INTEGRATION OF INFORMATION AND COMMUNICATION TECHNOLOGY TO ENHANCE TEACHING AND LEARNING FOR CHILDREN WITH AUTISM SPECTRUM DISORDER IN TANZANIA

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CERTIFICATION

The undersigned certifies that they have read and hereby recommend for acceptance by The Open University of Tanzania a Thesis entitled, "**Integration of Information and Communication Technology to Enhance Teaching and Learning for Children with Autism Spectrum Disorder in Tanzania"** in fulfilment of the requirements for the award of the Degree of Doctor of Philosophy in Education (PhD).

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DECLARATION

I, **Bilhuda Shelimoh Chamshama**, do declare that the work presented in this Thesis is my original work. It has not been, and it will never be presented to any other university or institution for a similar or any other award. Where other people's works have been reviewed, due references have been provided and acknowledged. The work is hereby presented in fulfillment of the requirement for award of the Degree of Doctor of Philosophy in Education.

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Signature

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Date

DEDICATION

This Thesis is dedicated to my beloved parents, Mr. Ally S. Chamshama and Mrs. Mwanahawa Omary Hozza, who have gone in the immediate presence of God Almighty. Your love, guidance, and sacrifices have shaped the person I am today. Though you are no longer physically here, your wisdom and unwavering support continue to inspire me. This work is a tribute to the values you instilled in me: faith, perseverance, and the pursuit of knowledge. I pray that you rest in eternal peace, knowing that your legacy will live on in all I do.

In loving memory of my dear brother, Mao Abdul Ally Chamshama. Your unwavering support, kindness, and belief in me were a source of strength throughout my academic journey. The joy of my PhD achievement was bittersweet, as I reached this milestone. I wish you were here to celebrate with me, but I find comfort in knowing that your spirit lives on in my heart. This work is a testament to the values you instilled in me- perseverance, compassion, and pursuit of knowledge. May your soul rest in eternal peace.

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ABSTRACT

This study examined how Information and Communication Technology (ICT) is integrated to enhance teaching and learning for children with autism spectrum disorder (ASD) in Tanzanian primary schools. Using a convergent mixed-methods design, data were collected from seven head teachers, thirty-six special needs education teachers, and twenty-four parents. Questionnaires were analysed in SPSS (Version 26) and interview transcripts were thematically analysed. Findings show strong stakeholder endorsement of ICT as a necessary component of contemporary, inclusive pedagogy, alongside clear evidence of systemic shortfalls in infrastructure and support. Teachers reported gaining ICT experience through pre-service training and classroom practice; however, pupils' direct interaction with ICT was limited by insufficient facilities and funding. Quantitative results indicated that perceptions of ICT integration were positively associated with the adequacy of resources and frequency of pupil ICT use, while reported challenges were inversely related to these outcomes. Overall, ICT integration was found to be uneven and constrained by resource gaps, minimal technical support, and variable teacher preparation. The study recommends whole-school ICT initiatives, targeted teacher professional development (with ASD-specific pedagogy), reliable school-level technical support, and sustained investment in assistive and instructional technologies to ensure equitable, effective learning opportunities for children with ASD in Tanzania.

Keywords: *Autism Spectrum Disorder, ICT Integration, Inclusive Education, Teacher and Parent Perceptions, Assistive Technology, Tanzania, Primary Schools, Mixed Methods.*

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LIST OF ABBREVIATIONS

AAC	Augmentative and Alternative Communication
ASD	Autism Spectrum Disorder
BCI	Brain Computer Interface
CWASD	Children with autism spectrum disorder
FEW	Facial Expression Wonderland
FMRI	Functional Magnetic Resonance Imaging
ICT	Information Communication Technology
IEP	Integrated Educational Programme
IQ	Intellectual Quotient
PDD	Pervasive Developmental Disorder
PET	Position Emission Tomography
SNE	Special Needs Education
SPSS	Statistical Package for Social Sciences
TAM	Technology Acceptance Model
UDL	Universal Design for Learning
UNESCO	United Nations Educational, Science and Cultural Organization
WHO	World Health Organisation

CHAPTER ONE

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Introduction

Integrating Information and Communication Technology (ICT) in teaching and learning is a topical agenda, emphatically for children with autism spectrum disorder. The use of ICT to support education for persons with autism remains a challenge to educators on how best to promote learning for children with autism spectrum disorder. This challenge is a critical area of scientific research to investigate the integration of ICT in teaching and learning for children with special needs, specifically those with autism. This chapter provides the introduction and background to the problem, the statement of the problem, the purpose and objectives of the study, the significance of the study, its limitations, and the definition of key terms and concepts related to the study.

1.2 Background to the Problem

The word autism is a generic term that is used to describe a group of complex developmental brain disorders known as Pervasive Developmental Disorders (PDD) or autism spectrum disorders (ASD). The PDDs include autistic disorder, Asperger's Syndrome, Pervasive Developmental Disorder –Not Otherwise Specified (PDD-NOS), Rett Syndrome, and Childhood Disintegrative Disorder (Carpenter, 2013). According to the American Psychiatric Association (2000), children with autism spectrum disorder must display at least a total of six characteristics in three main categories. These are social interaction impairment, communication impairment, and stereotyped behaviour patterns. Children with autism spectrum disorder cannot use

language effectively to communicate. This impairment could take several forms, as the child may have limited non-verbal communication, including flat facial expressions and no use of gestures in communication.

Autism has multiple causes that occur in diverse combinations. Some would dispute that the causes of ASD include both genetic and environmental factors (Amaral 2017). In some children, autism spectrum disorder appears after a traumatic case of malaria or rheumatic fever, which stands out as a major cause of autism (Prizant, 1996). Walker and Unterhalter (2007) are of the view that poor nutrition, object poverty, and shortages of proper child development are among the probable causes of autism in children, especially in the developing world. The cycle of poverty, poor maternal health, and poor child nutrition is believed to stunt cognitive development in children, leading to developmental disorders, including autism. In this case, autism becomes a disability on the increase in the developing world, including Tanzania.

Children with autism spectrum disorder find it difficult to follow their educational careers, hence the need to investigate how best to help and support their teaching and learning for improved future lives by considering different means of their education delivery. This includes the possible deployment of information and communication technologies. The application and/or integration of information and telecommunication technologies is gaining increasing roles and importance in social processes, including education delivery (Papageorgiou, 2020). The Tanzania education and training policy of 2014 makes provisions to ensure that all children of school age are admitted and enrolled for basic education, including children with special needs,

through improved teaching and learning as necessary for all children. This follows the Jomtien Declaration on Education for All, reaching out to all children, including those with autism. Appropriate use and integration of information and communication technology (ICT) in education involves professional development that encourages team teaching and learner focus and motivation (Kafyulilo, 2010; Mwalongo, 2011). Autism is considered a lifelong developmental disability affecting how a person communicates and relates to people around them, worldwide research indicates that information and communication technology (ICT) can contribute to effective course delivery and learning involving the affected learners.

Using computers is considered helpful in supporting the learning of children with autism spectrum disorder, with a broad continuum of conditions presenting a wide range of difficulties and learning and communication needs (Cochrane and Bateman, 2010). Most computer applications designed for people with autism focus on enhancing the relationship between the user and the computer, such as helping with specific behavioural problems associated with autism. According to Hileman (1996), computers are motivating tools for children with autism spectrum disorder due to their use predictability and consistency in outcomes, compared with the otherwise unpredictable nature of human behavioural responses. One merit of computer applications concerning social interactions is that the technological gadget does not send confusing social messages. One research respondent in Njenga (2009) observed that:

> *Children are highly motivated when allowed to use information and communication technology (ICT); teachers can better support their learning when they are so motivated. But not everyone can learn in the same way or at the same pace. If deployed in the process of teaching and learning information and communication technology (ICT) should offer*

> *support such as to help and enable learning for pupils with differing physical and sensory difficulties and learning styles" Hence both the teachers and the use of information and communication technology (ICT) should be equally flexible to respond to learner needs and expectations,* (Njenga, 2009:457).

Information and Communication Technologies (ICTs) have increased in treating autistic individuals. Information and Communication Technologies (ICTs) support mechanisms, such as computers, laptops, and robots, are particularly attractive and are adopted by children with autism spectrum disorder (Grossard et al., 2018). Jordan (1995) found that the use of computers for children with autism spectrum disorder increases their learning abilities; promotes focused attention in lessons; improves sitting behaviour; enables fine motor skills and decreases egocentric and self-stimulatory behaviours as well as perseverative responses.

Hardy (2000) wrote a book asserting that individuals with Autistic Disorders are often unable or unwilling to participate in situations that rely upon social or verbal interaction. In such cases, computer knowledge may offer an alternative based on specific software resources that can help to promote understanding of body language and enhanced teaching of social skills such as "Mind reading". The computer offers an autistic learner a less threatening exposition when working with others, who, in many cases, are individuals with autism spectrum disorder or Asperger's condition.

Those with autism spectrum disorder often find that they can converse with or through a computer or another person using e-mail, instead of directly with another person. Word processors offer a safe and controllable environment in which the person with autism spectrum can play, experiment, explore, be creative, and even make mistakes in computer games. This offers learners with autism a good

opportunity to excel in academic subjects alongside other learners, offering them the potential to build social relationships with other learners.

According to Jordan (1995), children with autism spectrum disorder may find it difficult to cope with the changing demands of the environment around them. The computer can offer such learners the opportunity, through the internet and other multimedia applications and programs, to experience the world around them with clear boundaries for their safety and well-being. The computer can, therefore, be a useful tool that encourages co-operative working and dialogue by promoting common interests that can extend beyond normal games. Boucenna et al. (2014) present advances in research on innovative information communication technology (ICT) for the education of people with autism. Their findings focused on an overview of information and communication technology (ICT) applications used in treating autism. They also focused on the early development of imitation and joint attention between learners and teachers in the context of children with autism spectrum disorder interacting with robotics.

The researchers indicated that a profusion of information and communication technology (ICT) applications had been developed for use by people living with autism. Interactive learning environments, virtual environments, avatars, and game settings, as well as tele-rehabilitation, have been used in numerous studies to develop and promote emotional skills in children with ASD. Mitchel *et al* (2007) attempted to demonstrate the efficacy of using Virtual Environments in teaching social skills to children with autism spectrum disorders. They used a sample of six teenagers and a Virtual Environment of real cafés and buses to learn where the affected learners

would sit and why.

