint of reference to other researchers in their contribution to the scientific knowledge.

**1.8 Justification of the Study**

The government of Uganda with support from Developed countries and donor agencies have heavily invested in Science Technology Mathematics and Engineering in order to embrace the science promotion policy. Efforts have been put in place to equip science teachers with skills, knowledge and values related to science teaching with the objective of improving teacher quality. Nonetheless, the performance of students at different levels is characterized with low grades and enrolment. Additionally, the there was a high gap in performance between males and females which has a great impact on the future labor force in the job market in education sector. It was therefore necessary to establish the extent to which ICT and Gender were being incorporated in the teaching of physics. This was even made easier with many relevant policies which are being implemented by the government so as to promote sustainability in development such as the ICT policy, Gender policy, science promotion policy and of recent the National Teacher Policy.

More still, the demands of the 21$^{st}$ century teachers should match with the 21$^{st}$ century skills which are needed by the teachers. This can be achieved all levels of teacher development, training and management. It is therefore necessary that the research is conducted so that refresher courses are conducted through Continuous Professional Developments (CPDs) to equip teacher educators with the 21$^{st}$ skills. Additionally, the government of the republic of Uganda, parents and other Development Partners has invested heavily in ICT Training in Teacher Training Institutions. It was therefore right to conduct this research so that analysis is made on the way they are utilizing theses funds meant for ICT initiatives.

**1.9 Definition of Terms**

| Term | Definition |
|---|---|
| **ICT** | Computer hardware, software, networks and any communication device or |

| | |
|---|---|
| | application encompassing cellular phones. |
| **ICT Competence** | ICT knowledge or skill possessed by an individual |
| **Physics** | One of the science subjects taught in secondary education and tertiary education curriculum dealing with the study of matter in relation to energy. |
| **Physics Education** | Is the study of the content and the methodology of teaching physics |
| **Teaching** | Engagement with students to enable their understanding and application of concepts, knowledge and processes. |

### 1.10 Structure of the Research Thesis

The research thesis is systematically structured into five comprehensive chapters, each focusing on critical aspects of the study, "The Incorporation of ICT and Gender in the Teaching of Physics Education in Teacher Training Institutions in Eastern Uganda."

**Chapter One: Introduction** The introductory chapter sets the stage for the research by providing an overview of the background and context of the study. It delineates the research problem, highlighting the gaps in the integration of ICT and gender considerations in physics education within Teacher Training Institutions (TTIs). The chapter also outlines the research purpose and objectives, which include investigating ICT competence levels among physics lecturers, identifying ICT applications used in teaching, examining barriers to ICT use, assessing student teachers' ICT competences, and comparing ICT usage between male and female students. Subsequent research questions, scope, significance, justification of the study, emphasizing its potential contributions to educational practices, policy formulation, and academic discourse, definition of terms, structure of the study and finally the chapter summary..

**Chapter Two: Literature Review:** This chapter presented key theories guiding the study, including Technological Pedagogical Content Knowledge (TPACK), Diffusion of Innovations (DOI), and sociocultural theory. a thorough review of existing literature relevant to the research topic. The theoretical framework is developed, helped in developing the conceptual framework that linked concepts to the research objectives and provided a solid foundation for the study. It also gave the review that synthesized previous research on ICT integration in education, gender disparities in ICT usage, and the effectiveness of various ICT applications in teaching and learning.

**Chapter Three: Methodology:** The methodology chapter details the research design and methods used to collect and analyze data. A mixed-methods approach was employed, combining qualitative and quantitative techniques to provide a comprehensive understanding of the research problem. Data collection methods included interview guides, observation checklists, and document analysis sheets, involving 12 physics lecturers, 46 students, and 12 administrators. The chapter explains the sampling procedures, data collection process, and analytical techniques, ensuring the reliability and validity of the findings.

**Chapter Four: Findings and Discussion:** This chapter presented and discussed the results of the study, organized according to the research objectives. It provides a detailed analysis of the ICT competence levels of physics lecturers, the types of ICT applications used in teaching, the factors impeding effective ICT use, the ICT competences of student teachers, and the gender differences in ICT usage and achievement. The findings were discussed in the context of the theoretical framework, linking them to TPACK, DOI, and sociocultural theories. Qualitative data from interviews and observations are complemented by quantitative data, providing a rich and nuanced understanding of the issues. Key themes and patterns are identified, offering insights into the current state of ICT integration and gender equity in physics education.

**Chapter Five: Conclusions and Recommendations:** The final chapter summarizes the key findings and draws conclusions based on the study's objectives. It emphasizes the critical need for enhanced ICT training for lecturers, improved ICT infrastructure, and targeted interventions to address gender disparities in ICT competence. The chapter provides actionable recommendations for policymakers, educators, and administrators. These include implementing mandatory ICT training programs, developing gender-sensitive policies, providing adequate resources, and promoting continuous professional development. The chapter also suggests areas for future research, such as investigating the long-term impact of ICT integration on student achievement and expanding the study to other regions. It comprised summary of the study, study findings, conclusions, recommendations, suggestions for future action and personal reflection on the study.

**Appendices and References** The thesis concludes with appendices that include the data collection instruments, detailed data tables, and other relevant materials. The references section lists all the academic sources cited throughout the thesis, demonstrating the breadth and depth of the literature reviewed and ensuring the credibility and scholarly integrity of the research. This structured approach ensures that the research is methodically presented, allowing readers to follow the progression from identifying the research problem to proposing practical solutions based on the findings.

## 1.11 Chapter Summary

This chapter serves as an introductory platform, framing the investigation into the integration of Information and Communication Technology (ICT) and gender dynamics in teaching Physics Education within Teacher Training Institutions (TTIs) in Eastern Uganda. It elucidates the indispensable role of ICT in modern education, particularly in STEM fields, vital for national development. Concurrently, it acknowledges persistent challenges such as the perceived difficulty of physics and gender disparities in enrollment and performance, necessitating innovative teaching practices and gender-responsive pedagogy. Identifying a literature gap, the chapter underscores the imperative to examine how physics lecturers integrate ICT and gender in teaching within TTIs in Eastern Uganda. The study aims to explore lecturers' ICT competences, utilization of ICT, factors impeding integration, and students' ICT competences and their impact on physics achievement. Geographical, time, and content scopes are delineated, emphasizing the study's significance in informing policy, improving instructional practices, and contributing to STEM education knowledge.

## CHAPTER TWO
## LITERATURE REVIEW

### 2.0 Introduction

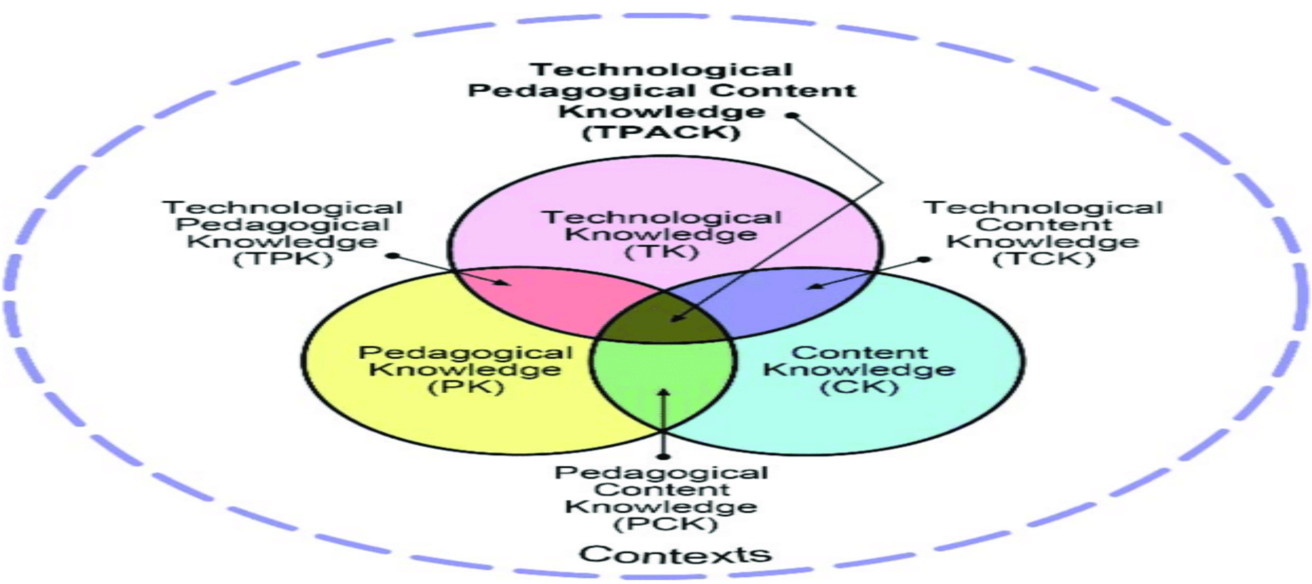
This chapter presented the theoretical frame work, conceptual frame work and the literature which was put by other researchers, educators and policy analysts on the incorporation of ICT and gender in the teaching of physics Education. The presentation of the literature review was put under the different themes that much the study objectives.

### 2.1 Theoretical Frame Work

Specifically the review of the literature was guided by the theoretical and conceptual frame works based on the variables like ICT use, use of gender inclusive methods of teaching. Vinz(2022) defines a theoretical frame work as a fundamental review of existing theories that serves as a roadmap for developing arguments to be used in research work. Basing on the key variables of teaching using technology as an innovation and focusing on gender, three theories, TPACK frame work, Diffusion on innovation (DOI) theory and the socio constructivism theory.

#### 2.1.1 TPACK Frame Work

**Figure 2.1 Showing the TPACK Frame Work**

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This TPACK frame work was introduced by Mathew K Koehler and Punya Mishra of Michigan University in 2006. Thompson and Mishra (2009) noted that the TPACK frame work was introduced in educational research fields to understand teachers' knowledge required for effective integration of technology in teaching (Mishra 2006). TPACK frame work helps teachers to remember and integrate the three types of knowledge namely Technological Knowledge (TK), Pedagogical Knowledge (PK) and Content Knowledge (CK). TPACK demonstrates the relationships and complexities that exist between the three basic components of knowledge (Hughes, 2004, Slough& Connell, 2006).This gives rise to Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Content Knowledge (TPK) and consequently, the Technological Pedagogical Content Knowledge (TPCK).

**The Description of the Different Types of Knowledge Based on TPACK Frame work**

***Technological Knowledge*** (TK) refers to the knowledge on various technologies, which range from low technologies like pencil and papers to digital technologies like internet, digital, videos, interactive white boards and software programs. This study examined the extent to which physics lecturers understand the different technologies relevant to physics teaching and learning. ***Content Knowledge*** (CK) refers to the knowledge related to actual subject matter which should be taught or learned (Koehler & Mishira, 2006). This study analyzed the physics content that is exposed to physics student teachers in relation available ICT tools.

***Pedagogical Knowledge*** (PK) describes the methods and processes of teaching. This includes knowledge in classroom management, assessment, lesson plan development and student learning. This investigation evaluated the lecturers' competences in handling physics students by using a gender lens as they implement planned lecturers. Shulman(1986) describes ***Pedagogical Content Knowledge***(PCK) as the content knowledge that deals with the teaching process. This knowledge enables the teacher to plan different teaching practices for specific areas. This embraces the teaching strategies that lecturers can use for specific physics contents. The extent to which physics lecturers are planning and implement relevant gender friendly strategies in teaching will be examined (Mishra & Thompson, 2009).

In the same reference, Mishra& Thompson (2009) defines ***Technological Content Knowledge*** (TCK) as the knowledge on how new representations can be made using technology. This knowledge enables the teacher to understand that learners' practices and understanding of concepts in specific areas can be promoted through the use of technology. The frame work helped the researcher to understand the extent to which physics lecturers are giving learners interactive practices that allows them to share and construct knowledge irrespective of gender using technology using the available resources. ***Technological Pedagogical Knowledge*** (TPK) describes the knowledge on the use of various technologies in teaching and an understanding on how technology can change the way a teacher teaches. This study explored how physics lecturers understand the various technologies used in classrooms and an observation on how they are using technologies to facilitate teaching and learning.

***Technological Pedagogical Content Knowledge*** (TPACK) refers to the knowledge needed by teachers to integrate technology in their teaching in any content area. This study specifically investigated how the different technologies are used by lecturers and student teachers in incorporating ICT and Gender in the teaching and learning physics. Serhat(2009) notes that TPACK frame work gives teachers an opportunity to use technological tools in instructing and guiding students' understanding of subject matter. The researcher examined the appropriate pedagogical methods and technology used in teaching specific physics matter (Mishra &Thompson (2009).The use of ICT in teaching physics using a gender lens by the teacher trainers have a multiplier effect where the skills can be transferred from teacher trainers to student teachers.

This frame work guided teachers to design and evaluate knowledge which is needed for effective learning in physics education. The researcher examined the degree to which physics lectures were using their TPACK to facilitate their innovative practices in preparation and lesson implementation in terms of selection of content, methodology, assessment activities and development of instructional materials for teaching. However, focus was put on the Lecturers' ' ability to embrace gender as they teach physics to student teachers using technology.

### 2.1.2 Diffusion of Innovation Theory

The Diffusion of Innovation (DOI) theory was developed by E, M Rogers in1962 (Wayne, 2022).This theory seeks to explain the rate at which information and technology spread throughout a given population or society (Jarson, 2022). It assumes that different populations adopt new innovations at different rates. Rogers (2003) defines technology which to him is a synonym to innovation, as a design for instrumental action that reduces the uncertainty in the cause effect relationship which is involved in achieving a desired outcome. He further identifies two parts of technology being hardware and software. Hardware refers to the tool that embodies the technology in form of material or physical objects. Software is the information base for the tools (Rogers, 2003).

This study examined the extent to which physics lecturers and students are using the hardware to send information contained in the software to teach and learn physics education. In this research context, the innovation at hand was the incorporation of ICT and gender in the teaching and learning of physics by lecturers and students respectively. It was therefore important that lecturers and students adopt this innovation for reduction of the gender gap that exists in physics performance and enrolment. Sahin (2006) cites Rogers (2003) describing adoption as a decision of full use of an innovation as the best course of action available whereas rejection is a decision not to adopt an innovation. The ability and interest of participants towards an innovation gives rise to five categories of adopters namely innovators, early adopters, early majority, late majority and laggards.

An adopter category refers to the members' classification in a social system based on their innovativeness (Rogers, 2003). In this study, focus was put on the establishment of the degree to which student teachers and lecturers of physics are willing to integrate ICT and gender based on the above categories. Innovators are the people who want to be the first in trying the innovation (Wayne, 2022). Early adopters are referred to as people who play leadership roles as they embrace the innovation. Early majority are people who adopt innovations before the average person. Late majority are people who are skeptical of change and only adopts an innovation after its trial by the majority. Lastly, Laggards refer to people who are conservative and bound by tradition (Rogers, 2003). With the use of the classroom observation tools, the researcher observed lecturers and students while teaching and learning physics respectively as they apply the innovation thought to be a solution to the problem under study. This gave the researcher a picture on how to classify participants according to the above categories.

Lecturers and students have different ICT competences which enable them to use technology for learning and teaching purposes. This creates an opportunity where students can construct knowledge as they socially interact using the internet based resources. It was intended that through the use of technology in teaching focus would be put on the transfer of knowledge from lecturers to students, interaction between students of all sexes, knowledge transfer from ICT tools or applications to students, interaction of teachers with fellow teachers and finally lecturer interaction with the content.

Nonetheless, Jarson (2022) identifies the following factors as determinants of the degree to which the diffusion of innovation, new technological advancements and ideas are influenced, innovation, communication channels, time frame and availability of the social structure. It is therefore imperative that lectures prioritize the use of technology in helping learners to attain better academic achievements and enrolment in physics.

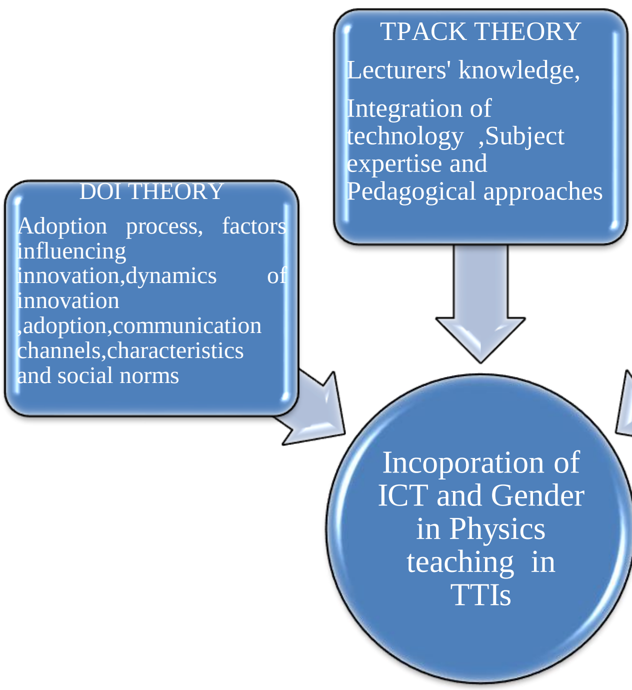
### 2.1.3 Sociocultural Theory

This study will also be guided by the Vygotsky's sociocultural theory of learning. The social learning theory of learning is relevant to instructional enhancement, classroom change and development (Goldfarb, 2000, Gudmundsdothir, 2000 & Blanton,1998).It draws on the work of Vygotsky (1962) and later on the work of Wertsch (1991).According to this theory, an individual learner must be situated within a particular social and cultural context(Rueda,2002,Flem et al,2000).This situatedness is necessary for the development of higher order functions which are acquired and cultivated through social interactions (Shambaigh & Magharo,2001) which are fundamental to development of cognition (Scheba & Valenzuela,2002).

According to Dabbagh & Ridle (1999), this theory views education as an ongoing process but not a product. For student teachers to reach a Zone of Proximal Development (ZPD), they should engage in social behavior (Kearsley, 2005).Vygotsky (1978) defines a Zone of Proximal Development as the distance between the actual development levels and the levels of potential development. For student teachers to reach the zonal of Proximal Development, they must actively interact socially with physics lecturers or capable peers (Kearsley, 2005 and Blanton, 1998). In this study, focus was put on the lecturers' use of technology as a way of delivering instruction, linking with fellow lecturers and student teachers. The extent to which lecturers were using technology to actively involve students in learning was explored. This theory looks at the lecturer - student teacher relationship as a collaborative with the learning experiences becoming reciprocal (Flem et al, 2000). Rogoff (1990) is cited by Scott(nd) noting that students' cognitive development is an apprenticeship which occurs through guided participation in social activity with companions who support and stretch their understanding of skills and using the tools of the culture. To this effect, guided participation was based on the interrelatedness between student teachers and lecturers' interactions using gender inclusive technology (Scott, nd). Through this frame work, lecturers' efforts in using gender focused technology in selecting methods of instruction, content, designing and using instructional materials and assessment activities to facilitate physics teaching was explored. This later determine the extent to which student teachers are using the same technology to enhance their achievement in physics through the vertical transfer of learning modeled from lecturers' attributes (Seel, 2012, International Bureau of Education, 2022).

**Figure 2.2**

*Showing the Linkage between the Three Theories used in studying the incorporation of ICT and gender in teaching Physics Education*




**Source: Self Constructed 2023**

### 2.1.4 Justification for the Joint Use of the Three Theories

**Table 2.1 Showing Justification for the Joint Use of the Three Theories**

| Theory | Aspect | Relevance | Justification for Use | Criticisms |
|---|---|---|---|---|
| **TPACK** | Intersection of Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) (Wayne,2022) | Provides insights into how teachers can effectively integrate technology while considering pedagogical approaches and subject matter expertise | TPACK offers a comprehensive framework for understanding how technology intersects with pedagogy and content knowledge, relevant for studying ICT incorporation in teaching physics. | - Simplistic representation of knowledge domains - May not adequately address contextual factors such as cultural nuances or institutional constraints (Tirtha,2018) |
| **DOI** | Adoption process of innovations within a social system | Offers insights into the dynamics of innovation adoption among teacher trainees, informing strategies for promoting ICT uptake | DOI provides valuable insights into how ICT integration practices are disseminated and adopted within teacher training institutions, informing strategies for promoting technology uptake. | - Overemphasis on individual adopters - Limited consideration of broader social and cultural contexts |
| **Socio cultural** | Influence of social interactions, | Highlights the significance of cultural norms, gender | Sociocultural theories offer a lens for understanding | - Risk of oversimplifying complex social phenomena - May |

| | | | | |
|---|---|---|---|---|
| | cultural context, and gender norms on learning and behavior<br><br>(mayvaras,2023) | dynamics, and societal expectations in shaping ICT integration practices | how gender dynamics and cultural contexts influence ICT integration, providing insights into the broader socio-cultural factors at play. | overlook individual agency and variation within cultural groups - Potential to essentialize gender roles and overlook intersectionality of identities and experiences |

**Source: Secondary Data**

Because of the criticisms raised to each of the theories, these three theories complemented each other, providing a comprehensive framework for studying the incorporation of ICT and gender dynamics in teaching Science (Physics) Education in Teacher Training Institutions in Uganda. TPACK offers insights into the integration of technology with pedagogy and content knowledge, DOI informs strategies for promoting ICT uptake among teacher trainees, and sociocultural theories highlight the influence of broader social and cultural factors on ICT integration practices, including gender norms and expectations. Together, they offer a nuanced understanding of the complex interactions shaping technology use in educational settings

## 2.2 Conceptual Framework

Sawen & George (2022) defines conceptual frame work as a representation of the relationship expected to be seen between research variables or characteristics that you want to study. The Figure I below shows the relationship between the variables. The quality of teachers that we have depends on the nature of teacher trainers that we have in teacher training institutions. With the lecturer's creativity, ICT is used to plan for the teaching learning process where the gender lens is useful. Specifically focus should be on participation, balance, language, rewards and collaboration. Additionally, ICT is used in preparing relevant instructional materials, content, methods of teaching and assessment and activities using the different ICT tools.

Efforts must be made by lecturers to ensure attention is drawn to equity, equality, variety, digital competence and networking. This would give all student teachers the opportunity to interact with content, themselves, lecturers and the wider community as they learn physics. Consequently abstract concepts can be concretized aiding memory and understanding. This ultimately motivates students to like the subject and subsequently perform better, become gender sensitive, acquire 21st century skills and become scientifically literate .Wholesomely, it is expected that the integration of ICT and Gender in the teaching of physics would help in eliminating gender disparity in performance and reenrollment. This would give opportunities to all men and women to participate in building our science, technology engineering and mathematics based economy. This was summarized in the conceptual frame work shown in the Figure 2.3 below.

**Figure 2.3**

*The Conceptual Frame Work*

**Source: Self constructed 2024**

## 2.3 Literature Review

### 2.3.1 Concept of Information and Communication Technology

Information Communication Technologies (ICTs) are defined as diverse set of technological tools and resources used in communicating, creating, disseminating, storing and managing information (Heng&Jing, 2012).Some of these tools relevant in educational technology include computers, cameras, tablets, interactive whiteboards, WIFI, internet, e books ,television, radios, emails ,blogs, multimedia, CDS, DVDs and projectors(Narrinderjit,2020).Mutika et al (2008) defines ICT is a collection of tools and resources for further relations, distribution, reservations and information management. This investigation focused on the lecturers' and student teachers' knowledge and use of the different ICTs relevant to Physics teaching and learning. In most cases, ICT is always associated to computers. In this 21st century, a computer refers to a fully modern automated technology needed for gathering, storing, storing and processing information. Nonetheless, it is encouraged that teachers use the ICT tools that students already have (Mitchel, 2012).

### 2.3.2 Physics Lecturers' ICT Competence Levels

Computer competence refers to the ability of a person to handle a wide range of varying computer applications for various purposes (Vannata, 2004). Teachers' computer self-efficacy is a judgment of their ability to use a computer (Compeau & Higgins, 1995). Studies conducted have shown that there is a correlation between teachers' competences with computers and ICT use in teaching (Knezek &Christensen, 2006). In the context of the 21st century, a computer is a modern fully automated technology for information gathering, storing, processing and sending.

This investigation established the extent to which physics lecturers were using ICT to help student teachers in learning Science (Physics) concepts with the aim of eliminating gender disparities in performance and enrolment. The extent to which they have embraced ICT and gender incorporation as an innovation geared towards improving the performance of student teachers was explored. Rogers (2003) defines adoption as the decision taken by an individual to use an innovation as the best course of action available. ICT adoption is a decision to use ICT as a way of improving teaching and learning outcomes.

Williams (2003) describes ICT integration as a means of using any ICT tool to assist teaching and learning. Nonetheless, some teachers fear or become reluctant in using ICT as a result of lack of confidence (Jones, 2004). This was associated with the lack of ICT knowledge and skills on addition to fear of failure (Blanskat et al, 2007). It is therefore important that teachers are equipped with ICT skills and knowledge so that they are able to implement ICT related initiatives. In this study, the focus was on the nature of the ICT competences possessed by lecturers of physics Education as they implement the teaching learning process.

Medichie et al (2019) in their study confirmed that new and emerging technologies have the ability to revolutionalise the quality of teaching and learning. Specifically, Habbler et al (2016) in their investigation discovered that the incorporation of ICT in teaching has helped in improving students' understanding of Physics concepts for example, the use of ICT simulations as compared to non-ICT teaching activities. This was made possible with the teachers' ability to use technology in managing the teaching learning process.

Sumak et al (2011) clarified that for teachers to successfully use ICT in teaching and learning, they should have adequate ICT competences and positive attitude towards ICT use. Hennessy et al (2022) added that it is difficult for teachers to integrate ICT in teaching if they lack ICT skills. Teacher competences relevant to ICT integration include the ability to know the type of pedagogy to incorporate in a learning environment (Langer et al, 2016), link technology with the content and relate it to real life situations so as to facilitate better understanding of content (Dzikite et al, 2017).

The following competences have been identified for successful implementation of ICT integration in teaching according to UNESCO framework for teachers' ICT use; pedagogy, collaboration, networking, social issues and technical issues (UNESCO, 2008). Pedagogy focuses on the teachers' instructional practices and their curriculum. This study attempted to discover the extent to which physics lecturers are developing applications which use of ICT in supporting and extending their teaching and learning(UNESCO, 2008). Collaboration and networking acknowledges communicative abilities of ICT to extend the learning beyond the classroom. The researcher explored the physics lectures' efforts in developing their ICT skills and knowledge.

Accordingly, the lecturers' efforts in developing their students' ICT skills and knowledge through learning activities was investigated. Social issues indicate how technology has catered for new rights and responsibilities. Focus was on equitable access to technology resources with focus on gender, care for the individual's health and respect for the intellectual property. The investigation explored the role of lecturers in helping themselves and students to access technology resources, opportunities given to students in accessing technology equipment, and access to relevant materials using institution accounts. Technical issues comprise aspects of lifelong learning where teachers update their skills on hardware and software as new technological discoveries emerge (UNESCO, 2008). The extent to which lecturers have been equipped with knowledge and skills on the new hardware and software was examined.

Rabach (2015) clarifies that before an institution can successfully integrate ICT in teaching, it needs to ensure that the teaching staffs acquire appropriate ICT skills and pedagogical skills. Additionally, provision of technological equipment may not be of value to teachers who have no competences on how to integrate ICT in teaching and learning. This is because empowering staff members with knowledge and skills is useful in shaping ICT mediated learning opportunities (Blundell et al, 2020).

Nonetheless, Yet et al (2014) in Ferksavec (2017) stresses that as teachers practice teaching with technology, they should have the following dimensions of knowledge; using ICT in understanding students, content plan ICT infused curriculum, use of ICT integrated strategies, infusion of ICT in teaching contexts, use of ICT in instruction and use of ICT to assess students. This is encompassed in the teachers' Technological, Pedagogical and Content Knowledge and their relationships (Mishra & Koehler, 2008). This investigation tried to explore the physics lecturers ICT competences used in incorporating ICT and gender in teaching physics.

To achieve gender equality, girls and women need equal access to technology, digital training and to be safe online (Maria et al, 2022). According to Plan International (2022), technology and internet can enable girls to participate actively in the learning of physics hence reducing the Gender Digital Divide (GDD) if given opportunity. The researcher intended to find out how physics lecturers are giving all students the opportunity to access and use ICT in learning. She continues to add that as they try to harness the power of technology and use of innovative solutions to focus on the rights of girls, there is need to use gender inclusive language. This is the writing or speaking in a way that does not discriminate against a particular sex, social gender and does not perpetuate gender stereotypes (Maria et al, 2022). Closing gender gaps and creating more opportunities for women in STEM Education and skills development is critical to ensure women's perspectives and diversity is reflected in innovations.

Asmiran et al (2012) in their study on Teachers' ICT skills and integration in the classroom in Malaysia, discovered that teachers' ICT skills were influenced by teachers' demographic factors like gender, age, years of teaching experience and type of ICT training. This study explored the relationship between teachers' demographic factors and their ICT skills.

Hains (2021) notes that since technology (ICT) is changing the way students learn and teachers work, the following ICT skills should be acquired by teachers ,basic computer literacy, ability to back up data or information, experience with online project work, ability to nurture creativity and mark it and social networking skills. It is therefore important that lecturers model those skills so that they are transferred from them to student teachers.

Makanda (2015) notes that availability and effective use of teaching and learning resources are key determinants of the quality of Science and Mathematics Education in every country. This is true because the quality of the teacher determines the end product of the educations system. Lecturers should therefore be conversant with the relevant ICT skills before they can teach physics to teacher trainers.

Kurt (2019) clarifies that TPACK is relevant to teachers as it helps them to implement their ICT in their teaching. This knowledge empowers them to implement and use hardware and soft ware, identify affordances of particular features and tools in pedagogically appropriate and effective ways. It is therefore important that teacher trainers become competent in ICT use through acquisition of basic, advanced and professional ICT skills (Markauskaite, 2005) and the $21^{st}$ skills**.** This will help them to manage the teaching learning process; I intend to find out the required ICT skills that are possessed by physics lecturers.

According to Carteli (2010) in Rizal (2021), the skills in using technology in education activities are shaped by digital literacy. These are a set of basic skills needed in using digital tools and information that can be used to develop strategies for solving problems. Henessey etal (2010) stresses that ICT offers specific opportunities to stimulate growth and increase innovations in every local setting. This enables individuals, and institutions to interact more productively with the global and the wider world. Accordingly, El Sawaf (2007) recommends very high quality training totally supported by ICT for highly committed teachers' change.

Teacher educators are judged with responsibility of preparing future human resources. Teachers should have a number of competences to become professional teachers through utilization of technology for communication, personal building and educational development activities (Rizal (2021). It therefore important that teacher trainers acquire the ICT skills needed to use in facilitating the teaching and learning process. These acquired skills can later be transferred to student teachers through modeling as digital technology helps teachers to give a new meaning to learning activities (Rizal, 2021).

### 2.3.3 ICT Applications Used by Physics Lecturers

The proficiency of physics lecturers in using ICT applications in teaching is instrumental to students success as it improves the quality of their learning achievement (Amora,Batan, Caay,Levarado & Palileo,2024). The research by Madiche et al (2019) has shown that the teachers' incorporation of new and emerging technologies has the ability to transform physics teaching and learning. This investigation tried to establish the extent to which physics lecturers in TTIs harness and use technology to complement and support their physics student teachers.

Wilbrath & Kinzie (2000) hinted that in order to be effective in the use of ICT and be models for students' computer use, teaching staff must have positive computer attitudes and feel self efficacious using them. This means that education institutions should be highly computerized. This would enable the teachers use technology to enhance their working methods through innovative processes (Fulantelli & Allegra, 2013).

Mulhall & Daniel (2019) noted that physics is stereotyped to be complex in nature in terms of teaching and learning. As such, it has made learners to belief that it is difficult, irrelevant and boring (Owen et al, 2018) because of its descriptive and mathematical nature. Nonetheless, this results from the disconnection that exists between teachers and students due to miscommunication (Carter, 2018). This could imply that physics lecturers need to use their knowledge of TPACK to ensure that students are given the correct contents through participatory gender friendly methods with the use of technology.

The incorporation of computers and communication technologies offers exceptional chances to coordinate upgrade and communicate with each other over a wide geographical separation meaningfully to accomplish learning objectives (Ramukadev et al, 2018).The incorporation of ICT in teaching gives teachers an opportunity to implement open and flexible learning strategies through ICT tools. With these ICT tools, learning can occur anytime and anywhere with synchronous and asynchronous communication across space, time and pace using web based instruction (Rumakev et al, 2018). ICT integration or adoption can occur through content websites and online education which are useful in supporting and assisting learning for better understanding. It could therefore be vital for physics lecturers to design learning programs that exposes leaner's to search engines, simulation tools ,synthesizers, emails ,eBooks and social learning platforms such as whatsApp , face book ,twitter and telegram . These help in opening opportunities for student teachers to access, extend, transform and share information. However, this can only occur if the teachers are using student centered approaches which can promote effective teaching and learning of physics (Bogusevschi et al, 2020).

ICT use in teaching helps teachers and students to access information through diverse sources such as searching, locating, selecting and authenticating materials in a wide range of multimedia forms. Extension of information is mainly done through processing, manipulating, analyzing and publishing material in different multimedia forms. ICT tools also help in transforming ideas and information into new or different forms through synthesizing, modeling, stimulating and creating material in many multimedia styles and formats. Lastly, information or ideas can also be shared across local, national and international networks by interacting electronically with others in actual or delayed time. The researcher explored situation under which physics lecturers have been mentoring physics teachers receive, access, transform and share information.

Rizal et al (2007) notes that the teachers of science should design and manage the teaching environments that provide students with the opportunities needed to learn science. They structure content and pace of lessons, introducing new materials, selecting various instructional activities with focus to gender. Alma et al (2016) in their studies discovered that the integration of ICT in physics instruction has the capability of simplifying the abstract content as well as creating a positive interest in learners and consequently improving the quality of education. Kurt (2019) stresses that for technology to be effectively implemented in the classroom; there should be dynamic, transactional relationship among content, pedagogy and the incoming technology within a unique context of the classroom.

Zafar & Khan (2017) recommends the following methods for physics teaching which promotes student centered pedagogy; Problem Based Learning (PBL), class experiments, cooperative learning, use of project, Inquiry Based Learning (IBL), collaborative learning, interactive question and answer. These are vital as they engage students which enable them to develop decision making, problem solving, and teamwork and presentation skills.

Kurt (2019) further clarifies that specific technological tool such as hardware, software and applications are best used to instruct and guide students towards better and more robust understanding of the subject matter. This study will try to establish whether Physics lecturers are using ICT to facilitate the teaching of physics in TTIs in Eastern Uganda.

Aladejana (2007) notes that training should involve the actual use of IT equipments, the use of specific software and the way IT equipments might be used in making physics real. The use of different applications from science websites is vital as simulations are used to help students understand abstract concepts. Nonetheless, there is need to expose them to actual tools which are used in teaching physics like description of the working mechanism of certain instruments. Their exposure to these tools will enhance their skills in using them hence making them competent in IT usage. This investigation figured out to see if these opportunities were given to physics student teachers to interact with IT tools virtually and physically.

### 2.3.4 Factors Impeding the Use of ICT in Teaching Physics

The Ministry of Education and Sports is challenged with improving the quality of lecturers through advocacy for the use of ICT in teaching and learning. This is promoted through the incorporation of ICT in teaching. However, a number of barriers to ICT incorporation have affected the implementation (Justus, 2017). Working with ICT is often difficult because some

ICTs are new for teachers. This implies that social routines should be built so as to use ICT for the expectations to meet new challenges. Alternatively ICT could act as alternative devices for replacement of old and conventional tools like pens, paper, chalk and boards. This therefore calls for the need for school administrators, college or university supervisors to promise the organization of refresher courses for lecturers and students to equip them with ICT skills and knowledge so that they are able to implement ICT initiatives.

Related to the above, Kozma et al (2004) noted that ICT integration is affected by lack of time in class and in the lecturer's schedule for planning. A study conducted in Saudi Arabia revealed that time is an important factor in integration of technology to science teachers as they are always having busy school schedules. This could imply that science teacher employs technology and sets aside additional remedial time so that students are given activities to enable manage their own learning through Self Regulated Learning (SRL).