Brain-Computer Interface (BCI) has been found to provide disabled people with a better quality of life. It is most likely that information and communication technology (ICT) can also accomplish the same goal for children with autism spectrum disorder. Researchers and designers are currently developing different types of ICT applications, specifically targeting children with autism spectrum disorders to facilitate improvement in their lives (Hardy et al., 2002). The benefits expected from information and communication technology (ICT) applications include delivering training to children with autism spectrum disorder and alleviating their families' burdens. Therefore, the relevance and the role of information and communication technologies (ICT) in the everyday lives of children with autism spectrum disorder is an undoubted emerging phenomenon. Recently, the development has indicated a significant contribution in facilitating education delivery for children with special needs, including those with autism (Selwyn & Gouseti, 2009).

Miranda, *et al.* (2011) used real-time facial synthesis of 3D characters to determine the effect of emotional recognition based on facial expressions on people with autism. Communication skills in people with autism spectrum disorders are impaired, and consequently, they are unable to recognise emotions in real life. The researchers also emphasise the need to create a solution to the problem of autism, which requires joint effort from different research fields, including computer vision, computer graphics, human-computer interaction, vis-à-vis facial, behavioural, and emotional expressions.

There has been a growing shift from ‘Education for ICT’ to the use of ‘ICT for Education’ and for ICTs integration throughout the curriculum, blending their use with other resources to support and promote learning in general, including the inclusion of specific educational needs of learners with the problems of autism. The ICT policy for basic education, 2007, emphasises the need for an environment that enables the effective development and application of ICTs for the sustainable development of basic education in Tanzania (URT, 2007). The policy provides for an enabling environment for primary education. ICTs' application is similarly important for the promotion of teaching and learning of children with ASD. Moore and Calvert (2000) documented that ICT applications have proved useful in several areas of vocalisation and vocabulary building for learners with autism.

Research evidence indicates that information and communication technology (ICT) can accomplish many tasks related to education delivery in many settings with due efficiency and effectiveness. Therefore, using information and communication technology (ICT) to facilitate health care delivery and management is common. Similarly, brain-computer interface (BCI) devices were under development to assist people with disabilities (Wolpaw et al., 2000). For instance, technologies already exist that enable people with severe cerebral palsy to communicate verbally with thoughts via electroencephalograph [EEG] (Neuper, et al., 2003). Alongside the benefits of information and communication technology (ICT) applications, many people with disabilities can now participate in many activities and enjoy independent lives.

Distinct from children with disabilities, children with autism spectrum disorder have indicated developmental malfunctions such as mental disability and language

disorders that affect their cognitive processes. Alongside the several other factors that hinder the integration and application of information and communication technology (ICT) in education delivery, the technology has enabled increased enrolment in primary schools in some years, as indicated in Table 1.1.

Table 1.1: Enrolment of Children with autism spectrum disorder in Primary Schools in Tanzania: 2012-2021

Year	Male	Female	Total
2012	63	49	112
2013	432	314	746
2016	590	391	981
2017	869	578	1447
2018	1091	755	1846
2019	1315	1008	2323
2020	1108	748	1856
2021	1339	898	2237

Source: URT, 2012; 2013; 2016; 2017; 2018; 2019; 2020; 2021.

The Ministry of Education and Vocational Training, now the Ministry of Education, Science and Technology (MoEST), developed and circulated an ICT policy for Basic Education (URT, 2007). This policy acknowledges that very few (mainly urban) schools had access to ICT infrastructure. The policy provides for every school to ensure the establishment of the necessary infrastructure to facilitate the adoption of information and communication technology (ICT) in the provision of and access to education through computers, digital equipment, telecommunication, internet access, radio, and TV. These policy provisions were gradually phased out, targeting national coverage by 2015. Table 1.2 illustrates the initiatives taken in implementing the 2007 ICT policy in the selected geographical regions. With the use of information and communication technology (ICT), education for persons with special needs would be much improved, and the initiatives started in Tanzania way back in the 1950s (Mnyanyi, 2014).

Table 1.2: Status of ICT Facilities in Selected Schools Some Regions in Tanzania (2015)

Regions	Desktop Computer	Laptop Computer	Projector	Tablet/smartphones	TV
Arusha	702	195	32	29	103
DSM	1921	440	68	174	234
Dodoma	263	21	5	26	22
Geita	12	5	1	1	2

Source: URT (2016).

The Tanzania Education and Training Policy (1995) stipulates that every child must be provided with primary education as a human right regardless of sex, colour, ethnicity, mental and physical abilities, or other disabilities. In the efforts to examine the contribution of information and communication technology (ICT) in enhancing teaching and learning for children with autism spectrum disorders. Bernard -Opitz et al (2001) conducted a study on computer-assisted instruction to train children with different difficulty levels under different task conditions. It was found that with the help of the introduced technologies, there were positive changes in the children's learning processes.

Enrolment for children with special needs, including those with autism, is increasing in Tanzania (Mnyanyi, 2014). Consequently, information and communication technology (ICT) has been recognised to be an important means of enhancing teaching and learning for such children (Mikre, 2011; UNESCO, 2006; Soby, 2013; Mnyanyi et al., 2012; Mnyanyi et al., 2009; Rhema et al., 2009; Seale, 2013). To justify this move, there is a need to investigate how best to integrate the technologies for more effective teaching and learning for autistic children in Tanzania and indeed in the education world as a whole.

1.3 Statement of the Problem

Information and communications technologies (ICT) are already integrated into the teaching and learning process in many educational and learning institutions worldwide. However, their use in supporting learners with autism, especially in low- and middle-income countries, remained limited. In Tanzania, national policies such as the ICT policy (URT, 2003) and the ICT policy for basic education (URT, 2007) advocate for the integration of ICT across all levels of education, including special needs education. Nevertheless, these policies do not explicitly address the unique needs of children with autism spectrum disorder, nor do they provide implementation strategies tailored to this group.

International research highlights the potential of information and communication technology (ICT) to support children with autism spectrum disorder by enhancing communication, cognitive engagement, and individualised learning. However, in the Tanzanian context, there is a noticeable gap in empirical research examining how information and communication technology (ICT) is integrated into classroom practice for children with autism spectrum disorder, particularly in public primary schools.

Most existing studies have focused on general ICT adoption or special education in broad terms, without specifically addressing autism spectrum disorder (ASD) as a distinct category with specific learning challenges. This gap is critical, as children with autism spectrum disorder often require highly specialised, structured, and visually supported learning environments that ICT can provide. Without evidence-based data on ICTs' availability, application, and effectiveness for autism learners in

Tanzania, educators and policymakers cannot make informed decisions to promote inclusive and equitable education.

If well integrated into the curriculum and teaching and learning strategies, information and communication technology (ICT) is believed to help children overcome many of their communication difficulties. The integration can encompass the wider curriculum, individual subjects, and lessons. Information and communication technology (ICT) devices, such as computers, can enable autistic learners to access the same curriculum content as their peers without disabilities. As stipulated in the ICT policy for basic education, Tanzania aims to promote acquiring and application of technological, scientific, vocational, and professional skills to develop and improve individuals and society (URT, 2007).

This study addresses the gap by investigating the extent and nature of integrating information and communication technology (ICT) in teaching and learning for children with autism spectrum disorder in Tanzania primary schools. Specifically, it explores the adequacy of ICT resources, teacher preparedness, and the challenges and opportunities surrounding ICT use in autism education. The findings will inform policy, teacher training, and school-level implementation strategies for more inclusive ICT practices.

1.4 Objectives of the Study

1.4.1 General Objective

The general objective of this study was to investigate the integration of information and communication technology (ICT) in enhancing the teaching and learning process

for children with autism spectrum disorder in Tanzania.

1.4.2 Specific Objectives

Specifically, the study sought to:

i. Investigate the teaching and learning environment for children with autism spectrum disorder in Tanzania
ii. Identify parents' and teachers' perceptions on integrating information and communication technology (ICT) to enhance teaching and learning for CwASD.
iii. Examine teachers' experiences of children with autism spectrum disorder regarding using information and communication technology (ICT) in the teaching and learning process.
iv. Examine the experiences of children with autism spectrum disorder about using information and communication technology (ICT) in their teaching and learning process.
v. Explore the challenges and opportunities of integrating information and communication technology (ICT) in enhancing the teaching and learning of children with autism spectrum disorder.

1.5 Research Questions

The following research questions guided the study:

1. How does the teaching environment influence teaching and learning for children with autism spectrum disorder?
2. What are the parents' and teachers' perceptions of integrating ICT in enhancing the teaching and learning for children with autism spectrum

disorder?

3. What are teachers' experiences of children with autism spectrum disorder regarding the use of ICT in enhancing the teaching and learning process?
4. What are the experiences of children with autism spectrum disorder about using ICT to enhance the teaching and learning process?
5. What are the challenges and opportunities of integrating ICT in enhancing the teaching and learning of children with autism spectrum disorder?

1.6 Significance of the Study

This study is useful for education policymakers, teachers, parents, and quality assurance staff especially in the era of web 2.0. The study is important in different ways for improved management of teaching and learning processes, management of learners' behavioural change, and improved communication and social interaction among the children with autism spectrum disorder, and indeed the concerned total school community. Web 2.0 is a collective term for a series of web-based technologies that include blogging and microblogging platforms, wikis, media sharing sites, podcasting, content aggregators, social networks, social bookmarking, and other emerging forms of participatory applications relevant to education and training promotion (Jimoyiannis, et al., 2013).

Findings will be useful to teachers who consider information and communication technology (ICT) integration in teaching children with autism spectrum disorder as one of the suitable methods for teaching children with autism spectrum disorder. Information and communication technology (ICT) enables the accomplishment of many teaching tasks quickly and efficiently. Information and communication

technology (ICT) is considered useful and relevant in this study since Autistic children tend to have destructive behaviour. Information and communication technology (ICT) can help in many ways to redress communication and motor difficulties for children with autism spectrum disorder. It should always be borne in mind that the computer can reinforce or provide appeasement for some of the conditions of Autism. A computer application can provide a comforting environment for autistic children by making them feel less threatened, more in control of their surroundings, less likely to fail, and they can choose whether or not to communicate with others.

The study's findings have added to existing literature and documentation on the possibilities of integrating information and communication technology (ICT) in enhancing teaching and learning in general and, more specifically, for children with autism spectrum disorder. The findings will also be useful for the government in providing appropriate guidance to teachers and related education personnel and stakeholders involved in providing education to persons with disabilities, especially those with autism. In its general nature, this study supports the basic human right to education for all through the application of ICT. The focus is to add to already existing and effective education delivery methods. Still, it focuses more on reducing existing barriers to access and application of information and communication technology (ICT) services for autism spectrum disorder learners, contributing to the right to basic education for all globally.

The study also aimed to determine and support the contribution of education stakeholders, including the government, teachers, parents, school administrators,

ICT specialists, and development partners, in promoting a better understanding of the needs of persons with autism. These stakeholders play a crucial role in ensuring that individuals with autism can participate fully and effectively in education at all levels in Tanzania. The researcher hopes and believes that the outcomes of this study will create a more supportive environment for implementing ICT policies in Tanzania, particularly within the education sector.

The application of information and communication technology (ICT) in the education of children with special needs is also expected to contribute to the better management of behavioural changes with the increasing development of social skills in children with autism spectrum disorder. The information and communication technology (ICT) initiative proposed in this study focuses on computer technology use as one of the methods of improving teaching for children with autism spectrum disorder. Therefore, the study was planned to provide an inclusive analysis of theoretical and empirical studies of pertinent issues related to information and communication technology (ICT) application in teaching and learning for children with special needs, focusing on those with autism spectrum disorder. The focus issues included a review of the characteristics, causes of autism spectrum disorder, teaching and learning approaches for children with autism spectrum disorder, and using information and communication technology (ICT) in teaching and learning in children with autism spectrum disorder. Furthermore, it identifies the knowledge gap.

1.7 Delimitation of the Study

This study focused on integrating information and communication technology (ICT) in teaching and learning for children with autism spectrum disorder, particularly in

Dar es Salaam, Morogoro, and Arusha regions. The study involved special needs education teachers, parents, and autistic children as key respondents to the research tools. The study focused on issues related to the application of information and communication technology (ICT) in enhancing teaching and learning for children with autism spectrum disorder in the selected primary schools that have enrolled pupils with autism.

1.8 Limitations of the Study

The assumptions for this study were that with the increased cases of autism in society, there is a need to integrate modern information communication technology (ICT) to support the teaching and learning of children with special needs, and specifically those with autism. This assumption is based on the view that information and communication technology (ICT) can facilitate teaching and learning for children with autism spectrum disorder in Tanzania. Yet, different stakeholders in education have not realised the importance and contribution of information and communication technology (ICT) integration in teaching and learning for children with autism spectrum disorder. With these assumptions, the researcher faced limitations when conducting this study.

These limitations include sampling limitations. Since the study focused on specific sample schools in Dar-es-salaam, Arusha, and Morogoro regions, it limits the ability to generalise the findings to other regions in Tanzania or beyond. This geographic limitation may affect the external validity of the study. Additionally, the selection of schools with enrolled pupils with autism might have excluded perspectives from schools where ICT integration is not yet in place, potentially skewing the findings

toward schools with more developed ICT infrastructure.

Subjectivity in self-reported data is also one of the limitations of the study. A key limitation was the reliance on self-reported data from teachers, parents, and children with autism spectrum disorder. Self-report can be subject to bias, including social desirability bias, where respondents may provide answers that they believe are socially acceptable or expected. This could have affected the accuracy of the responses, thereby reducing the reliability of the data.

The study asked participants to reflect on their experiences with ICT in the teaching and learning process, which may have led to recall bias. Teachers and parents may not have recalled all relevant instances or interpreted their experiences differently. This limitation could affect the study's internal validity by introducing inconsistencies in how the data was reported. Moreover, the study assumed that ICT resources in the selected schools were distributed uniformly across classrooms. However, there may have been variability in the quality and extent of ICT integration, such as differences in computer access, teacher training, and classroom support. This inconsistency in ICT infrastructure could have introduced variability in the experiences of teachers and students, potentially reducing the reliability of the findings.

On the other hand, teachers and parents may have had preconceived notions or biases regarding the effectiveness of ICT in teaching children with autism spectrum disorder, which could have influenced their perceptions and responses, leading to data that may not fully reflect the objective reality of ICT integration in autism

education. This limitation could affect the validity and reliability of the study's conclusion. Even so, caution was taken when operating amidst the identified and emergent challenges, such that they did not compromise the validity and reliability of the data collected and the findings. Therefore, the study's challenges included a lack of enthusiasm from some respondents. Some identified respondents were initially reluctant to participate in the study. To redress this challenge, the researcher spent more time elaborating on the importance and benefits of the study and its findings to the concerned learners, their parents, and families as a whole.

Through awareness creation about the importance and contribution of information and communication technology (ICT) integration in teaching and learning for children with autism spectrum disorder, it was possible to reduce the barriers to the expected collaboration between the researcher and the envisioned respondents to the research instruments. For instance, the respondents showed absenteeism. Several teachers and parents were unavailable for interviews or questionnaires due to conflicting schedules or other professional commitments. This challenge complicated the data collection processes and affected the timeliness of the study, but did not compromise the core findings. In dealing with this challenge, the researcher negotiated for a valid schedule for visitation for the sampled schools, including the most appropriate time of day when the planned respondents were most likely to be available for consultation with the researcher and or her representative.

1.9 Definition of the Key Terms

1.9.1 Children with Autism Spectrum Disorder

These children face a developmental disorder characterised by normal cognitive and

language development, impairments in all social areas, repetitive and stereotypic behaviours, preoccupation with atypical activities, pedantic speech, and motor clumsiness. The spectrum nature of autism means symptoms and abilities can vary widely among individuals.

1.9.2 Integration of Information and Communication Technology

This refers to the utilisation of Information and Communication Technology and other digital tools such as computers, tablets, internet resources, and interactive educational software and communication apps in teaching and learning to engage children with autism spectrum disorder effectively in the learning processes to enhance communication, reduce anxiety, and promote engagement in both teaching and therapeutic settings.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This Chapter presents a review of the literature related to the study. The review covers the conceptualisation of the autism spectrum disorder. This includes causes, characteristics of autism spectrum disorder, teaching and learning approaches for learners with autism spectrum disorder, with particular focus on applying information and communication technology (ICT) in enhancing teaching and learning for learners with autism spectrum disorder. The Chapter ends with indications of a knowledge gap in the support process for and enhancement of effective teaching and learning for learners with autism.

2.2 Theoretical Perspectives

This study was based on and guided by two theories: the Theory of Technology Acceptance Model (TAM) and the Constructivist Theory.

2.2.1 Technology Acceptance Model

The Technological Acceptance Model (TAM), developed by Davis (1986), is a widely used framework for understanding how individuals accept and use new technology. The model suggests that our attitudes toward technology are shaped by two key factors: perceived usefulness and perceived ease of use. According to TAM, individuals are more likely to adopt a new technology if they perceive it as useful in enhancing their performance and if it is easy to use. This model has been applied in various fields, including education, to understand how teachers and students adopt educational technologies.

The study aimed to integrate information and communication technology (ICT) for enhanced teaching and learning for children with autism spectrum disorder. The initiative intends to establish how best to deploy the Technology Acceptance Model (TAM) in adopting, mainstreaming, and enabling emerging technologies in education and training. The model supported by the TAM theory was chosen because it provides for, acknowledges, and clarifies the determinants of ICT application in education delivery, especially for learners with special needs, including and focusing on those with autism (Jaeger, 2006). The model also provides an opportunity for tracing the impact of external and internal factors, beliefs, and attitudes that influence the acceptability and futuristic actions about modern and emerging technologies in educating learners with special needs, and the appropriate steps that need to be taken as the new teaching and learning strategies are adopted and mainstreamed in special needs education.

The TAM theory asserts that the application of information and communication technology (ICT) in teaching and learning is determined and guided by two beliefs: the perceived usefulness of the methods and perceived ease of applying and using the technologies (Davis, 1989). For children with autism spectrum disorder, it is particularly important to determine how the expected use of information and communication technology (ICT) can best help and benefit the education process for the targeted learners. The perceived usefulness of this study includes the extent to which teachers, children with autism spectrum disorder, and other stakeholders in education can sustainably support the application and deployment of information and communication technology (ICT) for the education of children with autism spectrum disorder.

Several studies have applied TAM in the context of special education and autism. Jaeger (2006) applied TAM to examine the use of ICT in special education classrooms, finding that both perceived usefulness and ease of use were significant predictors of teachers' intentions to use technology. Similarly, Mwalongo (2011) found that teachers' acceptance of ICT tools in Tanzanian classrooms was influenced by their belief in their effectiveness and comfort. The selected theory fits well in this study as it enables the examination of the teaching and learning environment for children with autism spectrum disorder, including the underlying challenges and opportunities for the smooth and effective integration of information and communication technology (ICT) in education for children with autism spectrum disorder.

2.2.2 Constructivist Learning Theory

The constructivist learning theory, championed by theorists such as Piaget, Vygotsky, and Dewey, emphasizes active learning through social interaction and personal experience. According to this theory, knowledge is not passively received but actively constructed by the learner through interaction with their environment. This approach aligns well with the needs of children with autism spectrum disorder, as it encourages a learner-centred, adaptive, and engaging learning environment and thus counters the idea and approaches by which teachers spoon-feed children with all that their lessons provide (Mallory & New, 1994; Berk & Winsler, 1995).

The theory has been applied to support teaching processes for children with disabilities, including people who are deaf or hard of hearing (Anita, Stinson, and Gaustad, 2002). Under this theory, the learner-centeredness process in teaching is

encouraged with the assertion that the strategy has the potential to support the application of Information and communication technology (ICT).

In constructivist classrooms, hands-on activities encourage students to explore, collaborate, and build knowledge. For children with autism spectrum disorder, this can be particularly effective as it allows them to engage with content in a way that is meaningful to them. ICT tools can support this active learning process by offering interactive, personalised, and multimodal learning experiences that cater to the individual needs of children with autism spectrum disorder. For example, virtual reality (VR) environments and educational games provide an immersive learning experience that can help autistic children practice social skills and communication in a controlled, supportive environment.