Hinostroza (2018) ,Lawrence and Tar (2018) and Kilin et al (2018) backs the above by noting that ICT integration and incorporation is hindered by lack of resources ,inadequate training , insufficient technical support and lack of time . Students in institutions of higher education are admitted on both private and government sponsorship where they are funded through fees payments and grants remission accordingly. Accordingly ICT facilitation is planned which offers all students opportunities to access ICT facilities, services and lectures. Nonetheless other departments could be lacking department computer laboratories which make it hard for them to use the facilities for their respective department lecturers.

Khalid, Faroque & Reid (2016) in their studies claimed that adequate resources should be made available to teachers in their respective departments as the teaching involves technical expertise and credible pedagogical expertise. The teaching of physics is done with physics lecturers at different times. It is therefore relevant that the department of physics secures a Physics computer laboratory which can be used for virtual experiments and individualized research by physics students. In the study the researcher will find out whether there is a physics Laboratory and the ability of lecturers and students to use the same ICT tools for learning and teaching (Maithya & Ndebu, 2011).

Bingimlas(2009) clarified that for ICT integration to succeed, there is need for good technical support to both classrooms and the entire school. This helps in resolving or preventing some barriers to ICT use. Other barriers to ICT incorporation include teacher beliefs, visions concerning technology integration and views about teaching, learning and knowledge, conventional teaching culture, poor infrastructure and limited human resources (Valtomen et al, 2018). It is therefore vital that different stakeholder combines efforts to sure that ICT is promoted in teaching and learning as per the national ICT policy. This could be promoted in massive campaigns aimed at making the different stakeholder to understand their roles in promoting the incorporation of ICT and gender in teaching physics in TTIs.

Ramukadev et al(2018) in their study on factors influencing the effective use of ICT in education and learning in India outlined the following factors, network connectivity, incentives to integrate technology, failure of colleagues to integrate ICT in teaching, lack of hardware and software, students' lack of ICT skills and outdated hardware and soft ware. This study indicated that the integration of technology can not be a success if the individual institutions have not prioritized technology use in their organization. There is need for institutional administrators to plan and provide funds needed to procure new hardware and software tools, training teachers and students to acquire ICT skills and Knowledge and provision of broad band data connectivity.

Studies conducted by Alt (2018) and Lawrence and Tar (2018) noted that besides barriers to ICT use ,their enablers which affects ICT integration such as access to ICT ,quality software ,internet, technical, administrative and peer support which are ***External Enablers***. Others which are termed as ***Internal Enablers*** include personal beliefs, previous successes with technology and self-efficacy, allocation for more ICT integration budget, well planned policies and training programs. It therefore important different stake holders promote ICT use through performance of their duties in relation to the national ICT policy. This can be done at individual teachers' level, institutional level, communal level or national level.

Bergonia (2017) adds that for the Use of ICT to be vital to learners, the following challenges should be handled, poor connection, commitment of lecturers to get time for planning and preparing lessons using ICT, conduct of seminars and workshops, provision of technical support and availability of ICT tools and soft ware. This investigation found out the extent to which UNITE has planned for the management of challenges related to incorporation of ICT and gender in teaching and learning. Classes were observed to check on the ICT and gender incorporation practices by physics lecturers and student teachers.

### 2.3.5 ICT Competences Possessed by Physics Student Teachers

According to Global gender gap report (2022), the percentage of Gender Digital Divide (GDD) for sub Saharan Africa is 34%.Globally, men are 21%more likely to have access to the internet as opposed to 52% for the developed countries. Studies conducted by Cheryl and Laura(2009) on gender and ICTs in education revealed that gender and ICTs cannot b isolated and need to be considered in tandem with individuals' life histories and specific clusters of circumstances. It is therefore vital for physics lecturers to measure the IT skills possessed by their students by gender so that plan for a gender sensitive class.

Hatlevik &Christopher (2016) cited Bandura (1997) noting that sell efficacious students work harder, persist longer, show greater interest in learning and achieve at a higher level .This because students are likely to pursue activities which are in their range of perceived competence It should however be noted that students self regulation, experience with technology and social economic background results from the variation in their ICT self efficacy (Hatlevik& Christopher, 2016). They continue to explain that gender, self efficacy and socioeconomic background are important in understanding the students' computer and information literacy. This implies that physics lecturers should ascertain the ICT skills possessed by science student teachers so that they are able to plan relevant methods for delivering content based on students' background. Schun et al(2004) put that despite girls' performance being better than boys, they inclined to report lower self efficacy in sciences and mathematics. This results from the relationship that exist between students self efficacy and culture and gender (Dettingen, 1995).It is therefore inevitable that physics lecturers employ methods of teaching that require the use of technology in providing opportunities for knowledge sharing through networking.

Studies conducted by Hatlevik et al (2016) on gender and ICT in education showed that 62% of the female students indicated that their knowledge and skills in ICT was poor compared to 37% for males. It was also revealed that 64% of the female teachers noted that institutional support in ICT use is poor as opposed to 35% for males. This could imply that little attention is given to students on the use of ICT by institutions of higher learning with a great impact landing on the female. Accordingly, this study established the extent to which students are supported in ICT use through equipping them with relevant ICT skills as they learn physics.

Moos & Azevedo (2009) emphasizes that it is the quality of computers not the quantity of computer experiences that are most critical determinants in computer self efficacy. The quality of computer use may be related to technical support and mastery of experiences with ICT. Through social persuasions, students' computer efficiency can be promoted. This can be achieved through verbal persuasions or encouragement from teachers, parents and peers. In this research context, the research will examine the nature of activities which student teachers are given by physics lecturers to be accomplished while at home or at school.

However, Tondeour et al (2011) point out that students experience with computers and access to technology is positively related to their ICT self efficacy. In the long run, computer use outside the school and students efficacy is positively linked to computer attitudes. This makes learners to self regulated by taking responsibility to manage their own learning. Self Regulated Learning (SRL) is the process where learners take initiative to adjust their cognition, motivation and behavior in order to accomplish tasks or achieve learning goals (Zimmerman, 2000). Self regulated learners have a variety of strategies used in learning which can be adapted to suit different situations. The effort of physics lecturers in preparing physics student teachers for self regulated learning through the use of technology was sought. Focus was on the ICT competences that they have acquired with focus to gender.

Rizal et al (2021) clarifies that students involvement in various digital media provides them with a positive stimulus in developing knowledge, develops skills and prepares them for a good career in the future (Redmond, 2015) . Students' exposure to the different applications can help them acquire the content required to become future products needed in the Science, Technology and Engineering (STEM) fields. It is therefore important that students become computer literate with the current 21$^{st}$ century skills which are needed to create and use and share knowledge. Fraillon et al (2014) takes computer and information literacy as the ability to use the computer to create, investigate and communicate in order to participate effectively at home, school or at the workplace. In my study, I will find out the different ICT competences possessed by physics student teachers and how they were acquired with focus to gender to assess the disparity gaps.

Hatleviket al (2019) notes that teachers should identify their students' level of competence and make distinct plans to equalize these observed ability differences. Vuorikari, Punie, carretero &Brande (2016) notes that for effective learning to take place, students should equipped with the following competences information, communication, content creation, safety and problem solving. This study explored the extent to which physics lecturers are helping their students to develop their ICT competences.

Rizal, Setiawan& Rusdiana (2019)in their study found out that in order to ensure universal access to information, digital divide should be eliminated among students by focusing on access, availability of technology, differences in technology use and the as actual skills and benefits gained on the internet and ICT. This study intended to establish students' first, second and third digital divides with a keen observation on the deviations in the way they interact with ICT tools.

Aladejana (2007) explained that ICT should be used to promote students intellectual abilities through high order thinking problem solving, improved communication skills and understanding of learning tool and concepts to be taught. It was further urged that ICT promotes supportive, interactive teaching and learning environment. This in the long run creates greater learning communities and provides learning tools for students. This study explored the extent to which students possess the relevant skill vital in physics learning. Assessment of students ICT can take the domain perspective comprising ICT, digital and 21$^{st}$ century skills .Contrary to the above; ICT can also be assessed using the knowledge perspective where the focus was on literacy, competence and related skills.

Kiven et al (2008) in their study noted that as a way of developing students ICT skills, schools should prepare would be citizens for knowledge society by teaching them ICT literacy, knowledge assessment and skills of digital communication and cooperation. This study ventured into the extent to which physics lecturers are trying to provide an environment that develops this required ICT competences needed in physics learning.

### 2.3.6 Student Teachers' Use of ICT Competences in Learning Physics

Leaders in education institutions should take responsibility to overcome resistance to ICT integration and organize resources as well as getting involved in the integration process (Sadaff et al,2016).The attitude of teachers towards the use of ICT is governed by barriers and enablers to ICT use. Gunes and Bahman (2018) define attitude towards ICT as the teacher's general feeling of barriers and enablers to ICT for the use of IT in teaching and learning. Nonetheless, Female teachers have low levels of computer use due to their limited access, skills and interest (Volman, 2001).Wozney et al (2006) also put that male teachers used more IT in their teaching and learning processes than their female counter part..Umzeyimana et al (2018) reported that barriers towards effective learning and teaching of physics are related to traditional teacher centered teaching approaches practiced in physics classrooms. It is therefore logical that physics lecturers adopt a paradigm shift in methodology where learners are allowed to manage their one learning with technology adoption.

Learners knowledge revolves around technology that is they use technology to learn what technology knows and to learn what is contained within it,(Siemens,2017).This could imply that efforts should be made by lecturers to ensure that students are helped to understand the different types of technology and how they can use them to learn. This can be promoted thorough use of learner centered approaches which gives them the opportunity to interact with the content using technology. Osborn & Hennessey (2008) emphasize that teachers should create necessary conditions for ICT use, select and evaluate appropriate ICT tools for use.

Now that wireless devices act a s a compass for accessing and finding new knowledge, physics lecturers should design cooperative, contextual, constructive and authentic learning where mobile learning can be integrated with flexible teaching strategies (Vandi & Djebbari, 2011).Ring staff& Kelley(2002) adds that students learn from computers where technology is used essentially as tutors to increase their basic skills and knowledge. UNESCO (2004) identifies the following approaches relevant to teachers as they use ICT to facilitate their teaching, Integrated, enhanced and complementary approaches. An integrated approach is one where there is promotion of an enhancement of students learning through exposure to experiences that challenge their knowledge so as to give a deeper understanding into the insights of the discipline. Enhancement approach is one where students are exposed to new ways which encourage them to formulate their own explanations. . Complementary approach s one where students were given the freedom to respond to more challenging and subject focused tasks. The role of physics lectures in exposing physics student teachers to the above approaches in physics learning was sought.

Nhungu (2012) noted that ICTs are becoming integrated into the teaching approaches to shift it from teacher centered to student centered in most universities. Just like Hussain & Safdar (2008) put that ICT is a set of tools that can be used to help in providing the right people with the right information. Physics student teachers are supposed to use their technological knowledge to interact with the content, themselves and their lecturers. Chen et al (2011) advocates for students to use the mobile resources they have so as to offer immediate assistance. This calls for the lecturers' efforts in programming mobile devices so as to enable self regulated learning. This study will establish the situations under which students' are using their prior ICT skills to maximize their learning. The role of the lecturers in setting the atmosphere where student use their ICT competences in responding to given tasks as they learn was sought.

Bijgana &Capseka (2012) noted that simulations are used by students' addition to classical teaching for better visualization of problems. She added that ICT enables students to understand advanced science concepts for example the use of Geogebra in explaining the electrical charge and forces since physics has suffered low enrolments and performance in most schools (Alma, 2016). Umzemyimane et al, (2018) compliments the above with the use of virtual experiments and virtual environments which saves time and resources. Additionally, it allows students to repeat experiments with ease and provide experiences that would not be accorded to students. It is believed that the use of different applications with simulations will concretize those abstract concepts so as to enable them understand, master concepts and perform better in the subject.

Khalid,Faroq & Reid(2016) adds that schools are challenged with developing teaching approaches which take advantage of new technologies and integrates them into the learning experiences of future generations. This calls for the physics lecturers' pedagogical skills in studying the needs of different students based on sex and offer opportunities for interactive learning using ICT. Study conducted by International Communications Commission (ICC) (2017) indicated that ICT help women to access better education. However, benefits can only be realized if the women have access to ICT.

Ra et al (2016) asserts that ICT enhanced learning promotes collaboration as it promotes cooperation, communication and interaction where students learn to work with peers through team work or joint projects. Chan (2015) mentions new media interactions, animations and simulations as ways of which enhance transformation for learning materials from old state to current state by use of e Books. These technological innovations assist in enhancing students' active engagement in class activities (Holmes, et al, 2015).  This can be prevented or promoted by affordability, relevancy of the content and skills.

Swenson & Rhoads (2019) reveals another clicker technology application which is an audience or classroom response system which has gained popularity through virtual engagement of millennial learners. In this application, students are actively engaged in the classroom activities without being put on sport to respond to a question (Deng,2019).Clickers also boos the preparedness  and attentiveness of the learners in class(Hunter& MCcurry,2010).The use of clickers in providing immediate feedback  to learners helps teachers to assess students learning or understanding (Abdulhaman et al,2018). This study explored the basic ICT applications used by both male and female physics student teachers in learning physics.

### 2.4 Empirical Studies

In the most recent study by Kimani et al. (2023) titled "Enhancing Physics Teaching through ICT: A Comparative Study of Teacher Training Programs in Sub-Saharan Africa," the focus lies on comparing various teacher training programs within Sub-Saharan Africa regarding the integration of ICT in Physics Education. While this study offers valuable insights into different approaches to ICT integration, it lacks a specific examination of the Eastern Ugandan context, leaving a gap in the literature concerning the region's unique challenges and opportunities regarding ICT integration and gender dynamics in physics education.

Additionally, a study conducted by Okono & Awour (2022) in their article titled "ICT Integration in Learning of Physics in Secondary Schools in Kenya: Systemic Literature" explored the need to enhance the teaching and learning of Physics in secondary schools. This was done by adopting a learner centered teaching methodology and provision of a systematic review of frame works for the integration of technology towards enriching active class learning. The study employed document analysis by focusing on the relevant literature. Nonetheless, it lacked the focus on the integration of technology with focus to gender. This study focused on the incorporation of ICT and gender in the teaching of Science (Physics) Education in Teacher training institutions in the Ugandan context.

Building on this, the study conducted by Smith and Brown (2021), "Integrating ICT in Physics Teaching: Challenges and Opportunities," delves deeper into the challenges and opportunities associated with ICT integration in physics education. However, it does not directly address gender dynamics or focus on the Eastern Ugandan context, thus leaving a gap in understanding how gender disparities intersect with ICT integration specifically within the Eastern Ugandan Teacher Training Institutions.

Further back in 2020, Garcia and Johnson's study titled "Gender Differences in ICT Competence and Usage: Implications for Physics Education" provides insights into gender differences in ICT competence and usage in physics education. While this study sheds light on gender dynamics, it lacks a focus on the Eastern Ugandan context and the specific challenges faced by Teacher Training Institutions in that region, thus leaving a gap in the literature regarding gendered patterns of ICT usage within this context.

**2.5 Chapter Summary**

The literature reviewed has confirmed that ICT skills and knowledge is relevant in the incorporation of ICT and gender in teaching physics. These skills are relevant to both the lecturer and student teachers as they promote them to share and access information using technology. The literature review also revealed that ICT competences are responsible for lecturers' and students' adoption and integration or rejection of ICT in teaching and learning. Nonetheless, it was also discovered that technology initiatives cannot be embraced in an institution without the support of the administration. However, little literature is available to confirm that the government and various Teacher Training Institutions are embracing the incorporation of ICT and gender in the teaching of physics education more so after the emergency of corona virus pandemic.

# CHAPTERTHREE
# METHODOLOGY

## 3.0 Introduction

This chapter presents the methodology that was used in collecting data from the field about Physics Lecturers' incorporation of ICT and gender in teaching and learning physics in Teacher Training Institutions in Eastern Uganda. It comprised research approach, design, sample, methods of data collection and analysis, investigation procedure and ethical considerations.

## 3.1 Research Approach

A research approach is a collection of procedures and plans on which research process is based. It consists of research strategies and methods that extend decisions from assumption to thorough methodology of data collection and reasoning (Creswell, 2014).The researcher adopted a mixed method approach where both qualitative and quantitative approaches were used. Specifically, concurrent triangulation was employed. Dawadi, Shrestha & Giri (2021) define mixed methods as a methodology for conducting research that involves collecting ,analyzing and interpreting qualitative and quantitative data in a single study or longitudinal design of inquiry.

Mixed methods approach is good as it provides an understanding of the research problem because of the joint qualitative and quantitative research (Dawadi, Shrestha, &Giri, 2021).Both quantitative and qualitative data was collected to supplement each other for confirmation(Wisdom & Creswell, 2013). This approach was taken to enable the researcher understand the relationship between qualitative findings and quantitative results. It was also chosen with the intention of giving a voice to study participants so that the findings are grounded in their experiences (Wisdom & Creswell, 2013). Research tools collected both qualitative and quantitative data from respondents and conduct an observation to check on classroom lesson instruction and learning facilities.

## 3.2 Research Design

Tesfaye (2018) cites Creswell & Plano Clerk (2007) defining a research design as the procedures for collecting analyzing, interpreting and reporting data in research studies. Shona (2021) takes a research design as a strategy for answering your research questions using empirical data. The researcher employed a pragmatism research paradigm. Pragmatism advocates for the use of research designs that incorporate operational decisions based on what works well in finding solutions to research questions (Yefimov, 2004). Accordingly, the researcher adopted case study and survey research designs.

Shona (2021) describes a case study as an appropriate research design which enables you to gain concrete, contextual, in-depth knowledge about specific real world subject. Detailed descriptive questions were asked to develop an in-depth understanding about how physics lecturers incorporate ICT and gender in teaching physics in different contexts (Creswell, 2007). It was good in that it enabled the researcher to obtain data in form of characteristics, meanings and educational implications on the case under study.

Tahmina (2018) describes a survey study as procedures in quantitative research in which the investigator administers a survey to a sample to describe their attitudes, opinions, behaviors and characteristics in relation to the topic under study. The researcher surveyed TTIs administering questionnaire and interviews to respondents about the incorporation of ICT and gender in teaching physics. This design was good in that it allowed data to come from multiple sources at once, offers opportunities for scalability and allow data to be collected practically(Gaille,2020).

## 3.3 Sample and Sampling Procedures

### 3.3.1 Research Sites

The study was conducted in three Teacher Training Institutions in Eastern Uganda. These campuses were selected because they have computer laboratories and the population that has information needed to answer my research questions in detail (Walford, 2001). Finally the research sites were selected based on the regions that we have in Eastern Uganda for effective representation of views. These institutions were selected because they originate from the region were the researcher comes from. As such it was easy for him to interact with the respondents and collect the information required.

### 3.3.2 Sample Size

The participants in the study were drawn from a population of physics student teachers, physics lecturers and administrators in the campuses. Lindetal(2006) defines a sample as a portion of the respondents drawn from the population of interest . Bhandari(2022) defines population as the group that you want to draw conclusions about. The sample was selected from Five (05) physics lecturers, Five (05) administrators and Twenty (20) student teachers from each of the campuses making a total of Thirty (30) respondents. Of the Five (05) TTIs which are in the Far East of the country, Uganda, respondents were selected from Three (03) campuses to represent others having adopted a case study design. This gave a total population of Ninety (90) respondents as seen in the table below. The sample was determined using Krejcie & Morgan's table of sample selection which was developed in 1970. This gave the sample size to be Eighty (80) respondents comprising 14 physics lecturers, 14 institute administrators and 52 physics student teachers.

**Table3.1 Showing Sample Size**

| **Participants** | **Nature of Participants** | | | **Total** |
|---|---|---|---|---|
| | **Physics Lecturers** | **Student teachers** | **Administrators** | |
| **Population** | 15 | 60 | 15 | **90** |
| **Sample** | **14** | **52** | **14** | **80** |

### 3.3.3 Sampling Techniques

The researcher employed purposive and stratified random sampling techniques. Purposive sampling was used in selecting physics lecturers as they have relevant information on the incorporation of ICT and gender in teaching Physics Education. TTI administrators were selected because they supervise physics lecturers, plan and provide resources for teaching and learning. Patton (2002) recommends the use of purposive sampling in identifying and selecting information rich cases for the most effective use of limited resources. It was also used because administrators and physics lecturers are knowledgeable and have experiences with issues on incorporation of ICT and gender in teaching and learning (Creswell &Plano, 2011).Stratified Random Sampling was used in selecting students based on sex. It was good because it enabled the researcher to get respondents from both sexes so that the results are not gender insensitive (Bruce, 2018).

### 3.4 Data collection

#### 3.4.1 Data Collection Methods

Different methods for collecting both qualitative and quantitative data were employed in answering the research questions. This helped in increasing the credibility of the data through triangulation. Johnson et al (2007) defines triangulation as the combination of methodologies in the study of the same phenomenon. This triangulation takes different forms such as data triangulation where data is collected from variety of sources, theory triangulation with use of multiple perspectives and theories in interpretation of results, methodological triangulation with use of multiple methods to study the research problem and investigator triangulation where different researchers are used (Johnson, 2007).

Data triangulation is the collection of data from different sources. These were the primary and secondary sources. Petterson (2016) defines primary data as the first hand information collected by the researcher. Primary sources of data were relevant in this study because of their reliability and originality. These sources were interviews, observation, document analysis, and interviews. Chvack (2018) defines secondary information as the second information collected by other people apart from the researcher. Secondary sources were preferred because of their open opportunities for replication and affordability. This data was collected from published and unpublished sources such as articles, eBooks, government documents and newspapers. This data is entirely needed for the researcher to identify research questions and design in form of related literature. Below is a detailed description of the different methods of data collection.

##### 3.4.1.1 Survey

Biswajit et al (2017) defines survey as a data collection method through which a researcher can carry out a survey research. The researcher employed survey method to collect information from TTI administrators and physics lecturers on lecturers' ICT skills, incorporation if ICT and gender in teaching, factors impeding ICT use students' ICT skills and their use of ICT in learning Physics Education. This method was preferred because it provides relatively cheap, quick and efficient way of obtaining large amount of information from a large sample of people (Michael, 2018).

#### 3.4.1.2 Interviews

Creswell (2014) takes an interview as a process where a researcher asks one or more participants general or open ended questions and records their answers which are later transcribed and typed. First–hand information was collected from physics student teachers in a face to face interaction to confirm data given through other methods. It was important in that it enabled the researcher to gain insight into respondents' perceptions, understandings and experiences on Information and Communication Technology (ICT) incorporation in teaching physics education with focus to gender (Kenna, 2006). This method collected data from physics student teachers. It collected information to answer all the five research questions on lecturers' ICT competences, Use of ICT in teaching, factors that impede the use of ICT in teaching, ICT competences possessed by student teachers 'and their use in learning physics.

#### 3.4.1.3 Observation

According to Creswell (2014), observation is the process of gathering open ended, first hand information by observing people and places at a research site. The researcher collected information by looking at the nature and presence of ICT facilities, materials developed by Physics Lecturers with the use of ICT, connectivity of the institution and classroom environment. This method was good because it enabled the researcher to obtain first hand information which was used to confirm what has been given through other methods (Creswell, 2014).It was also necessary in that it enabled the researcher to access information based on current and past situations on the uses of ICT in teaching physics education (Jemielniak &Ciesieslska 2018)

#### 3.4.1.4 Document Analysis

Glenn (2009) defines documentary analysis as a systematic procedure of reviewing or evaluating both printed and electronic materials**.** The researcher analyzed physics lecturers' lesson plans, schemes of work and assessment records related to pedagogy to see how teachers use ICT materials in teaching and planning the lessons. The researcher prepared a documentary analysis protocol for systematization of data collection and having focus. This method was good as it is less time consuming and more efficient (Glenn, 2009).

### 3.4.2 Data Collection Tools

#### 3.4.2.1 Questionnaire

A questionnaire is a form used in a survey design that participants in a study complete and return to the researcher (Creswell, 2014). The researcher administered closed-ended and open ended questions to respondents. They collected data from all respondents so that the options or choices made are quantified. It sought information from administrators and physics lecturers on the possession of ICT competences, factors impeding the use of ICT and the use of ICT in teaching physics with focus to gender (Creswell, 2014).

#### 3.4.2.2 Interview Guides

Creswell (2014) defines an interview guide as a form on which the researcher records the answers supplied by the participants in the study. The researcher collected data through interacting with student teachers where questions will be asked and responses accordingly recorded. Specifically, respondents' feelings and opinions on the incorporation of ICT and gender in teaching physics Education were sought. The researcher administered this tool directly through a face to face interaction and online through phone calls.

#### 3.4.2.3 Observation Checklist

This tool was used in collecting data by identifying indicators that depict incorporation of ICT and gender in the teaching of physics Education. Indicators such as availability of Computer-generated materials in classroom displays, internet connectivity, and availability of ICT equipment were used in designing the check list for confirmation.

#### 3.4.2. 4 Document Analysis Protocol

The researcher analyzed physics lecturers' and students' documents that are vital in establishing their involvement in the use of ICT in teaching physics. The documentary analysis protocol was used in order to have focus and be done systematically. The following documents were analyzed after presentation, scheme of work, lesson plans, students' assessment sheets, students' note books and assessment records.

### 3.5 Measurement Levels

In the research project conducted, various types of measurement levels were utilized in data collection and analysis. Qualitative data, gathered from open-ended questions in interviews and document analysis, provided rich descriptive information about participants' perspectives and experiences. These open-ended questions yielded qualitative data, which is non-numeric and descriptive in nature (Creswell, 2014). Additionally, observations were conducted to directly observe phenomena such as the presence of ICT facilities and materials, allowing for qualitative data collection categorized into nominal levels (Creswell, 2014).

On the other hand, quantitative data were obtained through closed-ended questions administered in questionnaires. Respondents selected predetermined response options, aligning with ordinal or interval measurement levels (Creswell, 2014). Following data collection, responses were grouped accordingly to facilitate quantitative analysis (Creswell, 2014). This comprehensive approach to data collection, encompassing both qualitative and quantitative methods across different measurement levels, allowed for a holistic exploration of the research questions (Johnson et al., 2007)

### 3.6 Data Quality and Control

The methodology employed in this study aimed to ensure the validity and reliability of the research tools and data collected. Validity refers to the extent to which the research accurately measures or reflects the concept it claims to measure or reflect, while reliability refers to the consistency and stability of the measurements or data collection methods used in the study (Middleton, 2023). Validity was ensured through several measures. Firstly, the researcher utilized a mixed-method approach, incorporating both qualitative and quantitative methods, which allowed for a comprehensive understanding of the research problem from multiple perspectives. This approach, supported by relevant literature (Dawadi, Shrestha, & Giri, 2021), enabled the triangulation of data, enhancing the credibility and validity of the findings. Additionally, the use of multiple data collection methods like survey, interview, observation, and document analysis facilitated data triangulation (Johnson et al., 2007), ensuring consistency and reliability across different sources.

Furthermore, the researcher employed purposive and stratified random sampling techniques to ensure that the selected sample represented the population accurately. Purposive sampling was utilized to select participants with relevant knowledge and experiences related to the research questions, enhancing the validity of the findings (Patton, 2002). Stratified random sampling, particularly in selecting student participants based on sex, aimed to mitigate potential biases and ensure representation from diverse perspectives (Bruce, 2018).

Reliability was upheld through rigorous data collection and analysis procedures. Data collection tools, including questionnaires, interview guides, observation checklists, and document analysis protocols, were meticulously designed and pilot-tested to ensure clarity, coherence, and consistency in capturing relevant information. Moreover, the researcher followed established protocols and procedures, such as obtaining ethical clearance, seeking permissions from relevant authorities, and maintaining confidentiality and anonymity of participants, to uphold the integrity and reliability of the study (Resnik, 2011).

Additionally, the researcher employed systematic data analysis methods, such as content analysis for qualitative data and coding for quantitative data, to ensure consistency and accuracy in data interpretation (Creswell, 2014). The use of software tools like Excel and Microsoft Word facilitated the organization and presentation of quantitative data, enhancing transparency and reliability in data analysis.

### 3.7 Investigation Procedure

The researcher after proposal approval obtained an introductory letter from Selinus University and Ethical Clearance Certificate Busitema University Faculty of Health Science Ethics Review Committee (BUFHSERC) and an introductory letter from the university to go and collect data. Permission was sought from Uganda National Council of Science and Technology (UNCST) and the principals to allow the researcher to conduct the study in the college. After acceptance, respondents were met and requested to give consent for participation in the research. Through the different methods, data was collected from the respondents. Interviews were conducted through a face to face interaction and on line; questionnaires were given to respondents and collected. Those with ICT skills received tools through email and sent them back after completion. Through the request to the institute's administration, the researcher was led to check the classroom, physics laboratory and computer laboratory for observation of desired characteristics. Finally, the data was organized in themes, tables and figures for easy presentation and analysis

### 3.8 Data Analysis

Since the mixed approach was used, the data underwent both qualitative and quantitative analysis. Taherdoost (2020) refers to data analysis as the process of getting meaningful information through conversion of collected data. This process went through data preparation, coding, data entry, verifying missing values, and finally data transformation.

#### 3.8.1 Qualitative Data Analysis Methods

The data collected in audio form was transcribed to change to written form for critical analysis. The researcher also used content analysis method where categories and themes were identified from the study. Using numbers, data was coded to come up with different text under identified themes as per the responses. The ideas given were grouped under themes to gather evidence for discussion with headings that guided the discussion.

#### 3.8.2 Quantitative Data Analysis Methods

The data collected was coded and tallied to come up with frequencies. It was organized in tables and figures like bar graphs, pie charts and column graphs for easy presentation and interpretation. Frequencies and percentages were used in presenting the data for easy analysis. The researcher used excels to organize frequencies that helped in making graphs. Additionally, the researcher also used Microsoft word package to come up with tables so that frequencies and percentages are used in analysis.

### 3.9 Assumptions and Limitation of the Study

#### 3.9.1 Assumptions of the Study

This investigation was based on the assumption that all TTIs have computer literate physics lecturers who were trained to integrate ICT in teaching; there are ICT equipment and facilities used to implement ICT policy activities, Institutes of TTIs receive grants from the government and Parents contribute money on fees for ICT , Students are taught ICT as a component in Foundations of Teacher education , students are allowed to use phones for learning and institutes have ICT instructors responsible for repair and maintenance of ICT equipments and finally it was assumed that all institutes would be operational**.**

### 3.9.2 Limitations of the Study

Marilyn (2011) describes limitations as potential weaknesses in the research study that were out of the researcher's control. A number of factors interfered with the research process such as research methods not being implemented as planed due to the COVID -19 pandemic. Additionally, transport and communication costs were high as the researcher moved to look for respondents from different places in the study areas. The sampling techniques could not be used as planed since all the students were not available at the same time.

However in preparation to the above, the researcher used methods of data collection that are relevant to the situation on ground for example using phone calls or what's app interview instead of questionnaires or interviews instead of questionnaire. The researcher used convenience or accidental samplings were respondents who were readily available were contacted. Finally, the researcher solicited for funds so as to meet transport and communication or internet costs.

### 3.10 Ethical Considerations

Resnik (2011) clarifies that researchers should ensure that their research studies are ethical. The researcher obtained permission from different officers to allow him to conduct the study in their institutes. The researcher was cleared by the Ethical Review Committee (ERC) of Selinus University to go for data collection. Thereafter, Busitema University Faculty of Health Sciences Research Ethical Committee (BUFHSREC) was contacted for the expedited review of the research protocol after seeking permission from the principals of institutes to conduct research in their institutions. The researcher later obtained permission from the Uganda National Council of Science and Technology (UNCST). Respondents were assured of confidentiality in the information given for research use only and asked to give consent for their participation in the study. This was done after the researcher establishing a rapport with them. For privacy purposes, the anonymity of participants was protected by the use of pseudo names.

For reciprocity, the researcher shared research findings with the institutes after the research and discussed findings with the participants which may enable them to use the results for improving performance. The researcher disseminated data to enable research findings reach a relevant and wide audience. The target audience included Teacher Training Institutions in Uganda, physics educators and instructors, policy makers in the ministry of education and sports, gender equality organizations, academic community and researchers, NGOs and development agencies in education and the general public. The research findings were disseminated through various channels like academic journals, conferences and workshops, online repositories like research gate and academia, policy briefs, webinars and seminars, and social media and institutional reports. A detailed time line was developed showing the time and way of performing a given dissemination activities. The findings usage were monitored and evaluated by establishing the number of download, media coverage and policy changes. This was enabled with budget enforcement for conducting dissemination activities. The dissemination was conducted in adherence to the ethical considerations .Finally, efforts were in place to establish the feedback mechanism for engaging with stakeholders with questions or comments on the research study.

### 3.11 Research Schedule

The research study was expected to  approximately take three years ranging from 2022 to 2024.Anumber of activities were supposed to be executed in the research study basing on the following time frame.

**Table 3.2**

*Showing the Time frame for the Research Study*

| Phase | Activity | Period |
|---|---|---|
| **Designing and planning the study** | • Identification of the research topic | January 2022 - December 2022 |

| | | |
|---|---|---|
| | • Development of the research proposal<br>• Development of data collection tools | |
| **Refining Chapters and Preparing for Data collection** | • Assembling literature review<br>• Designing conceptual frame work<br>• Seeking for clearance from UNCST<br>• Revisiting Methodology<br>• Revisiting the development of data collection tools | January 2023-Decenber 2023 |
| **Data Collection** | • Conducting surveys<br>• Conducting interviews<br>• Observing classroom lessons<br>• Observing physics &Computer laboratories<br>• Analyzing documents | February 2024- June 2024 |
| **Data Analysis** | • Analysis of collected data to draw insights and conclusion | June 2024-July2024 |
| **Report Writing** | • writing report<br>• Organization of research findings and interpretation sand conclusions into a coherent report | August 2024-December 2024 |
| **Submission of Research report** | • Report submission | December 2024 |

### 3.12 Chapter Summary

This chapter presented the methodology employed in investigating Physics Lecturers' incorporation of ICT and gender in teaching physics in Teacher Training Institutions in Eastern Uganda. Utilizing a mixed-method approach, concurrent triangulation was adopted to gather qualitative and quantitative data simultaneously. Pragmatism research paradigm guided the use of case study and survey research designs, facilitating in-depth contextual understanding and data collection from various sources. Purposive and stratified random sampling techniques were used to select 80 respondents, including physics lecturers, administrators, and student teachers. Data collection involved surveys, interviews, observation, and document analysis, ensuring comprehensive data triangulation. Ethical considerations were addressed, and a detailed research schedule spanning three years was outlined. Wholesome, this chapter delineates a rigorous methodology ensuring the reliability and validity of the research findings.

# CHAPTER FOUR
# PRESENTATION AND DISCUSSION OF FINDINGS

## 4.0 Introduction

This chapter presents, interprets, analyses and discusses findings on ***"The Incorporation of ICT and Gender in the Teaching of Physics Education in Teacher Training Institutions in Eastern Uganda".*** It comprises the description of participants in terms of response rate, gender, education level and teaching experience. This is followed by presentation and analysis of data based on the expected research themes on Physics lecturers' ICT competence levels, ICT applications used by physics lecturers, factors impeding the incorporation of ICT and gender in teaching and learning physics, ICT competences possessed by physics student teachers and student teachers' use of ICT in physics learning.

## 4.1 Description of Participants

### 4.1.1 Response Rate

Seventy (70) participants out of Eighty (80) participated in the study which gave a response rate of 87.5%. The ten (10) participants who did not participate in the study were two (02) science tutors, six (06) science student teachers, and two (02) administrators who were not able to respond to the data collection tools. For purposes of not identifying participants by their names, synonyms were given to participants based on their respective institutes and categories. A lecturer from institute A was identified as AL and a student teacher from institute A was identified as AS. Accordingly, lecturers from institute A were identified as AL1, AL2 , AL3 ,AL4 and AL5 and students from institute A were identified as AS1,AS2,AS3,AS4,AS5 up to AS18. Administrators from institute A were identified as AA1, AA2, AA3, AA4, and AA5.