The application of constructivism in autism education is further supported by the works of Lev Vygotsky (1978), who emphasized the role of social interaction in cognitive development. In the context of Information and communication technology (ICT), tools such as social skills games, speech recognition software, and communication devices allow children with autism spectrum disorder to interact with their peers, teachers, and virtual environments, facilitating their cognitive and social development. By constructivism, Lev Vygotsky asserts that knowledge is socially constructed to develop skills that enable children, including those with autism, to be positively influenced by cultural norms and tools as they construct knowledge. Cultural tools include language, thinking styles, plays, and imagination. According to Vygotsky, language is learned through interaction with adults and peers (through modelling). It is key to developing abstract, concrete thought and

consequent formation of concepts (Bauminger & Kasari, 2000).

Generally, many children with autism spectrum disorder often lack friendships and opportunities to learn how best to interact and develop action and thinking skills, which are critically important in building a positive view of the world, knowledge, and understanding. (Selmer–Olsen, 1993; Bauminger, 2003; Koegel et al., 2005). In this study, both the children under study and concerned education stakeholders find themselves jointly constructing strategies to integrate Information and communication technology (ICT) into the curriculum and teaching and learning processes. A view to enhance the teaching and learning process for children with autism spectrum disorder.

The constructivist perspective emphasizes that children should be enabled and helped to build more of their knowledge from social experiences, such as those in the school environment, and more so outside the classroom (Prawat, 2008). For learners to participate and learn effectively, they will need to develop the needed skills with available resources and be full members of the community, contributing towards its maintenance and development. In the context of ICT, tools such as social skills games, speech recognition software, and communication facilitate their cognitive and social development.

2.3 Conceptualisation and Understanding of Autism Spectrum Disorder

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterised by persistent deficits in social, communication, and interaction across multiple contexts, associated with restricted, repetitive patterns of behaviour, interest, or activities that

are present from early childhood and result in significant functional impairments (American Psychiatric Association, 2013). This scholar went further, describing autism spectrum disorder as markedly impaired abnormal impairment of social and communication development, combined with patterns of a restricted repertoire of activities and interests. The severity of these symptoms can vary significantly, with some individuals displaying mild symptoms and others experiencing more profound impairments. Children with autism spectrum disorder often struggle with basic social interactions, including understanding facial expressions, making eye contact, engaging in reciprocal communication, and developing, maintaining, and understanding relationships. Additionally, they may display rigid behaviours, such as insistence on sameness, adherence to routines, and intense focus on specific interests.

According to the ICD of WHO 2015, autism spectrum disorder is characterised by persistent deficits in social communication and social interaction across multiple contexts, including deficits in social reciprocity, nonverbal communicative behaviours used for social interaction, and developing, maintaining, and understanding relationships. In addition, individuals with autism spectrum disorder demonstrate restricted, repetitive patterns of behaviour, interests, or activities, as manifested by at least two of the following behaviours. These include: Stereotyped or repetitive motor movements, use of objects, or speech. Autistic Children are insistent on sameness, inflexible adherence to routines, or ritualised patterns of verbal or nonverbal behaviours.

Moreover, they are highly restricted, fixated interests that are abnormal in intensity or focus. Children with autism spectrum disorder are also hyper- or hypo-reactive to

sensory input or have unusual interest in sensory aspects of the environment (American Psychiatric Association, 2013). These symptoms must be present from early childhood and limit or impair everyday functioning. The condition is considered a spectrum, meaning that the severity and presentation of symptoms can vary widely among individuals. The diagnosis is typically made based on clinical observation and assessment of behaviour and development. A child affected by autism will demonstrate diverse developmental disorders that lead to behavioural and communication difficulties with varying levels of severity (Riccio, 2011).

The condition affects the child's social and communication skills, which lead to learning difficulties. Autism Spectrum Disorder, therefore, falls under a broader category of health conditions referred to as "Pervasive Developmental Disorders (PDDs). PDDs are demonstrated by delays in many areas of childhood development, such as skills to communicate and interact. Autism, in general terms, is a developmental disorder in social and communication abilities, including rigid and repetitive patterns of behaviour and interest. The manifestations of these traits vary with a child's age and ability.

Autism exists cross–culturally. However, understanding autism is further complicated by cultural differences in how the disorder is perceived, mainly outside the Western context (Grinker, 2007). Most people in many parts of the developing world do not know what autism is about, nor its causes. In African countries, autism is still viewed through the lens of traditional beliefs, where children with autism spectrum disorder may be perceived as cursed or suffering from spiritual afflictions. This misunderstanding often leads to social isolation and a lack of appropriate

interventions, hindering a child's development and access to education. The lack of culturally relevant resources and trained professionals further complicates the situation, as most children with autism spectrum disorder are not diagnosed or supported properly. However, in many places in developing countries, autism is described according to its signs and symptoms, mainly based on how the affected person behaves. In many parts, and traditionally, autism is viewed in terms of what is referred to as the "trial of impeachment" in socialisation, communication, and imagination.

According to the reviewed literature, several approaches are applicable and helpful for understanding the mystery of ASD with its wide spectrum of symptoms. Researchers from the fields of genetics, psychology of neuroscience have conducted a full range of experiments and observations in the effort to discern and establish the causes of ASD (Spence et al, 1985; Happe & Frith, 1996; Lamb et al., 2002) Non-invasive techniques, such as electroencephalography (EEG), Position Emission Tomography (PET) and Functional Magnetic Resonance Imaging (FMRI) have all been used as mechanisms for investigating ASD (Brambilla et al, 2004; Koshino et al, 2005**;** Schultz, 2005). These methods have been dedicated to establishing prevention and treatment of the conditions in children, targeting those already with ASD and so bypassing the disorder in their daily lives.

2.3.1 Characteristics of Autism Spectrum Disorder

Existing literature reveals no consistency among researchers about a typical profile of characteristics of ASD syndrome for the recognition of facial emotional expressions. This shortfall is attributed to the high inter-variability among

individuals with autism spectrum disorder, which in most cases is more related to the intelligence Quotient (IQ) of individuals and less to other characteristics of individuals. Indeed, there is no established upper ceiling in IQ of a person with autism spectrum disorder. Hence, researchers often refer to high-functioning autism (normal or high IQ) and low-functioning autism (low IQ), referring to the difference in the cognitive skills of affected persons.

Moreover, children with autism spectrum disorder are more likely to demonstrate language, communication, and repetitive patterns of behaviour and social skills problems (Jones & Frederickson, 2010; Lindsay et al., 2014). The deficiencies in communication demonstrated by children with autism spectrum disorder are demonstrated in terms of inappropriateness in conversations, misreading nonverbal interactions, and difficulty in building friendships appropriate to the ages of the concerned children.

In addition, Children with autism spectrum disorder may be overly dependent on routine, may be highly sensitive to changes in their environment, or may be intensely focused on issues or items inappropriate to their ages (Carpenter, 2013). Thus, for a child to be diagnosed with autism, they must display at least six characteristics in three main categories: social interaction impairment, communication impairment, and stereotyped patterns of behaviour (American Psychiatric Association, 2000). All children with autism spectrum disorder can generally use language or communicate well. This impairment could take several forms; the child may have limited non-verbal communication, including flat facial expressions and lack or non-use of bodily gestures.

2.3.2 Causes of Autism Spectrum Disorder

The main causes of autism spectrum disorder are still generally unknown. However, theories and scientific evidence point to a combination of factors such as genetic makeup and prenatal components of child development. The relevant research is complicated by the possibility that autism is not a single condition, but is based on a range of developmental disorders in the brain. In developing countries such as Tanzania, cases of autism have been noted to appear after a particularly traumatic case of childhood malaria or rheumatic fever. This has been confirmed by scientific research as a source of autism (Mankoski et al., 2006). Other researchers are more convinced by the genetics behind this developmental disorder. Through monozygotic twin studies, it has been found that when there is a diagnosis of autism, there is a 90% chance that both twins will have some form of the disorder (Rapin, 1997).

Poor nutrition, poverty, and improper child development have also been researched in the developing world and considered as probable causes of autism in children. The cycle of poverty, poor maternal health and poor child nutrition is believed to stunt cognitive development and lead to developmental disorders such as autism (Walker & Unterhalter, 2007). Other sources of aetiology, such as prenatal development, are not as clearly understood, and research in this area is still being conducted (Claassen, Naude, Pretorius, and Bosman, 2008).

2.3.3 Autism Worldwide

Autism is a globally occurring health condition, knowing no borders. It does not discriminate based on race, nationality, ethnicity, or social and economic status of communities or families (Kopetz and Lee Endowed, 2012). Posserud et al., (2010)

and Wong (2007) endeavoured to establish respective countries' approximate prevalence rates of autism diagnoses per 1,000 children throughout the world and observed that Australia had 6.25; China, 1.1; Denmark 9; Japan: 3; Mexico, between 2 and 6; India 1 in 250; Canada, 1 in 154; Sweden, 1 in 188; Finland and Denmark 1 in 833 and 1 in 833 respectively; Iceland, 1 in 769, Philippines, 500,000 children (in total) and Thailand, 180,000 children, (in total).

These statistics show that the global prevalence of autism has been steadily increasing, with estimates suggesting that approximately 1 in 100 individuals are affected by ASD. According to the World Health Organisation (WHO), the rise in prevalence may be due to improved awareness, better diagnostic practices, and a broader understanding of the spectrum of autism. The data calls for respective countries to develop strategic action plans and special attention to the group of children with autism spectrum disorder. The actions may include developing policies and actions to help children with autism spectrum disorder get appropriate education as part of their rights. The strategic policies, plans, tasks, and actions will help autistic children live normal lives like the other children. To give proper education to children with autism spectrum disorder, there is a need for appropriate redevelopment and realignment of the curriculum for relevance and ease of implementation by specially trained and inducted teachers.

2.3.3 Autism in Africa and Other Developing Countries

Autism is a relatively new health condition and a developmental disability in Africa. The prevalence of autism in Africa is estimated to be similar to that of other parts of the world. However, in many African countries, diagnosis and treatment access

remain limited due to various challenges such as a shortage of specialised health care, limited numbers of trained professionals, inadequate resources, and cultural stigma surrounding mental health and developmental disorders. Autism Spectrum Disorder significantly affects families and caregivers in Africa, who often struggle with accessing support services and managing the associated challenges.

In many developing countries, including Tanzania, autism remains poorly understood. Children with autism spectrum disorder are often viewed as cursed and excluded from mainstream educational settings due to societal stigma and a lack of resources, factors that contribute to social exclusion and even social violence. In Tanzania, there is a significant gap in knowledge, data on prevalence, and available care for children with ASD. Very little information exists on these children, and efforts to support them have been scattered and uncoordinated (Kareem et al., 2016).

In Kenya, for instance, there is an influx of inaccurate information about the condition available to parents, teachers, and medical professionals. Parents and educators established both the Autism Society of Kenya and Autism Awareness Kenya to close the growing gaps in understanding and opening up possibilities for children with autism spectrum disorder to have normal lives and get an education like their normal counterparts. Government schools in Kenya have begun to deploy inclusive education to replace what was previously referred to as special needs education to increase and guarantee educational opportunities for children with disabilities like autism (Riccio, 2011). Therefore, all parents, medical professionals, and education stakeholders in developing countries need to emulate, adopt, and adapt what has been done in Kenya to promote the health and educational development of

children with autism spectrum disorder.

In Ghana, the general education curriculum does not include direct teaching of core skills (such as imitation or language), which are usually inherently lacking in individuals with autism and stand out as prerequisites to the acquisition of other forms of knowledge (Dawson & Osterling, 1997). Including curriculum content that addresses culturally relevant social and communicative behaviours could mitigate attitudinal barriers to inclusive education. Furthermore, discrimination by fellow students and lowered teacher expectations can compound a student's difficulties and reinforce negative perceptions (Anthony, 2009). Students who are stigmatised and silently excluded cannot realistically be said to benefit from inclusive education. Large class sizes, low or non-availability of trained teachers, and the inflexibility of the mainstream curriculum are among the challenges that must be addressed before the meaningful inclusion of learners with autism in Ghana is actualised in schools.

In the study conducted by Anthony (2009), on what children with autism spectrum disorder acquired after attending schools, showed that the average percentage of autistic children from 2-9 years (2.1%) old could not learn to do things like the other children of the same age; 3.4% appeared mentally backward, dull, or slow; 2.6% were not able to speak/could not be understood; and 4.1% had no understanding of instructions given. As a matter of policy, children with such characteristics should and must be given priority in providing good quality and relevant education.

In the past, Asian people believed that children with moderate to severe disabilities were not teachable. Thousands of life stories have demonstrated that children can

achieve remarkable outcomes if given learning opportunities (Huang & Wheeler, 2007). The educational programs of great benefit to children with autism spectrum disorder in Southeast Asian countries, together with triangulation of policy, research, and practice, are the best options for the successful implementation of interventions. Huang and Wheeler (2007) outline other related concerns such as cooperation with Western countries, i.e., learning from their successful experiences, asking for technical assistance and support, establishing cooperative training programs and implementing. All these strategies are considered essential for the development of suitable educational programs for children with autism spectrum disorder in Southeast Asian countries.

2.4 Empirical Review of Literature

This section synthesizes empirical evidence on the integration of information and communication technology (ICT) to enhance teaching and learning for children with autism spectrum disorder (ASD), with attention to what is known globally and within Tanzania. The review foregrounds studies that report primary data (quantitative, qualitative, or mixed methods) and focuses on four recurring constructs: (i) stakeholder perceptions and attitudes (teachers and parents), (ii) teacher capacity and classroom practice (training, confidence, and pedagogical use), (iii) school-level enablers and constraints (infrastructure, technical support, leadership, and policy), and (iv) learner-level outcomes (engagement, communication, task completion, and academic progress). Emphasis is placed on research conducted in primary school settings, including resource-constrained contexts typical of many Tanzanian public schools.

Across the literature, most designs are descriptive cross-sectional surveys, school-based case studies, and small-N interventions; rigorous experimental and longitudinal designs remain relatively scarce. While many studies converge on the potential of ICT to individualize instruction and enhance engagement for learners with ASD, findings vary in magnitude and durability, often moderated by teachers' digital competence, availability of appropriate devices and software (including assistive technologies), and the presence of school-based technical support.

Notably, several investigations highlight implementation barriers—limited infrastructure, uneven teacher training, and fragmented policy uptake—that attenuate classroom use and learner benefits. At the same time, emerging qualitative evidence underscores parents' and teachers' broadly positive views of ICT, tempered by ethical and socio-cultural concerns (e.g., exposure to inappropriate content) and by practical challenges in sustaining use.

The empirical corpus also reveals important gaps that frame the present study. First, there is limited Tanzania-specific evidence that simultaneously examines parents' and teachers' perceptions alongside measured school conditions and reported learner experiences. Second, few studies link perceptions to concrete indicators of ICT use (e.g., frequency of pupil interaction, lesson design practices) and to ASD-specific pedagogical adaptations. Third, rural and peri-urban primary schools remain under-represented, as do analyses of technical support models and costed implementation pathways. By structuring the review around these gaps, Section 2.4 provides an evidence-based foundation for the study's objectives, refines the conceptual framing, and identifies where the current investigation can make a substantive contribution to

policy and practice in inclusive education.

2.4.1 Teaching and Learning Environment for Children with Autism Spectrum Disorder

Creating an effective teaching environment for children with autism spectrum disorder is essential for their success. Studies from developed countries show that ICT tools can significantly improve the learning experience for children with autism spectrum disorder by providing individualised and adaptive learning. For example, Konstantinidis, et al., (2009) conducted a literature survey indicating that computer-based educational delivery methods could serve as a key for educating children with autism spectrum disorders (ASDs). The literature revealed that people with autism, especially children, enjoy interacting with computers and consider them a "safe" environment due to the lack of expectations and judgments that make social interaction problematic.

Wang, et al., (2019) examined the use of virtual environments (VEs) in classrooms. They found that VEs, usually accompanied by 3D humanoid characters, significantly improved social interaction and communication skills in autistic children. Using avatars and interactive scenarios allowed students to practice social skills in a safe, controlled environment. Unobtrusive wireless sensors often integrate an autistic person's feedback and reaction. The study demonstrated specific artefacts in a proof-of-concept fashion to improve the educational process of people with ASDs. Similarly, Baker et al. (2020) conducted a study in the UK. They found that ICT tools like communication devices and interactive applications helped autistic children stay engaged and focused on tasks, ultimately improving academic

performance and behaviour. The study also highlighted the importance of teacher training in ICT integration, as teachers who were more familiar with the tools could better support students effectively.

Alotaibi and Almalki (2016) investigated Saudi Teachers' Perceptions and understanding of ICT application in enhancing the learning process for children with autism spectrum disorder in Mainstream Schools. The study used qualitative methodology that entailed a review of existing literature on the research topic and a survey questionnaire that involved a sample of 70 teachers from Riyadh City who specialise in teaching students with autism. The sample was determined randomly, and data were collected using questionnaires. Cronbach's alpha coefficient was used to determine the reliability of the data. The findings indicated that the referred teachers had a positive attitude towards using ICT in teaching children with autism spectrum disorder. They agreed that simple electronic systems that could support social interactions among learners promoted their learning. It is concluded that using teachers to collect necessary information for designing effective ICT integration and use in teaching and learning was the most feasible strategy in the application of ICT to enhance learning for children with autism spectrum disorder.

However, challenges still exist, particularly in developing countries. For instance, Odom et al. (2019) conducted a large-scale study on ICT integration in the U.S.. They found that while teachers were generally positive about using ICT tools in classrooms, lack of resources and insufficient training were significant barriers. These findings are echoed by Mithmunye and Pedro (2018), who investigated factors that can enhance or hinder the meeting of the educational needs of Autistic Children

in Western Cape Province, South Africa. The present study ventured to explore the perception and understanding of parents about children with ASD.

The key themes that evolved from the two research projects include developmental and educational awareness and support (that is, enhancement); the holdbacks in the education system (hindrance); the need to develop the capacity of teachers through specialised training (enhancement); and bottlenecks in financial resources to address the identified needs (hindrance). This current study recognises that there are some strategies for the enhancement of teaching and learning for children with ASD, and for the reduction or removal of hindrances to the educational development of concerned children. Existing research findings have also shown the need for more inclusive schooling and learner support in mainstream schooling, focusing on children with autism spectrum disorder, to enable them to access education during the agreed schooling age applicable to all children.

The parents involved in the studies indicated barriers to accessing schooling for children with learning difficulties, including being placed on waiting lists or schools being provided with alternative or special arrangements for concerned children. Therefore, there was a need for alternative schooling arrangements for the concerned children. The researchers recommended that, since the need for special needs education continues to grow, there should be special efforts and plans to train specialised teachers for children with autism spectrum disorder.

Several other studies on autism have been conducted outside Africa, including the USA and Europe. Partlo (2018) studied how best to meet the learning needs of

children with ASD in elementary education in the United States of America. The study was a qualitative case study that included ten elementary general education teachers. The research questions focused on how general education teachers met learners' individual support and service needs, academic needs, structured learning environment needs, communication and language needs, discipline maintenance needs, and what supports and resources teachers felt needed to meet the learners' needs. The study revealed that general education teachers experience many challenges, such as managing inappropriate behaviours, understanding and utilising the contents of an Integrated Educational Programme (IEP), and addressing individualised needs and support requirements for children with ASD. Teachers need adequate support, especially in specialised training, to address these and other emerging challenges relating to education delivery and meet children's special needs.

Further to Partlo's study, another study was conducted in Portugal by Santos, Breda, and Almeida (2016) to assess the state of the learning environment for learners with ASD with the hope of promoting the concerned children's mathematical reasoning. The researchers devised a description of a universal learning environment, emphasising the results obtained from an evaluation conducted with end users, and aimed to evaluate a prototype of the typical learning environment for children with autism spectrum disorder in mathematical reasoning.