Therefore lecturers were referred to as AL1, AL2, AL3, AL4, AL5, BL1, BL2, BL3, BL4, BL5, CL1, CL2, CL3, CL4 and CL5. Student teachers are referred to as AS1, AS2, AS3, AS4, AS5 up to AS18, BS1, BS2, BS3,BS4,BS5 to BS18 and CS1,CS2,CS3,CS4,CS5 up to CS18. Administrators were identified as AA1, AA2, AA3, AA4, AA5, BA1, BA2, BA3, BA4, BA5, CA1, CA2, CA3, CA4 and CA5. AA1 means the first administrator from institute A,AA2 second administrator from institute A, AA3 third administrator from institute A, AA4 fourth administrator from institute A and AA5 fifth administrator from institute A. BA1 mean first administrator from institute B, BA2 means second administrator from institute B,BA3 means third administrator from institute B, BA4 means fourth administrator from institute B ,BA5 means fifth administrator from institute B . CA1 means first administrator from institute C, CA2 means second administrator from institute C, CA3 means third administrator from institute C, CA4 means fourth administrator from institute C, and CA5 means fifth administrator from institute C.

AL1 means first lecturer from institute A,AL2 means second lecturer from institute A,AL3 means third lecturer from institute A ,AL4 means fourth lecturer from institute A,AL5 means fifth lecturer from institute A,BL1 means first lecturer from institute B,BL2 means second lecturer from institute B,BL3 means third lecturer from institute B,BL4 means fourth lecturer from institute B,BL5 means fifth lecturer from institute B,CL1 means first lecturer from institute C,CL2 means second lecturer from institute C,CL3 means third lecturers from institute C,CL4 means fourth lecturer from institute C ,and CL5 means fifth lecturer from institute C.

AS1 means first student teacher from institute A, AS2second student teacher from institute A, AS3 third student teacher, AS4 fourth student teacher from institute A, AS5 fifth student teacher from institute A continued to AS18which means $18^{th}$ student teacher from institute A. BS1 first student teacher from institute B, BS2 second student teacher from institute B, BS3 third student from institute B, BS4 fourth student teacher from institute B, BS5 fifth student teacher from institute B up to BS18which identifies the $18^{th}$ student teacher from institute B. Additionally ,CS1 means first student teacher from institute C,CS2 second student teacher from institute C,CS3 third student teacher from institute C ,CS4 fourth student teacher from institute C ,CS5 fifth student teacher from institute C ,up to CS18 that means the $18^{th}$ student teacher from institute C.

### 4.1.2 Gender of Respondents

Gender was considered in the process of data collection as all sexes were used. Out of 70 participants, 48 were males and 22 were females. This represented 68.8% and 31.4% responses for males and females respectively as shown in the Table 4.1 below . This finding match with what UNICEF (2021) noted with only 30% of the STEM researcher being female unlike the males who were represented by 70%.This finding confirms that there are indeed more male scientists than female scientists.

**Table 4.1**

***Showing the Gender of Respondents***

| Gender | Frequency | Percentage (%) |
|---|---|---|
| **Males** | 48 | 68.6 |
| **Females** | 22 | 31.4 |
| **Total** | 70 | 100 |

**Source: Primary Data**

Similarly, it rallies behind what UNICEF (2018) found out ,30% of the STEM students body in higher education being females and 25% of the STEM work force being females. This means that physics lecturers should use gender friendly technology enhanced methods that will help female student teachers to learn and master science concepts. This can be achieved through the use of technology to simplify abstract concepts through promotion of collaboration ,networking and access to resources.

### 4.1.3 Age of Respondents

The range of participants' age was from 20 years to 60 years. It contained five (05) age groups of 20-35 years, 36-45 years, 46 -55 years and 56 years and above.

**Table 4.2**

*Showing the Age of Participants*

| Age Group | Frequency | Percentages (%) |
|---|---|---|
| **20-35 years** | 32 | 45.72 |
| **36-45 years** | 29 | 41.43 |
| **46-55 years** | 05 | 7.14 |
| **56 years and above** | 04 | 5.71 |
| **Total** | **70** | **100** |

**Source: Primary Data**

Viewing the Table 4.2 above, it can reveal that the age of respondents ranged from Twenty (20) to Fifty Six (56) years. However, the age group of 20-35 years was the one comprising more respondents with a 45.72% score. This was later followed with the age group of Thirty Six (36) to Fifty Five (55) years. Lastly the age group of Fifty Six years and above was the one with the least number of respondents as revealed with the 5.7% ratio. This means that the opinions and views about the incorporation of ICT and gender in physics teaching and learning were obtained from mature participants making them to be dependable. It could also imply that younger teachers and lecturers could have had better access to technology compared to old ones. This calls for the efforts to ensure that all are equipped with ICT competences needed in transforming teaching and learning physics (Medichie et al, 2019).This could done through the organization of refresher courses and workshops related to ICT and gender incorporation in teaching

#### 4.1.4 Education Level of Respondents

**Table 4.3**

*Showing the Education Level of Participants*

| Level of education | Frequency | Percentage (%) |
|---|---|---|
| **PhD** | 00 | 00 |
| **Masters** | 06 | 8.57 |
| **Graduate** | 18 | 25.71 |
| **Diploma** | 00 | 00 |
| **Certificate** | 46 | 65.71 |
| **Total** | **70** | **100** |

***Source: Primary Data***

Table 4.3 above unanimously showed that the level of education for respondents ranged from certificate to masters as none of them had a doctorate. The masters level which was the highest level had the least number of participants represented by the 8.57 % score compared to grade three certificate holder represented with 65.71%. These findings shows that majority of the respondents have low level of education. This has a great impact on their computer competency as they influence the way they work. Respondents who have high level of education, masters could have more skills and knowledge related to technology which can influence their teaching.

Opportunities should be created to ensure that all physics lecturers and student teachers are supported to ensure effective and efficient teaching and learning.

### 4.1.5 Teaching Experience

**Table 4.4**

*Showing the Teaching Experience of Respondent*

| Teaching Experience | Frequency | Percentage (%) |
|---|---|---|
| **1-15 years** | 28 | 40 |
| **16-30 years** | 32 | 45.71 |
| **31-45 years** | 10 | 14.29 |
| **46 years and above** | 00 | 00 |
| **Total** | 70 | 100 |

**Source: Primary Data**

Table 4.4 above revealed that majority of the teachers had their teaching experience ranging from16 years to 30 years. This was followed with those whose experience in teaching ranged from One (01) year to Fifteen (15) years. This implies that refresher courses should be organized to help physics lecturers, administrators and students acknowledge and embrace the use of ICT with gender friendly strategies in the teaching of Science Education. This matches with what UNESCO (2008) stressed that teachers should update their skills on hardware and soft ware due to the emergency of new technological discoveries. It was also supported by Blundell et al (2020) who asserted that through Continuous Professional Developments (CPDs), staff members acquire knowledge needed in shaping their ICT mediated learning opportunities.

## 4.2 Presentation of Findings on Physics Lecturers' ICT Competences

### 4.2.1 Existence of Programs for Enhancing Physics Lecturers' ICT Competences

Enhancement of ICT competences to Physics Education lecturers can be promoted through implementation of several programs with focus to integrating technology into teaching and learning. Examples of such programs included ICT integration workshops ,online learning platform and courses ,professional development programs, subject specific ICT training, collaborative learning communities ,ICT assessment workshops ,blended learning models and institutional support for ICT integration. The implementation of the above mentioned programs was achieved at different degrees as seen in the table below.

**Table 4.5**

***Table Showing Responses from Physics Lecturers on Availability of Programs that Enhance Their ICT Competences***

| Program | Frequency | Percentage (%) |
|---|---|---|
| **ICT integration workshops** | 06 | 50 |
| **Online learning platforms and courses** | 04 | 33.3 |
| **Professional development programs** | 08 | 66.7 |
| **Empowerment on blended learning models** | 06 | 50 |
| **Institutional support for ICT integration** | 04 | 33.3 |

**Source: Primary Data**

Analyzing the programs used for ICT integration among educators through the lenses of TPACK, DOI, and sociocultural theories offers insights into the strategies employed to enhance technology integration in educational practices. Professional Development Programs emerge as the most prevalent program, reported by 66.7% of respondents (Blundeellet al, 2020). This aligns with TPACK principles, emphasizing the importance of providing educators with the necessary knowledge and skills to effectively integrate technology into teaching practices. Professional development programs offer educators opportunities to enhance their technological, pedagogical, and content knowledge, equipping them with the skills needed to leverage technology to support student learning effectively.

Empowerment on Blended Learning Models follows closely behind, reported by 50% of respondents. Blended learning combines traditional face-to-face instruction with online learning activities, offering flexibility and personalized learning experiences for students. From a DOI perspective, empowerment on blended learning models reflects the incremental adoption of innovation, as educators explore and implement new approaches to instruction that integrate technology seamlessly into teaching practices.

ICT Integration Workshops and Institutional Support for ICT Integration, reported by 50% and 33.3% of respondents respectively, highlight the importance of ongoing support and resources to facilitate technology integration efforts (Sumak et al, 2011). These programs provide educators with opportunities to collaborate, share best practices, and receive support and guidance from their institutions in implementing technology-enhanced teaching strategies. From a sociocultural perspective, ICT integration workshops and institutional support contribute to the creation of a collaborative learning culture that values innovation and continuous improvement in educational practices.

Online Learning Platforms and Courses were reported by 33.3% of the respondents, indicating potential areas for further development and support in technology integration efforts. These programs offer opportunities for educators to explore new technologies, collaborate with peers, and assess the effectiveness of technology-enhanced teaching practices, aligning with the principles of TPACK, DOI, and sociocultural theories in promoting effective technology integration in educational settings.

In summary, the programs used for ICT integration among educators reflect a multifaceted approach aimed at enhancing technological, pedagogical, and content knowledge to support student learning effectively. By providing professional development opportunities, empowering educators with blended learning models, and offering ongoing support and resources, institutions can foster a culture of innovation and collaboration that promotes the successful integration of technology into teaching and learning practices.

### 4.2.2 Demands for Successful Incorporation of ICT and Gender in Physics Teaching

In the process of analyzing lecturers' responses on demands for successful incorporation of ICT and gender in physics teaching, it's evident that certain factors are prioritized more than others, as reflected by the percentages in descending order in the Table 4.6 below. Professional Development on Gender Sensitivity and ICT Training Programs stand out as the highest priorities, each reported by 100% of respondents. This underscores the critical need for educators to receive training not only in technological proficiency but also in fostering gender sensitivity within educational settings. These demands align closely with the principles of TPACK, emphasizing the integration of technological, pedagogical, and content knowledge alongside gender sensitivity training to create inclusive learning environments.

**Table 4.6**

*Lecturers' Responses on Demands for Successful Incorporation of ICT and Gender in Physics Teaching*

| Approach | Frequency | Percentage (%) |
|---|---|---|
| **ICT Infrastructure and Resources** | 10 | 83.3 |
| **ICT Training Programs** | 12 | 100 |
| **Gender Inclusive Curriculum Design** | 08 | 66.7 |
| **Promotion of Girls' Interest in Physics** | 05 | 41.7 |
| **Accessible and Inclusive ICT Tools** | 09 | 75 |
| **Professional Development on Gender Sensitivity** | 12 | 100 |
| **Encouraging Collaborative Learning** | 10 | 83.3 |
| **Regular Assessment and Evaluation** | 08 | 66.7 |
| **Addressing Gender Stereotypes and Biases** | 04 | 33.3 |
| **Policy Support and Institutional Commitment** | 04 | 33.3 |

**Source: Primary Data**

Following closely behind are ICT Infrastructure and Resources, Accessible and Inclusive ICT Tools, and Encouraging Collaborative Learning, reported by 83.3%, 75%, and 83.3% of respondents respectively. These priorities highlight the importance of providing equitable access to technology and fostering inclusive classroom environments. Through the lens of DOI, these demands represent incremental steps toward adopting innovation; ensuring educators have the necessary resources and support to integrate technology effectively while promoting collaboration and engagement, regardless of gender.

Gender Inclusive Curriculum Design and Regular Assessment and Evaluation, reported by 66.7% of respondents; emphasize the need for curriculum and assessment practices that are sensitive to gender differences and biases. These priorities align with sociocultural theories, advocating for educational practices that promote equitable outcomes for all students by addressing systemic barriers and biases. However, demands such as Promotion of Girls' Interest in Physics, Addressing Gender Stereotypes and Biases, and Policy Support and Institutional Commitment received less emphasis, reported by 41.7%, 33.3%, and 33.3% of respondents respectively.

While these areas are equally important for promoting gender equity, they may require more attention and investment to ensure a comprehensive approach to addressing gender disparities in physics education. This based on the philosophy that lecturers’ ability to use technology in education is shaped by their digital literacy (Rizal, 2021).As Maria et al (2022) noted, there is need to promote gender equality through provision of equal access to technology through digital training. This will give all students the opportunity to actively participate in physics learning (Plan International, 2022). To conclude, the demands for successful incorporation of ICT and gender in physics teaching reveal a hierarchy of priorities, with certain factors receiving more emphasis than others. By addressing these demands in descending order of percentages and through the lenses of TPACK, DOI, and sociocultural theories, educators and institutions can create inclusive and empowering learning environments that support the diverse needs and experiences of all students in physics education.

### 4.2.3 Administrators’ Initiatives in Supporting the Incorporation of ICT and Gender in Physics Teaching

Analysis of Table 4.7 below on administrators’ views on initiatives for supporting the incorporation of ICT and gender in teaching physics concepts reveals various priorities, with certain aspects receiving more emphasis than others. Resource allocation and Professional Development Programs emerge as the highest priorities, reported by 100% of respondents. This highlights the recognition of the importance of providing educators with the necessary resources and training to effectively integrate technology and address gender disparities in educational practices. From a gender perspective, these initiatives signify a commitment to fostering gender equity by ensuring equitable access to resources and opportunities for professional growth.

**Table 4.7**

*Administrator's Views on Initiatives for supporting the Incorporation of ICT and Gender in Teaching Physics concepts.*

| Support form | Frequency | Percentage (%) |
|---|---|---|
| **Strategic planning** | 06 | 50 |
| **Resource allocation** | 12 | 100 |
| **Professional development programs** | 12 | 100 |
| **Infrastructure development** | 08 | 66.7 |
| **Partnerships and collaboration** | 00 | 00 |
| **Policy development and implementation** | 05 | 41.6 |
| **Creation of support environment** | 08 | 66.7 |
| **Advocacy and communication** | 04 | 33.3 |
| **Monitoring and evaluation** | 06 | 60 |
| **Celebrating success stories** | 00 | 00 |

**Source: Primary Data**

The above two were later followed with Infrastructure development, reported by 66.7% of respondents. This indicates the acknowledgment of the significance of creating a supportive technological infrastructure to facilitate effective technology integration in educational settings. Through the lens of DOI, infrastructure development represents an incremental step toward the adoption of innovation, ensuring that educators have access to the necessary tools and resources to leverage technology effectively in teaching practices.

Strategic planning and Creation of a support environment, reported by 50% and 66.7% of respondents respectively, underscore the importance of establishing a conducive environment that supports the integration of ICT and promotes gender equity in education. These initiatives align with sociocultural theories, emphasizing the role of the broader socio-cultural context in shaping educational practices and fostering inclusivity and support for all learners.

Policy development and implementation, Advocacy and communication, and Monitoring and evaluation were reported by fewer respondents, indicating potential areas for further attention and investment. These initiatives are essential for creating a policy framework that supports technology integration and gender equity in education, fostering advocacy and communication efforts to raise awareness and build support, and ensuring effective monitoring and evaluation of progress toward goals.

Celebrating success stories and Partnerships and collaboration were not reported by any respondents, suggesting potential opportunities for enhancing collaboration with external stakeholders and celebrating achievements in technology integration and gender equity initiatives. These aspects are crucial for fostering a collaborative and supportive ecosystem that promotes continuous improvement and innovation in educational practices.

Administrators' views on initiatives for supporting the incorporation of ICT and gender in teaching Science Education reflect a multifaceted approach aimed at fostering gender equity and effective technology integration. These findings are aligning with what Rabach (2015) put that before institutions successfully integrate ICT in teaching, it is necessary for the staff to acquire ICT skills and pedagogical skills. Ferksavec (2017) put more emphasis s on the use of ICT in understanding students and content, planning ICT infused curriculum, use of ICT integration strategies, infusion of ICT in teaching, use of ICT in instruction and assessment of students using their TPACK

By addressing these initiatives through the lenses of gender, TPACK, DOI, and sociocultural theories, administrators can create supportive and inclusive environments that empower educators and students to thrive in science education.

One administrator asked on how physics lecturers are being supported to incorporate ICT and gender in teaching noted that,

> “I allow them to go for ICT related trainings and empower them to purchase what they feel can help them in integrating ICT and gender in teaching” (Interview Transcript from AA1).

The approach described by the administrator in supporting physics lecturers to incorporate ICT and gender in teaching reflects a strategy that emphasizes autonomy and empowerment. By allowing lecturers to attend ICT-related trainings and empowering them to make purchasing decisions aligned with their teaching needs, this approach promotes a sense of ownership and agency among educators.

Analyzing this approach through the lens of TPACK, it encourages the integration of technological, pedagogical, and content knowledge by providing educators with opportunities to enhance their ICT skills and knowledge. By attending ICT-related trainings, lecturers can develop their technological proficiency while also gaining insights into effective pedagogical strategies for integrating ICT in teaching. Additionally, empowering lecturers to choose resources that align with their teaching goals and approaches ensures that they can tailor their instructional practices to meet the specific needs of their students, thereby enhancing the quality of teaching and learning experiences.

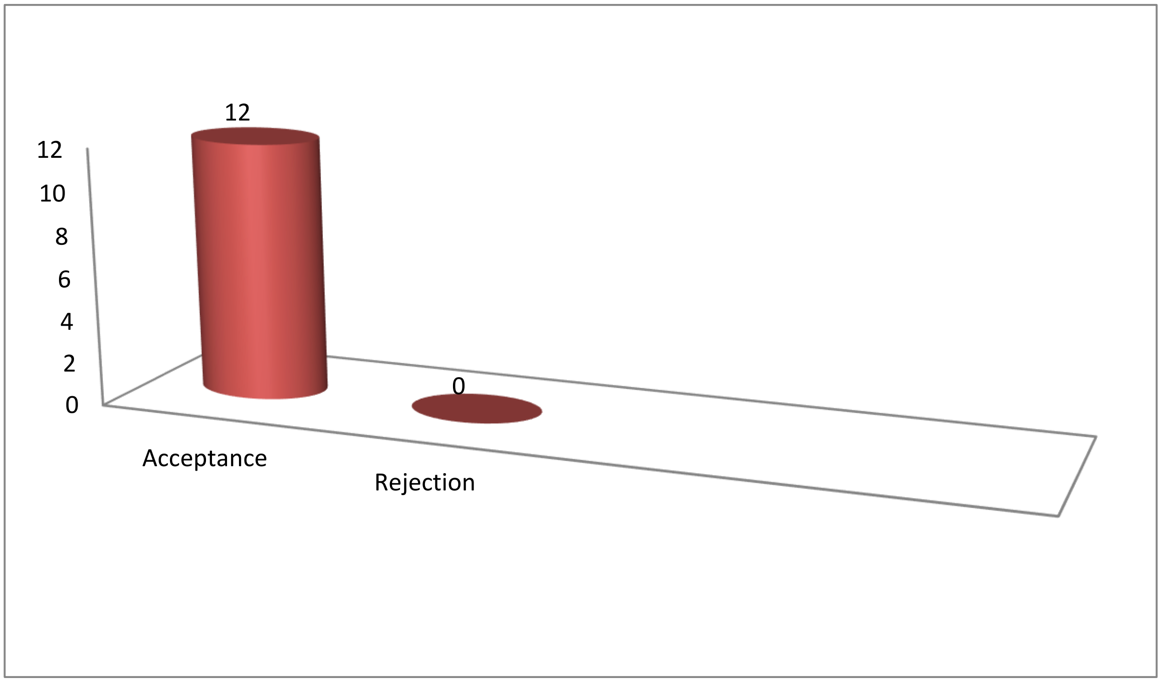
Much as administrators acknowledged that they support lecturers in attending trainings and empowering them to acquire what they feel is required for teaching, observation on ground revealed that little is done by administrators to support lecturers. This confirms what Hains (2021) put that since technology is changing the way students learn and teachers work, it is the responsibility of lecturers to ensure that they embrace technology in promoting effective teaching and learning.

From a sociocultural perspective, this approach fosters a supportive and collaborative environment that values educators' expertise and contributions. By entrusting lecturers with the responsibility to make decisions regarding ICT integration, the administrator acknowledges their professional autonomy and expertise (Kurt, 2019). This approach also promotes a culture of continuous learning and improvement, as educators are encouraged to seek out relevant trainings and resources to enhance their teaching practices.

Overall, the administrator's approach reflects a commitment to supporting lecturers in their efforts to incorporate ICT and gender considerations in teaching while also fostering a culture of empowerment and professional development within the educational institution. By providing opportunities for skill development and autonomy, this approach has the potential to enhance teaching effectiveness and promote inclusivity in physics education

**4.2.4 Impact of Physics Lecturers Demographic Factors on ICT and Gender Incorporation in Teaching**

Figure *4.1 Showing Administrators' Views on the Effect of Demographic Factors on Incorporation of ICT and Gender in Teaching*




**Source: Primary Data**

Information from the Figure 4.1 above revealed that all Twelve (12) lecturers interviewed , acknowledged that their demographic factors have an influence on their status of incorporating ICT and Gender in teaching representing 100% response score . This finding is in line with what Asmiran et al (2012) that teachers' ICT skills are influenced by their demographic factors. This in the long run influences their readiness or resistance to change based on their perspectives, experiences and approaches used in incorporating ICT and gender in teaching. However, different demographic factors influence the incorporation of ICT and gender in teaching differently. These deviations can vary from lecturer to lecturer. This means that focus institutional leaders should plan to support lecturers in incorporating ICT and gender basing on the history of their demographic factors. Specifically, they should institute support mechanisms needed to address the specific needs of their teaching staff so as to foster a continuous culture of improvement and innovation.

**Table 4.8**

*Lecturers' Responses on the Demographic Factors Affecting the Incorporation of ICT and Gender in Teaching Physics concepts*

| Demographic Factors | Frequency | Percentage (%) |
|---|---|---|
| **Age** | 08 | 66.7 |
| **Educational Background** | 09 | 75 |
| **Gender** | 07 | 58.3 |
| **Teaching Experience** | 11 | 91.7 |
| **Technological Competence** | 12 | 100 |
| **Cultural Background** | 08 | 66.7 |
| **Attitudes and Support** | 11 | 91.7 |
| **Access to Professional Development** | 12 | 100 |
| **Institutional Support** | 10 | 83.3 |

**Source: Primary Data**

According to Table 4.8 above, it was shown that all (100%) of the lecturers interviewed confirmed that access to professional development and technological competences that they possess have a great influence on their action in incorporating ICT and gender in teaching. This was later followed by teaching experience and attitude and support for lecturers which were rated at 91.7%. All the other demographic factors were cited to be having an influence on lecturers' incorporation of ICT and gender in teaching as their response scores were all above 50%. The above findings revealed that teachers' demographic factors are instrumental in influencing their incorporation of ICT and gender in physics (Asmirani, 2012). For example older lecturers may have less exposure to modern ICT tools and teaching methods compared to young lecturers. Lecturers with a background in educational technology are able to integrate technology in teaching unlike others. More still the gender may influence their influence and awareness and understanding of gender inclusive teaching practices. Additionally, institutional support influences lecturers; willingness and ability to incorporate ICT and gender considerations. Lecturers' culture may influence their perspectives on gender roles and use of technology. To add, lecturers' positive attitude may influence benefits of ICT and gender inclusiveness. Lastly, access to professional development on ICT and gender leads to best practices and innovative practices in physics education. It should be used in identifying their strengths and weaknesses so that they are helped to improve and maintain their positive patterns.

Observations from the grounds confirmed that indeed physics lecturers' demographic factors affected their adoption of ICT and gender in teaching. A few lecturers who were having a higher level of education were able to use technology in teaching; few of the old lecturers were not conversant in using the technology as well as majority of the respondents not being able to have all the required appropriate ICT competences. This is an indication that administrators should take charge to ensure that lecturers' demographic factors are used as a basis for identifying their training needs related to ICT and gender incorporation.

#### 4.2.5 Effect of Lecturers' Digital Literacy on ICT and Gender Incorporation

Digital literacy of lecturers is very important as it influences their ability to use ICT tools, adapt technological changes, develop digital content, use learning management systems ,access online resources, promote gender inclusive practices ,participate in professional development ,engage students and collaborate with the wider community. When lectures were asked of the value of their digital competency in ICT and gender incorporation, this is what was put by different respondents. Only salient responses which were appearing most times were shown.

One lecturer from one college AL2 asked on how lecturers' digital competency influences his or her use of ICT in teaching clarified that,

> "If utilized, lecturer's digital literacy eases the lecturer's work as proper illustrations can be provided hence effectively delivering to students. In case it is not utilized, the delivery of the lectures to students will be poor for example when explaining abstract concepts" (Transcript from lecturer AL2 conducted 02/11/2023).

Another lecturer asked on the same noted that,

> "Digital literacy positively influences the lecturer as he uses the ICT in teaching physics since can access the internet for physics content" (Transcript from lecturer BL1).

Lecturer CL2 similarly stressed that “Digital literacy enables the lecturer to search and select relevant content which helps to boost performance” (Transcript of interview from lecturer CL2). One administrator AA2 asked on the way lecturers’ digital literacy influences the incorporation of ICT and gender stressed that,

> “The physics lecturers with elementary of ICT don’t go further in research work as lack of skill limits them” (Transcript from administrator AA2).

This is supported with another administrator AA1 who also clarified that “Lecturers cannot research much if they cannot understand how to use ICT to get more information **(**Transcript from administrator AA1). Similarly, administrator BA1 clarified that “Lecturer’s digital literacy makes them incorporate ICT and gender in teaching physics.

Analysis of the statements through the gender lens in addition to the TPACK, DOI, and sociocultural theories provides a comprehensive understanding of the implications of digital literacy for incorporating ICT and gender considerations in teaching physics. From a gender perspective, digital literacy plays a crucial role in addressing gender disparities in access to and utilization of technology in education. The statements from the lecturers and administrators emphasize how digital literacy influences educators' ability to incorporate ICT and gender considerations in teaching. However, there may be gender differences in the level of digital literacy among educators, which can impact their teaching practices and students' learning experiences.

Lecturer AL2's statement underscores how digital literacy facilitates effective delivery of lectures, potentially benefiting all students. However, without adequate digital literacy, educators may struggle to provide proper illustrations, which could disproportionately affect students, including those who may already face barriers to learning, such as female students. Similarly, the statements from lecturer BL1 and CL2 highlight how digital literacy positively influences educators' ability to access relevant content and enhance instructional quality, potentially benefiting all students, regardless of gender (Habbler, 2016).

However, administrator AA2's statement suggests that limitations in digital literacy may disproportionately affect educators' research activities, potentially impacting their ability to incorporate gender considerations in teaching physics. Just like Hennessey et al (2022) noted, it is difficult for lectures to integrate ICT in physics teaching if they lack ICT skills. The digital literacy possessed by physics lecturers who should be models to student teachers is paramount as it influences their ability to plan and deliver physics lessons. Specifically, the rate of digital literacy among the female lecturers who are motivators for the female student teachers has the power of transforming the future of STEM students. If female educators are more likely to have limited digital literacy skills, they may face additional barriers in accessing information and resources, further exacerbating gender disparities in teaching practices.

Plan international (2022) advocated for the use of technology and the internet to promote active participation of females in the learning of physics .Physics lecturers should harness the power of technology by use of innovative solutions through addressing the rights of females using gender inclusive language (Maria et al,2022). As such, digital literacy plays a crucial role in addressing gender disparities in education by enabling educators to effectively incorporate ICT and gender considerations in teaching physics. Through the lenses of TPACK, DOI, sociocultural theories, and the gender lens, it becomes evident that digital literacy influences educators' readiness to adopt and utilize technology, their ability to access and select relevant content, and the broader socio-cultural factors shaping their teaching practices, with potential implications for gender equity in education.

Another lecturer on the same issue noted that,

> "Lecturers with digital literacy skills are able to cater for individual differences among students by designing appropriate learning activities using ICT" (Transcript from lecturer AL3).

The above is backed with lecturer AL1 who noted that "Digital literacy facilitates the use of ICT in teaching and makes him very confident and effective" (Transcript from lecturer AL1).

Analyzing the statements of lecturer AL3 and AL1 regarding digital literacy skills through the lenses of TPACK, DOI, sociocultural theories, and the gender lens highlights the multifaceted impact of digital literacy on teaching practices, student engagement, and gender equity in education.

From a TPACK perspective, digital literacy skills enable educators to effectively integrate technology into their teaching practices while considering the content and pedagogical aspects of instruction. Lecturer AL3's statement emphasizes how digital literacy facilitates the design of appropriate learning activities tailored to individual student needs using ICT. This aligns with TPACK principles by demonstrating how technological knowledge can be applied to address diverse learning needs, enhancing the quality of teaching and learning experiences. Additionally, lecturer AL1's assertion underscores how digital literacy fosters educators' confidence and effectiveness in utilizing ICT in teaching, reflecting the integration of technological, pedagogical, and content knowledge.

DOI principles highlight the role of individual readiness and skills in adopting innovations. Lecturers AL3 and AL1's statements illustrate how digital literacy skills positively influence educators' ability to effectively incorporate ICT into teaching practices. By being digitally literate, educators can cater to individual differences among students, design appropriate learning activities, and confidently utilize ICT, thereby enhancing teaching effectiveness and student engagement. These perspectives align with DOI principles by emphasizing the importance of educators' skills and readiness in adopting and utilizing technology to improve teaching practices.

From a sociocultural perspective, digital literacy contributes to fostering inclusive and equitable learning environments. Lecturer AL3's statement suggests that digital literacy skills enable educators to cater to individual differences among students, potentially promoting inclusivity and addressing diverse learning needs. However, the gender lens highlights potential disparities in digital literacy skills among educators, which may disproportionately affect teaching practices and student outcomes. If female educators are less likely to possess digital literacy skills, they may face additional challenges in designing appropriate learning activities and utilizing ICT effectively, potentially exacerbating gender disparities in education. These findings are supported by Rizal (2021) who noted that digital literacy shapes these of technology in managing and organizing physics lessons.

Conclusively, digital literacy skills play a crucial role in enhancing teaching practices, student engagement, and gender equity in education. Through the lenses of TPACK, DOI, sociocultural theories, and the gender lens, it becomes evident that digital literacy enables educators to effectively integrate technology into teaching practices, cater for the diverse learning needs, and fosters inclusive learning environments, with potential implications for addressing gender disparities in education. Efforts should therefore be taken by TTIs administrators to ensure that physics lecturers are empowered to enhance their digital skills. This can be achieved through the organization of refresher courses and workshops aimed at improving their ICT skills and competences

### 4.2.6 Nature of Knowledge Possessed by Physics Lecturers

**Table 4.9**

*Physics Lecturers' Views on the Nature of knowledge they posses*

| Nature of knowledge | Frequency | Percentage (%) |
|---|---|---|
| **Subject matter expertise** | 12 | 100 |
| **Pedagogical knowledge** | 12 | 100 |
| **Educational technology** | 06 | 50 |
| **Assessment and evaluation** | 05 | 33.3 |
| **Research and scholarship** | 10 | 83.3 |
| **Communication skills** | 07 | 58.3 |
| **Adaptability and lifelong learning** | 05 | 33,3 |
| **Inclusivity and diversity** | 06 | 50 |
| **Collaboration and team work** | 05 | 33.3 |

**Source: Primary data**

Table 4, 9 above indicated that all (100%) of the lecturers acknowledge that they possess subject knowledge and pedagogical knowledge. This followed by 10 out of 12 who acknowledged that they possess research and scholarship knowledge representing 83.3%.Six (06) lecturers out of

Twelve(12) representing 50% accepted that they have some knowledge on educational technology and communication skills. This was later followed by 33.3 % response rate from lecturers that acknowledged that they have knowledge on assessment and evaluation, adaptability and lifelong learning and collaboration and team work.

These findings reveal that lecturers need to be retooled on the need to acquire the relevant types of knowledge that is lacking. This if taken up can help teacher educators and trainees to know how to use ICT in assessing and evaluating learning programs, selecting strategies that are promoting inclusion and diversity and be able to work with teams through collaboration using technology. This can be achieved through the training and retraining of lecturers on the integration of ICT in teaching with much emphasis on gender friendly strategies. The above findings are related to Kurt's (2019) assertion that technology implementation in classrooms require dynamic transaction relationships between content, pedagogy and the incoming technology, bearing in mind the unique contexts of the classroom. This calls for the lecturers efforts to use their TPACK in implementing physics lessons.

Specifically, Zafar & Khan (2017) advocate for the use of student centered pedagogy comprising, problem based learning, class experiments, collaborative learning, interactive learning and project based learning which have the opportunity to engage students through the incorporation ICT and gender in teaching. This can be achieved through the use of hardware and software applications which demands lecturers' understanding of the different applications and their uses. This can be addressed through trainings, retraining on ICT applications in physics teaching and learning with emphasis on adoption of technology in eliminating gender disparities related to performance and enrolment.

### 4.2.7 Gender Knowledge Possessed by Physics Lecturers

The removal of the belief that physics is only meant for men but not women demands teachers to be knowledgeable on convergent issues that give rise to misconceptions around physics teaching and learning. This section presents the nature of knowledge possessed by physics lecturers crowned in gender issues.

**Table 4.10**

*Showing Responses from Lecturers on Their Gender Knowledge*

| Gender knowledge | Frequency | Percentage (%) |
|---|---|---|
| **Gender inclusive teaching strategies** | 09 | 75 |
| **Awareness of gender stereotypes** | 08 | 66.7 |
| **Promotion of diversity and inclusion** | 10 | 83.3 |
| **Equitable assessment practices** | 08 | 66.7 |
| **Representation in teaching materials** | 04 | 33.3 |
| **Facilitation of gender inclusive discussions** | 11 | 91.7 |
| **Addressing implicit bias** | 07 | 58.3 |
| **Promotion of gender equity in STEM** | 11 | 91.7 |

**Source: Primary Data**

Table 4.10 revealed that majority, Eleven (11) out of Twelve (12) lecturers representing 91.7 % acknowledged that they have knowledge on facilitating gender inclusive discussions and promoting equity in Science Technology Engineering and Mathematics (STEM).This was followed by an acceptance from Ten(10) lecturers revealing that they possess knowledge on promoting diversity and inclusion as shown by their 83.3% score. Besides possession of other types of knowledge like awareness on gender stereotypes, equitable assessment practices ,gender inclusive teaching strategies and address of implicit bias with the acknowledgement scores being above 50%,there was less acknowledgement on the acknowledgement on representation on teaching materials with only 33.3% of the lecturers.

According to Mulhall & Daniel (2019), physics is stereotyped to be complex in nature in terms of teaching and learning. This requires the lecturers' ability to simplify the content so that it is easy to teach and learn. This implies that efforts should be made to equip lecturers with the required kinds of knowledge such as pedagogical content knowledge and technological content knowledge. After acquiring this knowledge, they can be able to use gender friendly approaches in delivering the content to diverse number of science student teachers. Ramakev et al (2018) advocated for the incorporation of ICT in teaching where teachers are able to use open and flexible learning strategies through ICT tools. Bogusevschi et al (2020) encourages teachers to design programs that exposes students to search engines, simulations tools, synthesizers, electronic books and learning platforms for students and teachers can access, extend, transform and share resources and information. These platforms include WhatsApp, face books, twitter, and telegram where students can gender friendly resources for use in transforming teaching and learning.

### 4.2.8 ICT Knowledge Possessed by Physics Lecturers

The knowledge based possessed by physics lecturers enables them to create a supporting environment that prepares students for success in Science Education. This section presented specifically the lecturers' understanding on ICT based on observation of classroom lessons and document analysis. It presents the lecturers' understanding and use of the technological content knowledge which comprises ICT competences and their application in selecting physics content.

**Table 4.11**

*Acknowledgement on ICT Knowledge Possessed by Physics Lecturers*

| ICT Knowledge | Frequency | Percentage (%) |
|---|---|---|
| **Digital literacy** | 06 | 50 |
| **Educational technology tools** | 07 | 58.3 |
| **Learning management systems** | 06 | 50 |
| **Online collaboration tools** | 07 | 58.3 |
| **Data analysis software** | 04 | 33.3 |
| **Open educational resources** | 08 | 80 |
| **Blended learning models** | 05 | 41.7 |
| **Assistive technologies** | 05 | 41.7 |
| **Cyber security awareness** | 04 | 33.3 |

**Source: Primary Data**

Information from Table 4.11 above indicated that Eight (08) out of Twelve (12) which represents 80% noted that they have knowledge on open educational resources. Additionally, Seven (07) lecturers out of Twelve (12) representing 58.3% acknowledged that they have knowledge on educational technology tools and online collaboration tools that showed a 58.3% response rate. Nonetheless ,less acknowledgement was registered on the following ICT knowledge cyber security awareness, data analysis software, blended learning models, assistive technology with their scores being below 50%.Analysis of the Table 4.12 above reveals that physics lecturers need to be retooled with the necessary ICT knowledge which can make them marketable in the workforce. This can be done through undergoing short ICT courses to enable them program and use computers for teaching Physics Education.