The researcher analyses case studies relating to children with ASD and involving the digital environment, and embraces a multidisciplinary approach to scientific studies. In general terms, the findings of the studies established that the digital environment facilitates easy interaction, is simple and intuitive, and has great potential as an

important tool to promote mathematical reasoning in children with ASD. The researchers concluded that the digital environment this study aims to promote may enhance learning and actualise individual needs for learners. Potentially, integrated ICT in teaching will provide a powerful platform to support the roles and duties of teachers and educators vis-à-vis learners with autism and other special needs.

2.4.2 Parents' and Teachers' Perception on Integrating ICT in Enhancing the Teaching and Learning

The integration of ICT in primary school teaching requires the support of education stakeholders, specifically in terms of ICT infrastructure and training support for concerned teachers (Soto-Chodiman, Pooley, Cohen and Taylor, 2012). The referred stakeholders include the government, private sector organisations, ministries, school administration, parents, communities, teacher education institutions, and teachers themselves. Studies have shown that several stakeholders contribute meaningfully to educational innovation (Mwalongo, 2011; Kafyulilo et al., 2013; Geraldina, 2015).

The perceptions and attitudes of both parents and teachers heavily influence the integration of ICT in classrooms for children with autism spectrum disorder. Mwalongo (2011) studied teachers' perceptions of applying and incorporating ICT for teaching, teacher professional development, school administration, and personal use in Tanzania. The study used a case study approach with 74 teachers (33 females and 41 males). The Findings indicated that, while the frequency of use of ICT was influenced by access, the competence of ICT use was influenced by training. Further, the teacher used ICT in various activities, including teaching, administrative duties, and professional development and improvement programmes for personal use.

Even so, the teachers did not use ICT to change their pedagogical practices radically, but rather to sustain their traditional teaching approaches. From the USA, Hedges et al. (2018) examine how secondary students with autism spectrum disorder use technology in supportive ways. One of the research questions dealt with the perceptions of the benefits and barriers of that technology's use. The study used a self-report survey; 472 adolescents with autism spectrum disorder enrolled in high school described the forms of technology they use and the purposes for which they use it. It was revealed that the use of technology provides a variety of ways adolescents with ASD are using technology, such as to increase their independence, enhance their social opportunities, and relieve their anxiety and stress. However, they outlined that the biggest barrier to supportive technology use at school was related to the distracting nature of technology. They concluded that Practitioners may benefit from coaching and support on integrating technology to aid learning while reducing the distracting nature of technology.

Similarly, Scherer et al. (2018) explored parents' perceptions of ICT tools in autism education in the U.S. They found that parents generally supported the use of ICT but were concerned about the over-reliance on technology. Some parents feared that too much screen time might lead to further social withdrawal in their children. Despite these concerns, many parents saw ICT as a necessary tool to help their children engage with learning in ways that traditional methods could not facilitate.

Nguyen, et al., (2021) conducted a study in Vietnam that explored teachers' and parents' attitudes towards using ICT for children with autism spectrum disorder. The study found that while both groups recognised the potential benefits of ICT, such as

enhancing communication and social interaction, there were significant barriers to its effective use. Teachers expressed concerns about the lack of professional development in ICT integration, while parents highlighted financial challenges in accessing necessary resources.

Again, in Vietnam, Hue and Jalil (2013) conducted descriptive-survey research to determine lecturers' attitudes towards ICT integration into the curriculum and its use in the classroom. The research questions sought to measure the frequency of ICT use in teaching and learning among lecturers and their attitudes towards ICT integration into the curriculum to improve teaching. They also sought to determine if a correlation existed between lecturers' attitudes towards ICT integration into the curriculum and their ICT use in the classroom. The results of the correlation analysis identified a slightly moderate positive relationship between lecturers' attitudes towards ICT integration into the curriculum and their ICT use in the classroom. Although ICT was not highly used, lecturers recognised the benefits of ICT and chose to incorporate it into their teaching. These findings could be used for future research to promote positive educational changes by integrating ICT into the curriculum in universities.

2.4.3 Experiences of Teachers and Children with autism spectrum disorder in Integration of ICT in the Teaching and Learning Process

Scholars have documented that, computers and other digital technologies assist the classroom learning of children with ASD (Attwood, 2000; Hedges et al., 2018). The integration of ICT supports the learning of children with ASD. For any innovation for children with special needs, the degree to which interventions are easy to use and

can be used by typical teachers in natural applied settings is paramount (Massaro & Bosseler, 2006). Higginson and Chatfield (2012) conducted a project on teaching and learning strategies for children with autism spectrum disorder in New Zealand. Teachers described strategies such as comic strips, computers, literacy techniques, numeracy techniques, and pen profiles in teaching. Teachers demonstrated abilities using computers and other inclusive strategies, including individualised education programmes and educating the class about ASD. It was also found that the severity of ASD, the impact on other children, and the lack of support of the teacher and/or the child with ASD were reasons given for withdrawing the children from the classroom.

Many teachers reported knowing people with ASD: either having taught them, been aware of them in the schools, or through personal contact. It was concluded that by incorporating a team approach with individual mentoring, alongside one-off workshops/seminars by experts in the ASD field, teachers were given multiple opportunities to gain the knowledge they needed to include children with ASD in their classrooms successfully.

In Egypt, Al-Gawhary and Kambouri (2012) conducted a study to measure the impact of using ICT in Individual Learning Programmes of students with learning disabilities. Twenty-five students and thirteen teachers participated in the research based on classroom observations. A high correlation between keyboard, PowerPoint, and literacy skills (writing, reading, and maths) was revealed, suggesting the significance and impact of keyboard training as an essential component towards achieving educational objectives. Findings further confirmed the positive impact of

computer skills training on the students' learning experience, revealing a strong belief in the right of every child to all learning opportunities, particularly ICT, regardless of their abilities.

Drigas (2013) presented an overview of the most representative studies of the last decade (2001-2010), which deal with the two important issues in special education. As a result of research, cumulative evidence has been gathered about using ICTs. The diagnosis of autism or the rest of the ASD is, most of the time, a result of the several traditional assessment tests that are available to professionals. However, in recent years, important attempts have been made in ICT assessment.

In addition, a large number of studies have employed ICT to facilitate and train youngsters and adults with autism spectrum disorders. For example, Ozonoff et al. (2004) conducted a computer-administered set of neuropsychological tests designed to examine specific components of cognition. These tests examine the integrity of frontal functions since several studies support the involvement of the frontal cortex in autism. This method was tested on 79 participants with autism and 70 typical controls, and the results indicated that the autism group had difficulties in planning efficiency and extra-dimensional shifting relative to the control group.

Based on the results of this study, they argued that there is frontal lobe involvement in autism. Another research by Tseng and Yi-Luen Do (2010) presented a novel design prototype of an ICT application for children with ASD. The Facial Expression Wonderland (FEW) application is designed to improve ASD learners' ability to recognise facial expressions. FEW is a daily training tool that consists of

different levels. Moreover, requires learners with ASD to play on an everyday basis to improve their skills in facial expression recognition and 'Theory of Mind' (the ability to understand the mental status of other people). The real impact of FEW applications has not yet been evaluated and will be estimated in the future.

2.4.4 Challenges and Opportunities of Integrating ICT in Enhancing the Teaching and Learning of Children with autism spectrum disorder

Integration of ICT into the educational system is essential to support and build the competency of children with ASD. Even though the integration is inevitable, several challenges are associated with such initiatives. Scholars worldwide have documented the challenges. In Rwanda, for instance, Ntalindwa, et al., (2019) conducted a descriptive qualitative study on information communication technologies among children with ASD. The study aimed to understand the perceptions of students with ASD, their parents, and their teachers on the use of Information and Communication Technology (ICT) in the education of those with ASD. Students' disruptive behaviour in the inclusive classroom may be a barrier to effectively implementing the proposed competence-based curriculum. The behaviours of children are very challenging, and it is not easy to teach them with others, regardless of the government's policy emphasising their inclusion in schools.

Another challenge was that parents of children with ASD lack awareness of ASD as a factor, which supports the stigmatisation of their children with autism spectrum disorder among different families, and it also seemed to encourage them to drop out of school. In Tanzania, Geraldina (2015) conducted a phenomenological study to explore teachers' knowledge and perceived challenges of teaching children with

autism spectrum disorder in regular primary schools. The study's teachers from three regular primary schools in Dar es Salaam participated.

The study revealed that most of the primary school teachers had low knowledge about children with autism spectrum disorder. Other challenges were a lack of in-service training and seminars, among the challenges towards teaching children with autism spectrum disorder in regular classes. The researcher thought that providing regular in-service training and workshops could help many teachers gain appropriate knowledge and skills in teaching children with autism spectrum disorder in different regular classes. It was recommended that different educational stakeholders work with teachers to let every child with and without autism learn and enjoy the benefits of education in regular schools.

In Ethiopia, Alemu (2015) investigated integrating ICT into teaching-learning practices at Adama Science and Technology University in Ethiopia. This study explored integrating ICT into teaching-learning practices and its emerging challenges. Although this study is based on higher education, its findings are informed by similar attitudes found in teachers of lower levels of education (Mwalongo, 2013; Garaldina, 2015). It was found that most of the instructors have never been exposed to ICT integration into teaching-learning training, except for a few-day orientation. The number of instructors in need of retraining was very large. Instructors provided evidence of the necessity for another ICT training to promote professional development in integrating Information Communication Technology (ICT) into classroom teaching.

The training that Adama University provided for a few instructors was considered very important to the instructors who were interviewed, as they claimed that it gave them the basic computer skills. This study promised that instructors saw the need to develop more confidence in using ICT as a requirement to explore more effective ways of using ICT for teaching and learning. While instructors need to be aware of a broad range of ICT software and resources, their training needs should relate to the technologies available daily. However, there are opportunities for overcoming these challenges. The rise of mobile technology has provided a cost-effective solution for many schools. Kaiser, et al., (2020) highlighted the potential of mobile apps in supporting autism education, particularly in regions with limited access to traditional ICT resources. These mobile apps allow children with autism spectrum disorder to practice communication, self-regulation, and social interaction in an interactive, engaging way.

2.5 Knowledge Gap

Based on the reviewed literature, both theoretical and empirical studies. The researcher is informed comprehensively about the nature and range of teaching-learning strategies for children with autism spectrum disorder. Scholars (Drigas, 2013; Hedges et al, 2018; Partlo, 2018; Ntalindwa et al, 2019) indicate possibilities of integrating ICT in teaching children with autism spectrum disorder. Although this literature has revealed several issues on the relationship between teaching and learning for children with autism spectrum disorder and ICT in educating them, very little seems to have been done or said and recorded on the use of ICT in teaching and learning for children with autism spectrum disorder, with a focus on the Tanzanian education system. Furthermore, there is a lack of research on teacher training, policy

development, and resource allocation for autism education in Tanzania, making it difficult to assess the overall effectiveness of ICT tools in this context. This study, therefore, seeks to fill the gap by investigating the integration of ICT into the Tanzanian primary school curriculum for enhanced teaching and learning for children with autism spectrum disorder.

2.6 Conceptual Framework

The proposed study's conceptual framework comprises the factors considered important in integrating information and communication technology (ICT) in enhancing the teaching and learning of children with autism spectrum disorder. Generally, the model is influenced and guided by the theory underlying the Technological Acceptance Model (TAM) and the Constructivist viewpoints of learning that assert knowledge is socially constructed and shared. In this view, the framework considers and embraces different players who are likely to influence the integration of ICT in the curriculum, subject syllabuses and lesson delivery system for enhanced teaching and learning, and the general educational environment of children with autism spectrum disorder.

The framework highlights the key variables that influence the successful integration of ICT in the education of children with autism spectrum disorder: independent variables (Teacher experience on ICT, school policies, ICT resources, parental support/involvement; Intervening variables (Teachers attitudes, school culture, student motivation; dependent variables (improved in social skills, communication abilities and academic performance). The framework posits that the interactions of the identified variables (teaching and learning environment, teachers' experiences on

ICT, and parents' support /involvement) will determine the success of ICT integration in autism education. It emphasises that the support of teachers, parents, and the wider community is crucial in creating a suitable and effective ICT-integrated educational environment for children with autism spectrum disorder in Tanzania and elsewhere.

The interactions of the identified variables (teaching and learning environment, teachers' experiences on ICT, and parents' support) with ICT enable the application of modern communication technologies in teaching and learning for children with autism spectrum disorder in Tanzania and elsewhere. The reviewed literature has indicated the relevant and enabling presence of ICT policies and the general mainstreaming of ICT in different realms, including education. The question remains whether policy is enough as a government and public document. How about teachers' knowledge and skills? The presence of ICT experts to support the integration process, teachers' knowledge and skills in the integration process, availability of resources, and availability of school support systems are also important.

Teaching children with autism spectrum disorder requires a befitting school environment, teachers with specialised skills, and mainstreaming ICT in their teaching strategies (Haramaki, et al., 2001). Integration of ICT in the teaching-learning processes, require befitting teaching and learning methods as well as experiences of both teachers and children with ICT applications in education The experiences of teachers and children can enhance and motivate the acquisition of socially constructed knowledge and skills with due consideration of the immediate social environment of all those concerned and involved including the school

administration, parents and the specialised teachers and the children with special needs in education with particular focus on those with autism.

The integrated use of ICT in teaching and learning is seen as essential in motivating Children with autism spectrum disorder to use the internet both at school and at home for school work as well as leisure and personal interests, which encourages them to learn more and so perform well in school and life (Worth, 2001). The models assume that once ICT is integrated into the education process, children will most likely acquire the necessary social and academic knowledge and skills, such as communication abilities, improved mastery and use of language in daily interaction, and increased social help skills. In the adopted model, stakeholders are expected to support in all ways possible the effort made by those in direct contact with children with autism spectrum disorder. Henceforth, the interaction between these variables determines the success of ICT integration, and the framework emphasises the collaborative role of teachers, parents, and students in adopting ICT tools that address the educational needs of children with autism spectrum disorder.

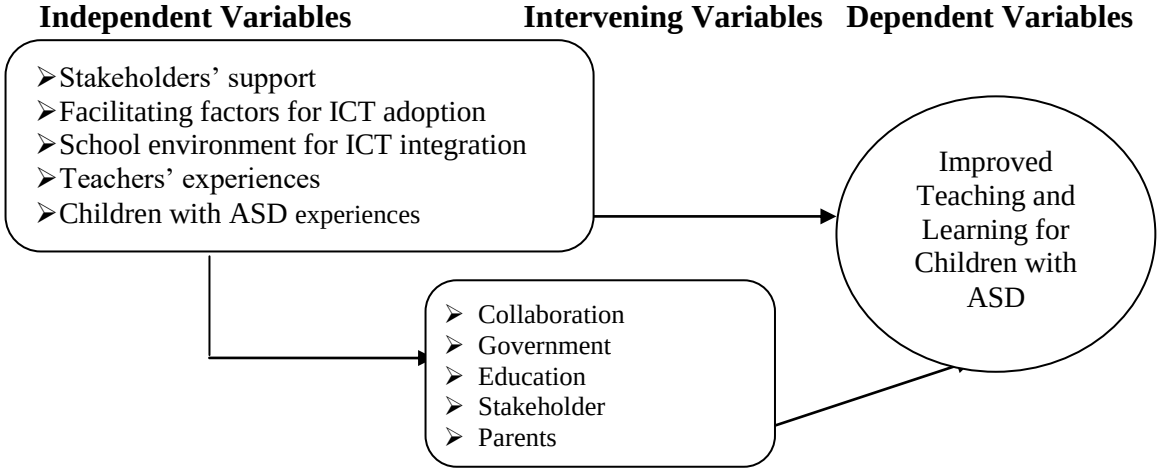

Figure 2.1: Conceptual Framework of the Study

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodological procedures used in data collection relevant to the research objectives and research questions outlined in Chapter One. The chapter highlights the research approach, design, study area, target population, sample, and sampling techniques. It also includes a description of the methods used to collect data, the procedure for data analysis, and the research protocols.

3.2 Philosophical Underpinning of the Study

The pragmatist paradigm guided this study. This philosophical approach advocates using qualitative and quantitative methods, commonly called mixed methods, to address complex research questions. Pragmatism provides a flexible and practical framework for research, allowing the researcher to draw on the strengths of multiple methods. Many scholars widely recognise and adopt it in mixed methods research (Jackson, 2013; Teddlie & Tashakkori, 2009).

As a philosophy, pragmatism prioritises the research question over the methods used to answer it. This approach is especially useful when examining multifaceted phenomena such as the application of information and communication technology (ICT) for children with autism spectrum disorder, which requires a combination of data sources to understand the complexities involved. The pragmatic approach is fundamentally concerned with the utility of research outcomes and the practical impact of the findings, making it ideal for a study aiming to solve educational challenges in Tanzania.

The major underpinning of pragmatist philosophy is that knowledge and reality are based on beliefs and habits that are socially constructed. Pragmatists generally agree that all knowledge in this world is socially constructed, but some versions of those social constructions match individuals' experiences more than others (Morgan 2014). The primary importance of the question is asked rather than the methods, and on the use of multiple data collection methods to inform the problems under study.

Pragmatism offers an alternative that embraces both positivist/postpositivist and constructivist paradigms and research questions that determine the extent to which quantitative and/or qualitative methods are used (Teddlie and Tashakkori, 2009). It provides a middle position methodologically and philosophically by offering a mix of quantitative and qualitative methods to answer research questions. As a research paradigm, pragmatism orients itself toward solving practical problems in the real world. It emerged as a method of inquiry for more practical-minded researchers (Creswell and Clark, 2011; 2018). It is further based on applying multiple methods, but research problems should always guide the use of the methods. The philosophy values both objective and subjective knowledge to meet chosen research objectives.

This study embraced this pragmatism philosophy to identify the worldview of the phenomenon focused on in the study context. Since the paradigm acknowledges each person's knowledge as she/his unique experiences create it. Nevertheless, much of this knowledge is socially shared as it is created from shared experiences. This study recognises that each teacher, parents, and student have a unique experience of integrating information and communication technology (ICT) in education, shaped by their particular context, needs, and understanding. However, these individual

experiences are influenced by shared societal practices, such as government policies on special needs education, access to information and communication technology (ICT) tools, and the training opportunities available to educators. These social constructions need to be investigated to understand how ICT tools can be leveraged effectively in Tanzanian classrooms for children with autism spectrum disorder.

Pragmatist epistemology does not view knowledge as reality. Rather, it is constructed with the purpose of better managing one's existence and taking part in the world (Goldkuhl 2012). Inquiry is an investigation to understand some part of reality and to create knowledge to bring change in that part of reality. It is a systemization of humans' natural effort to improve their situation. The primary purpose of inquiry is to create knowledge in the interest of change and improvement. This is crucial in the context of this study, as the research aims to improve the education of children with autism spectrum disorder in Tanzania by exploring how information and communication technology (ICT) can be integrated effectively into their learning experiences. By focusing on practical outcomes, the study does not seek to abstractly theorise about information and communication technology (ICTs)' role in autism in education, but instead strives to generate actionable insights that can inform policy decisions, teacher training programs, and school curricula.

Pragmatist research allows researchers to be flexible in their methods to answer research questions. Knowledge generation depends on what has been observed, independent of the researcher's values, feelings, or perceptions. It is therefore associated with deductive and inductive logic in which the realist ontology, Positivist epistemology, and value-free research approach are adopted. Most importantly, the

flexibility to use the worldview best fits the particular study's context. This is more in line with Maxwell's (2011) notion that paradigms can be productively thought of as tools creatively used to fit a certain research situation. It is believed that multiple paradigms can be used in mixed methods studies, and the one(s) used often relates to the type of mixed methods research (Teddlie & Tashakkori, 2009).

This study, however, employed a mixed methods approach, combining both qualitative and quantitative methods to gather comprehensive data on information and communication technology (ICT) in teaching children with autism spectrum disorder. The choice of the mixed method is rooted in the belief that integrating both approaches, offers a complete understanding of the research problem. Quantitative data (questionnaires on ICT usage) helps generalise findings across a wider population. In contrast, qualitative data (interviews and classroom observations) provide deep insight into teachers' lived experiences, parents, and children.