The above findings are in confirmation to what Yuccel &Kocak (2010) put that technological competence is now a skill that should be possessed by all teachers since it is now a professional competence. Rizal (2021) acknowledges the power of technology in transforming teaching and learning. They encourage teachers to acquire basic computer literacy, ability to backup data, experience with online project work, ability to nurture creativity, and social networking skills. This can be achieved through enhancing their TPACK through adopting the use of technology with gender friendly approaches.

### 4.2.9 Effect of Lecturers' Attitudes and Efficacy on ICT and Gender Incorporation

The attitude of physics lecturers is crucial as it influences the rate at which they incorporate ICT and gender in teaching. Lecturer AL3 stressed that,

> "Lecturers with positive attitude towards the ICT use with gender friendly strategies are more likely to embrace change and actively seek ways of integrating technology in addressing gender disparities in their instruction."(Transcript for AL3 conducted on 02/11/2023)

Specifically, one lecturer AA1 noted that,

> "Attitude is a driving factor to any successful venture. It is therefore hard if the lecturer does not have the interest to the right thing"(Interview Transcript for AA1 conducted on 02/11/2023)

Related to the above, another administrator AA2 clarified that,

> "The mystical attitude of I cannot manage makes them to remain at the ordinary level without attempt to dig into the detailed concepts"(Interview Transcript for AA2 conducted on 02/11/2023).

Findings from another administrator AA3 revealed that,

> "Attitude plays a recommendable role in that the more the attitude is positive, the more the teacher tries to use it in classroom instruction"(Interview Transcript for AA3 conducted on 02/11/2023).

Related to the above, lecturer AL1 clarified that,

> "Negative attitude makes the use of ICT and gender not supported .However, the positive attitude enhances or promotes the incorporation of ICT and gender"(Interview Transcript for AL1 conducted on 03/11/2023).

Another lecturer AL2 stressed that,

> "Fear to use the ICT tools due to failure to manipulate and use them in teaching. The thinking that physics is for boys and not for girls is an attitude among some lecturers" (Interview Transcript for AL2 conducted on 03/11/2023).

AL3 also noted that,

> "Physics lecturers' attitude affects incorporation of ICT and gender in teaching by determining how lecturers effectively and efficiently plan the content to be taught to the students" (Transcript for AL3 conducted on 03/11/2023).

Analyzing the statements of lecturers AL1, AL2, and AL3 regarding attitudes towards ICT and gender incorporation in teaching through the lenses of TPACK, DOI, sociocultural theories, and the gender lens sheds light on the critical role of attitudes in shaping teaching practices and promoting gender equity in education. From a TPACK perspective, attitudes towards ICT and gender influence educators' readiness to integrate technology into teaching practices while considering content and pedagogical aspects.

The above findings matches with what Valtonnen et al (2018) stressed that teacher beliefs about technology integration prevent their adoption of integrating ICT and gender in physics teaching. The beliefs possessed by physics lecturers about teaching and learning have a high influence on their plan to adopt and use technology in mitigating the disparity issues related to gender in enrolment and performance terms of enrolment. TTI administrators should ensure that efforts are made to sensitize physics lecturers on the value of incorporating ICT and gender in reducing gender disparities in physics related to enrolment and performance. More importantly, efforts should be instituted by TTI administrators and government to equip lecturers with ICT competences needed in conducting effective teaching .This can be achieved through the procurement of ICT facilities and employment of ICT specialist instructors to support physics lecturers in using ICT equipments to eliminate gender disparity.

Lecturer AL1's statement underscores how positive attitudes towards ICT and gender promote their incorporation in teaching, reflecting the integration of technological, pedagogical, and content knowledge. Conversely, AL2's statement highlights how negative attitudes, such as fear of failure or gender stereotypes, may hinder educators' willingness to utilize ICT tools effectively. These attitudes can affect educators' ability to leverage technology to enhance teaching practices and promote gender equity in education.

DOI principles emphasize the importance of individual attitudes and perceptions in adopting innovations. AL1 and AL2's statements demonstrate how attitudes towards ICT and gender influence educators' willingness to embrace technological innovations and address gender disparities in teaching practices. Positive attitudes towards ICT and gender promote openness to change and innovation, facilitating the adoption of ICT tools and the promotion of gender equity in education. Conversely, negative attitudes may result in resistance to change, hindering efforts to integrate technology and address gender disparities effectively.

Sociocultural theories highlight the role of broader socio-cultural factors in shaping attitudes and behaviors in educational settings. AL3's statement emphasizes how educators' attitudes towards ICT and gender impact their instructional planning and delivery, reflecting the influence of socio-cultural norms and beliefs on teaching practices. Attitudes towards ICT and gender are shaped by societal perceptions and expectations, which may contribute to the perpetuation of gender stereotypes and inequalities in education. Through the gender lens, it becomes evident that attitudes towards ICT and gender may vary based on gendered expectations and experiences. Gender stereotypes and biases, as mentioned by AL2, can influence educators' attitudes towards ICT and their perceptions of gender roles in education. Positive attitudes towards ICT and gender may be particularly important for promoting inclusivity and addressing gender disparities in traditionally male-dominated fields such as physics. In summary, attitudes towards ICT and gender play a significant role in shaping teaching practices and promoting gender equity in education. Through the lenses of TPACK, DOI, sociocultural theories, and the gender lens, it becomes evident that attitudes influence educators' readiness to adopt technology, address gender disparities, and creates inclusive learning environments, highlighting the importance of fostering positive attitudes towards ICT and gender in educational settings.

### 4.2.10 Classroom Lesson Observations on Demonstration of ICT Use

Basing on class lessons which were observed it can be asserted that lecturer did not have a positive attitude towards the incorporation of ICT and gender in teaching physics but rather tried to embrace gender at a low pace. There was no clear sign of physics lecturers' actions in using ICT to reduce or eliminate gender disparities in Physics performance or achievements. Efforts were shown by lecturers to use active learning strategies such as group discussions, problem solving and sometimes lecture methods to catch up with time. This relates to what Setlawan & Rusdiana (2019) emphasized that teachers should promote universal access to information by eliminating digital divide. This could be achieved through advocating for students' access to technology, availability of technology, differences in technology use, skills possessed by student teachers and how they benefit from the technology in place.

Specifically it is inevitable for physics lecturers to be practical in using technology in planning instruction, teaching and assessment so that they are able to act as models to students through vertical and horizontal transfer of learning. Kevinet al (2008) emphasizes that students should be equipped with ICT literacy, knowledge on assessment and skills of digital communication and cooperation. Sadaff et al (2016) adds by encouraging administrators to responsible in overcoming resistance to ICT integration through organization of resources and involvement in ICT integration. This implies that probably they were not having a positive attitude in using ICT gender friendly strategies due to lack of ICT skills or infrastructure. For example in the three colleges where the study was conducted, only one had internet connection for students, lecturers and administrators connected differently. This gives lecturers and student teacher s an opportunity to interface with each other due to the connectivity.

Focusing on the sociocultural theory, our students come from different localities with different cultural beliefs and economic backgrounds which make it hard for some to access technology and acquire ICT competences. It calls for the efforts of stakeholders so that equality and inclusion is promoted by providing equal opportunities to access and use technology in learning. This can be done by initiating infrastructure like computer and stocking them with fully connected computers for continuous use in learning by students. Related to the above, all instruments of instruction comprising lesson plans and schemes of work indicated that little was done by physics lecturers in embracing technology in reducing gender disparities. This was evidences with majority of the lecturers not indicating instructional materials and methods that utilizes technology to equally access students to learning content.

### 4.2.11 Tutors' knowledge on ICT use

***Table 4: 12***

*Observations on lecturers 'Use of Knowledge on ICT Use*

| Knowledge | Frequency | Percentage (%) |
|---|---|---|
| **Use of ICT to understand students and content** | 02 | 16.7 |
| **Planning ICT informed curriculum** | 04 | 33.3 |
| **Using ICT in planning** | 07 | 58.3 |
| **Using ICT integration strategies** | 03 | 25 |
| **Infusion of ICT in teaching content** | 08 | 66.7 |
| **Use of ICT in instruction** | 03 | 25 |
| **Use of ICT in assessing students** | 02 | 16.7 |

**Source: Primary Data**

Table 4.12 above revealed that Eight (08) lecturers out of Twelve (12) representing 66.7 % were able to infuse ICT in teaching content more especially the use of a projector in delivering content to students. . This followed by Seven (07) lecturers out of Twelve (12) who were able to use ICT in planning. This was particularly seen in the area of selecting content and teaching activities represented by 58.3%. More still, it was also shown that Four (04) lecturers which represent 33.3 of the lecturers were able to plan ICT informed curriculum .The table also indicated that only Three (03) lecturers representing 25% of the lecturers were able to use ICT integrated strategies and use ICT in instruction. Lastly only Two (02) lecturers were able to use ICT in assessing students and understanding students and the content.

Findings from Table 4.12 indicated that majority of the physics lecturers were able to display their use on infusing ICT in teaching content and planning. Other areas like using ICT in understanding students and content, assessing students, instruction using ICT integration strategies and planning informed curriculum were not used by majority of the lecturers. The inability of physics lecturers to utilize ICT in the above areas could be associated to their ICT incompetency and attitude towards ICT use. This is in support of Hinostroza (2018),Lawrence &Tar (2018),and Kilin et al(2018) who argued that that ICT integration is hindered by lack of resources ,inadequate training, insufficient technical support and lack of time.

Currently, there are no ICT instructors employed in Teacher Training Institutions in Uganda. Additionally, ICT lessons are not conducted in the institutes as they are not timetabled. This makes it hard for the student teachers and lecturers to learn and apply ICT skills needed in conducting effective teaching and learning. This calls for the organization of refresher courses, workshops or trainings to enable physics lecturers and students to enhance their TPACK and be able to adopt the incorporation of ICT and gender in teaching. Focus should be on the actual use of IT equipments, use of specific software and the way IT equipments make physics real as emphasized by Aladejana(2007).

### 4.2.12 Gender Concerns on ICT Use

**Table 4.13**

*Lecturers' Gender Considerations Exhibited in ICT Use*

| Gender Concerns in ICT Use | Frequency | Percentages (%) |
|---|---|---|
| **Promoting accessibility and inclusivity** | 02 | 16.7 |
| **Using gender representation in leaning materials** | 05 | 41.7 |
| **Using interactive and collaborative tools** | 02 | 16.7 |
| **Using flexible learning platforms** | 02 | 16.7 |
| **Use of Gender inclusive language** | 07 | 58.3 |
| **Addressing gender stereotypes and biases** | 04 | 33.3 |
| **Promoting digital literacy to all** | 03 | 25 |
| **Provision of diverse examples** | 08 | 66.7 |
| **Encouraging active participation** | 12 | 100 |
| **Participation in Professional development** | 07 | 58.3 |
| **Provision of feedback on assessment practices** | 12 | 100 |
| **Creation of online supportive community** | 02 | 16.7 |

***Source: Primary Data***

Analyzing lecturers' gender considerations in Table 4.13 above exhibited in ICT use through the lenses of TPACK, DOI, sociocultural theories, and the gender lens highlights the efforts to promote inclusivity, address gender biases, and enhance teaching practices in the context of technology integration. Physics lessons were observed to see how lecturers are using ICT friendly methods to reduce gender disparities in performance and enrolment by promoting active interaction between female and male students. Lesson patterns related to incorporation of ICT and gender were observed, recorded and tallied to come up with the above results. Encouraging active participation (100%) and provision of feedback on assessment practices (100%) demonstrate recognition of the importance of leveraging ICT to engage all students actively and provide meaningful feedback on their learning progress. This aligns with TPACK principles by emphasizing the integration of technological, pedagogical, and content knowledge to promote effective teaching practices.

Lecturers' gender considerations, such as provision of diverse examples (66.7%) and participation in professional development (58.3%), reflect a commitment to addressing gender biases and promoting equitable access to ICT resources and opportunities for all students. By providing diverse examples and engaging in professional development activities, educators aim to create inclusive learning environments that empower all students to succeed. Efforts to address gender stereotypes and biases (33.3%) and use gender representation in learning materials (41.7%) highlight recognition of the role of socio-cultural norms and biases in shaping educational experiences. By challenging stereotypes and promoting gender-inclusive practices, educators seek to create supportive learning environments that promote gender equity and inclusivity.

Promotion of digital literacy to all was recorded at 25% as Promoting accessibility and inclusivity (16.7%) and using interactive and collaborative tools (16.7%) reflect efforts to mitigate barriers and promote equal opportunities for all students in accessing ICT resources and engaging in collaborative learning experiences. These considerations aim to create a supportive environment conducive to technology integration and learning. Through the gender lens, it becomes evident that lecturers' gender considerations aim to promote gender equity and inclusivity in ICT use. Efforts to address gender biases, use gender-inclusive language, and provide diverse examples reflect a commitment to challenging gender norms and promoting equal opportunities for all students. However, the varying frequencies of certain considerations suggest potential areas for further attention and investment to ensure that gender concerns are adequately addressed in ICT integration efforts.

Table 4.13 unonimously indicated that all tutors provided feedback on assessment practices and encouraged active participation with focus to gender. These were followed with majority being able to provide diverse examples in teaching, participating in professional developments and use of gender inclusive language. Nonetheless, little was done in promoting accessibility and inclusivity, using interactive and collaboration tools, use of flexible learning platforms and creation of online supportive community. Basing on the research recommendation by Cheryl & Laura (2009), efforts should be instituted to ensure that gender and ICT are incorporated in teaching physics education. This was to be achieved through the tutors' efforts in identifying ICT skills possessed by student teachers so as to plan gender sensitive classes.

Rizal (2021) emphasizes that students 'involvement in various digital media provides them with a positive stimuli to knowledge development, skills development and preparation for a future career (Redmond, 2015). Following the above, it can be concluded that, lecturers' gender considerations in ICT use reflect a multifaceted approach to promoting inclusivity, addressing gender biases, and enhancing teaching practices. Through the lenses of TPACK, DOI, sociocultural theories, and the gender lens, it becomes evident that educators play a crucial role in creating supportive learning environments that empower all students to succeed in the digital age

### 4.2.13 UNESCO ICT Competences Possessed by Physics Lecturers

Based on the data provided from Table 4.14 below on the survey or analysis of UNESCO competences possessed by physics lecturers, it was shown that Ten (10) lecturers out of Twelve (12) representing 83.3% acknowledged possessing instructional practices and the curriculum. This competence was possessed by the highest number of physics lecturers surveyed, indicating that a large majority of them are proficient in designing instructional practices and managing the curriculum effectively.

**Table 4. 14**

*UNESCO Competences Possessed by Physics Lecturers*

| UNESCO Competences possessed by lecturers | Frequency | Percentage (%) |
|---|---|---|
| **Teacher's instructional practices and the curriculum.** | 10 | 83.3 |
| **Communication ability of extending the learning beyond the classroom.** | 05 | 41.7 |
| **Caring for learners' rights and responsibilities** | 07 | 58.3 |
| **Updated skills on hardware and software.** | 04 | 33.3 |

**Source: Primary Data**

This was followed with Five (05) lecturers out of Twelve (12) which is 41.7% being in possession of Communication ability of extending the learning beyond the classroom. While still a significant portion, fewer physics lecturers seem to possess strong communication abilities to extend learning beyond the classroom. This could suggest that there may be room for improvement in this area among some lecturers. Additionally Seven (07) lecturers out of Twelve (12) represented by 58.3% accepted that they possess the competence of caring for learners' rights and responsibilities. This means that majority of physics lecturers demonstrate care for learners' rights and responsibilities, although not as overwhelmingly as instructional practices and curriculum management. Lastly ,updated skills on hardware and software were acknowledged by on Four(04) lecturers out of Twelve(12) representing 33.3%score.In this respect ,the competence was possessed by the fewest number of physics lecturers surveyed. It indicates that there might be a need for more training or professional development in staying updated with hardware and software relevant to their field.

Result from Table 4.14 above revealed that despite the possession of lecturers' competence in instructional practices and curriculum, caring for learners rights and responsibilities, they mainly lack communication ability of extending the learning beyond the classroom and updated skills on hardware and software. Since Medichie (2019) confirmed that new emerging technologies have the ability to revolutionalize the quality of teaching and learning, lecturers should enhance the development of their TPACK. This enables them to adopt the incorporation of ICT and gender as an innovation for reducing disparities in physics performance and enrolment. This is backed by Sumak et al (2011) who noted that there is need to for teachers to have adequate competences and positive attitude towards ICT use .These competences include the ability to know the type of pedagogy to incorporate in a learning environment (Langer et al,2016). Generally, the data suggests that while physics lecturers generally excel in instructional practices, curriculum management, and caring for learners' rights, there might be areas like extending learning beyond the classroom and keeping up with technological advancements where improvements could be made. As such, very high quality training is needed totally supported by ICT for highly committed teachers change (Elsarf, 2007).

## 4.3 Presentation of Findings on ICT Applications Used by Physics Lecturers

### 4.3.1 Importance of ICT Use in Teaching Physics

**Table 4.15**

*Lecturers' Views on the Importance of Using ICT in Teaching Physics Education*

| Importance | Frequency | Percentage (%) |
|---|---|---|
| **Enhanced Learning Experiences** | 12 | 100 |
| **Preparation For Real World Applications** | 10 | 83.3 |
| **Promoting Gender Equity In STEM** | 12 | 100 |
| **Development of 21st Century Skills** | 06 | 50 |
| **Personalized Learning** | 08 | 66.7 |
| **Creation of Global Learning Opportunities** | 06 | 50 |
| **Data Driven Decision Making** | 11 | 91.7 |
| **Preparation for Technological Advancements** | 07 | 58.3 |
| **Adaptation to Technological Changes** | 09 | 75 |
| **Inclusive and Diverse Learning Environments** | 10 | 83.3 |

**Source: Primary Data**

The data provided in the Table 4.15 above offers insights into lecturers' perspectives on the significance of integrating ICT into teaching physics education. It appears that there is widespread acknowledgment among lecturers regarding the positive impact of ICT on various aspects of learning. For instance, all surveyed lecturers unanimously agree on the importance of ICT in enhancing learning experiences. This collective stance underscores the consensus that incorporating technology can significantly improve the quality of education delivery in physics. On addition to the above, a substantial majority of lecturers, totaling 83.3%, recognize ICT's role in preparing students for real-world applications within the field of physics. This suggests a strong belief that technology-enhanced learning can bridge the gap between theoretical knowledge and practical skills, ensuring students are better equipped for professional endeavors post-education.

Similarly, all surveyed lecturers also unanimously support the idea that ICT contributes to promoting gender equity in STEM subjects, including physics. This alignment underscores the understanding that technology can play a pivotal role in fostering inclusivity and diversity within educational settings. While there is robust agreement on certain aspects, such as enhanced learning experiences and gender equity promotion, there are varying degrees of consensus on other dimensions. For instance, half of the surveyed lecturers, representing 50%, believe that ICT facilitates the development of 21st-century skills, such as critical thinking and collaboration. This indicates a moderate level of agreement on the transformative potential of technology in nurturing essential competencies among students.

Furthermore, while a majority of lecturers recognize the importance of ICT in fostering personalized learning experiences (66.7%), creating global learning opportunities (50%), and preparing students for technological advancements (58.3%), there are also areas where consensus is stronger. For instance, an overwhelming majority, comprising 91.7% of lecturers, endorse the role of ICT in enabling data-driven decision-making processes in physics education. This suggests a widespread recognition of technology's capacity to facilitate evidence-based instructional strategies and educational interventions. These findings are in a perfect agreement with Hains (2021) who clarified that ICT has the ability to transform teaching and learning. They revealed the pivotal role of ICT in shaping modern pedagogical practices and advancing educational outcomes in physics. It reflects a collective acknowledgment among lecturers of technology's transformative potential in enhancing learning experiences, promoting inclusivity, fostering critical skills development, and preparing students for the challenges and opportunities of the digital age. Despite some variations in perspectives, the overarching trend highlights a shared commitment to leveraging technology for the betterment of physics education.

### 4.3.2 Degree of Integration of ICT and Gender in Teaching

Classroom lesson observations were conducted where physics lecturers were supervised. The lesson instruction was observed to establish the extent to which lecturers were integrating ICT and gender in teaching. Under ICT integration, focus was put on technology usage, accessibility to technology, integration of pedagogy in teaching and the quality of teacher training. On addition, efforts were made to analyze gender related patterns such as participation of students in the lesson, inclusive education practices, supportive environments and perceptions and attitudes of lecturers and student teachers on incorporating ICT and gender in teaching.

Findings from the field revealed that all the Twelve (12) physics lecturers were males. This finding implied that female student teachers may be demotivated with a thinking that physics is meant for men. In a similar manner, it was discovered that gender has a great influence on the adoption of ICT and gender incorporation due to different perceptions among those who are supposed to implement the innovation. For example out of the Forty Six (46) science student teachers, only 19 were females and 27 males. This represents the respective gender scores of 41.3% and 58.7%. This means that there are more male student teachers doing science compared to female science student teachers leading to disparities in enrolment and performance. This calls for mass sensitization of the student teachers and invitation of female scientists to instill the spirit of studying science among the female students. However, it was also discovered that the rate of ICT and gender integration was low. This was based on the finding that ICT competences possessed by both lecturers and physics student teachers were inadequate there by influencing their self efficacy and ICT usage.

More importantly, the number of computers was very low compared to the number of students. This makes it hard for the students and lecturers to utilize them in teaching. To add the computer s available are not connected to the internet. This makes it difficult for the lecturers’ to interact with their students and collaborate with other lecturers through networking online. Just like Kurt

(2019) put, lecturers should utilize their TPACK in implementing ICT and gender incorporation in physics. More importantly, female physics student teachers should be helped to access technology through digital training to promote safety while online (Maria et al, 2022). As such, administrators should work with other stakeholders so that different digital divides are avoided by creating a favorable conducive environment where all the resources and infrastructure are in place.

### 4.3.3 Priority Areas Stressed by Lecturers

Table 4.16 below indicated that majority, Five (05) of the Twelve (12) physics lecturers concentrate more on advocating for student teachers on the actual use of information technology equipments which represented 41.7%. This was followed with Four (04) who advocated for the use of IT equipments in making physics resources amounting to a score of 33.3%. Lastly, Three (03) lecturers representing 25% of the lecturers advocated for the use of specific software.

**Table 4.16**

*Showing Priority Areas Advocated by Physics Lecturers in Technology Integration*

| Areas Stressed by lecturers | Frequency | Percentage (%) |
|---|---|---|
| **Actual use of IT Equipment** | 05 | 41.7 |
| **Use of specific software** | 03 | 25 |
| **Use of IT equipment in making physics resources** | 04 | 33.3 |
| **Total** | 12 | 100 |

**Source: Primary Data**

Viewing the findings above, it can be argued that lecturers stressed the specific areas where they were knowledgeable. It is therefore necessary that lecturers and student teachers are equipped with the resources which necessary in incorporating ICT and gender .This can be materials, human and financial which can be used to procure required IT equipments, recruit ICT experts and organize refresher courses to empower implementers with knowledge and skills necessary in implementing the innovation. Result from the Table 4.16 above confirmed that physics lecturers are inefficient in using IT equipments and software, Blundell et al (2020) noted that provision of technological equipment may not be of value to teachers who have no competency for integrating ICT in teaching and learning. This calls for administrators' efforts in equipping teachers with the different dimensions of knowledge advocated by Ferjsavec (2017).

#### 4.3.4 The Use of ICT and Gender Incorporation in Elimination of Physics Misconceptions

The Table 4.17 below shows the different methods that are employed by physics lecturers in teaching. Focus was put on the extent to which lecturers where using technology to reduce gender disparity in performance and enrolment. This results from their lack of concepts or provision of misconceptions in learning.

**Table 4.17**

*Lecturers 'Responses on Ways of Integrating ICT in Eliminating physics Misconceptions Teaching*

| Way | Frequency | Percentage (%) |
|---|---|---|
| **Interactive Simulations and Virtual Labs** | 05 | 41.7 |
| **Multimedia Presentations and Visualizations** | 05 | 41.7 |
| **Customizable Learning Paths** | 04 | 22.2 |
| **Online Discussion Forums and Collaborative Platforms** | 00 | 00 |
| **Gender Inclusive Teaching Strategies** | 08 | 66.7 |
| **Diverse Representations in Teaching Materials** | 06 | 50 |
| **Active Learning Strategies** | 11 | 91.7 |
| **Real Life Application Through Technology** | 03 | 25 |
| **Feedback and Assessment Strategies** | 10 | 83.3 |
| **Cultivating a Growth Mindset** | 07 | 58.3 |

**Source: Primary Data**

Information from the Table 4.17 above indicated that Eleven (11) lecturers acknowledged that they use active learning strategies in overcoming physics misconceptions by student which amounted to a 91.7%. This was later followed by Ten (10) lecturers noting that they use feedback and assessment strategies in guiding students to clear their misconceptions which were shown with the 83.3% score. Much as there were other ways which were used in avoiding physics misconceptions with the percentage score of above 50% like gender inclusive technologies and cultivation of a growth mindset, there other ways which were not completely employed like use of online discussion forums. Those methods for eliminating misconceptions in Physics which were used by less than 50% of the lecturers included customizable learning paths (22.2%), real life application through technology (25%), and use of interactive simulations and virtual labs with multimedia presentations and visualizations at 41.7%.

According to the sociocultural theory of learning, individuals should be situated in particular social and cultural contexts (Rekeda, 2002). Shambaigh & Maghara (2000) links this situatedness to the development of higher order functions which can be acquired and cultivated through social interactions needed in the development of cognition. It is therefore necessary that physics lecturers adopt the incorporation of ICT and gender for physics student teachers so that opportunities are created for physics student teachers to interact with their lecturers and content. This can be done through the use of different learning platforms like WhatsApp, twitter ,face book where all students regardless of gender are given opportunities to interact with physics content.

Accordingly, physics lecturers should prepare students for a rapidly changing digital landscape. College administrators should collaborate with other stakeholders to ensure that lecturers are prepared to transfer ICT skills to the student's through lateral transfer of learning. The lecturers should be empowered with more ICT competences through training and retraining with the focus on gender .This empowerment should be guided by the theories of TPACK, diffusion of innovation theory and the sociocultural environment. All factors which influence adoption of information and communication technology should be addressed to ensure effective elimination of physics misconceptions through incorporation of ICT and gender in teaching.

### 4.3.5 Categorization of Physics Lecturers

Viewing Table 4.18 below, responses from physics lecturers regarding their categorization into different adopter categories reveal a distribution across the innovation adoption spectrum. The largest group among the surveyed lecturers belongs to the late majority category, comprising Four (04) out of Twelve (12) which is 33.3% of the total responses. This suggests that a significant portion of lecturers tends to adopt new teaching methods or technologies only after they have become widely accepted or established within the field.

**Table 4. 18**

*Responses from Physics Lecturers Showing Their Categorization*

| Category | Frequency | Percentage (%) |
|---|---|---|
| **Innovators** | 00 | 00 |
| **Early adopters** | 02 | 16.7 |
| **Early majority** | 02 | 16.7 |
| **Late majority** | 04 | 33.3 |
| **Laggards** | 04 | 33.3 |
| **Total** | **12** | **100** |

**Source: Primary Data**

The Table 4.18 above continues to show that the second group following the first category is the laggards, also representing 33.3% of respondents. This group typically adopts innovations reluctantly and often only when pressured to do so, indicating a more conservative approach to embracing change within teaching practices. Meanwhile, the early adopters and the early majority each account for 16.7% of responses, indicating a smaller but notable proportion of lecturers who are more open to trying out new methods or technologies earlier in their adoption cycle.

Surprisingly, there are no respondents categorized as innovators, suggesting that none of the lecturers identified themselves as pioneers or trailblazers in adopting innovative teaching practices. Focusing on the DOI theory, it is assumed that different populations adopt new innovations at different rates (Jarson, 2022). Efforts should be made by TTI administrators to ensure that ICT is embraced. This can be handled through the procurement of ICT gadgets conducting trainings and retraining where students and lecturers can be equipped with knowledge and skills on hardware, software and application management and provide access to IT equipment for them to collaborate and network with others and the students at large. Refresher courses need to be organized so that lecturers are equipped with the required ICT competences needed for adopting ICT and gender incorporation in teaching (Salim, 2006). Overall, the distribution reflects a varied landscape of adoption behaviors among physics lecturers, with a substantial portion preferring to wait and observe before embracing change, while others are more proactive in their approach to adopting new methodologies or technologies

### 4.3.6 Methods of Teaching Used by Physics Lecturers

**Table 4.19**

*’ Responses from Lecturers on the Methods Used in Teaching Physics*

| Method Used by Physics Lecturers | Frequency | Percentage (%) |
|---|---|---|
| **Project Based Learning** | 09 | 75 |
| **Blended Learning** | 02 | 16.7 |
| **Class Experiments** | 06 | 50 |
| **Flipped Classroom** | 01 | 8.3 |
| **Inquiry Based Learning** | 09 | 75 |
| **Collaborative Learning** | 02 | 16.7 |
| **Interactive Simulations and Virtual laboratory** | 03 | 25 |
| **Discussion** | 12 | 100 |
| **Interactive Question and Answer** | 10 | 83.3 |
| **Lecture** | 12 | 100 |
| **Online Collaboration and Discussion** | 04 | 33.3 |

***Source: Primary Data***

The Table 4.19 above presents the methods which were applied by physics lecturers in the teaching of Physics concepts. The dynamic landscape of contemporary education, the effective teaching of physics demands a nuanced understanding of pedagogical approaches and instructional methods tailored to engage and empower learners. Table 4.19 revealed that among the methods used by physics lecturers, discussion and lecture-based instruction received the highest scores, with 100% frequency each. This suggests that traditional teaching formats remain prevalent within physics education, indicating a reliance on direct instruction and verbal exchanges to convey knowledge. Following closely behind are project-based learning and inquiry-based learning, both registering at 75%. These active learning approaches emphasize hands-on exploration and problem-solving, highlighting a commitment among lecturers to engage students in meaningful, experiential learning experiences.

Additionally, class experiments, interactive question and answer sessions, and interactive simulations/virtual laboratories garnered moderate frequencies, ranging from 25% to 50%, indicating a varied approach to integrating practical and interactive elements into teaching methodologies. However, blended learning, flipped classroom models, collaborative learning, and online collaboration/discussion methods received lower frequencies, suggesting that while some lecturers are embracing innovative approaches, there may be room for further exploration and adoption of alternative pedagogical strategies within the discipline of physics education.

Generally, the data reflects a diverse landscape of instructional methods employed by physics lecturers, with a blend of traditional and innovative approaches aimed at enhancing student engagement and learning outcomes. Information from Table 4.19 above revealed that all physics lecturers used discussion and lecture methods .This was followed with interactive question and answer, inquiry based learning, project based learning and class experiments. Nonetheless, other methods like blended learning, interactive simulations and virtual laboratory, online collaboration, and discussion were used by few lecturers. This could be associated to their inability to use ICT in promoting inclusion and diversity among all students. Mishra &Thompson (2009) clarified that the use of pedagogical methods and technology has the ability to deliver physics specific content with the use of their TPACK. This indicates that physics lecturers should be equipped with ICT skills needed in using methods that require the use of ICT to reduce gender disparities in performance, enrolment and benefit from technology among science students. Focus should be put on reducing their resistance to adopting the incorporation of ICT and gender in teaching. Jarson (2022) advises that for the innovation to diffuse, emphasis should be put on communication channel, time frame and availability of the social structure. In this respect, lecturers should use participatory methods that promote interaction between lecturers, students and content through the adoption of ICT as it has the ability to revolutionalise the quality of teaching and learning.

### 4.3.7 ICT Development Stages Reached by Lecturers

Responses from lecturers in Table 4.20 below regarding their ICT development stages revealed that the most frequently reported stage is recognition, accounting for 50% of the total responses. This suggests that half of the surveyed lecturers have acknowledged the importance and potential benefits of ICT integration in teaching practices.

**Table 4.20**

*Responses from Lecturers on Their ICT Development Stages Reached*

| ICT Development stage | Frequency | Percentage (%) |
|---|---|---|
| **Recognition** | 06 | 50 |
| **Persuasion** | 03 | 25 |
| **Decision adaptation** | 02 | 16.7 |
| **Implementation** | 01 | 8.3 |
| **Confirmation** | 00 | 00 |
| **Total** | 12 | 100 |

***Source: Primary Data***

. Following recognition is the persuasion stage, with 25% of respondents indicating that they are in the process of convincing themselves or others about the value of adopting ICT. Meanwhile, the decision adaptation stage is reported by 16.7% of lecturers, indicating that some are in the process of adjusting or adapting their decisions regarding ICT implementation based on evolving circumstances or information. A smaller proportion, representing 8.3% of responses, reported being in the implementation stage, suggesting that only a few lecturers have progressed to actively incorporating ICT into their teaching methodologies. Notably, there were no respondents in the confirmation stage, indicating that none of the lecturers have completed the process of confirming the effectiveness or success of their ICT integration efforts.

Viewing the above trend, the data suggests a mixed landscape of ICT development stages among lecturers, with varying degrees of progress in recognizing, persuading, deciding, and implementing ICT integration within their teaching practices. These findings revealed that the degree of adoption of ICT in teaching physics concepts was low. This could be linked to lecturers' lack of knowledge on specific technological tools like hardware, software and applications which are capable of instructing and guiding students in understanding physics content (Kurt, 2019).This requires the organization of refresher courses aimed at helping lecturers to appreciate and embrace the incorporation of ICT and gender through the use of learner centered methods of teaching.

## 4.4 Presentation of Factors Impeding the Incorporation of ICT and Gender in Physics Teaching

### 4.4.1 Factors Limiting the Incorporation of ICT and Gender in Physics Teaching

In Table 4.21 below, factors limiting the incorporation of ICT and gender in physics teaching are detailed, revealing the primary challenges encountered by educators. Topping the list is resistance to change, reported by all surveyed lecturers (Valtomen et al, 2018). This unanimous response underscores the pervasive reluctance or opposition faced by educators when attempting to integrate ICT and address gender-related issues within physics education.

**Table 4.21**

*Factors Limiting the Incorporation of ICT and Gender in Physics Teaching*

| Factor | Frequency | Percentage (%) |
|---|---|---|
| **Limited Access to Technology** | 08 | 66.7 |
| **Gender Stereotypes and Bias** | 11 | 91.7 |
| **Lack of Gender Inclusive Content** | 09 | 75 |
| **Insufficient Teacher Training** | 08 | 66.7 |
| **Cultural and Societal Norms** | 11 | 91.7 |
| **Unconscious Bias** | 11 | 91.7 |
| **Resource Constraints** | 11 | 91.7 |
| **Institutional Policies** | 10 | 83.3 |
| **Digital Divide** | 09 | 75 |
| **Resistance to Change** | 12 | 100 |

**Source: Primary Data**

Following closely behind were gender stereotypes and bias, cultural and societal norms, unconscious bias, and resource constraints, each reported by 91.7% of the respondents (Bingmulas, 2009, Khalid, Faroque & Reid, 2016)). These factors highlight the significant influence of societal attitudes, biases, and structural limitations hindering efforts to promote gender equity and effective ICT integration in physics teaching. Institutional policies emerge as another noteworthy factor, reported by 83.3% of lecturers. This suggests that institutional frameworks and regulations may not sufficiently support initiatives aimed at addressing ICT incorporation and gender equity in physics education. Additionally, challenges such as limited access to technology, insufficient teacher training, lack of gender-inclusive content, and the digital divide are reported by varying proportions of respondents, ranging from 66.7% to 75% (Rumukadev et al, 2018, Lawrence &Tar, 2018). These obstacles reflect practical barriers and educational gaps that impede the effective utilization of ICT and the promotion of gender equity in physics teaching.

The data highlights the complex array of obstacles faced by educators striving to integrate ICT and address gender-related concerns in physics education. It underscores the need for comprehensive strategies addressing technological limitations, societal attitudes, institutional barriers, and educational inequalities to foster inclusive and equitable learning environments in physics classrooms. Basing on the above findings, the principals of TTIs should work with government to ensure that the necessary facilities and resources needed to adopt ICT use in teaching physics are instituted. This can be supplemented with continuous professional developments geared towards equipping lecturers with the appropriate ICT competences as advocated by Aladejana (2007).

### 4.4.2 Role of Administrators in Overcoming Resistance on ICT Use among Lecturers

The data in the Table 4.22 below sheds light on the perceived role of administrators in overcoming resistance to ICT use among lecturers. The most prevalent role identified by the surveyed lecturers is the organization of continuous professional development, reported by all respondents (100%). This suggests a unanimous recognition among educators that ongoing training and skill development opportunities play a crucial role in addressing resistance and enhancing the effective integration of ICT into teaching practices. However, other roles such as showcasing successful examples and fostering a collaborative culture did not receive any reported frequencies. This absence may imply a gap in current administrative approaches, as these strategies are not being utilized to overcome resistance effectively. Nonetheless, providing supportive resources and aligning incentives and recognition were reported by 33.3% of respondents each, indicating some acknowledgment of the importance of these factors in facilitating ICT adoption among lecturers.

**Table 4.22**

*Role of Administrators in Overcoming Resistance on ICT Use among Lecturers*

| Role | Frequency | Percentage (%) |
|---|---|---|
| **Organization of continuous professional developments** | 12 | 100 |
| **Show casing successful examples** | 00 | 00 |
| **Providing supportive resources** | 04 | 33.3 |
| **Fostering a collaborative culture** | 03 | 25 |
| **Aligning incentives and recognition** | 04 | 33.3 |

**Source: Primary Data**

Tondeour et al (2011) noted that students experiences with computers and access to technology is positively related to their ICT self efficacy. Efforts should be made to ensure that TTIs are equipped with quality computers with the connection to the internet (Moos& Azevedo, 2009). This will provide for students to learn from computers as tutors ,interact with fellow students and lecturers, access relevant appropriate physics content and conduct self regulated learning (SRL)where CPDs can be attended to ensure efficiency and effectiveness(Kozma et al,2004).

Viewing the data above it can be argued, that administrators play a pivotal role in supporting lecturers in overcoming resistance to ICT use. By prioritizing continuous professional development, providing necessary resources, and aligning incentives, administrators can create an environment conducive to embracing technological innovation and fostering a culture of collaboration and growth within the educational institution. However, there appears to be room for improvement in utilizing strategies such as showcasing successful examples and fostering collaborative cultures, which could further enhance the effectiveness of efforts to promote ICT integration among lecturers.

### 4.4.3 Administrators' Role in Overcoming Resistance on ICT Integration by Students

**Table 4.23**

*Administrators' Role in Overcoming Resistance on ICT Integration by Students*

| Strategy of overcoming resistance | Frequency | Percentage (%) |
|---|---|---|
| **Creation of inclusive learning environments** | 04 | 33.3 |
| **Students' involvement in decision making** | 05 | 41.7 |
| **Provision of support services** | 03 | 25 |
| **Promotion of role models** | 06 | 50 |

**Source: Primary Data**

The data provided in the Table 4.23 outlines various strategies for overcoming resistance to ICT use among student teachers, indicating both frequencies and percentages. The strategy reported with the highest frequency is the promotion of role models, cited by 50% of respondents. This suggests that half of the surveyed educators view the demonstration of successful examples as an effective means of inspiring and motivating students to overcome resistance and embrace ICT integration in teaching practices. Following closely behind is students' involvement in decision-making, reported by 41.7% of respondents. This indicates recognition among educators that engaging students in the decision-making process regarding ICT use can foster a sense of ownership and accountability, ultimately facilitating acceptance and adoption among student teachers.

Creation of inclusive learning environments is the next most frequently cited strategy, reported by 33.3% of respondents. This suggests recognition that fostering inclusive environments where all individuals feel valued and respected can help mitigate resistance to ICT use by promoting a sense of belonging and collaboration. Provision of support services follows with 25% of respondents indicating its importance. This underscores the significance of offering assistance and resources to students navigating the challenges associated with ICT integration, thereby easing their transition and enhancing their confidence in utilizing technology effectively. The above findings are in line with what Sadaf et al (2016) noted that leaders in education institutions should take responsibility to overcome resistance to ICT integration by organizing resources and being involved in ICT integration. This calls for them to be models of the ICT integration attributes that they want teachers to emulate. This is backed with Kiven et al (2008) and Osborn & Hennessey (2008) who stressed that teachers should teach them ICT literacy and create necessary conditions for ICT use. The data suggests that promoting role models, involving students in decision-making processes, and creating inclusive learning environments are perceived as the most effective strategies for overcoming resistance to ICT use among students. However, there may be opportunities for improvement in the implementation of support services, student awareness campaigns, and feedback mechanisms to further enhance the effectiveness of efforts in this regard.

### 4.4.4 Document Analysis on ICT and Gender Integration in Teaching

The researcher tried to analyze schemes of work and teaching- learning materials in the classrooms and the following were the observations:-

The Researcher checked schemes of work and lesson plans but little attention was drawn towards using the projector to present the content to the class through normal teaching lessons. This was mainly observed in most lecturers who were associating the ICT knowledge to the use of Microsoft and PowerPoint in organizing their work .these were mainly lesson notes.

No special attention was made to refer to physics online electronic resources. The assessment methods or activities were mainly traditional that required the student to respond to given questions using word or sometimes power point for class presentations.

Little attention was given the use of ICT in responding to given questions. Similarly, there was no mention of the physics lecturer's use of learning management systems in presenting assignments to students as almost no website was given for reference in lesson conduct or access to e resources.

The observations regarding the limited utilization of ICT in teaching physics highlight several areas where administrators could play a pivotal role in overcoming resistance from both lecturers and students. Drawing upon frameworks such as TPACK (Technological Pedagogical Content Knowledge), DOI (Diffusion of Innovations), and sociocultural theories pertaining to ICT and gender incorporation in physics teaching, administrators can implement targeted strategies to address these challenges effectively.

Firstly, administrators can facilitate professional development opportunities focusing on TPACK, which emphasizes the integration of technological knowledge, pedagogical understanding, and subject matter expertise. By providing training sessions that emphasize the diverse range of ICT tools and resources available for teaching physics, administrators can empower lecturers to expand their repertoire beyond traditional methods like Microsoft PowerPoint. Additionally, administrators can encourage the exploration of online electronic resources specifically tailored to physics education, thus enriching the content and enhancing the learning experience for students.

Secondly, leveraging the principles of DOI, administrators can create a supportive environment conducive to innovation adoption. This involves not only providing access to technological resources but also fostering a culture of experimentation and collaboration. Administrators can encourage lecturers to explore new assessment methods and activities that leverage ICT, such as interactive quizzes or multimedia presentations. By showcasing successful examples and providing ongoing support, administrators can help overcome resistance to change and promote the adoption of innovative teaching practices.

Furthermore, administrators can address gender disparities in ICT incorporation by incorporating sociocultural theories into their approach. This entails promoting inclusivity and diversity in both content and pedagogy, ensuring that ICT tools and resources are accessible and relevant to all students, regardless of gender. Administrators can support lecturers in designing inclusive learning experiences that cater to diverse learning styles and preferences, thus empowering all students to engage actively with ICT in their physics education. Findings confirmed that, administrators have a crucial role to play in overcoming resistance to ICT use among lecturers and students in physics education (Sadaff et al, 2016). By providing targeted professional development, fostering a culture of innovation, and promoting inclusivity, administrators can facilitate the effective integration of ICT into teaching and learning processes, ultimately enhancing the quality and equity of physics education for all students.

## 4.5 Presentation of Findings on ICT Competences Possessed by Physics Student Teachers

### 4.5.1 Students' Prior ICT competences and ICT and Gender Incorporation

Students' prior ICT competences are paramount to their learning as they influence their academic achievement positively or negatively. The table below presents responses from tutors on the impact of students' prior ICT competences on their learning achievements. The data provided in Table 4.24 below highlights lecturers' views on students' prior ICT competences and their impact on learning outcomes. The most prevalent view among lecturers is that students' prior ICT competences promote their access and familiarity with digital tools, reported by all respondents (100%). This aligns with TPACK principles, emphasizing the importance of technological knowledge in enhancing teaching and learning experiences.

**Table 4. 24**

*Lecturers 'Views on Students' Prior ICT Competences and Gender Incorporation*

| Impact Factor | Frequency | Percentage (%) |
|---|---|---|
| **It promotes students' access and familiarity with digital tools** | 12 | 100 |
| **Students with digital competences demonstrate better performance** | 11 | 91.7 |
| **Proficient skills on online research and information retrieval have better academic achievement** | 10 | 83.3 |
| **Strong ICT Communication and collaboration competes promotes students active participation in learning** | 12 | 100 |
| **Students with prior ICT competences adapt more easily to online assessments** | 10 | 83. |
| **Students with proficiency in Problem solving and critical thinking excel in subjects requiring analytical skills and application of knowledge** | 11 | 91.7 |
| **Students with prior ICT skills demonstrates better Self-directed learning** | 10 | 83.3 |

**Source: Primary Data**

Additionally, it reflects the principles of DOI, indicating a widespread recognition among educators of the role of prior ICT competences in shaping teaching practices. Following closely behind is the belief that students with digital competences demonstrate better performance, reported by 91.7% of respondents. This view resonates with sociocultural theories, suggesting that students' proficiency in ICT can positively influence their academic achievement by enabling them to engage more effectively with digital learning resources and collaborative platforms. Similarly, the belief that students proficient in online research and information retrieval achieve better academic outcomes is reported by 83.3% of respondents. This underscores the importance of ICT skills in facilitating independent inquiry and knowledge acquisition, aligning with both TPACK and sociocultural theories.

Another prevalent view is that strong ICT communication and collaboration competencies promote students' active participation in learning, reported by all respondents (100%). This reflects the sociocultural perspective, emphasizing the role of social interaction and collaboration in constructing knowledge and fostering meaningful learning experiences. Additionally, the belief that students with prior ICT competences adapt more easily to online assessments is reported by 83.3% of respondents. This supports the notion that ICT skills facilitate flexibility and adaptability in navigating digital assessment formats, resonating with both TPACK and DOI principles.

Finally, the view that students proficient in problem-solving and critical thinking excel in subjects requiring analytical skills and application of knowledge is reported by 91.7% of respondents. This underscores the importance of ICT competences in developing higher-order cognitive skills essential for academic success, aligning with TPACK principles emphasizing the integration of technological tools to enhance pedagogical practices. Information from Table 4.24 indicated that students' prior ICT competences are paramount in adopting the incorporation of ICT and gender in teaching. Hatlevik & Christopher (2016) noted that self efficacious students persist longer, work harder and show greater interest in learning. This is linked to their pursuance of activities which are in the range of their perceived competences.

Toneour et al (2011) stress that student computer attitudes are influenced by their experiences with computers and access to technology. It is therefore important that physics lecturers prepare students for self regulated learning. Rizal et al (2021) advocates for their involvement in digital media which provides a positive stimulus in knowledge and skills development which prepares them for future STEM careers. Viewing the Table 4.24 above, the data reflects a consensus among lecturers regarding the significant impact of students' prior ICT competences on various aspects of learning outcomes. By recognizing the role of ICT in promoting access, collaboration, critical thinking, and adaptability, educators can leverage these competences to create more engaging and effective learning environments, thereby enhancing students' academic achievement and success.

### 4.5.2 Benefits of Self-Efficacy to Student Teachers ICT and Gender Incorporation

**Table 4.25**

*Benefits of Self-Efficacy to Student Teachers ICT and Gender Incorporation*

| Benefit | Frequency | Percentage (%) |
|---|---|---|
| Students with high self efficacy feel motivated to participate in technology enhanced environment | 11 | 91.7 |
| Students with high self efficacy approach technological challenges with confidence that lead to effective problem solving | 09 | 75 |
| Self efficacious students are likely to adapt to new technology | 12 | 100 |
| Self efficacious students are more likely to persist when faced with challenges. | 08 | 66.7 |
| Students with high self efficacy may experience Positive learning outcomes | 10 | 83.3 |
| Self efficacy leads to the development of digital skills | 12 | 100 |
| Self efficacious students are more Confident in collaborative learning environments | 09 | 75 |

**Source: Primary Data**

Analyzing the benefits of self-efficacy to student teachers' ICT and gender incorporation through the lenses of TPACK, DOI, and sociocultural theories reveals the multifaceted impact of self-efficacy on learning outcomes and pedagogical practices. Firstly, from a TPACK perspective, self-efficacious student teachers possess the confidence and motivation to engage effectively with technology-enhanced environments, as reported by 91.7% of respondents. This aligns with TPACK principles, which emphasize the intersection of technological knowledge, pedagogical understanding, and content knowledge. High self-efficacy enables student teachers to integrate technology seamlessly into their teaching practices, leveraging their confidence to explore innovative approaches and adapt to diverse learning contexts. Secondly, drawing upon DOI principles, self-efficacious student teachers are more likely to approach technological challenges with confidence, leading to effective problem-solving, as reported by 75% of respondents. This reflects the diffusion of innovations theory, which suggests that individuals with high self-efficacy are early adopters of new technologies and are more willing to experiment and innovate. Their confidence in their abilities enables them to navigate technological complexities and harness the potential of ICT to enhance teaching and learning experiences.

From a sociocultural perspective, self-efficacious student teachers play a crucial role in fostering collaborative learning environments, as reported by 75% of respondents. Sociocultural theory emphasizes the importance of social interaction and collaboration in constructing knowledge and shaping learning experiences. Self-efficacious student teachers are more confident in their abilities to collaborate effectively with peers and students, facilitating meaningful interactions and knowledge sharing in digital learning environments. These findings rally behind Hatlevik & Christopher (2016) who clarified that self efficacious students work harder, persist longer, show great interest in learning and possess a higher achievement. It is therefore inevitable that science lecturers and students are equipped with ICT skills and knowledge. TTI administrators should make efforts to motivate them by reducing resistance to technology use in teaching and learning. More importantly, methods and approaches that require the use of ICT in teaching physics education should be adopted.

In summary, the benefits of self-efficacy to student teachers' ICT and gender incorporation are multifaceted and intersect with principles from TPACK, DOI, and sociocultural theories. High self-efficacy enables student teachers to navigate technology-enhanced environments with confidence, leading to effective problem-solving, adaptation to new technologies, persistence in the face of challenges, positive learning outcomes, development of digital skills, and confidence in collaborative learning environments. By cultivating self-efficacy among student teachers, educators can empower them to embrace technology integration and promote gender-inclusive pedagogical practices, ultimately enhancing the quality and equity of education for all learners.

### 4.5.3 Responses from Lecturers on the Relationship between Students' Computer Competences and Self-Efficacy

Student teachers' Computer experiences affect their beliefs on their ability to perform special tasks with the help of digital devices. One physics lecturer asked on the relationship between students' computer competences and their self-efficacy noted that positive computer experiences foster self-efficacy. Specifically, the teacher educator (AL1) had this to say,

> "Positive and successful experiences of students with computers related skills enhances their self-efficacy. Such experiences could be effective use of software, navigation of online platforms, and troubleshooting issues" (Transcript for Interview with AL1 on 02/12/2023)

He continued to elaborate that student teachers computer competences and self-efficacy helps them to master and acquire computer related skills. Lecturer BL2 explained that,

> "The development of students' self-efficacy stems from the acquisition and mastery of compute related competences. The confidence of students to handle tasks depends on their development in computer competences" (Interview Transcript for BL2 on 12/12/2023).

CL2 asked on the relationship between students' computer competences and self-efficacy noted that,

> "Successful problem solving experiences like trouble shooting hardware and software issues lead to the development of self-efficacy. As such, overcoming such challenges reinforces the belief in one's ability to address similar problems"(Interview on 15/12/2023).

Related to the above, another physics lecturer AL3 stressed that,

> "Positive feedback and recognition of computer related achievement to students significantly influences their self-efficacy. This means that encouragement and acknowledgement of student teachers' computer competences reinforces their belief and capabilities" (Interview on 17/12/2023).

Another lecturer BL3 clarified that,

> "Positive observation of students 'computer experiences from role models or peers influences their self-efficacy. This is because observing others succeed in computer related tasks inspires confidence in one's own abilities"(Interview on 4/01/2024).

The statements provided by physics lecturers highlight the relationship between students' computer competences and their self-efficacy, shedding light on various factors that contribute to the development of self-efficacy in the context of technology use. Firstly, the statements emphasize the importance of positive and successful experiences with computer-related skills in enhancing students' self-efficacy. Lecturer AL1 underscores the significance of effective use of software, navigation of online platforms, and troubleshooting issues as experiences that can boost students' confidence in their abilities. This aligns with Bandura's theory of self-efficacy, which posits that mastery experiences play a crucial role in shaping individuals' beliefs about their capabilities. Furthermore, the statements highlight the role of successful problem-solving experiences in fostering self-efficacy. Lecturer CL2 emphasizes that overcoming challenges, such as troubleshooting hardware and software issues, contributes to the development of self-efficacy by reinforcing students' belief in their ability to tackle similar problems. This aligns with Bandura's theory, which suggests that overcoming obstacles strengthens individuals' confidence in their problem-solving abilities.

Moreover, positive feedback and recognition of computer-related achievements are identified as significant factors influencing students' self-efficacy. Lecturer AL3 emphasizes the importance of encouragement and acknowledgment in reinforcing students' belief in their capabilities. This highlights the social and motivational aspects of self-efficacy, as individuals' beliefs are influenced by external feedback and validation. Additionally, the statements highlight the role of observation and modeling in shaping self-efficacy. Lecturer BL3 points out that observing role models or peers succeed in computer-related tasks can inspire confidence in one's abilities. This aligns with Bandura's social learning theory, which emphasizes the importance of observational learning and vicarious experiences in shaping individuals' beliefs and behaviors.

It is important for TTI administrators to procure ICT facilities which are capable of supporting student teachers in enhancing their ICT competences (Frailon,2014).Stakeholder should ensure that workshops related to incorporation of ICT and gender in teaching are organized to equip lecturers and student teachers with the required ICT competences . In summary, the statements provided by physics lecturers underscore the complex interplay between students' computer competences and their self-efficacy. Positive experiences, successful problem-solving, feedback and recognition, and observation of role models all contribute to the development of self-efficacy in the context of technology use, highlighting the importance of both individual experiences and social influences in shaping students' beliefs about their capabilities

The above lecturer BL3 continued to stress that,

> “Exposure of students to variety of technologies and applications broadens their experiences and influences their self-efficacy on many computer related tasks. This therefore mean that that familiarity with many tools contribute to a more versatile belief in their capabilities”(Interview Transcript from BL3 )

Lecturer BL3's statement can be analyzed through the lenses of TPACK, Diffusion of Innovations (DOI), and sociocultural theories, highlighting the significance of exposure to diverse technologies in shaping students' self-efficacy regarding computer-related tasks.

From a TPACK perspective, exposure to a variety of technologies and applications contributes to the development of students' technological knowledge (T), pedagogical understanding (P), and content knowledge (C). By engaging with different tools and applications, students gain practical experience in utilizing technology to enhance their understanding of subject matter and pedagogical strategies (Hains, 2022). This aligns with TPACK principles, which emphasize the integration of technological, pedagogical, and content knowledge to support effective teaching and learning practices. Regarding Diffusion of Innovations (DOI), exposure to a variety of technologies can be viewed as a form of innovation diffusion, wherein new ideas or practices are adopted and spread within a social system. By introducing students to diverse technological tools and applications, educators facilitate the diffusion of innovative practices and encourage students to explore and adopt new technologies. This aligns with DOI principles, which emphasize the importance of innovation adoption and diffusion in driving change and improvement within educational contexts.

Moreover, from a sociocultural perspective, exposure to diverse technologies provides students with opportunities for social interaction and collaborative learning, thereby shaping their self-efficacy beliefs (Rueda, 2002). Sociocultural theories emphasize the role of social interactions and cultural influences in shaping individuals' beliefs, attitudes, and behaviors. By engaging with peers and instructors in the exploration and use of various technologies, students develop confidence in their abilities and beliefs about their capacity to navigate and master technological challenges. This aligns with sociocultural theories, which highlight the importance of social learning and collaborative experiences in shaping individuals' self-efficacy and competence.

The 5$^{th}$ sustainable which advocates for achieving gender equality and empowerment of all women calls for the enhancement use of technology in reducing gender gap (Guterres, 2019).It is therefore necessary that UNITE implements a CPD frame work geared towards retooling all teachers on technology initiatives for improving the teaching learning process. In summary, Lecturer BL3's statement underscores the significance of exposure to diverse technologies in shaping students' self-efficacy regarding computer-related tasks. This analysis highlights how exposure to a variety of technologies aligns with principles from TPACK, DOI, and sociocultural theories, emphasizing the importance of integrating technological, pedagogical, and content knowledge, fostering innovation adoption and diffusion, and leveraging social interactions and collaborative experiences to support students' self-efficacy and competence in technology use.

### 4.5.4 Digital Divides Experienced by Student Teachers

#### 4.5.4.1 Types of Digital Divides Experienced by Student Teachers

The most frequently reported digital divide among student teachers is the usage divide, with 87% of respondents indicating its presence. This suggests that a significant proportion of student teachers perceive differences in how technology is utilized, which may reflect gendered patterns of engagement with digital tools and platforms. Such disparities in usage may arise from factors such as access to technology, social norms, and cultural expectations regarding gender roles in technology use.

**Table 4.26**

*Responses from Student Teachers on the Types of Digital Divides Experienced*

| Digital Divides Experienced by Student Teachers | Frequency | Percentage (%) |
|---|---|---|
| **Access divide** | 34 | 73.9 |
| **Usage divide** | 40 | 87 |
| **Skills divide** | 38 | 82.6 |
| **Attitude divide** | 32 | 69.6 |
| **Economic divide** | 38 | 82.6 |
| **Pedagogical divide** | 29 | 63.3 |
| **Cultural and societal divide** | 25 | 54.4 |
| **Regional divide** | 37 | 80.4 |

**Source: Primary Data**

Besides the above, the access divide, reported by 73.9% of respondents. While access to technology is crucial for all individuals, gender disparities in access may exacerbate existing inequalities, particularly if female student teachers face barriers to acquiring or utilizing digital devices and internet connectivity. This could result from economic constraints, unequal distribution of resources, or cultural norms that prioritize access for male counterparts. Moreover, the skills divide and economic divide, reported by 82.6% of respondents each, highlight the intersectional nature of digital inequality with economic factors and gender dynamics. Female student teachers may encounter challenges in acquiring digital skills or accessing training opportunities due to economic constraints or gendered expectations that prioritize male students' educational and career advancement in STEM fields. The pedagogical divide, reported by 63.3% of respondents, underscores the gendered implications of educational practices and instructional methods. Female student teachers may face barriers in accessing pedagogical resources or opportunities for professional development, which can impact their confidence and competence in integrating technology into teaching practices. Additionally, the cultural and societal divide and regional divide, reported by 54.4% and 80.4% of respondents respectively, highlight the influence of cultural norms, social expectations, and geographic location on digital inclusion. Gender norms and stereotypes prevalent in specific cultural contexts may restrict female student teachers' access to technology or limit their opportunities for digital participation, exacerbating regional disparities in digital access and opportunities.

Plan international (2022) noted that Gender Digital Divide (GDD) stands at 32.9% with only 19%of the women in LDC able to use the internet (ITU, 2022). It is therefore vital for the government to work with other donor agencies to ensure that ICT initiatives and programs in the ministry of education and sports are funded. Rizal, setaiwan, & Rusdiana(2019)noted that digital divide needs to be eliminated among students by ensuring availability of technology ,differences in technology and actual skills and benefits gained on the internet and ICT. Specifically, efforts should be invested in incorporating ICT and gender in teacher development, training and management practices (MOES, 2018). This can ensure equitable access and use of technology by all students irrespective of gender. Comprehensively, the data underscores the multifaceted nature of digital divides experienced by student teachers through a gender lens. Addressing these divides requires comprehensive strategies that consider the intersecting influences of gender, socioeconomic status, pedagogical practices, cultural norms, and regional disparities to promote equitable access to technology and empower all student teachers to harness the potential of digital tools for learning and professional.

#### 4.5.4.2 Ways of Avoiding the Digital Divides Experienced by Student Teachers

When lecturers were asked on how they can avoid digital divide, this is what they said. Lecturer AL3 clarified that

> "Digital divide can be avoided by offering stable internet connectivity which is affordable and organizing digital literacy training for students"(Interview Transcript by AL3).

Another lecturer AL1 also added that digital divide can be avoided by infusing ICT in all lessons of physics. This was supplemented with what BL1 stressed that " Digital divide can be avoided by creating an inclusive environment towards the access of computer laboratory, Using available technology avoids digital divide (Interview Transcript by CL1),Provision of a balanced equipment of ICT to all students in all regions of the country(Interview Transcript by AL1),Motivating student teachers ,increasing accessibility and affordability of the ICT gadgets (Interview Transcript by BL2 ) and finally being gender sensitive(Interview Transcript by CL3).

The responses provided by lecturers offer insights into strategies for addressing the digital divide, which can be analyzed through the lenses of TPACK, Diffusion of Innovations (DOI), and sociocultural theories. Firstly, from a TPACK perspective, the emphasis on infusing ICT in all lessons of physics, as suggested by Lecturer AL1, aligns with the integration of technological, pedagogical, and content knowledge. By incorporating ICT into teaching practices, educators can enhance students' learning experiences and digital literacy skills, addressing both access and usage aspects of the digital divide. This approach emphasizes the importance of leveraging technology to support teaching and learning objectives, in line with TPACK principles. Moreover, the suggestions for providing stable internet connectivity, organizing digital literacy training, and ensuring access to computer laboratories align with DOI principles, which emphasize the importance of innovation adoption and diffusion. By ensuring reliable access to technology and providing training opportunities, educators facilitate the adoption and integration of ICT into educational practices, thereby narrowing the digital divide (Ellermeijer & Tran, 2019). These strategies aim to promote the widespread adoption of technology and create a supportive environment conducive to digital inclusion. From a sociocultural perspective, the emphasis on creating an inclusive environment and being gender-sensitive reflects the importance of addressing cultural norms, social barriers, and gender disparities in access to technology. Sociocultural theories highlight the influence of social interactions, cultural practices, and power dynamics in shaping individuals' experiences and opportunities. By fostering inclusivity and sensitivity to gender differences, educators can create a supportive and equitable learning environment that promotes digital inclusion for all students.

Furthermore, the suggestions for increasing accessibility and affordability of ICT gadgets, motivating student teachers, and providing balanced equipment to all students across regions align with sociocultural theories, which emphasize the importance of addressing systemic inequalities and structural barriers. By addressing economic constraints, providing equitable access to resources, and fostering motivation and engagement, educators can mitigate the effects of the digital divide and promote equitable opportunities for all students (Hains, 2021). The strategies proposed by lecturers for addressing the digital divide resonate with principles from TPACK, DOI, and sociocultural theories, emphasizing the importance of integrating technology into teaching practices, promoting innovation adoption and diffusion, and fostering inclusivity, equity, and cultural sensitivity in educational contexts. These approaches highlight the multifaceted nature of the digital divide and the need for comprehensive strategies that address technological, pedagogical, economic, and sociocultural factors to promote digital inclusion for all students. As such, physics lecturers should be conversant with ICT tools capable of transforming teaching and learning (Narinderrit, 2020).This can be achieved through acquisition of prerequisite technological competences needed to conduct effective teaching with digital platforms

### 4.5.5 ICT Competences Possessed by Student Teachers

#### 4.5.5.1 Nature of ICT Competences Possessed by Student Teachers

Analyzing the ICT competences possessed by student teachers through the lenses of TPACK, DOI, and sociocultural theories offers insights into their readiness to integrate technology into teaching practices and navigate digital environments effectively. Table 4.27 below revealed that Integration of ICT in lesson planning emerges as the most prevalent competence, reported by 43.5% of student teachers. This aligns with TPACK principles, emphasizing the intersection of technological, pedagogical, and content knowledge. Student teachers with proficiency in integrating ICT in lesson planning demonstrate an understanding of how to leverage technology to support teaching objectives and enhance learning experiences, reflecting a holistic approach to technology integration.

Online research skills and proficiency with the use of digital communication tools follow closely behind, reported by 41.3% and 39.1% of student teachers respectively. These competences align with TPACK and DOI principles, as they reflect the ability to access and utilize digital resources effectively, as well as the adoption and diffusion of communication technologies for educational purposes. Student teachers with strong online research skills and proficiency in digital communication tools are better equipped to engage with digital content and collaborate with peers and students in online environments.

**Table 4.27**

*ICT Competences Possessed by Student Teachers*

| ICT Competences Possessed by Student Teachers | Frequency | Percentage (%) |
|---|---|---|
| **Digital literacy** | 16 | 34.8 |
| **Basic computer skills** | 28 | 60.9 |
| **Possession of knowledge on educational software and tools** | 15 | 32.6 |
| **Proficiency with the use of digital communication tools** | 18 | 39.1 |
| **Production of media content** | 10 | 21.7 |
| **Information management skills** | 15 | 32.6 |
| **Online research skills** | 19 | 41.3 |
| **Adaptability to new technologies** | 08 | 17.4 |
| **Integration of ICT in lesson planning** | 20 | 43.5 |
| **Assessment and feedback provision using technology** | 04 | 8.7 |
| **Remote teaching skills** | 10 | 21.7 |
| **Cyber security awareness** | 05 | 10.9 |

**Source: Primary Data**

Basic computer skills and digital literacy are also prevalent among student teachers, reported by 60.9% and 34.8% respectively. While these competences form the foundation for digital literacy and technology use, they are essential for building confidence and competence in navigating digital environments. From a sociocultural perspective, access to training and resources plays a crucial role in developing these foundational skills, highlighting the importance of addressing systemic inequalities and providing equitable opportunities for all student teachers to acquire basic digital competences. Other competences such as information management skills, production of media content, and adaptability to new technologies demonstrate varying levels of prevalence among student teachers, reflecting the diverse range of skills required to navigate digital environments effectively. While some competences, such as remote teaching skills and cyber security awareness, are reported by fewer student teachers, they underscore the importance of addressing emerging challenges and considerations in digital learning environments.

Findings from the Table 4.27 above revealed that a minimal number of science teachers possess some ICT competences .However, Kubrickya & Castkove(2015) stress that technological competence must be possessed by all teachers as a professional competence. it is therefore relevant that TTI administrators utilizes ICT funds contributed by the student teachers through PTA collections to procure ICT equipment and organize ICT related trainings and retrainings to enable students and lecturer enhance and use their ICT skills and knowledge in teaching and learning physics concepts. To crown it all, the competences possessed by student teachers reflect the intersection of technological, pedagogical, and sociocultural factors. This highlights the importance of comprehensive strategies that address systemic inequalities, promote innovation adoption and diffusion, and foster inclusive and equitable opportunities for all student teachers.

#### 4.5.5.2 Comparison of ICT Competences Possessed by Student Teachers by Sex

Physics lecturers were asked to compare ICT skills possessed by female and male student teachers, this is what they noted. Lecturer CL3 revealed that,

> "From my perspective, it appears that male students are better versed with ICT skills compared to their female counter parts" (CL3 Transcript from the interview).

Related to the above, one lecturer BL1 put that "Female physics students have little engagement in the use of ICT for learning". This was supported with AL2 who stated that "Females have fewer ICT skills compared to male students". Additionally Lecturer CL1 noted that males achieve faster than females. Nonetheless, lecturers AL1 and CL3 opinionated that female physics student teachers and male physics student teachers have equal and average ICT competences respectively.

Analyzing the observations of physics lecturers regarding the ICT skills possessed by female and male student teachers through the lenses of TPACK, DOI, and sociocultural theories provides insights into the gendered dynamics of technology use and digital literacy. From a TPACK perspective, the observations suggest disparities in the integration of technological, pedagogical, and content knowledge among female and male student teachers. Lecturer CL3's perspective that male students are better versed with ICT skills implies differences in technological competence, which may impact their ability to effectively integrate technology into teaching practices. This aligns with TPACK principles, as proficiency in ICT skills is essential for leveraging technology to enhance teaching and learning experiences. Furthermore, the observations reflect the influence of sociocultural factors on technology use and digital literacy. The statements suggesting that female physics students have little engagement in ICT for learning and possess fewer ICT skills compared to male students highlight the impact of cultural norms and gender stereotypes on access to and utilization of technology. Sociocultural theories emphasize the role of socialization and cultural expectations in shaping individuals' beliefs, attitudes, and behaviors, including their engagement with technology.

Besides, the observations suggest potential disparities in access to training and resources, which may contribute to differences in ICT skills between female and male student teachers. Lecturer BL1's statement that female physics students have little engagement in ICT for learning could indicate limited opportunities or support for female students to develop digital literacy skills. This reflects DOI principles, as unequal access to training and resources can impede the diffusion of technology adoption and exacerbate digital divides. These findings align with what Voltman (2001) put that female teachers have low levels of computer use due to their access, skills, and interest. Related to the above, Wozneyet al(2006) also acknowledges that male teachers used more information technology in their teaching than their counterparts the females. Conclusively, the observations of physics lecturers highlight the complex interplay of technological, pedagogical, and sociocultural factors in shaping ICT skills among female and male student teachers. Disparities in access to training, cultural norms and gender stereotypes, and societal expectations contribute to differences in digital literacy and technology use. Addressing these disparities requires comprehensive strategies that promote equitable access to training and resources, challenge gender stereotypes, and foster an inclusive and supportive learning environment for all student teachers, regardless of gender. More importantly, lecturers should ensure that students use technology to learn what technology knows and learn what is contained in it (Siemens, 2007)

### 4.5.6 Lecturers’ Role in Developing Students’ ICT Skills

**Table4.28**

*Physics Lecturers’ Views on their Role in Developing Students ICT Competences.*

| Lecturer’ Role | Frequency | Percentage (%) |
|---|---|---|
| **Modelling effective ICT use** | **05** | **41.7** |
| **Incorporation of ICT into instruction** | **07** | **58.3** |
| **Provision of hands on ICT activities** | **05** | **41.7** |
| **Guiding independent research** | **12** | **100** |
| **Utilization of learning management systems** | **04** | **33.3** |
| **Addressing digital ethics and responsibility** | **03** | **25** |

**Source: Primary Data**

Analyzing physics lecturers' views on their role in developing students' ICT competences through the lenses of TPACK, DOI, and sociocultural theories provides insights into their approaches to integrating technology into teaching practices and fostering digital literacy. Guiding independent research emerges as the most prevalent role identified by physics lecturers, reported by 100% of respondents. This aligns with TPACK principles, emphasizing the importance of providing students with opportunities for independent inquiry and exploration supported by technology. By guiding independent research, lecturers facilitate students' development of critical thinking skills, digital literacy, and research capabilities, reflecting the integration of technological, pedagogical, and content knowledge.

Incorporation of ICT into instruction follows closely behind, reported by 58.3% of respondents. This role aligns with both TPACK and DOI principles, as it involves the intentional integration of technology to enhance teaching and learning experiences. By incorporating ICT into instruction, lecturers promote innovation adoption and diffusion, leveraging technology to support instructional objectives and engage students in meaningful learning activities. Modeling effective ICT use and provision of hands-on ICT activities are also prevalent roles identified by physics lecturers, reported by 41.7% of respondents each. These roles align with TPACK principles, as they involve demonstrating and facilitating students' use of technology in authentic contexts. By modeling effective ICT use and providing hands-on activities, lecturers foster students' digital literacy skills and confidence in utilizing technology for learning and problem-solving. Utilization of learning management systems was acknowledged by 33.3 % of the physics lecturers.This calls for the efforts to strengthen lecturers' and students' ability to use their TPACK in teaching and learning. It also gives students an opportunity to interact and share with others content through the adoption of ICT and gender incorporation in teaching.

Additionally, addressing digital ethics and responsibility, reported by 25% of respondents, underscores the importance of promoting responsible and ethical use of technology. This role reflects sociocultural theories, which emphasize the role of educators in guiding students' ethical behavior and digital citizenship. By addressing digital ethics and responsibility, lecturers contribute to students' development of critical perspectives on technology use and awareness of ethical considerations in digital environments.

Aladejana (2007) emphasizes on the use of ICT in promoting their intellectual abilities through higher order thinking, problem solving, and improved communication and understanding of technology tools and concepts. To overcome this, physics lecturers should support science student teachers to acquire learnt concepts by giving them activities that simplify the abstract concepts to become concrete. This can later enable them to understand what is taught and consequently high achievement. However, their efforts could be limited by their TPACK in teaching them ICT literacy, knowledge on assessment and digital communication and cooperation (Kiven et al, 2018). This calls for the enhancement of physics lecturers and students ICT competences through training and retraining. The roles identified by physics lecturers highlight their multifaceted approach to developing students' ICT competences, encompassing a range of instructional strategies and pedagogical practices. By guiding independent research, incorporating ICT into instruction, modeling effective ICT use, providing hands-on activities, and addressing digital ethics and responsibility, lecturers play a critical role in fostering students' digital literacy skills and preparing them for success in an increasingly digital world.

When physics lecturers were asked on how they support their student teachers, this is what was stated by one lecturer AL1,

> "Teaching them how to use it, encourage them to buy laptops, smart phones, developing positive attitudes concerning the use of ICT, and giving them tasks that involve ICT "(Interview Transcript from AL1).

Another Lecturer CL1 also emphasized that,

> "I help them to develop ICT skills by encouraging them to research using smart phones and encourage them to do course works and assignment submission on soft copy"

On addition to the above views, BL1 noted that "I allow student teachers to access the computer laboratory" (Interview Transcript from BL1), AL1stated that he ensures that student teachers are continuously engaged in using ICT in their learning (Interview Transcript by AL1) and AL3 that he supports student teachers by " giving them assignments and encouraging them to search for information online, sending lecturer notes and assignment online"(Interview Transcript by AL3).

The statements from the lecturers shed light on the multifaceted approaches they employ to support student teachers in enhancing their ICT skills and incorporating technology into their teaching practices.

Lecturer AL1 emphasizes the importance of direct instruction in ICT, ensuring that student teachers acquire practical skills necessary for effective technology use. Additionally, both AL1 and CL1 stress the significance of encouraging student teachers to have personal access to technology like laptops and smart phones, facilitating their independent engagement with digital tools. Moreover, fostering positive attitudes towards ICT, as mentioned by AL1, is crucial for empowering student teachers to embrace technology confidently. Integration of ICT into coursework, assignments, and tasks, as advocated by AL1 and CL1, provides student teachers with opportunities to apply their skills in real-world contexts.

BL1 highlights the importance of providing access to computer laboratories, offering controlled environments for student teachers to explore and utilize ICT resources under supervision. AL1 further emphasizes the need for continuous engagement with ICT to ensure student teachers remain updated with technological advancements. Finally, AL3 underscores the significance of online support and resources, such as assignments and lecturer notes, in facilitating convenient access to educational materials. Collectively, these strategies demonstrate a comprehensive approach to supporting student teachers in developing their ICT proficiency and leveraging technology effectively for teaching and learning

#### 4.5.7 Websites Used by Lecturers for Planning Physics Lessons

**Table 4.29**

***Websites Consulted by Physics Lecturers Based on Documentary Analysis***

| **Website** | Frequency | Percentage |
|---|---|---|
| **Phet interactive simulations** | 04 | 33.3 |
| **Khan academy** | 05 | 41.7 |
| **Physics classroom** | 04 | 33.3 |
| **American Association of Physics Teachers** | 06 | 50 |
| **Share ability Uganda** | 04 | 33.3 |
| **Digital teachers Uganda** | 02 | 16.7 |

**Source: Primary Data**

The analysis of the websites consulted by physics lecturers, as presented in Table 4.31, offers valuable insights into their preferences and strategies for accessing educational resources. Among the consulted websites, Phet Interactive Simulations and Physics Classroom were each accessed four times, indicating their popularity, likely due to their provision of interactive simulations and comprehensive tutorials, respectively. Khan Academy, renowned for its extensive collection of educational videos and exercises across various subjects, including physics, was consulted five times, demonstrating its significance as a supplementary resource for lecturers seeking additional explanations and materials.

The American Association of Physics Teachers (AAPT) website, with six consultations, emerged as a prominent resource, possibly due to its role as a professional organization dedicated to advancing physics education, offering a wide range of resources and professional development opportunities. Additionally, Shareability Uganda and Digital Teachers Uganda were consulted four and two times, respectively, indicating lecturers' interest in accessing local or context-specific resources tailored to the educational landscape of Uganda. This diverse range of consulted websites reflects lecturers' proactive efforts to access a variety of online resources, both international and local, to enrich their teaching practices and enhance students' learning experiences in physics.

## 4.6 Presentation of Findings on Student Teachers' Use of ICT in Learning Physics

### 4.6.1 Relationship between Students' ICT Use and Learning Achievement

When student teachers were asked on the relationship between ICT use and their learning achievement, this what one student AS8 clarified,

> "Of course sir in this current world everything that we do depends on technology. Equally in the teaching profession, students depend on Google search for doing assignments and communicating with others. When you linkup with other people, you can discuss things which can make you pass highly"

Related to the above another student BS5 emphasized that

> "There is great scenario behind technology because it is either good or bad depending on the way you are using. When students use ICT willingly to help them learn through computer guided learning or self regulated learning, they excel. Where they misuse ICT in doing other things like watching useless movies on the internet, they can fail because they have lost focus"

The responses from student teachers regarding the relationship between ICT use and their learning achievement highlight several key points within the Ugandan context. Firstly, student AS8 emphasizes the ubiquitous nature of technology in contemporary society, highlighting its indispensability in various aspects of life, including education. This sentiment reflects the increasing reliance on ICT tools such as Google search for academic tasks and communication. The student's acknowledgment of the collaborative potential enabled by ICT underscores its role in facilitating peer-to-peer learning and knowledge sharing, ultimately contributing to academic success.

Similarly, student BS5 underscores the dual nature of technology, portraying it as a tool that can either enhance or detract from learning outcomes depending on its usage. This recognition of the importance of intentionality in ICT utilization aligns with the challenges faced by educators in promoting responsible and purposeful technology integration in the classroom (Nhungu, 2012). The student's differentiation between constructive engagement with ICT for educational purposes, such as computer-guided or self-regulated learning, and its potential misuse for non-academic activities underscores the need for digital literacy and responsible use practices among students.

In simple terms, these responses highlight the complex interplay between ICT use and learning achievement among student teachers in Uganda. They underscore the need for educators to leverage technology effectively to enhance learning outcomes while also addressing challenges related to digital distraction and misuse. This analysis emphasizes the importance of fostering digital literacy skills and promoting responsible ICT use practices to maximize the educational benefits of technology in Ugandan classrooms. Ra et al (2016) encourages teachers to use ICT in teaching to provide collaboration as students cooperate, communicate and interact with others as they learn to work with peers through team work and project work. Zafar & Khan (2017). Students should be supported to access hardware and, software and applications that can instruct and guide them to a better and more robust understanding of physics concepts.

#### 4.6.2 Lecturers' Concerns in the Use of Technology in Addressing Gender Differences

**Table 4.30**

*Showing Lecturers' Concerns on Gender in integrating ICT in Teaching*

| Concern | Frequency | Percentage (%) |
|---|---|---|
| **Experiential learning** | 04 | 33.3 |
| **Conducting class discussion** | 12 | 100 |
| **Cooperative learning** | 06 | 50 |
| **Inquiry based instruction** | 07 | 58.3 |
| **Students led instruction** | 10 | 83.3 |
| **Proper seating arrangement** | 08 | 66.7 |
| **Giving wait time to ladies** | 03 | 25 |
| **Ensure quality and equity** | 06 | 50 |
| **Gender sensitive language** | 03 | 25 |
| **Use of variety of ICT tools** | 03 | 25 |

**Source: Primary Data**

Analyzing physics lecturers' views on their role in developing students' ICT competences through the lenses of TPACK, DOI, and sociocultural theories provides insights into their approaches to integrating technology into teaching practices and fostering digital literacy. Table .4.30 above presents a detailed account of the research findings. Guiding independent research emerged as the most prevalent role identified by physics lecturers, reported by 100% of respondents. This is normally done through class discussions where members are encouraged to do thorough consultations through social interaction before actual presentation.

The above findings are in agreement with what Scot (nd) put that students should be led through guided participation which is promoted through social activity. To him, focus should be placed on the interaction between students and lecturers using a cognitive development enterprise. This aligns with TPACK principles, emphasizing the importance of providing students with opportunities for independent inquiry and exploration supported by technology. By guiding independent research, lecturers facilitate students' development of critical thinking skills, digital literacy, and research capabilities, reflecting the integration of technological, pedagogical, and content knowledge.

Incorporation of ICT into instruction follows closely behind, reported by 58.3% of respondents. This role aligns with both TPACK and DOI principles, as it involves the intentional integration of technology to enhance teaching and learning experiences. By incorporating ICT into instruction, lecturers promote innovation adoption and diffusion, leveraging technology to support instructional objectives and engage students in meaningful learning activities (Rabach, 2015). Modeling effective ICT use and provision of hands-on ICT activities are also prevalent roles identified by physics lecturers, reported by 41.7% of respondents each. These roles align with TPACK principles, as they involve demonstrating and facilitating students' use of technology in authentic contexts. By modeling effective ICT use and providing hands-on activities (Makanda, 2015), lecturers foster students' digital literacy skills and confidence in utilizing technology for learning and problem-solving.

Additionally, addressing digital ethics and responsibility, reported by 33.3% of respondents, underscores the importance of promoting responsible and ethical use of technology. This role reflects sociocultural theories, which emphasize the role of educators in guiding students' ethical behavior and digital citizenship (Redmond, 2015). By addressing digital ethics and responsibility, lecturers contribute to students' development of critical perspectives on technology use and awareness of ethical considerations in digital environments. The roles identified by physics lecturers highlight their multifaceted approach to developing students' ICT competences, encompassing a range of instructional strategies and pedagogical practices. By guiding independent research, incorporating ICT into instruction, modeling effective ICT use (Ringstaff &Kelly,2002), providing hands-on activities, and addressing digital ethics and responsibility, lecturers play a critical role in fostering students' digital literacy skills and preparing them for success in an increasingly digital world.

### 4.6.3 ICT Competences Used by Student Teachers in Learning Physics

**Table 4.31**

*ICT Competences Used by Student Teachers in Learning Physics*

| ICT Competence | Frequency | Percentage (%) |
|---|---|---|
| **Searching Information** | 08 | 66.7 |
| **Storing Information** | 05 | 41.7 |
| **Uploading and Downloading Documents** | 05 | 41.7 |
| **Using Power Point** | 07 | 58.3 |
| **Using Excel to Draw Graphs and Work out Calculations** | 02 | 16.7 |
| **Making Instructional Materials** | 04 | 33.3 |
| **Creating Contents** | 03 | 25 |
| **Programming Computers** | 00 | 00 |
| **Problem Solving** | 01 | 8.3 |

**Source: Primary Data**

Analyzing the ICT competences used by student teachers in learning physics provides insights into their digital literacy skills and the extent to which technology is integrated into their learning experiences as put in the Table 4.31 above. The most prevalent ICT competence reported by student teachers is searching for information, with 66.7% of respondents indicating its use

(Tondour et al, 2011). This suggests that student teachers frequently rely on digital resources to gather information related to their physics studies, highlighting the importance of information literacy skills in accessing and evaluating online content. Following closely behind are competences related to using PowerPoint, reported by 58.3% of respondents, and storing information and uploading/downloading documents, each reported by 41.7% of respondents (Fraillon, 2014). These competences reflect students' engagement with presentation software and file management tools, indicating their ability to create and organize digital materials for learning purposes.

In contrast, competences such as using Excel for graphing and calculations, making instructional materials, and creating content are reported by fewer student teachers, ranging from 16.7% to 33.3% (Hatlevik et al, 2016). While these competences are valuable for enhancing learning experiences and creating educational resources, their lower prevalence suggests potential areas for further development and integration of technology into teaching and learning practices. Moreover, competences such as programming computers and problem-solving are reported by very few student teachers, with only 8.3% and 0% of respondents indicating their use, respectively. This indicates a limited engagement with more advanced ICT skills that are relevant for computational thinking and problem-solving in physics education. Addressing these competences could enhance students' ability to leverage technology for analytical tasks and complex problem-solving challenges.

To sum up, the analysis of ICT competences used by student teachers underscores the importance of information literacy skills and basic digital tools in supporting their learning experiences in physics. While competences related to information searching and document management are prevalent, there is potential need for further development in areas such as data analysis, content creation, and computational thinking. By addressing these competences, educators can enhance student teachers' digital literacy skills and prepare them for success in utilizing technology for teaching and learning in physics education

### 4.6.4 Benefit of Incorporating ICT and Gender in Physics Learning

Analyzing the responses from student teachers on the benefits of incorporating ICT and gender in physics learning provides valuable insights into the perceived advantages of technology integration and gender considerations in educational practices.

**Table 4.32**

*Responses from Student Teachers on Benefits of Incorporating ICT and Gender in Physics Learning*

| Benefit | Frequency | Percentage (%) |
|---|---|---|
| **Promotion of student intellectual abilities** | 41 | 89.1 |
| **Provision of opportunities for investigation** | 39 | 84.9 |
| **Simplifying physics content** | 43 | 93.5 |
| **Improving communication skills** | 37 | 80.4 |
| **Transforming teaching and learning** | 45 | 97.8 |
| **Understanding learning tools** | 33 | 71.7 |
| **Developing creativity and problem solving skills** | 29 | 63. |
| **Allows students to monitor their own learning** | 40 | 85.9 |

***Source: Primary Data***

The most prevalent benefit reported by student teachers is the transformation of teaching and learning, with 97.8% of respondents indicating its importance. This suggests that student teachers recognize the potential of ICT to revolutionize educational practices, making learning more dynamic, interactive, and engaging. This aligns with TPACK principles, emphasizing the integration of technological, pedagogical, and content knowledge to enhance teaching and learning experiences. Simplifying physics content is also widely recognized as a significant benefit, reported by 93.5% of respondents. This reflects the role of ICT in breaking down complex concepts and making physics more accessible and comprehensible to students. By leveraging technology, educators can present information in interactive and visually engaging formats, catering to diverse learning styles and abilities.

Furthermore, the promotion of student intellectual abilities and provision of opportunities for investigation, reported by 89.1% and 84.9% of respondents respectively, highlight the role of ICT in fostering critical thinking, problem-solving, and inquiry-based learning. By providing access to digital resources and tools, educators empower students to explore, analyze, and evaluate scientific phenomena, promoting deeper understanding and higher-order thinking skills.Other benefits identified by student teachers include improving communication skills, developing creativity and problem-solving skills, and allowing students to monitor their own learning. These benefits reflect the multifaceted impact of ICT on students' cognitive, social, and metacognitive skills, supporting their holistic development as learners.

The above findings are in perfect agreement to what Thompson (2000) noted that the use of ICT in physics using gender lens by teacher educators has a multiplier effect. He argues that knowledge and skills are transferred from teacher trainers to students. In the same line, the research findings are also supported with Medichie (2019) who commented the power of new and emerging technologies in revolutionalizing the quality of teaching and learning. Habbler (2016) in their research discovered that the incorporation of ICT and gender has improved students understanding with great achievement in learning (Seel, 2012). In summary, the responses from student teachers highlight the diverse benefits of incorporating ICT and gender considerations in physics learning. From enhancing teaching and learning experiences to promoting critical thinking and inquiry skills, ICT integration plays a transformative role in physics education. By leveraging technology and addressing gender disparities, educators can create inclusive and engaging learning environments that empower all students to succeed in physics and beyond.

### 4.6.5 Approaches Used in Incorporating ICT and Gender in Learning

Analysis of responses in Table 4.33 below on approaches used by lecturers in incorporating ICT and gender in learning Physics provides insights into different strategies for promoting technology integration and gender equity in educational practices. The most prevalent approach reported by lecturers is the integrated approach, with 56.5% of respondents indicating its use.

This approach aligns with TPACK principles, emphasizing the integration of technological, pedagogical, and content knowledge to enhance teaching and learning experiences.

**Table 4.33**

*Responses from Lecturers on Approaches Used by Lecturers in Incorporating ICT and Gender in Learning*

| Approach | Frequency | Percentage (%) |
|---|---|---|
| **Integrated approach** | 26 | 56.5 |
| **Enhancement approach** | 12 | 26,1 |
| **Complementary approach** | 08 | 17.4 |
| **Total** | **46** | **100** |

***Source: Primary Data***

This finding aligns with Siemen (2007) who noted that students' knowledge revolves around technology. To him, students use technology to learn what technology knows and learn what is contained within technology. By adopting an integrated approach, lecturers combine technology seamlessly with instructional practices, leveraging ICT to support educational objectives and address gender disparities in learning outcomes.

The enhancement approach follows behind, reported by 26.1% of respondents. This approach reflects the use of technology to enhance existing teaching practices and improve learning outcomes. Osborn &Hennessey (2008) gives clear direction for teachers to create good conditions for ICT use, select and evaluate appropriate ICT tool for use. Proper planning should be prioritized so that appropriate assessment and learning activities are prepared through the use of relevant ICT tools. From a DOI perspective, the enhancement approach aligns with the incremental adoption of innovation, as lecturers seek to augment traditional teaching methods with digital tools and resources to enhance student engagement and achievement.

Moreover, the complementary approach, reported by 17.4% of respondents, involves using technology in conjunction with other instructional strategies to support teaching and learning goals. This approach emphasizes the role of technology as a complementary tool rather than a replacement for traditional methods. Umzeyimana et al (2018) reveals that one of the barriers to effective teaching and learning is the physics teachers' use of traditional teacher centered methods .efforts should be made to ensure that learner centered methods of teaching are used by physics lecturers . This would give room for interaction between male and female students with the use of technology enhanced methodology (UNESCO, 2004). From a sociocultural perspective, the complementary approach recognizes the importance of considering cultural norms, social dynamics, and individual differences in technology integration efforts, ensuring that technology complements and enhances rather than detracts from the learning experience. Overall, the responses from lecturers highlight a variety of approaches used in incorporating ICT and gender in learning, reflecting the complexity of technology integration and the diverse needs of students. By adopting integrated, enhancement, or complementary approaches, lecturers can leverage technology to promote equitable access to educational opportunities, foster inclusive learning environments, and empower all students to succeed in their academic pursuits

#### 4.6.6 **Approaches Used By Physics Lecturers in Teaching**

**Table 4.34**

*Approaches Used by Physics Lecturers in Incorporating ICT and Gender in Teaching*

| **Approach** | **Frequency** | **Percentage (%)** |
|---|---|---|
| **Inclusive Curriculum Design** | 02 | 16.7 |
| **Use of Interactive Simulations and Virtual Labs** | 04 | 33.3 |
| **Online Collaboration Projects** | 04 | 33.3 |
| **Blended Learning Environment** | 05 | 41.7 |
| **Integration of Gender –Inclusive Language** | 10 | 83.3 |
| **Implementation of Flipped Classroom Models** | 05 | 41.7 |
| **Utilization of Educational Applications and Games** | 06 | 50 |
| **Customization of Learning Materials** | 06 | 50 |
| **Implementing Universal Design of Learning** | 04 | 33.3 |
| **Incorporation of Social Media and Online Platforms** | 04 | 33.3 |
| **Continuous Evaluation and Feedback** | 02 | 16.7 |
| **Collaboration With Diversity and Inclusion Initiatives** | 02 | 16.7 |

**Source: Primary Data**

Physics lecturers incorporate ICT and gender in teaching physics concepts using a number of different approaches. These are designed with the aim of creating an inclusive and equitable educational environment capable of leveraging technology. The Table 4.34 above shows quantified responses from the Twelve (12) lecturers on the approaches used in teaching. Analyzing the approaches used by physics lecturers in incorporating ICT and gender in teaching through the lenses of TPACK, DOI, and sociocultural theories offers insights into their strategies for promoting technology integration and gender equity in educational practices.

Integration of Gender-Inclusive Language emerges as the most prevalent approach, reported by 83.3% of respondents. This approach aligns with sociocultural theories, emphasizing the importance of addressing gender biases and promoting inclusivity in educational environments. By using gender-inclusive language, lecturers create a more welcoming and equitable learning environment, ensuring that all students feel valued and represented.

Blended Learning Environment and Utilization of Educational Applications and Games follow closely behind, reported by 41.7% and 50% of respondents respectively. These approaches align with TPACK principles, as they involve the integration of technological, pedagogical, and content knowledge to support diverse learning needs and preferences. By blending face-to-face instruction with online resources and incorporating educational games and applications, lecturers create engaging and interactive learning experiences that cater to different learning styles and abilities.

Similarly, Online Collaboration Projects and Customization of Learning Materials, reported by 33.3% and 50% of respondents respectively, reflect the integration of technology to promote collaborative learning and personalized instruction. These approaches align with DOI principles, as they involve the adoption and diffusion of innovation to enhance teaching and learning practices. By facilitating online collaboration projects and customizing learning materials to meet students' individual needs, lecturers empower students to take ownership of their learning and engage more deeply with course content.

Additionally, the Implementation of Flipped Classroom Models and Incorporation of Social Media and Online Platforms, reported by 41.7% and 33.3% of respondents respectively, highlight the use of technology to flip traditional teaching paradigms and leverage social media for educational purposes. These approaches align with both TPACK and sociocultural theories, as they involve the integration of technology to promote active learning, collaboration, and social interaction among students.

Vandi & Djebbari (2011) specifically advises physics lecturers to design cooperative, contextual, constructive, and authentic learning where opportunities can be created to integrate mobile learning with flexible learning strategies. It is therefore inevitable that physics lecturers make the teaching learning environment conducive for ICT use. This can be promoted through the selection, and evaluation of ICT tools (Hennessey, 2008).In summary, the approaches used by physics lecturers in incorporating ICT and gender in teaching reflect a diverse range of strategies aimed at promoting technology integration and gender equity in educational practices. By leveraging technology to create inclusive learning environments, customize instruction, and empower students to actively engage with course content, lecturers can enhance teaching and learning experiences and promote equitable opportunities for all students to succeed.

**4.6.7 ICT Applications Used by Students in Learning Physics**

**Table 4.35**

*Showing Responses from Student Teachers on ICT Applications Used in Learning Physics*

| Application Used | Frequency | Percentage (%) |
|---|---|---|
| **Simulation Software** | 21 | 45.7 |
| **Learning Management Systems** | 19 | 41.3 |
| **Online Collaboration Platforms** | 15 | 32.6 |
| **Podcast and Video Lectures** | 18 | 39.1 |
| **Digital Text Books and E-Books** | 32 | 69.6 |
| **Webinars and Virtual guest speakers** | 10 | 21.7 |
| **Educational Applications for Mobile Devices** | 40 | 86.9 |
| **Online Journals and Science Blogs** | 06 | 13. |
| **Social Media Platforms** | 32 | 69.6 |

**Source: Primary Data**

Knowing the different types of application used by student teachers in learning physics helps teacher trainers in selecting the teaching methods that suit the learning styles of learners. The Table 4.35 below shows the different applications used in learning Science (Physics) Education. Analyzing the responses from student teachers on ICT applications used in learning physics provides insights into the prevalence and effectiveness of various technological tools in supporting physics education. Digital Text Books and E-Books emerge as the most widely used ICT application, reported by 69.6% of respondents. This high frequency suggests the widespread adoption of digital resources for accessing course materials and supplementary readings. Digital textbooks and e-books offer students convenient access to a wealth of information, supporting self-directed learning and providing flexibility in studying course materials.

The above was followed with Educational Applications for Mobile Devices, reported by 86.9% of respondents, and Social Media Platforms, reported by 69.6% of respondents. These applications reflect the growing trend of mobile technology and social media integration in education. Educational apps offer interactive learning experiences tailored to students' individual needs, while social media platforms provide opportunities for collaboration, communication, and knowledge sharing among peers.

Simulation Software and Learning Management Systems are also prevalent ICT applications, reported by 45.7% and 41.3% of respondents respectively. Simulation software allows students to engage in virtual experiments and explore complex scientific concepts in a safe and controlled environment. Learning management systems facilitate the organization and delivery of course materials, assignments, and assessments, streamlining communication and collaboration between students and instructors.

Podcast and Video Lectures, reported by 39.1% of respondents, and Online Collaboration Platforms, reported by 32.6% of respondents, reflect the use of multimedia resources and collaborative tools to enhance learning experiences. Podcasts and video lectures offer alternative modes of instruction, catering to diverse learning preferences, while online collaboration platforms enable students to work together on projects, share ideas, and problem-solve collaboratively. Webinars and Virtual Guest Speakers, reported by 21.7% of respondents, and Online Journals and Science Blogs, reported by 13% of respondents, are less frequently used ICT applications. However, they still provide valuable opportunities for students to engage with experts in the field, explore current research, and broaden their understanding of physics concepts beyond the classroom.

Results from Table 4.35 indicated that students had made an endeavor to use ICT applications in learning physics. Nonetheless, these could have been affected by ICT enablers (Alt, 2018, Lawrence &Tar, 2018).These are both external and internal. External enablers include access to technology; quality of software, internet, technical, administrative and peer support .Internal enablers could be personal beliefs, previous success with technology, self efficacy, allocation of ICT funds in the budget, planned policies and training programs. It is therefore necessary that physics lecturers work hand in hand with other stakeholder to ensure that these factors are reviewed to support physics lecturers and students in teaching and learning using ICT enhances gender friendly strategies. Conclusively, the responses from student teachers highlight the diverse range of ICT applications used in learning physics, reflecting the increasing integration of technology in education. By leveraging these technological tools, educators can create engaging, interactive, and personalized learning experiences that foster student engagement, deepen understanding, and promote academic success in physics education

## 4.7 Chapter Summary

This chapter presented the interpretation, analysis, and discussion of data which was collected from administrators, physics lecturers, and student teachers regarding the integration of ICT in teaching physics with focus to gender. The data emphasizes the significance of integrating Information and Communication Technology (ICT) and gender considerations in teaching physics. Various programs and initiatives aim to enhance physics lecturers' ICT competencies and promote gender equity in education. Challenges in incorporation exist, including resistance to change, gender stereotypes, and resource constraints, highlighting the need for administrative support and targeted interventions. Lecturers employ diverse teaching methods and ICT applications, focusing on enhancing learning experiences, promoting inclusivity, and fostering student engagement. Student teachers and lecturers recognize the benefits of ICT integration, such as transforming teaching and learning, simplifying complex concepts, and promoting critical thinking skills. Strategies to address digital divides and promote digital inclusion for student teachers emphasize technology integration, innovation adoption, inclusivity, equity, and cultural sensitivity. Overall, the integration of ICT and gender considerations is essential for creating inclusive, engaging, and effective learning environments in physics education.

# CHAPTER FIVE

# SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

## 5.0Introduction

This chapter presented the findings, summarizing the research outcomes and drawing conclusions based on the data collected on the topic ".The incorporation of Information and Communication Technology (ICT) and gender considerations in teaching physics education within Teacher Training Institutions (TTIs) in Eastern Uganda". It provides evidence-based recommendations aimed at enhancing the use of ICT in teaching physics, addressing the identified challenges, and fostering an inclusive and technologically enriched educational environment in TTIs. The significance and contributions of the study to the field of education, particularly in the context of ICT integration and gender equity was presented. The following headings guided the presentation, summary of the study, summary of findings, conclusions, recommendations, and suggestions for future action, personal reflection and chapter summary

## 5.1 Summary of the Study

This study investigated the incorporation of Information and Communication Technology (ICT) and gender in the teaching of physics education in Teacher Training Institutions (TTIs) in Eastern Uganda. The background of this study stems from the increasing importance of ICT in education, which has the potential to transform teaching and learning processes. The context is set within Eastern Uganda, where educational institutions are striving to integrate ICT into their curricula amidst various challenges.

The study aimed to achieve several objectives: to investigate the ICT competence levels of physics lecturers, identify the ICT applications used by physics lecturers in teaching physics in TTIs, examine the factors that impede lecturers' use of ICT in teaching physics, assess the ICT competences possessed by physics student teachers in TTIs, and compare the ability of students to use ICT to enhance their achievement by gender. These objectives guided the formulation of research questions that directed the investigation and analysis.

Adopting a mixed methods approach within the pragmatism paradigm allowed for the use of both quantitative and qualitative data, utilizing survey and case study designs. Physics lecturers, science student teachers, and administrators were selected using purposive and simple random sampling techniques. Data were collected through interview guides, questionnaires, observation guides, and document analysis review guides, and analyzed using thematic analysis and descriptive statistics.

The findings revealed varying levels of ICT competence among physics lecturers, with some demonstrating high proficiency and others exhibiting limited skills, indicating a need for targeted professional development. Lecturers utilized a variety of ICT applications, including simulation software, learning management systems, and mobile educational applications, to enhance teaching and learning. Key barriers to ICT use included inadequate infrastructure, limited access to digital devices, lack of technical support, insufficient training, resistance to change, and lack of awareness about ICT benefits. Student teachers showed proficiency in using digital textbooks, educational apps, and social media, but required more training in advanced ICT skills like simulation software and online research. Gender differences were noted, with both male and female students having similar access to ICT tools but using different types of applications and exhibiting varying confidence levels. Female students preferred social media and collaboration platforms, while male students leaned towards simulation software and technical apps.

The study's significance lies in its comprehensive analysis of ICT integration in physics education within TTIs in Eastern Uganda, guided by the Technological Pedagogical Content Knowledge (TPACK) framework, the Diffusion of Innovations (DOI) theory, and sociocultural theory. It contributes valuable insights into the current state of ICT use, highlighting gaps in competence among lecturers and students, identifying barriers, and emphasizing gender considerations.

By providing evidence-based recommendations, the study informs policymakers, educators, and stakeholders about the necessary interventions to promote equitable and effective ICT use in physics education. Addressing the identified challenges and leveraging technology's potential can enhance the educational experience, leading to improved learning outcomes and increased engagement in physics.

In conclusion, this study underscores the importance of targeted professional development, infrastructure improvements, and the promotion of digital literacy to foster an inclusive and technologically advanced educational environment in TTIs.

## 5.2 Summary of Findings

### 5.2.1 Physics Lecturers' ICT Competences

#### 5.2.1.1 Programs for Enhancing Lecturers' ICT

The integration of ICT among educators is facilitated through a diverse array of programs, including professional development, empowerment on blended learning models, ICT integration workshops, institutional support, and online learning platforms.

#### 5.2.1.2 Demands Considered  for ICT Integration

The analysis highlights key priorities for integrating ICT and gender in physics teaching. Professional development in gender sensitivity and ICT training is unanimously emphasized. Other priorities include accessible ICT infrastructure, inclusive tools, and collaborative learning. However, areas such as promoting girls' interest in physics and addressing gender biases warrant more attention.

#### 5.2.1 .3.Administrators' Initiatives in Supporting the Incorporation of ICT and Gender

Analysis of administrators' views on initiatives for supporting ICT and gender incorporation in physics education highlights key priorities. Resource allocation and Professional Development Programs are top priorities, emphasizing the importance of providing resources and training for effective technology integration and addressing gender disparities. Infrastructure development follows closely, indicating recognition of the need for supportive technological environments. Strategic planning and creating a supportive environment are also crucial, aligning with sociocultural theories to foster inclusivity. Policy development, advocacy, and monitoring are identified as areas needing attention. However, aspects like celebrating success stories and partnerships require further focus.

#### 5.2.1.4.Influence of Demographic Factors on ICT and Gender Incorporation

The study underscores the significant influence of lecturers' demographic factors on their incorporation of ICT and gender considerations in physics education. Professional development and technological competencies emerged as pivotal, with all lecturers affirming their impact. Teaching experience and attitude/support for lecturers followed closely, indicating their importance. Various demographic factors, including age, educational background, gender, institutional support, and culture, were acknowledged to influence lecturers' adoption of ICT and gender in teaching. Observations confirmed disparities in technology use among lecturers based on education level and age.

#### 5.2.1.5 Lecturer's Digital Literacy and ICT Integration

The study underscores the crucial role of lecturers' digital literacy in incorporating ICT and gender considerations in physics education. Digital literacy positively influences educators' ability to utilize ICT tools effectively, access relevant content, and cater to individual student needs. However, disparities in digital literacy skills among educators, particularly across gender lines, may exacerbate existing gender disparities in teaching practices and student outcomes.

#### 5.2.1.6 Levels of Knowledge among Lecturers

The findings from the study revealed varying levels of knowledge among lecturers, with subject knowledge and pedagogical knowledge being universally acknowledged. However, gaps exist in other areas such as research and scholarship knowledge, educational technology, communication skills, and assessment and evaluation.

#### 5.2.1.7 Gender Knowledge Possessed by Physics Lecturers

The findings outlined the gender knowledge possessed by physics lecturers, revealing strong awareness in facilitating gender-inclusive discussions and promoting equity in STEM. Lecturers demonstrate understanding of promoting diversity and inclusion, as well as awareness of gender stereotypes. However, there is a noted gap in acknowledging the need for representation in teaching materials.

#### 5.2.1.8 ICT Knowledge Possessed by Physics Lectures

Research findings indicated that a significant majority of physics lecturers possess knowledge of open educational resources and educational technology tools for online collaboration .However, there's a notable lack of acknowledgment regarding cyber security awareness, data analysis software, blended learning models, and assistive technology.

#### 5.2.1.9 Lecturers Attitudes towards ICT and Gender Incorporation in Teaching

The analysis of lecturers' attitudes towards ICT and gender incorporation in teaching reveals their crucial role in shaping teaching practices and promoting gender equity in education. Positive attitudes facilitate the integration of technology and gender considerations into teaching, fostering openness to change and innovation. Conversely, negative attitudes, such as fear of failure or gender stereotypes, may hinder educators' willingness to utilize ICT tool effectively, hindering efforts to address gender disparities. Socio cultural norms and beliefs, along with gendered expectations and experiences, further influence attitudes towards ICT and gender.

#### 5.2.1.10 Result from class Observations on ICT Use by Physics Lecturers

The observations of class lessons suggest that physics lecturers exhibited a reluctance to fully embrace the incorporation of ICT and gender-inclusive strategies in teaching. While efforts were made to employ active learning strategies, such as group discussions and problem-solving, there was a lack of clear action to address gender disparities in physics performance through ICT utilization. This reluctance may stem from a lack of positive attitudes towards ICT integration or inadequate ICT skills and infrastructure, as evidenced by limited internet connectivity in some colleges. Moreover, sociocultural factors, including diverse cultural beliefs and economic backgrounds of students, pose challenges to equal access to technology and ICT competencies.

#### 5.2.1.11 Lecturers' Knowledge on ICT Use

Findings from the study demonstrated that while a majority of physics lecturers were proficient in infusing ICT into teaching content and planning, other critical areas such as understanding students and content, assessing students, employing ICT integration strategies in instruction, and planning informed curriculum were underutilized.

#### 5.2.1.12 Gender Considerations on Lectures' ICT Use

The analysis indicated that physics lecturers were making efforts to promote inclusivity, address gender biases, and enhance teaching practices through the integration of ICT and gender considerations. Physics Lecturers encouraged active participation and provided feedback on assessment practices which demonstrated a commitment to engaging all students effectively.

While provision of diverse examples and participation in professional development activities reflected efforts to challenge stereotypes and promote equitable access to resources, there was room for improvement in areas such as promoting accessibility, using interactive tools, and creating online supportive communities.

#### 5.2.1.13 UNESCO ICT Competences Possessed by Lecturers

Findings from the study highlighted that physics lecturers excel in instructional practices and curriculum management, with a large majority acknowledging proficiency in these areas. However, fewer lecturers demonstrated strong communication abilities to extend learning beyond the classroom, and even fewer possessed updated skills on hardware and software. While most lecturers demonstrated care for learners' rights and responsibilities, there is room for improvement in certain competencies, particularly in communication and technological skills.

### 5.2.2 ICT Applications Used by Physics Lecturers

#### 5.2.2.1 Importance of ICT in Physics Teaching

The findings revealed a widespread acknowledgment among physics lecturers regarding the positive impact of integrating ICT into teaching physics education. All surveyed lecturers unanimously agreed on the importance of ICT in enhancing learning experiences, preparing students for real-world applications, and promoting gender equity in STEM subjects. While there is strong consensus on certain aspects, such as enabling data-driven decision-making processes, there are varying degrees of agreement on others, such as facilitating the development of 21st-century skills.

#### 5.2.2.2 Degree of ICT and Gender Integration in Teaching

The classroom lesson observations revealed that all twelve physics lecturers were males, potentially impacting the motivation of female student teachers in pursuing physics. Gender disparities were evident among science student teachers, with more males than females, affecting enrolment and performance rates. Low rates of ICT and gender integration were observed due to inadequate ICT competencies among lecturers and student teachers, alongside limited computer availability and internet connectivity.

#### 5.2.2.3 Priority Areas Stressed by Lecturers

Information from the study revealed that physics lecturers prioritize advocating for student teachers' actual use of information technology (IT) equipment, followed by the use of IT equipment in creating physics resources and the use of specific software.

#### 5.2.2.4 The Use of ICT and Gender in Eliminating Physics Misconceptions

Findings from the study highlighted various methods employed by physics lecturers to integrate ICT in eliminating misconceptions in teaching. The majority of lecturers utilized active learning strategies and feedback or assessment strategies, indicating a proactive approach to addressing misconceptions in physics education. Gender-inclusive teaching strategies and diverse representations in teaching materials are also commonly used. However, some methods, such as online discussion forums, customizable learning paths, and real-life application through technology, are underutilized.

#### 5.2.2.5 Categorization of Physics Lecturers

Study findings illustrated the distribution of physics lecturers across different adopter categories regarding innovation adoption. The largest group, the late majority, represented lecturers who tend to adopt new methods or technologies only after they have become widely accepted. Similarly, the laggards, comprising another significant portion, adopt innovations reluctantly and often only under pressure. Surprisingly, there are no respondents categorized as innovators, indicating a lack of pioneers in adopting innovative teaching practices.

#### 5.2.2.6 Methods Used by Physics Lecturers

Findings indicated that active learning approaches like project-based and inquiry-based learning also feature prominently, highlighting efforts to engage students in hands-on exploration and problem-solving. However, some innovative methods like blended learning, flipped classrooms, and online collaboration received lower frequencies, suggesting potential for further exploration and adoption.

#### 5.2.2.6 ICT Development Stages Reached by Physics Lecturers

Findings from the study illustrated different stages of ICT development among lecturers, ranging from recognition to implementation. The most common stage reported is recognition, followed by persuasion, decision adaptation, and implementation. Surprisingly, no lecturers have reached the confirmation stage, indicating incomplete evaluation of ICT integration efforts.

### 5.2.3. Factors Impeding the Incorporation of ICT and Gender in Physics Teaching

#### 5.2.3.1 Factors Limiting the Incorporation of ICT and Gender in Physics Teaching

Findings from the study revealed showed that resistance to change emerged as the primary obstacle, followed by gender stereotypes and bias, cultural norms, unconscious bias, and resource constraints. Institutional policies also play a notable role in hindering progress, while challenges such as limited access to technology, insufficient teacher training, lack of gender-inclusive content, and the digital divide further impede effective integration efforts.

#### 5.2.3.2 Role of Administrators in Overcoming Resistance on ICT Use among Lecturers

Continuous professional development emerged as the most prevalent role, recognized unanimously by all respondents. This underscores the importance of ongoing training and skill development in addressing resistance and facilitating effective ICT integration. However, strategies such as showcasing successful examples and fostering a collaborative culture were not reported, suggesting potential gaps in current administrative approaches. Nonetheless, providing supportive resources and aligning incentives and recognition were acknowledged by a portion of respondents, indicating some recognition of their importance in facilitating ICT adoption.

#### 5.2.3.3 Administrators' Role in Overcoming Resistance on ICT Integration by Students

Promoting role models emerged as the most frequently cited strategy, indicating the importance of demonstrating successful examples to inspire students. Involving students in decision-making processes and creating inclusive learning environments are also recognized as effective methods, fostering ownership and collaboration. Additionally, provision of support services is acknowledged as crucial for easing the transition to ICT integration.

#### 5.2.3.4 Document Analysis on ICT and Gender Integration in Teaching

The observations on the limited use of ICT in teaching physics concepts reveal significant areas where administrators can intervene to address resistance from both lecturers and students effectively. By leveraging frameworks like TPACK and DOI, administrators can offer targeted professional development to empower lecturers with diverse ICT tools beyond traditional methods like PowerPoint. Encouraging exploration of online resources tailored to physics education can enrich content and learning experiences. Administrators can foster a supportive environment for innovation adoption, showcasing successful examples and providing ongoing support to overcome resistance. Additionally, incorporating sociocultural theories can address gender disparities, promoting inclusivity and diversity in content and pedagogy.

### 5.2.4 Findings on ICT Competences Possessed by Physics Student Teachers

#### 5.2.4.1 Students' Prior ICT competences and ICT and Gender Incorporation

All respondents agreed that students' familiarity with digital tools promotes their access to technology, aligning with TPACK principles. Additionally, the majority of lecturers acknowledged that students with digital competences demonstrate better performance, excel in problem-solving and critical thinking, and adapt more easily to online assessments.

#### 5.2.4.2 Benefits of Self-Efficacy to Student Teachers ICT and Gender Incorporation

The data from the field underscores the significant benefits of self-efficacy to student teachers' ICT integration and gender incorporation. It revealed that high self-efficacy motivates student teachers to participate in technology-enhanced environments and approach technological challenges with confidence, leading to effective problem-solving. Moreover, self-efficacious student teachers are more likely to adapt to new technologies, persist in the face of challenges, and experience positive learning outcomes. They also exhibit greater confidence in collaborative learning environments and contribute to the development of digital skills.

#### 5.2.4.3 Responses from Lecturers on the Relationship between Students' Computer Competences and Self-Efficacy

The key findings from the section on the relationship between students' computer competences and self-efficacy highlight several significant factors. Physics lecturers underscore the importance of positive experiences with computer skills in enhancing students' self-efficacy. Overcoming challenges, receiving positive feedback, and observing successful role models all contribute to students' confidence in their technological abilities. Exposure to a variety of technologies broadens students' experiences and fosters a versatile belief in their capabilities.

#### 5.2.4.4 Digital Divides Experienced by Student Teachers

##### 5.2.4.4.1 Types of Digital Divides Experienced by Student Teachers

The analysis of student teachers' responses revealed nuanced insights into the types of digital divides experienced through a gender lens. Usage divide emerges as the most prevalent, indicating differences in how technology is utilized, possibly reflecting gendered patterns of engagement. Access divide follows closely, highlighting disparities in access to technology that may exacerbate existing inequalities, especially for female student teachers. Additionally, the skills divide and economic divide underscore the intersectional nature of digital inequality with economic factors and gender dynamics. Female student teachers may face barriers in acquiring skills or accessing training opportunities due to economic constraints or gendered expectations. The pedagogical divide points to gendered implications in educational practices, impacting female student teachers' confidence and competence in technology integration. Cultural and societal divides, along with regional disparities, further exacerbate digital inclusion challenges.

##### 5.2.4.4.2 Ways of Avoiding the Digital Divides Experienced by Student Teachers

The responses from physics lecturers offer valuable insights into strategies for addressing the digital divide experienced by student teachers. These strategies encompass a range of approaches, including infusing ICT into physics lessons, providing stable internet connectivity, organizing digital literacy training, ensuring access to computer laboratories, and increasing the accessibility and affordability of ICT gadgets. Additionally, creating an inclusive environment, being gender-sensitive, motivating student teachers, and providing balanced equipment across regions are highlighted as essential steps in narrowing the digital divide.

#### 5.2.4.5 ICT Competences Possessed by Student Teachers

##### 5.2.4.5.1 Nature of ICT Competences Possessed by Student Teachers

The analysis of ICT competences among student teachers revealed a varied landscape, with competences such as integration of ICT in lesson planning, online research skills, and basic computer literacy standing out. While some competences are prevalent, others, like remote teaching skills and cyber security awareness, are less common but equally important.

#### 5.2.4.5.2 Comparison of ICT Competences Possessed by Student Teachers by Sex

The observations of physics lecturers regarding the ICT skills possessed by female and male student teachers highlighted notable gender disparities in technology use and digital literacy. While some lecturers perceive male students as better versed in ICT skills, others noted limited engagement and proficiency among female students.

#### 5.2.4.5 Lecturers' Role in Developing Students' ICT Skills

Physics lecturers play a crucial role in developing student teachers' ICT competences, employing various strategies to foster digital literacy and technology integration. Guiding independent research emerged as a prevalent approach. Incorporating ICT into instruction, modeling effective ICT use, and providing hands-on activities also featured prominently. Addressing digital ethics and responsibility underscores the importance of promoting ethical behavior and digital citizenship. Strategies employed by lecturers included direct instruction in ICT, encouraging personal access to technology, integrating ICT into coursework, providing access to computer laboratories, ensuring continuous engagement with ICT, and offering online support and resources.

#### 5.2.4.6 Websites Used by Physics Lecturers

Among the frequently consulted sites are Phet Interactive Simulations and Physics Classroom, valued for their interactive simulations and comprehensive tutorials, respectively. Khan Academy, known for its vast collection of educational videos and exercises, serves as a supplementary resource for additional explanations and materials. The American Association of Physics Teachers (AAPT) website emerges as another prominent resource. Additionally, Shareability Uganda and Digital Teachers Uganda were also utilized, indicating lecturers' interest in accessing local or context-specific resources tailored to Uganda's educational landscape.

### 5.2 .5 Student Teachers' Use of ICT in Learning Physics

#### 5.2.5.1 Relationship between Students' ICT Use and Learning Achievement

The responses from student teachers regarding the relationship between ICT use and learning achievement highlight the pervasive influence of technology in contemporary education within the Ugandan context. Students recognized the integral role of ICT tools, such as Google search, in facilitating academic tasks and communication, emphasizing their collaborative potential for peer-to-peer learning and knowledge sharing. However, there is also an acknowledgment of the dual nature of technology, with its effectiveness in enhancing learning outcomes contingent upon responsible and purposeful usage. Students differentiated between constructive engagement with ICT for educational purposes and its potential misuse for non-academic activities, underscoring the importance of digital literacy and responsible use practices.

#### 5.2.5.2 Lecturers' Concerns in the Use of Technology in Addressing Gender Differences

. Guiding independent research emerged as a prevalent role, reflecting the emphasis on promoting critical thinking and research skills through technology-enabled inquiry. Additionally, the incorporation of ICT into instruction is highlighted, demonstrating efforts to leverage technology for enhancing teaching and learning experiences. Modeling effective ICT use and providing hands-on activities further contributed to students' digital literacy and confidence in utilizing technology. Addressing digital ethics and responsibility underscores the importance of promoting ethical behavior and digital citizenship among students.

#### 5.2.5.3: ICT Competences Used by Student Teachers in Learning Physics

The analysis of ICT competences used by student teachers in learning physics reveals significant insights into their digital literacy skills and technology integration in education. The most commonly used competence is searching for information, highlighting the importance of information literacy. Many student teachers also use PowerPoint and engage in basic file management, indicating proficiency with presentation software. However, advanced ICT tools like Excel for graphing and calculations, and the creation of instructional materials and content, are less commonly used. Minimal engagement is observed in programming and problem-solving.

#### 5.2.5.4 Benefits of Incorporating ICT and Gender in Teaching

The responses from student teachers underscore the numerous benefits of incorporating ICT and gender considerations in physics learning. Nearly all respondents acknowledged the transformative impact of technology on teaching and learning, recognizing its potential to make education more dynamic and engaging. Additionally, ICT is seen as a tool for simplifying complex physics content, catering to diverse learning needs and styles. Furthermore, student teachers emphasize the promotion of critical thinking, problem-solving, and inquiry skills facilitated by ICT integration. Other identified benefits included enhancement of communication skills, creativity, and self-regulated learning. Overall, the findings highlight the pivotal role of ICT in creating inclusive and empowering learning environments that foster holistic development among physics students.

#### 5.2.5.5 Approaches Used in Incorporating ICT and Gender in Learning

The analysis of responses from lecturers revealed key insights into the approaches used to incorporate ICT and gender considerations in physics learning. The most prevalent approach reported is the integrated approach, emphasizing the seamless integration of technology with instructional practices to enhance learning experiences. Additionally, the enhancement approach, utilized by a significant portion of respondents, focuses on leveraging technology to improve existing teaching methods incrementally. Furthermore, the complementary approach, employed by a notable percentage of lecturers, underscored the importance of using technology in conjunction with other instructional strategies to support teaching and learning goals..

#### 5.2.5.6 Approaches Used by Physics Lecturers in Teaching

The analysis of the approaches used by physics lecturers in incorporating ICT and gender in teaching reveals several key findings. Firstly, the integration of gender-inclusive language emerges as the most prevalent approach, highlighting lecturers' efforts to promote inclusivity and address gender biases in educational settings. Additionally, approaches such as blended learning environments, utilization of educational applications and games, and customization of learning materials emphasize the integration of technology to support diverse learning needs and preferences, aligning with TPACK principles. Furthermore, the implementation of flipped classroom models and incorporation of social media and online platforms highlight innovative uses of technology to promote active learning and collaboration among students.

#### 5.2.5.7 ICT Applications Used by Students in Learning Physics

A number of applications were revealed by science student teachers in using ICT applications for learning .Firstly, digital textbooks and e-books emerge as the most widely used ICT application, indicating the prevalent adoption of digital resources for accessing course materials and supplementary readings. This reflects the convenience and flexibility offered by digital formats in supporting self-directed learning among students. Additionally, the widespread use of educational applications for mobile devices and social media platforms underscores the growing trend of mobile technology and social media integration in education, providing interactive and collaborative learning experiences tailored to students' individual needs. Besides, simulation software and learning management systems are prevalent tools that facilitate virtual experimentation and streamline the organization of course materials, assignments, and assessments. Podcasts, video lectures, online collaboration platforms, webinars, virtual guest speakers, online journals, and science blogs are also utilized, albeit to a lesser extent, providing additional opportunities for multimedia learning, collaboration, and engagement with experts in the field.

## 5.3 Conclusion

The researcher made the following conclusion based on the study findings guided by the study objectives.

First of all, the investigation into physics lecturers' ICT competence levels revealed a mixed landscape. While some lecturers demonstrated a high level of proficiency in integrating ICT into their teaching practices, others exhibited varying degrees of competency. Factors influencing this variance included access to training and resources, attitudes towards technology, and institutional support. These findings underline the importance of ongoing professional development initiatives tailored to enhancing lecturers' ICT skills and knowledge.

Secondly, the study identified a wide range of ICT applications utilized by physics lecturers in teaching, including simulation software, learning management systems, online collaboration platforms, podcasts and video lectures, digital textbooks and e-books, educational applications for mobile devices, social media platforms, and others. These applications play a crucial role in enhancing teaching effectiveness, fostering student engagement, and providing access to diverse learning resources. Recommendations for leveraging these applications to their fullest potential are discussed in detail.

Thirdly an examination of factors hindering lecturers' use of ICT in teaching physics highlighted several challenges, including limited access to ICT infrastructure, inadequate training opportunities, time constraints, and resistance to change. Addressing these barriers requires a multi dimensional approach encompassing policy interventions, institutional support mechanisms, and professional development initiatives. Strategies for overcoming these obstacles and fostering a conducive environment for ICT integration are delineated.

More still ,the study identified various competences possessed by physics student teachers in TTIs, including proficiency in integrating ICT in lesson planning, online research skills, digital communication skills, basic computer skills, and digital literacy. However, disparities in competence levels were observed, particularly concerning gender. Female student teachers were perceived to have fewer ICT skills compared to their male counterparts, reflecting broader societal gender norms and inequalities. Addressing these disparities necessitates targeted interventions aimed at promoting digital literacy and equitable access to ICT resources among all student teachers.

Lastly, gender differences in the ability of science student teachers to use ICT to enhance their achievement were observed, with male student teachers generally perceived to be better versed in ICT skills compared to their female counterparts. However, it is essential to note that individual differences exist within gender categories, and efforts should be directed towards promoting equitable opportunities for all students to develop their ICT competencies. Recommendations for bridging the gender gap in ICT use and promoting gender-inclusive practices in physics education are outlined.

**5.4 Recommendations**

In the rapidly evolving landscape of education, the integration of Information and Communication Technology (ICT) and gender considerations has emerged as a critical endeavor to enhance teaching practices and promote inclusive learning environments. This section sets the stage for comprehensive recommendations aimed at policymakers, educators, and researchers based on the study findings. The research delves into the competences, practices, and challenges faced by both physics lecturers and student teachers in utilizing ICT tools and addressing gender disparities in physics education. It highlights the multifaceted nature of challenges faced by educators and underscores the imperative for targeted interventions at policy and practice levels.

### 5.4.1 Recommendation for Policy

To foster effective ICT integration and address gender disparities in physics education, policies should focus on comprehensive ICT training for both lecturers and student teachers. Integrating ICT training into teacher education programs and mandating ongoing professional development can ensure that all educators are proficient in digital literacy. Policies should also ensure adequate funding for technological infrastructure, including updated hardware, reliable internet access, and technical support in educational institutions. Additionally, gender sensitivity training should be incorporated into professional development to promote an inclusive teaching environment. Policy development should also include monitoring and evaluation mechanisms to ensure the effectiveness of these initiatives and to address any gaps in implementation.

### 5.4.2 Recommendations for Practice

In practice, both lecturers and student teachers should engage in structured activities to enhance their information literacy and digital skills. Practical workshops and hands-on training sessions focusing on advanced ICT tools, such as data analysis software and digital content creation, should be regularly conducted. Collaborative learning projects can be promoted where both lecturers and student teachers work together to create and share digital instructional materials. This will help in building a collaborative learning environment and in demonstrating the practical applications of ICT in education. Institutions should also provide platforms for sharing success stories and best practices to motivate and guide educators in integrating ICT and gender considerations into their teaching practices.

## 5.5 Recommendations for Future Research

Future research should conduct longitudinal studies to track the progression of ICT competences among both lecturers and student teachers. This will help identify the most effective training methods and provide data on the long-term impact of ICT training on teaching practices and student outcomes. Investigating the impact of different levels of ICT competence on teaching effectiveness and student learning outcomes can provide valuable insights for targeted interventions. Research should also explore barriers to ICT integration, such as access to technology, attitudes of educators, and institutional support, to develop strategies that address these challenges and promote more effective integration of technology in teaching and learning.

### 5.6 Personal Reflection on the Study

As a researcher, reflecting on this study provokes a sense of responsibility and urgency regarding the integration of ICT and gender-inclusive practices in physics education. The findings underscore the transformative potential of technology in enhancing teaching and learning experiences, while also highlighting the persistent challenges of gender disparities in access and utilization. Personally, this study has deepened my understanding of the complex interplay between technology, pedagogy, and sociocultural factors in educational settings.

Moreover, the findings emphasize the importance of adopting a multifaceted approach to address these challenges, encompassing policy changes, pedagogical innovations, and ongoing professional development initiatives. As a researcher, I recognize the need for continued advocacy and action to promote equitable access to ICT resources, foster digital literacy skills, and challenge gender stereotypes in science education.

Furthermore, this study has illuminated the diverse perspectives and experiences of stakeholders involved in physics education, from lecturers to student teachers. Engaging with their insights and recommendations has underscored the importance of collaborative efforts and co-creation in designing effective interventions and initiatives.

Overall, this study has been a valuable opportunity to contribute to the discourse on ICT integration and gender equity in physics education. It has reinforced my commitment to advancing inclusive and innovative practices in teaching and learning, and has inspired me to continue exploring ways to harness the power of technology to create more engaging, accessible, and empowering educational experiences for all learners

### 5.7 Chapter Summary

This chapter provides a comprehensive summary and implications of the study on integrating Information and Communication Technology (ICT) in physics education in Teacher Training Institutions (TTIs) in Eastern Uganda. It highlights varying ICT competence levels among physics lecturers, emphasizing the need for targeted professional development. Additionally, it identifies diverse ICT applications utilized in teaching, outlines barriers to ICT integration, and underscores gender differences in ICT usage among student teachers. The chapter emphasizes the urgency of addressing challenges such as infrastructure limitations and resistance to change, advocating for strategic interventions including infrastructure enhancements, training programs, and digital literacy promotion. Ultimately, it underscores the importance of fostering an inclusive and technologically advanced educational environment to improve learning outcomes in physics education within TTIs in Eastern Uganda

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## APPENDICES

## APPENDIX 1: INFORMATION SHEET

## SELINUS UNIVERSITY

## INFORMATION SHEET

**Title of study**: The Incorporation of ICT and Gender in the Teaching and learning Science (Physics) Education in Teacher Training Institutions in Eastern Uganda.

**Principal investigator**: Waninga Willy

**Institute**: Selinus University

**Institutiom of Affiliation**: Busitema University

**Introduction**

I am Waninga Willy, a Student pursuing a PhD by research in Physics Education at the above mentioned University. I am carrying out a research on **"The Incorporation of ICT and Gender in the Teaching of Physics Education in Teacher Training Institutions in Eastern Uganda".** I wish to explore on physics lecturers' ICT competences, Use of ICT in teaching physics, factors impeding the integration of ICT in teaching, Physics students ' ICT competences and their use in learning physics. Since the government is implementing the teacher policy that is demanding all teachers to be graduates using the Uganda National Institute of Teacher Education which is responsible for quality control, I intend to establish the extent to which selected institutes or campus are embracing the ICT and gender as they implement the teacher policy. Specifically the focus will be put on the integration of ICT and gender in teaching and learning physics.

**Purpose of this research study**

The purpose of this study is to find out how Physics Lecturers are incorporating ICT and Gender in teaching and learning Physics in Teacher Training Institutions in Eastern Uganda.

**Procedure**

In this study I intend to collect data from 8 respondents. I will collect data from physics lecturers; TTI administrators and Physics student teachers using interviews and questionnaires. I will also analyze lecturers 'instruments of instruction namely schemes of work and lesson plans and observe physics laboratories and classroom lessons to ascertain the extent to which lecturers are integrating ICT and gender in physics teaching.. The findings will be used for study purposes only and nothing else.

**Possible Risks or Benefits**

There is no risk involved in this study except using a few minutes of the teachers' busy schedules during the interviews and observation at the work place and classrooms. There is also no direct benefit to you. However, the research findings will be shared with the respondents and may help in reflecting on constructive practice that may improve the integration of ICT in teaching Physics.

**Right of Refusal to Participate and Withdrawal**

You are free to choose to participate in the study. You may refuse to participate without any loss of benefit which you are otherwise entitled to. You may also withdraw at any time from the study without any adverse effect on management of your school or any loss of benefit which you are otherwise entitled to. You may also refuse to answer some or all questions if you do not feel comfortable with the questions.

**Confidentiality**

The information obtained from your school will remain confidential as per the Uganda Data Protection and Privacy Act of 2019. Nobody except principal investigator will have an access to it. The name and identity of your school and students will also not be disclosed at any time. However the data may be seen by Ethical review committee and may be published in a journal and elsewhere without giving your name or disclosing your identity.

**Authorization**

You will be asked to sign a consent form to indicate your voluntary participation. You will receive a copy of the form. Your consent does not take away any legal rights in the case of negligence or other legal fault of anyone who is involved in this study. Nothing in the consent form is intended to replace any applicable national, state or local laws.

**Available Sources of Information**

For further questions, you may contact Principal investigator Waninga Willy

Phone Number: +256782539867/779068082

## APPENDIX II: ETHICAL CONSENT FORM FOR PHYSICS LECTURERS

**Research Topic: The Incorporation of ICT and Gender in Teaching and Learning Physics Education in Teacher Training Institutions in Eastern Uganda**

I have been informed of the requirements of the study and fully understand what will be expected of me as a participant.

I therefore agree to be amongst the participants in this study with the following conditions. Put a tick (✓ ) as appropriate against each statement;

- ☐ This study focuses on the incorporation of ICT and gender in Teaching Physics education in TTIs in Eastern Uganda.
- ☐ The purpose of the study is to find out how physics lecturers incorporate ICT and gender in the teaching and learning physics in Teacher Training Institutions in Eastern Uganda
- ☐ My identity as a research participant will remain confidential and my name and my responsibility/role in the school and the name of the school will not be used at any point in the research or in reporting the findings.
- ☐ I maintain the right to withdraw from the study at any point in time.
- ☐ I will be interviewed as part of the study
- ☐ My voice can be recorded during my interview.
- ☐ My class can be observed when I am teaching ABC lessons
- ☐ My records (schemes of work and lesson plans) can be analyzed for this study.
- ☐ Photographs (or scans) of my work or classroom will be taken for research purposes
- ☐ I will be compensated for the time ,inconveniences and efforts spent on the project
- ☐ I hold the right to refuse to answer any question.
- ☐ I will receive the summary of the final report of the study.
- ☐ Findings of this study may be used in conference presentations and in academic publications

I express willingness to participate in this study by signing this form.

Name: …………………………………….…………… Designation: Physics Lecturer

Signature: ………………………… Date: ……………………………………

Name of TTI: ……………………………………………………………………

Researcher's Name: Waninga Willy

Signature:…………………………….. Date:………………………………………

Researcher's Contact: +256782539867/779068082

Name of Institution: Selinus University, Rome, Italy

Institution of Affiliation: Busitema University

## APPENDIX III: ETHICAL CONSENT FORM FOR TTI ADMINISTRATORS

**Research Topic: The Incorporation of ICT and Gender in Teaching and Learning Physics Education in Teacher Training Institutions in Eastern Uganda.**

I have been informed of the requirements of the study and fully understand what will be expected of me as a participant. I therefore agree to be amongst the participants in this study with the following conditions. Put a tick (✓ ) as appropriate against each statement;

- ☐ This study focuses on the incorporation of ICT and gender in Teaching Physics education in TTIs in Eastern Uganda
- ☐ The purpose of the study is to find out how physics lecturers incorporate ICT and gender in the teaching and learning physics in TTIs in Eastern Uganda
- ☐ My identity as a research participant will remain confidential and my name and my responsibility/role in the school and the name of the school will not be used at any point in the research or in reporting the findings.
- ☐ I maintain the right to withdraw from the study at any point in time.
- ☐ I will be interviewed as part of the study
- ☐ I will follow Covid 19 SOPs while interacting with the researcher
- ☐ I will be compensated for the time ,inconveniences and efforts put on the project
- ☐ My voice can be recorded during my interview.
- ☐ My teachers can be observed when they are teaching Physics lessons
- ☐ Lecturers' records (schemes of work and lesson plans) can be analyzed for this study.
- ☐ Photographs (or scans) of teachers & pupils' work or classroom will be taken for research purposes
- ☐ I will be compensated for the time, inconveniences, and efforts put on the project
- ☐ I hold the right to refuse to answer any question.
- ☐ I will receive the summary of the final report of the study.
- ☐ Findings of this study may be used in conference presentations and in academic publications

I express willingness to participate in this study by signing this form.

Name: ………………………………Designation: Administrator

Signature: …………………………… Date: ……………………………………

Name of TTI: ………………………………………………………………………

Researcher's Name: Waninga Willy

Signature:………………………………Date:………………………………………

Researcher's Contact: +256782539867/779068082

Name of Institution: Selinus University, Rome, Italy

Institution of Affiliation: Busitema University

## APPENDIX IV: ETHICAL CONSENT FORM FOR STUDENT TEACHERS

**Research Topic: The Incorporation of ICT and Gender in Teaching and Learning Physics Education in Teacher Training Institutions in Eastern Uganda.**

I have been informed of the requirements of the study and fully understand what will be expected of me as a participant.

I therefore agree to be amongst the participants in this study with the following conditions. Put a tick (✓ ) as appropriate against each statement;

- ☐ This study focuses on the incorporation of ICT and gender in Teaching Physics education in TTIs
- ☐ The purpose of the study is to find out how physics lecturers incorporate ICT and gender in the teaching and learning physics in TTIs
- ☐ My identity as a research participant will remain confidential and my name and my responsibility/role in the school and the name of the school will not be used at any point in the research or in reporting the findings.
- ☐ I maintain the right to withdraw from the study at any point in time.
- ☐ I will be interviewed as part of the study
- ☐ I will follow Covid 19 SOPs while interacting with the researcher
- ☐ I will be compensated for the time and effort spent on the project
- ☐ My voice can be recorded during my interview.
- ☐ My class can be observed when I am teaching physics lessons
- ☐ My records (schemes of work and lesson plans) can be analyzed for this study.
- ☐ Photographs (or scans) of my work or classroom will be taken for research purposes
- ☐ I hold the right to refuse to answer any question.
- ☐ I will receive the summary of the final report of the study.
- ☐ Findings of this study may be used in conference presentations and in academic publications

I express willingness to participate in this study by signing this form.

Name: …………………………………………… Designation: Student Teacher

Signature: ……………….…………… Date: ……………………………………

Name of TTI: ………………………………………………………………………

Researcher's Name: Waninga Willy

Signature:…………………………….Date :………………………………

Researcher's Contact: +256782539867/779068082

Name of Institution: Selinus University, Ragusa Rome, Italy

Institution of Affiliation: Busitema University

## APPENDIX V: COVID-19 INFORMED CONSENT FORM

**Study Title:** "Incorporation of ICT and Gender in Teaching Physics Education in Teacher Training Institutions in Eastern Uganda"

**Researcher:** Waninga Willy **Institution:** Selinus University of Sciences and Literature

**Institution of Affiliation**: Busitema University

**Introduction:** The purpose of this form is to inform you about the measures we have put in place to protect your health and safety during our research activities related to the study titled "Incorporation of ICT and Gender in Physics Education in Teacher Training Institutions in Uganda." This research involves interviews, questionnaires, document analysis, and observations. The ongoing COVID-19 pandemic requires us to take extra precautions.

**COVID-19 Safety Measures:** We are committed to your safety during our research activities. Here are the COVID-19 safety measures we have implemented:

1. **Personal Protective Equipment (PPE):** All research team members will wear masks and gloves during in-person interactions. Hand sanitizers will also be readily available.
2. **Physical Distancing:** We will maintain a safe physical distance of at least 2 metres during interviews, observations, and questionnaire administration.
3. **Health Screening:** Before any in-person interaction, we will ask you a series of health-related questions to assess your risk of COVID-19. If you exhibit any symptoms or have had recent exposure to a confirmed case, we may need to reschedule or explore remote data collection options.
4. **Remote Data Collection:** Whenever possible, we will use remote methods (e.g., video conferencing and online surveys) to conduct interviews and administer questionnaires.
5. **Staggered Scheduling:** To minimize the number of people at research sites, we will schedule research activities at different times and rotate team members.

**Your Role:** We ask for your cooperation in adhering to these safety measures. If you have any concerns about your safety during our research activities, please let us know immediately.

**Confidentiality:** All information you provide during the study, including your health status, will be kept strictly confidential. Your identity will not be disclosed in any research reports or publications.

**Voluntary Participation:** Your participation in this study is entirely voluntary. If, at any point, you decide not to participate or wish to withdraw, you are free to do so without any negative consequences.

**Consent:** I have read and understood the COVID-19 safety measures and procedures outlined above. I voluntarily agree to participate in the study "Incorporation of ICT and Gender in

Teaching Physics Education in Teacher Training Institutions in Easter Research" under these conditions.

Participant's Name: ………………………………………………………………………………

Participant's Signature: …………………………… Date: ………………………………………

**Researcher's Statement:** I have explained the COVID-19 safety measures and procedures to the participant. I have also provided them with an opportunity to ask questions and have addressed any concerns they may have had.

Researcher's Name:……………………………………………………………………………….
Researcher's Signature: ……………………………………. Date: ……………………………….

## APPENDIX VI: COMMUNITY ENGAGEMENT PLAN

Creating a community engagement plan for this research project, "The Incorporation of ICT and Gender in the Teaching of Physics Education in Teacher Training Institutions in Eastern Uganda," is crucial to ensure that valuable insights are gathered from the target community. This is a comprehensive plan to engage administrators, physics lecturers, and physics student teachers throughout the research process from 2022 to 2024:

**1. Pre-Research Engagement (2022)**

The researcher will identify key stakeholders, including administrators, physics lecturers, and physics student teachers in Teacher Training Institutions (TTIs) in Eastern Uganda. The researcher will further establish initial contacts with relevant authorities in TTIs to introduce his research project and seek their support. The researcher intends to conduct orientation workshops in selected TTIs to introduce the research topic, objectives, and potential benefits. A project platform will be created where updates and resources related to this research will be shared.

**2. Data Collection Phase (2022-2023)**

The researcher will distribute surveys/questionnaires to administrators and physics lecturers to gather their input. In-depth interviews will be conducted with physics student teachers to explore their perspectives on the incorporation of ICT and gender in physics teaching in TTIs in more detail. The researcher will organize workshops or focus group discussions to delve deeper into specific issues related to ICT and gender in physics education. These sessions will be used to collect qualitative data and foster dialogue among stakeholders.

**3. Mid-Research Engagement (2023)**

The researcher will share preliminary findings and insights with the community during meetings or workshops. Participants will be encouraged to participate in providing feedback and suggestions for refining the research. The researcher will offer training sessions or workshops on ICT tools and strategies that can enhance physics education. Efforts will be made to include a gender sensitivity component in the training to address gender-related concerns.

**4. Data Analysis Phase (2023-2024)**

Open communication channels will be maintained with stakeholders to update them on the progress of data analysis. The researcher will seek additional insights or clarifications as needed during this phase. More importantly, efforts will be made to collaborate with physics education experts to validate the findings and interpretations.

**5. Post-Research Engagement (2024)**

The researcher will organize seminars and attend conferences to present his research findings to the community and other relevant stakeholders. Research reports, policy recommendations, and practical guidelines will also be shared with participants, policymakers, NGOs, and the public.

The researcher intends to Work closely with TTIs to facilitate the integration of ICT and gender-sensitive approaches in physics education. This will be promoted through the provision of resources, workshops, or training sessions to assist in the implementation of your research recommendations.

**6. Ongoing Engagement (Throughout the Study Period)**

The researcher will continue to engage stakeholders through your project's website, social media, and periodic meetings. This will help in fostering a sense of ownership among the community regarding the research outcomes. Administrators of TTIs, physics lecturers, and physics student teachers will be encouraged to share their own experiences and success stories in integrating ICT and gender considerations into physics education.

**7. Evaluation and Feedback (2024)**

Efforts will be made to conduct a final feedback session or survey to gather input on the overall research process and its impact. Possibilities for future collaborations or projects that can further enhance physics education in TTIs will be discussed. This community engagement plan will adapt and adjusted based on the specific needs and responses of community members in TTIs in Eastern Uganda.

## APPENDIX VII: PROPOSED COVID 19 MITIGATION PLAN

Creating a COVID-19 mitigation plan for this study on the incorporation of ICT and gender in teaching physics education in Teacher Training Institutions in Uganda is essential to ensure the safety of both researchers and participants while conducting research during the pandemic. Below is a presentation of the strategies that I intend to use in mitigating the effects of Covid 19 pandemic.

**1. Remote Data Collection:**

When occasions demand, the researcher will conduct interviews and administers questionnaires remotely, using video conferencing and online survey tools to minimize in-person contact.

**2. Personal Protective Equipment (PPE):**

Since the researcher intends to interact with s student teachers, efforts will be put to ensure that researcher and student teachers have access to necessary PPE, such as masks, gloves, and hand sanitizers.

**3. Participant Safety Measures:**

The researcher will implement safety measures for in-person data collection. Examples of these measures include maintaining physical distancing, conducting interviews in well-ventilated areas, and avoiding crowded spaces.

**4. Informed Consent and Health Screening:**

The researcher developed a COVID-19 consent form that explains the safety measures being taken. Participants interviewed to confirm that they are not exhibiting COVID-19 symptoms. The researcher will work with the institutional leaders to ensure that participants examined for COVID-19 symptoms before each in-person interaction.

**5. Data Collection Schedule and Rotations:**

In order to reduce incidences of interaction the researcher will rotate data collection activities. Only one activity will be done at a time to reduce on the number of people present at the research sites. Different respondents will be met on different days and activities.

**6. Remote Collaboration:**

The researcher will utilize remote collaboration in meeting respondents utilizing virtual meetings and communication tools to minimize physical presence in the same location.

**7. Data Handling and Transmission:**

The researcher will minimize physical data transfers by using secure digital methods for sharing and storing research data. Specifically the cloud will be used in storing data uploaded after scanning.

**8. Contingency Plans:**

Develop contingency plans for the possibility of a team member or participant testing positive for COVID-19 during the study.

Ensure that team members are aware of local guidelines and procedures for handling such situations.

**9. Training and Education:**

The researcher sensitized Research participants on COVID-19 safety protocols, including proper mask-wearing, hand hygiene, and maintaining physical distance. Participants will be provided with information on COVID-19 safety measures being implemented during the study. This will be promoted with the help of signing the Covid 19 consent forms.

**10. Regular Monitoring and Adaptation:**

The Researcher continuously monitored the COVID-19 situation in Teacher Training Institutions in Uganda more especially Eastern Uganda and adhere to local health guidelines and restrictions. The researcher is prepared to adapt the mitigation plan based on changes in the pandemic situation.

**11. Budget Allocation:**

The researcher allocated a portion of the research budget for COVID-19-related expenses, such as PPE, remote data collection tools, and additional time for scheduling and coordination.

**12. Ethical Considerations:**

Efforts were made by the researcher to ensure that all COVID-19 mitigation measures align with ethical guidelines and respect participants' rights and well-being.

**13. Postponement Option:**

The researcher considered the option to postpone in-person data collection activities if the COVID-19 situation worsens significantly, prioritizing the safety of all involved. Following this COVID-19 mitigation plan, you can prioritize the health and safety of both the researcher and study participants while still conducting valuable research during these challenging times

## APPENDIX V1II: QUESTIONNARE FOR ADMINISTRATORS

I am Waninga Willy a Doctoral Student of Selinus University, Italy conducting a study on the topic **"The Incorporation of ICT and Gender in the Teaching of Physics Education in Teacher Training Institutions in Eastern Uganda".** The information given will be handled with confidentiality and serve the study purpose only.

**Instructions**

You are requested to participate in this study by ticking the correct alternative or filling in the blank space provided to the questions.

**Section A: Biographical Data**

| **Type of Data** | **Description of Data** | | | |
|---|---|---|---|---|
| Age | 20-35Years | 36-45years | 46-55years | 56yearsand above |
| Sex | Male | | Female | |
| EducationLevel | Doctoral | Masters | Bachelor | Diploma |
| TeachingExperience | 1-15YEARS | 16-30 | 31-45 | 45yearsabove |
| Responsibility | HOD | Registrar | Coordinator | Student |

**Section B: Physics Lecturers' ICT Competence Levels**

1 (a) Do you have programs geared towards enhancing physics lecturers' ICT competences?(i)Yes (ii)No

(b)If yes, which ones?

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2. What is needed to ensure successful implementation of the incorporation of ICT and gender in teaching physics education?

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3. How are you supporting your lecturers in incorporating ICT and gender in teaching physics?

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4(a) Basing on your supervision, evaluation and monitoring experiences, is the physics Lecturer's incorporation of ICT and gender in teaching affected by their demographic factors?

(i) Yes

(ii) No

(b)If yes, how?

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5. How does physics lecturers' digital literacy affect their incorporation of ICT and gender in teaching?

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**Section C: ICT Applications Used by Physics Lecturers**

6. How do physics lecturers' attitude and self efficacy affect the incorporation of ICT and gender in teaching?

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7. How is the incorporation of ICT and gender important in teaching physics education?

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8. How do physics lecturers integrate ICT and gender in improving the teaching learning environment?

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9. Whichofthefollowingshouldbepriorityareasforlecturerstostresstostudentteacherswhileontr aining?

- Actual use of IT equipments
- Use of specific software
- The use of information technology equipments in making physics real

**Section D: Factors Impeding the Incorporation of ICT and Gender in Teaching and Learning Physics**

10. (a)What factors limit the incorporation of ICT and Gender in the teaching of Physics in this institution?

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(b)What do you think should be done to address the above challenges?

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**Section E: ICT Competences Possessed by Physics Student Teachers**

11. (a)What is the relationship between students' prior ICT competences and their achievement?

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(b) What are the benefits of self efficacy to student teachers pertaining ICT use or incorporation

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(c) What is the connection between students' computer experiences and self efficacy?

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**Section F: Student Teachers' Use of ICT in Learning Physics**

12(a) What is the relationship between student teachers' ICT use and their learning achievements?

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(b) Which of the following digital divides is mainly experienced by your students?

- First digital divide with access to technology
- Second digital divide with difference to skills
- Third digital divide with differences in benefit from the technology
- If other, Mention

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(c) How can digital divides be avoided among physics student teachers?

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13 (a) What are the benefits of Incorporating ICT and gender in learning physics?

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(b)What is your role in overcoming resistance in ICT use by lecturers and students?

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14(a) What is the value of integrating technology with gender friendly methodology in teaching physics education?

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(b) What considerations do you follow in using technology to address gender differences?

- Experiential learning
- Conducting class discussions
- Cooperative learning
- Inquiry based instructions
- Having students led classrooms
- Proper seating arrangement
- Giving wait time for ladies
- Ensuring equity and equality in technology access and use
- Use of gender sensitive language
- use of variety of ICT tools

( c) Which ICT applications or tools do you employ in teaching specific physics content?

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**THANK YOU VERY MUCH**

## APPENDIX IX: INTERVIEWGUIDEFOR PHYSICS STUDENTTEACHERS

CAMPUS:…………………………………………………………………………………
PROGRAM:……………………………………….……………………………………
CLASS:……………………………………………………………………………….....

**Section A : Biographical Data**

| **Type of Data** | **Description of Data** | | | |
|---|---|---|---|---|
| Age | 20-35Years | 36-45years | 46-55years | 56yearsand above |
| Sex | Male | | Female | |
| Education Level | Doctoral | Masters | Bachelor | Diploma |
| Teaching Experience | 1-15YEARS | 16-30 | 31-45 | 45yearsabove |
| Responsibility | HOD | Registrar | Coordinator | Student |

**Section B: Physics Lecturers ’ICT Competence Levels**

1. How are ICT competences relevant to physics lecturers?

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2. Which of the following dimensions of knowledge on ICT are possessed by physics lecturers?

- Use of ICT to understand students and content
- Planning ICT infused curriculum
- Using ICT integrated strategies
- Infusion of ICT in teaching contexts
- Use of ICT in instruction
- Use of ICT in assessing students

3. How is the physics lecturer's incorporation of ICT and gender in teaching affected by the following demographic factors?
    - Age
    - Level of Education
    - Teaching Experience and
    - Gender

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4. Which of the following ICT skills are used by physics lecturers?

- Basic computer literacy
- Ability to back up data
- programming computers
- Experience with online project work
- Ability to nurture creativity and mark it
- Social networking skills

**Section C: ICT Applications Used by Physics Lecturers**

5. How can the incorporation of ICT and gender in teaching eliminate misconceptions about physics?

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6. Under which of the following categories do lecturers fall as they incorporate ICT and gender in teaching physics?

- Innovators
- Early Adopters
- Early Majority

- Late Majority
- Laggards

7. How do physics lecturers integrate ICT and gender in improving the teaching learning environment?

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8. Which methods of teaching do physics lecturers use in teaching?
    - Problem Based Learning
    - Class Experimentation
    - Inquiry Based Learning
    - Collaborative Learning
    - Interactive Question and Answer

9. At what stage of ICT development are you physics lecturers?

- Recognition stage where the lecturer recognizes alignment of technology with subject matter
- Persuasion where the lecturer forms favorable and unfavorable attitudes towards ICT use towards teaching specific content
- Adapting decision where the lecturer engages in activities that lead to a choice of adopting or rejecting teaching specific content with appropriate technology
- Implementation stage where the lecturer integrates teaching and learning with appropriate technology
- Confirmation stage where the lecturer is able to redesign curricular and evaluate the result the result of the decision to integrate technology in teaching and learning specific content with appropriate technology

**Section D: Factors Impeding the Incorporation of ICT and Gender in Teaching and Learning Physics**

10. (a)What factors limit the incorporation of ICT and gender in the teaching of Physics in this institution?

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(b)What do you think should be done to address the above factors?

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**Section E: ICT Competences Possessed by Physics Student Teachers**

11. (a)What ICT competences do you have?

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(b)How are you helped by physics lecturers to develop your ICT competences?

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**Section F: Student Teachers 'Use of ICT in Learning Physics**

12. (a) Which of the following ICT competences do you use in learning physics?

- Searching information
- sharing information
- uploading and down loading documents
- using power point to prepare presentations
- using excel to draw graphs and carry out calculations

- making instructional materials for teaching
- Creating content
- programming computers
- Problem solving

(b)Which of the following digital divides to you experience?

- First digital divide with access to technology
- Second digital divide with difference to skills
- Third digital divide with differences in benefit from the technology

13. (a)Which of the following are the benefits of Incorporating ICT and gender in learning physics?

- Promotion of students intellectual abilities through acquisition of high order thinking skills
- Provides opportunities for own investigation
- It makes physics education less difficult, more connected to real life and authentic
- Improvement in communication skills
- Transforms the teaching learning process from being teacher centered to student centered
- Understanding learning tools
- Gives students opportunities to develop creativity and problem solving skills
- Allows learners to monitor and manage their own learning
- Fosters the developmentof21$^{st}$centuryskills

(b) WhichofthefollowingapproachesdophysicslecturersemployinincorporatingICTandgen derinteaching?

- Integrated Approach which advocates for an enhancement in students' learning through exposure to experiences that challenge their knowledge for deeper understanding

- Enhancement Approach where students are exposed to new ways which help them to formulate their own explanations
- Complementary Approach in which students are given freedom to respond to more challenging physics tasks

14. Which of the following ICT applications do you use in learning physics?

- Clickers
- Velocity and acceleration simulations
- Audio sky tours
- Video science
- Physics one gravity
- Thormas Edson's lab
- Complete physics
- If others, mention them

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**THANK YOU VERY MUCH**

## APPENDIX X: CLASSROOM OBSERVATION CHECKLIST

CAMPUS ……………………………………………………………………………..………

PROGRAM……………………………………………………………………………………

CLASS/YEAR…………………………………………………………………………………

**Section B: Physics Lecturers 'ICT Competence Levels**

ICT competences shown by physics lecturers

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Transfer of ICT competences from lecturers to students

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Demonstration of knowledge on ICT use by lecturers

- Use of ICT to understand students and content
- Planning ICT infused curriculum
- using ICT in planning
- Using ICT integrated strategies
- Infusion of ICT in teaching contexts
- Use of ICT in instruction
- Use of ICT in assessing students

Gender considerations in ICT use (variety, Access, balance, language)

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**C: ICT Applications Used by Physics Lecturers**

- Lecturer's attitude towards ICT use

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- ICT Tools /applications used in physics teaching

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- Methods used in Teaching Physics Education

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**Section D: Factors Impeding the Incorporation of ICT and Gender in Teaching and Learning Physics**

Enablers for ICT and gender incorporation exhibited in the campus

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Factors limiting the incorporation of ICT and Gender in the teaching of Physics in this institution

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**Section E: ICT Competences Possessed by Physics Student Teachers**

Comparison of ICT competences possessed by female and males students

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Evidence of Students' ICT competence development by physics lecturers

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Students' exposure to ICT or digital materials

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**Section F: Student Teachers' Use of ICT in Learning Physics**

Activities given to students for developing ICT competences

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Approaches used in incorporating ICT and gender in learning physics

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ICT applications or tools employed in learning Physics Education

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General Observation Remarks

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**END**

## APPENDIX XI: QUESTIONNAIRE FOR PHYSICS LECTURERS

I am Waninga Willy a Doctoral Student of Selinus University, Italy conducting a study on the topic **"The Incorporation of ICT and Gender in the Teaching of Physics Education in Teacher Training Institutions in Eastern Uganda".** The information given will be handled with confidentiality and serve the study purpose only. You are requested to participate in this study by ticking the correct alternative or filling in the blank space provided.

**Section A: Biographical Data**

| **Type of Data** | **Description of Data** | | | |
|---|---|---|---|---|
| Age | 20-35Years | 36-45years | 46-55years | 56yearsand above |
| Sex | Male | | Female | |
| Education Level | Doctoral | Masters | Bachelor | Diploma |
| Teaching Experience | 1-15YEARS | 16-30 | 31-45 | 45yearsabove |
| Responsibility | HOD | Registrar | Coordinator | Student |

**Section B: Physics Lecturers' ICT Competence Levels**

1. Which of the following ICT competences do you have as recommended by UNESCO?

- Teachers' instructional practices and their curriculum
- Communication ability of extending the learning beyond the classroom
- Catering for learners' rights and responsibilities
- Updated skills on hard ware and software

2. How are you supported by the institute administrators to acquire the required ICT competences necessary in teaching physics?

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3. Which of the following dimensions of knowledge on ICT use do you have?

- Use of ICT to understand students
- Using ICT to understand content
- Planning ICT infused curriculum
- Using ICT integrated strategies
- Infusion of ICT in teaching contexts
- Use of ICT in instruction
- Use of ICT in assessing students

4. (a) Which ICT skills do you have?

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(b)How does the lecturer's digital literacy affect his or her use of ICT in teaching?

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**Section C: ICT Applications Used by Physics Lecturers**

5. (a)How does the physics lecturers' attitude and self efficacy affect the incorporation of ICT and gender in teaching?

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(b) How can the incorporation of ICT and gender in teaching eliminate misconceptions about physics?

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(c) Under which of the following category do you fall as you incorporate ICT and gender in teaching physics?

- Innovators
- Early Adopters
- Early Majority
- Late Majority
- Laggards

6(a) Which of the following methods of teaching do you employ while incorporating ICT and gender in teaching physics?

- Problem Based Learning
- Class Experimentation
- Inquiry Based Learning
- Collaborative Learning
- Interactive Question and Answer

(b) Which of the following should be priority areas for lecturers to stress to student teachers while on training?

- Actual use of IT equipments
- Use of specific software
- The use of information technology equipments in making physics real

(c) At what stage of ICT development are you?

- Recognition stage where the lecturer recognizes alignment of technology with subject matter
- Persuasion where the lecturer forms favorable and unfavorable attitudes towards ICT use towards teaching specific content
- Adaptingdecisionwherethelecturerengagesinactivitiesthatleadtoachoiceofadopting or

rejecting teaching specific content with appropriate technology

- Implementation stage where the lecturer integrates teaching and learning with appropriate technology
- Confirmation stage where the lecturer is able to redesign curricular and evaluate the result the result of the decision to integrate technology in teaching and learning specific content with appropriate technology

**Section D: Factors Impeding the Incorporation of ICT and Gender in Teaching and Learning Physics**

7 (a)What factors limit the incorporation of ICT and Gender in the teaching of Physics in your class?

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(b) What do you think should be done to address the above factors?

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**Section E: ICT Competences Possessed by Physics Student Teachers**

8 (a)What is the relationship between students' prior ICT competences and their achievement?

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(b) What are the benefits of self efficacy to student teachers pertaining ICT use or incorporation

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(c) What is the comparison of ICT competences possessed by female and males students?

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9. (a) How do you help student teachers to develop their ICT competences?

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(b) What is the connection between students' computer experiences and self efficacy?

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**Section F: Student Teachers' Use of ICT in Learning Physics**

10 (a)Which of the following digital divides is greatly experienced by physics students teachers?

- First digital divide with access to technology
- Second digital divide with difference to skills
- Third digital divide with differences in benefit from the technology

(b) How can digital divides be avoided among physics student teachers?

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(c)What are the benefits of students' Incorporating ICT and gender in learning physics?

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11 (a)How do you develop your physics student teachers' ICT competences?

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**(b)** Which of the following approaches do you employ in incorporating ICT and gender in teaching physics?

- Integrated Approach which advocates for an enhancement in students 'learning through exposure to experiences that challenge their knowledge for deeper understanding

- Enhancement Approach where students are exposed to new ways which help them to formulate their own explanations
- Complementary Approach in which students are given freedom to respond to more challenging physics tasks

12 Which ICT applications or tools do you employ in engaging students as they learn physics?

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**THANKYOUVERY MUCH**

APPENDIX XII: DOCUMENTARYANALYSIS PROTOCOL

**Campus:……………………………………………………………………**

| **S/No** | **Description** | **Observation Comments** |
|---|---|---|
| **1.** | **Schemes of Work**<br>• Presence of we blinks in references<br>• Current and updated content<br>• Mention of digital resources<br>• Nature of instructional activities | |
| **2.** | **Lesson plans**<br>• Lesson procedures<br>• Instructional materials prepared for the lesson<br>• Lesson activities<br>• Assessment activities | |

**Other Analytical Comments**

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## APPENDIX XIII: BUDGET FOR THE RESEARCH STUDY

| S/No | Activity | Unit cost | Total cost |
|---|---|---|---|
| 1. | Payment for Research permit | 350 us dollars | 1,400,000/= |
| 2. | Airtime | | 300,000/= |
| 3. | Internet bundles | | 500,000//= |
| 4. | Transport and compensation | | 1,500,000/= |
| 5. | Data dissemination | | 1,250,000/= |
| 6. | Typingandbinding | | 200,000/= |
| 7. | Stationary | | 100,000/= |
| 8. | Administration | | 320,000/= |
| 9. | Miscellaneous | | 250,000/- |
| | **Total** | | **5,820,000/=** |

## APPENDIX XIV: KREJCIE AND MORGAN SAMPLE SIZE FORMULAR (1970)

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

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

Source: Krejcie & Morgan, 1970

## APPENDIX XV: RESEARCH PERMIT FROM UNCST

Uganda National Council for Science and Technology

*(Established by Act of Parliament of the Republic of Uganda)*

**4th October 2023**

**Our Ref: SS1891ES**

willy waninga

Kotido Primary Teachers College

**Kotido**

**Re: Research Approval: THE INCORPORATION OF ICT AND GENDER IN THE TEACHING OF PHYSICS EDUCATION IN TEACHER TRAINING INSTITUTIONS IN EASTERN UGANDA**

I am pleased to inform you that on **04/10/2023**, the Uganda National Council for Science and Technology (UNCST) approved the above referenced research project. The Approval of the research project is for the period of **04/10/2023** to **04/10/2024**.

Your research registration number with the UNCST is **SS1891ES**. Please, cite this number in all your future correspondences with UNCST in respect of the above research project. As the Principal Investigator of the research project, you are responsible for fulfilling the following requirements of approva

1. Keeping all co-investigators informed of the status of the research.
2. Submitting all changes, amendments, and addenda to the research protocol or the consent form (where applicable) to the designated Research Ethics Committee (REC) or Lead Agency for re-review and approval **prior** to the activation of the changes. UNCST must be notified of the approved changes within five working days.
3. For clinical trials, all serious adverse events must be reported promptly to the designated local REC for review with copies to the National Drug Authority and a notification to the UNCST.
4. Unanticipated problems involving risks to research participants or other must be reported promptly to the UNCST. New information that becomes available which could change the risk/benefit ratio must be submitted promptly for

UNCST notification after review by the REC.

5. Only approved study procedures are to be implemented. The UNCST may conduct impromptu audits of all studyrecords.
6. An annual progress report and approval letter of continuation from the REC must be submitted electronically to UNCST. Failure to do so may result in termination of the research project.

Please note that this approval includes all study related tools submitted as part of the application as shown below:

| No. | Document Title | Language | Version Number | Version Date |
|---|---|---|---|---|
| 1 | RESEARCH TOOLS | ENGLISH | WORD | 23 June 2023 |
| 2 | CONSENT FORMS AND INFORMATION SHEETS | WNGLISH | WORD | 23 June 2023 |
| 3 | Project Proposal | English | PDF | |
| 4 | Approval Letter | English | | |
| 5 | Administrative Clearance | English | | |
| 5 | cOMMUNITY ENGAGE MENT PLAN | ENGLISH | WORD | 30 September 2023 |
| 6 | COVID 19 MITIGATION PLAN | ENGLISH | WORD | 30 September 2023 |
| 7 | INFORMATION AND CONSENT FORMS | ENGLISH | WORD | 30 September 2023 |

Yours sincerely,

Hellen Opolot

For: Executive Secretary

**UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY**

## APPENDIX XVI: ETHICS RESEARCH COMMITTEE CLEARANCE CERTIFICATE FROM BUSITEMA UNIVERSITY

BUSITEMA UNIVERSITY
*Pursuing Excellence*

P.O Box 236, Tororo, or 226 BusiaUganda
Tel: +256-454448876/454448838
Fax: +256-454436517
www.busitema.ac.ug

### FACULTY OF HEALTH SCIENCES' REC

**15/11/2023**

To: willy waninga
+256782539867
**Type:** Initial Review

**Re: BUFHS-2023-107: THE INCOPORATION OF ICT AND GENDER IN THE TEACHING OFPHYSICS EDUCATION IN TEACHER TRAINING INSTITUIONS IN EASTERN UGANDA**

I am pleased to inform you that the Busitema University Faculty of Health Sciences REC, through expedited review held on **02/11/2023** approved the above referenced study.

Approval of the research is for the period of **15/11/2023** to **15/11/2024.**

As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes.
3. Reports of unanticipated problems involving risks to participants or any new information which could change the risk benefit: ratio must be submitted to the REC.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed byparticipants and/or witnesses should be retained on file. The REC may conduct audits of all study records,and consent documentation may be part of such audits.
5. Continuing review application must be submitted to the REC **eight weeks** prior to the expiration date of **15/11/2024** in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely

fashion may result in suspension or termination of the study.

6. The REC application number assigned to the research should be cited in any correspondence with the RECof record.
7. You are required to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of all documents approved in this application by Busitema University Faculty of HealthSciences REC:

| No. | Document Title | Language | Version Number | Version Date |
|---|---|---|---|---|
| 1 | Protocol | English | PDF | 2023-10-05 |
| 2 | Informed Consent forms | ENGLISH | PDF | 2023-10-04 |
| 3 | Data collection tools | ENGLISH | PDF | 2023-10-04 |

Yours Sincerely

Dr.Edith Mbabazi
For: Busitema University Faculty of Health Sciences REC

*LOCATION/CORRESPONDENCE*
*Plot 6 Kimera Road, Ntinda*
*P.O. Box 6884*
*KAMPALA, UGANDA*

*COMMUNICATION*
TEL: (256) 414 705500
FAX: (256) 414-234579
EMAIL: info@uncst.go.ug
WEBSITE: http://www.uncst.go.ug

## APPENDIX XVII: FIRST ADMINISTRATIVE CLEARANCE

Selinus University of Sciences and Literature

Via Rome 200-9700

Rugasa-Italy

12th May 2023

The Principal

Nyondo Teacher Training Institute

P.O Box 920,Mbale

Dear Sir/Madam,

Permission granted. 18/5/2023

ST. JOHN BOSCO T.T.I. NYONDO
PRINCIPAL
P. O. BOX 920, MBALE

**RE: REQUEST FOR PERMISSION TO CONDUCT MY PHD RESEARCH IN YOUR INSTITUTE**

I hereby submit my request to your office as per the above mentioned reference. I am a student of Selinus University of sciences and literature conducting a study on the research project entitled "The incorporation of ICT and Gender in the teaching of Science (Physics) Education in Teacher Training Institutions in Eastern Uganda. This study will enable me to come up with a report as a requirement for the award of the degree of the Doctor of Philosophy in Science Education of Selinus University of Sciences and Literature.The research conduct will be based on the procedures guided by the stipulated research ethics. I am therefore requesting your office to issue me with an administrative clearance to be submitted to Uganda National Council of Science and Technology (UNCST) for the research permit request.

Hope for your positive consideration

Yours faithfully

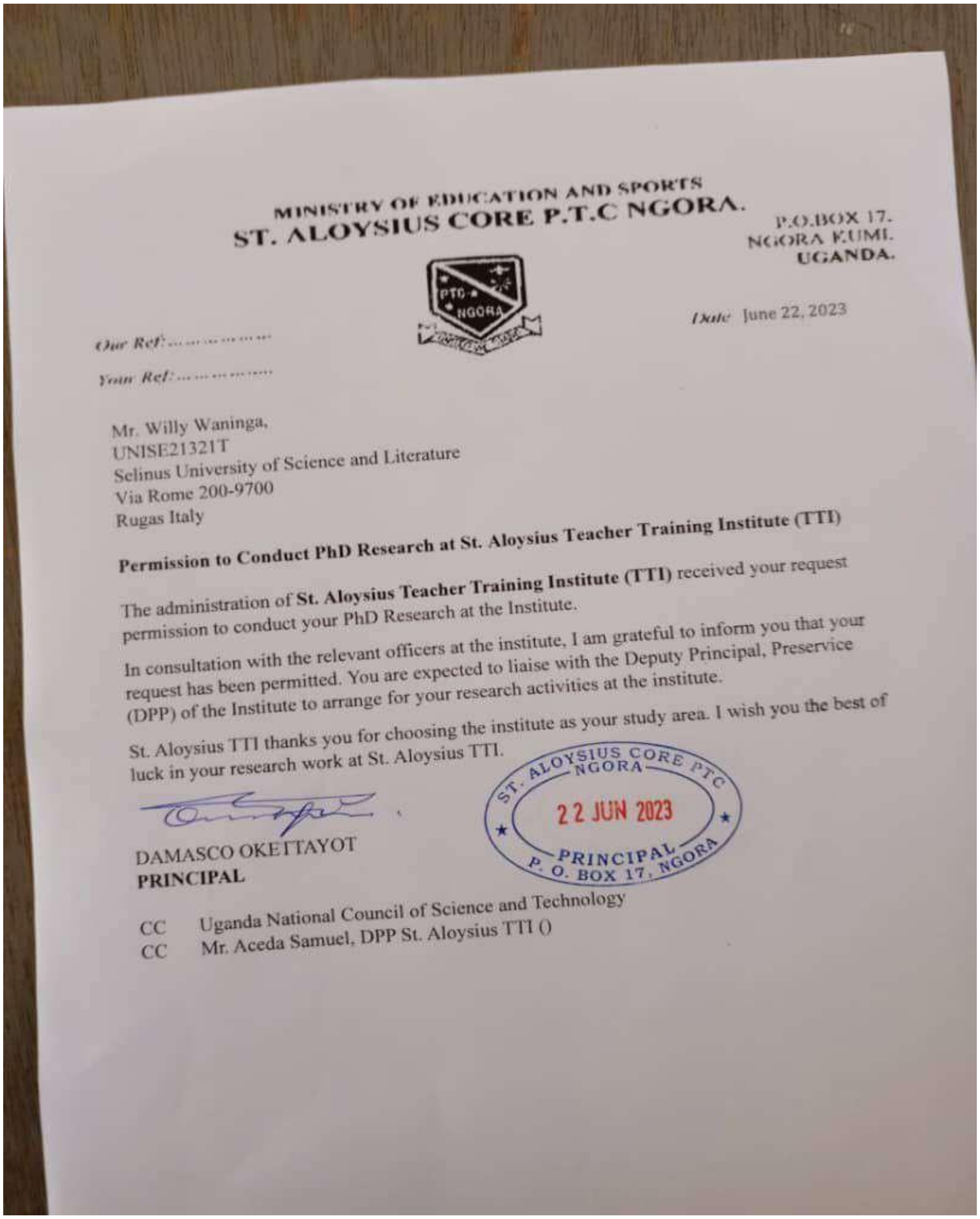
WANINGA WILLY

REG NUMBER: UNISE21321T

Email: willywaninga@gmail.com

Telephone: +256782539867

## APPENDIX XVIII: SECOND ADMINISTRATIVE CLEARANCE



MINISTRY OF EDUCATION AND SPORTS

ST. ALOYSIUS CORE P.T.C NGORA.

P.O.BOX 17.
NGORA KUMI.
UGANDA.

Our Ref:………………

Your Ref:………………

Date June 22, 2023

Mr. Willy Waninga,
UNISE21321T
Selinus University of Science and Literature
Via Rome 200-9700
Rugas Italy

**Permission to Conduct PhD Research at St. Aloysius Teacher Training Institute (TTI)**

The administration of **St. Aloysius Teacher Training Institute (TTI)** received your request permission to conduct your PhD Research at the Institute.

In consultation with the relevant officers at the institute, I am grateful to inform you that your request has been permitted. You are expected to liaise with the Deputy Principal, Preservice (DPP) of the Institute to arrange for your research activities at the institute.

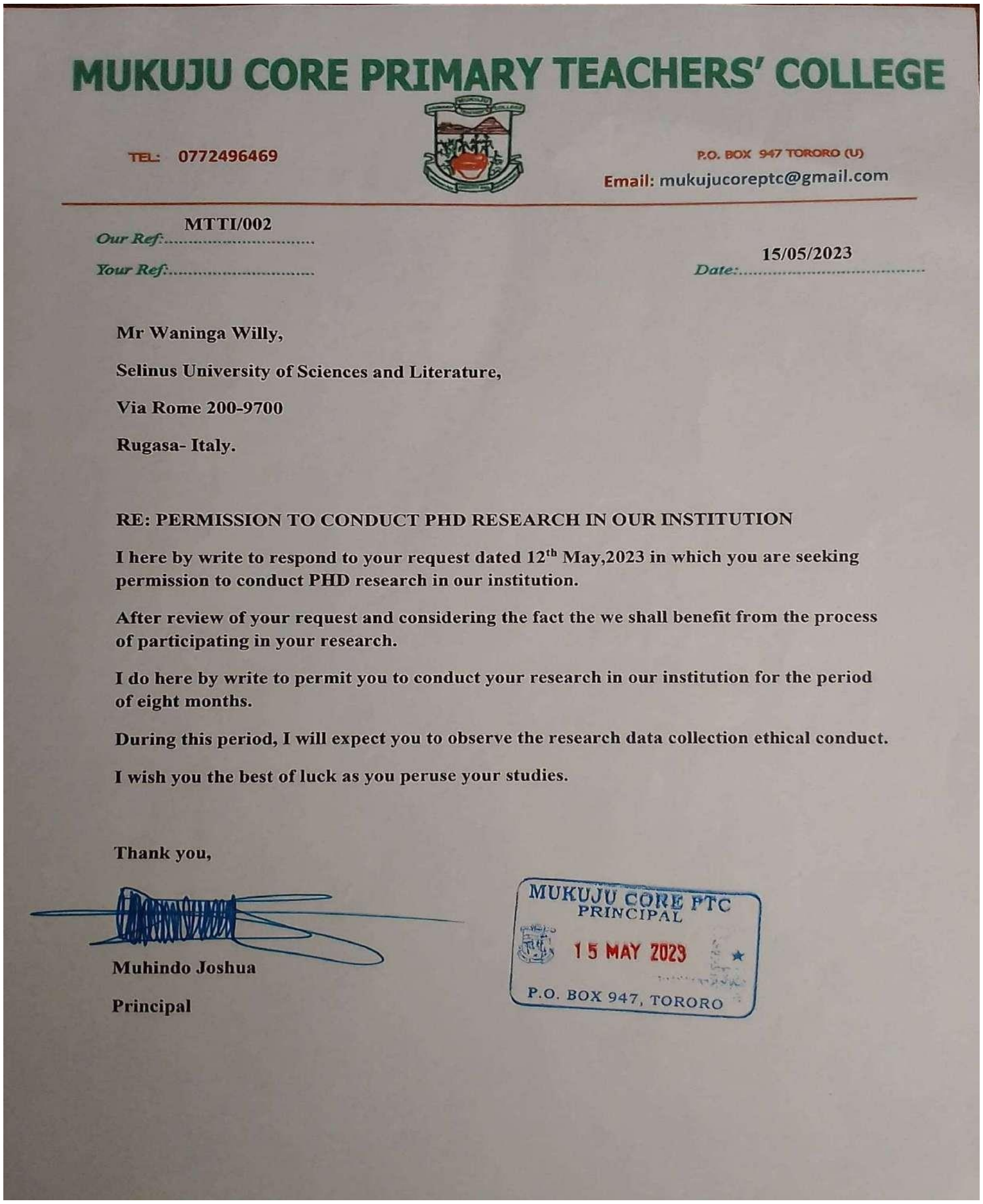
St. Aloysius TTI thanks you for choosing the institute as your study area. I wish you the best of luck in your research work at St. Aloysius TTI.

ST. ALOYSIUS CORE PTC NGORA
22 JUN 2023
PRINCIPAL
P. O. BOX 17, NGORA

DAMASCO OKETTAYOT
**PRINCIPAL**

CC Uganda National Council of Science and Technology
CC Mr. Aceda Samuel, DPP St. Aloysius TTI ()

# APPENDIX XIX: THIRD ADMINISTRATIVE CLEARANCE



MUKUJU CORE PRIMARY TEACHERS' COLLEGE

TEL: 0772496469

P.O. BOX 947 TORORO (U)

Email: mukujucoreptc@gmail.com

Our Ref: MTTI/002

Your Ref:

Date: 15/05/2023

Mr Waninga Willy,

Selinus University of Sciences and Literature,

Via Rome 200-9700

Rugasa- Italy.

**RE: PERMISSION TO CONDUCT PHD RESEARCH IN OUR INSTITUTION**

I here by write to respond to your request dated 12th May,2023 in which you are seeking permission to conduct PHD research in our institution.

After review of your request and considering the fact the we shall benefit from the process of participating in your research.

I do here by write to permit you to conduct your research in our institution for the period of eight months.

During this period, I will expect you to observe the research data collection ethical conduct.

I wish you the best of luck as you peruse your studies.

Thank you,

Muhindo Joshua

Principal

MUKUJU CORE PTC
PRINCIPAL
15 MAY 2023
P.O. BOX 947, TORORO

**APPENDIX XX: INTRODUCTORY LETTER FOR DATA COLLECTION**

SELINUS UNIVERSITY
OF SCIENCES AND LITERATURE

To whom it may concerns

It is attested that the student:

***WILLY WANINGA,*** resident in MBALE, Uganda.

Registration number: UNISE2132IT - Date of enrollment: 6th December 2022

Is enrolled in the **Faculty of Arts & Humanities** of Selinus University and he is about to pursue a **PhD inEducation.**

This letter will formalize the process of gathering the necessary information and data for his research thesis: *"The Incorporation of ICT and Gender in the Teaching of Physics Education in Teacher Training Institutions in Eastern Uganda ."* through questionnaires, observation and interviews. Since his research work will be his PhD thesis, you are kindly requested to provide the information he needs. We assure you that there will be no misuse of this information and the source of this information will be kept concealed. The student will carry out his research work with constant commitment in order to defend his final doctoral thesis.
This letter is issued for permitted uses in each country.
Selinus University of Science and
Literature20th January 2023
Dr Salvatore Fava

MEMENTO AUDERE SEMPER

President Selinus University

## APPENDIX XX1: DOCUMENTS WITH THE DATA REVIEWED

| Aspects of Incorporating ICT and Gender | Analytical Points | Analysis Documents |
|---|---|---|
| **Integration of ICT in Lesson Plans** | Analyze the extent to which ICT tools and resources are integrated into lesson plans, focusing on gender-sensitive teaching strategies and inclusive content. Evaluate whether there are disparities in ICT usage and gender representation in lesson plans. | Review of Physics Lecturers' Lesson Plans |
| **Gender-Inclusive Curriculum Design** | Assess the inclusivity of the physics curriculum in addressing gender stereotypes, providing diverse role models, and offering opportunities for both male and female students to engage with physics concepts. Evaluate whether ICT resources and activities are tailored to cater to different learning styles and gender preferences. | Examination of Physics Curriculum |
| **Assessment Items with Gender Sensitivity** | Examine assessment items to ensure gender sensitivity, fairness, and inclusivity. Assess whether assessment tasks and criteria consider diverse perspectives, avoid gender bias, and provide opportunities for students of all genders to demonstrate their understanding and skills in physics. Evaluate whether ICT tools are utilized effectively in assessment processes and whether gender disparities exist in assessment outcomes. | Analysis of Assessment Items |
| **Technological Resources and Infrastructure** | Evaluate the availability and accessibility of ICT resources and infrastructure in TTIs, considering potential gender disparities in access to technology. Assess whether ICT facilities are equipped with tools | Inspection of ICT Resources and Infrastructure |

| | | |
|---|---|---|
| | and software that cater to the diverse needs and preferences of both male and female students. | |
| **Professional Development Opportunities** | Analyze the availability of professional development opportunities for physics lecturers to enhance their ICT competencies and promote gender-inclusive teaching practices. Evaluate whether training programs address gender-related challenges and provide strategies for integrating ICT effectively to support gender equity in physics education. | Review of Professional Development Programs |
| **Student Engagement and Participation** | Assess student engagement and participation in ICT-integrated activities, considering gender dynamics. Analyze whether ICT tools and activities foster active participation, collaboration, and inclusive learning environments for both male and female students. Evaluate whether gender disparities exist in students' access to and utilization of ICT resources for learning physics. | Examination of Student Engagement Data |
| **Institutional Support for ICT Integration** | Examine the level of institutional support for ICT integration in physics education, focusing on gender considerations. Evaluate whether institutional policies and initiatives promote equitable access to ICT resources, address gender disparities in technology use, and support gender-inclusive teaching practices in TTIs. | Analysis of Institutional Policies and Initiatives |