It was concluded that pragmatism is the most appropriate philosophy for the study. It seeks to provide a working solution without limitations to prior assumptions about the nature of study variables or social phenomena under investigation. Henceforth, the study recognises that the educational needs of these children are multidimensional, influenced by both the availability of technological resources and the social context in which these resources are deployed. Thus, the study does not just aim to measure ICT usage but also investigates how it can be integrated effectively into everyday teaching practices to support children with autism spectrum disorder in Tanzania primary schools.

3.3 Research Approach

This study employed a mixed-methods research approach. The method offers several benefits needed in approaching complex research issues. The approach integrates philosophical frameworks of both post-positivism and interpretivism (Fetters, 2016). Quantitative data were obtained from the practices and challenges in using ICT for teaching and learning children with ASD. In contrast, qualitative data were obtained by examining the effectiveness of ICT application in teaching and learning for ASD children with ASD in selected primary schools. The research approach for this study was selected based on its suitability and ability to capture the issue relating to the study's objectives.

The research combined quantitative and qualitative data due to four benefits found in mixing the two approaches (Mertens & Tarsila, 2015). Firstly, the mixed methods research approach enabled the researcher to widen the inquiry with sufficient depth and breadth. It was easier to generalise the findings to a population and develop a detailed view of the meaning of a phenomenon or concept for individuals. The advantages of collecting closed-ended and open-ended qualitative data support understanding a research problem. Secondly, combining the two approaches helped gain values from both approaches, and in some respects, they were complementary, thus adding value to the combination.

Thirdly, the mixed methods research approach helped to obtain more rigorous conclusions by employing two methods so that the strengths of the qualitative methods offset the weaknesses of the quantitative methods and vice versa. This implies that a quantitative method can be strong in those areas where a qualitative

method is weak and vice versa. Finally, data triangulation in the mixed-methods study was used as a strategy for validating results obtained from the use of the individual method. The researcher obtained a more valid picture of the integration of ICT in the teaching and learning of children with ASD by directly comparing the findings drawn from one method (qualitative or quantitative) to those obtained from another.

3.4 Research Design

In this research, the focus was on ICT integration in teaching and learning for children with autism spectrum disorder. The strategy involved capturing the views and experiences of the children, their teachers, and parents, and the data was subjected to a concurrent triangulation design. The purpose of the concurrent triangulation design was to enable qualitative and quantitative data to define possible relationships among variables of interest more accurately. The research managed to cross-validate findings from both approaches.

Therefore, this design generally uses separate quantitative and qualitative methods to offset the weaknesses inherent within one method with the strengths of the other (Creswell & Plano Clark, 2011). With the help of this design, the researcher obtained both quantitative and qualitative data from different sources and methods, which increased a comprehensive understanding of the role of ICT in teaching and learning of children with autism spectrum disorder in the involved primary schools. Creswell and Plano Clack (2006) suggest that a qualitative approach, in which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time through detailed, in-depth data collection should involve multiple sources of

information such as observations, interviews, audio-visual material, and documents and reports, and report a case description and case-based themes. In line with this, the present study employed multiple data collection techniques to ensure a comprehensive understanding of the role of ICT in teaching and learning for children with autism spectrum disorder. The triangulation of interviews, observation, and questionnaires enhanced the findings' depth and validity.

The concurrent triangulation design has several merits that favour this study. One of the merits is that it is a one-phase design in which researchers implement the quantitative and qualitative methods during the same timeframe and with equal weight. This design's single-phase timing is why it has also been called the "concurrent triangulation design" (Creswell et al, 2003). The design has proven efficient, in which both types of data are collected during one research phase at roughly the same time. Data collection was generally concurrent and separate, and it included collecting and analysing quantitative and qualitative data, enabling the researcher to understand the research problem better. Another benefit from the selected design was that the researcher validated quantitative data by expanding the quantitative findings from a survey by including a few open-ended qualitative questions.

One of the challenges in using concurrent triangulation design is that it requires much effort and expertise, particularly because of the concurrent data collection and the fact that equal weight is usually given to each data type (Onwuegbuzie & Collins, 2007). This can be addressed by forming a team that includes members with quantitative and qualitative expertise, including researchers with quantitative and

qualitative expertise on graduate committees, or by training single researchers in quantitative and qualitative research (Dawadi et al., 2021). Sometimes, researchers may question what to do if the quantitative and qualitative results do not agree. These differences can be difficult to resolve and may require additional data collection. To address those challenges, the researcher used various techniques to obtain valuable_qualitative data through interviews and classroom observations where the head of schools, special education teachers, and parents were involved.

3.5 Area of the Study

This study was conducted in selected primary schools with children with autism spectrum disorder in Arusha, Dar es Salaam, and Morogoro. These regions were purposefully selected due to their suitability for applying ICT in teaching. The regions were selected because primary schools have children who have autism. The selected regions also have ICT facilitation and special needs education teachers who are actively responsible for teaching children with autism spectrum disorder. Similarly, the teaching and learning conditions in the selected regions made them a suitable choice for pursuing this study.

In total, the three regions at the time of study had 517 children with autism spectrum disorder enrolled in primary schools, while the total number of children with autism spectrum disorder in primary education pan-territorially was 2,323 (URT, 2019). Therefore, the number in Arusha, Dar es Salaam, and Morogoro was around 24.6% of the total population of the children with autism spectrum disorder in the United Republic of Tanzania.

3.6 Population and the Sample of the Study

3.6.1 Target Population

In research, the population can be explained as a comprehensive group of individuals, institutions and objects with common characteristics that interest he researcher. The target population included all children with autism spectrum disorder in school, their teachers, as well as parents of children with autism spectrum disorder in Arusha, Dar es Salaam and Morogoro. In other words, all those who met the criteria the researcher had set and were interested in studying.

3.6.2 Sampling Techniques and Sample Size

The researcher employed probability and non-probability sampling techniques to obtain the participants' required data characteristics. The sample size for this study involved 67 respondents selected to incorporate the needed informants for the study. The sample included seven (7) Head teachers, 36 SNE teachers, 24 parents, and the children with autism spectrum disorder whose learning was observed to need ICT integrated into their teaching and learning. The study involved only children with autism spectrum disorder found in selected schools, and observing them in their actual learning environments had the potential to provide information and data needed by the researcher. All these respondents informed the researcher well, based on their work and life experiences.

The selected samples from the three regions represented country-wise primary schools with children with autism spectrum disorder. Categories of respondents for the study are indicated in Table 3.1.

Table 3 1: Number of Respondents Involved in the Study

	Region	Primary school	Head Teachers	SNE Teachers	Number of parents
1.	Arusha	Baraa & Jafary	2	14	6
2.	Dar es Salaam	Airwing, Al-Muntazir, Mbuyuni & Mseto	4	17	12
3.	Morogoro	Mazimbu 'A'	1	5	6
	Total	**7**	**7**	**36**	**24**

Source: Researcher, 2024.

In mixed methods research, different kinds of samples (both probability and non-probability, and either separately or together) were used for analysis at different levels of units.

3.6.2.1 Selection of Primary Schools

Purposive sampling was employed to obtain the appropriate schools for the study when selecting primary schools. The choice also considered other factors such as school age factors, hoping that the oldest schools, which were established earlier and that have been enrolling children with autism spectrum disorder, had sufficient experience in the provision of special needs education. This enabled the researcher to obtain sufficient information about the need for ICT in teaching and learning, and its application to children with autism spectrum disorder. Such schools allowed the researcher to meet special needs education teachers and children with autism spectrum disorder from different social backgrounds.

3.6.2.2 Selection of Head Teachers and SNE Teachers

In selecting SNE teachers to participate in this study, the researcher considered rules guiding sampling in mixed methods research that Cohen et al (2018) suggest should address issues and criteria relevant to such a study. In the sampled primary schools, head teachers, all SNE teachers, and those assigned to teach children with autism

spectrum disorder were involved in the study. This enabled the yield average responses together with actual practices about the integration of ICT for children with autism spectrum disorder. In this study, SNE teachers were key respondents as they are most knowledgeable and experienced in teaching and learning children with autism spectrum disorder.

3.6.2.3 Selection of Parents

The selection of parents was done through non-probability sampling under convenience sampling. Convenience sampling involves choosing the nearest individuals to serve as respondents and continuing that process until the required sample size has been obtained of those who are available and accessible. The researcher asked teachers to locate a few parents with children with autism spectrum disorder at the nearest location to think about ICT integration issues in their children's teaching and learning.

3.7 Data Collection Instruments

The study used primary sources of data collection tools. These included teacher questionnaires, parent questionnaire and a classroom observation protocol . This study's quantitative data were obtained through questionnaires administered to special education teachers and parents. In contrast, qualitative data were obtained through interviews and classroom observation, involving the head of schools, special education teachers, children with autism and parents.

3.7.1 Interviews

The researcher used unstructured interviews, which gave informants broad freedom to express themselves in their way. This type is also profitable in securing highly

personal and threatening information. Unstructured interviews are also strong methods for capturing spoken and non-spoken information. To obtain sufficient information, the role of a researcher is not to influence interviewees' reactions to the questions, but rather to probe the interviewees to make the question clear or to seek more information about the question and/or direct the interviewees' responses to the research objectives.

In some circumstances, participants may be reluctant to participate in an interview. However, they volunteer the information to a skilful interviewer who asks the right questions and probes for more information through a semi-structured interview (Creswell, 2012). In this study, the researcher utilised interviews to acquire facts and experiences from heads of schools and parents in determining the integration of ICT in teaching and learning for children with autism spectrum disorder (Appendix **B** and **C**).

3.7.2 Questionnaire

Questionnaires rely on written information provided by people in response to questions asked by the researcher. The information from questionnaires tends to fall into two broad categories, facts and opinions, and it is vital that at all stages of using questionnaires, the researcher is clear about whether the information being sought is to do with facts or to do with opinions (Denscombe, 2007; Creswell, 2012). This study employed both open-ended and closed-ended questionnaires. The questionnaire was adopted and modified from Hume et al. (2020). Both instruments were administered to special education teachers on the application of ICT in teaching, opportunities and challenges regarding teaching and learning of children

with autism spectrum disorder in primary schools (Appendix **A**).

In open-ended items, the researcher asked a question to which respondents provided any answer they wished to give without restrictions. These items enquire about possible responses not given in closed items and the respondent writes down the answers in their own words (Lodico et al, 2006). Open-ended questions permit unlimited possible answers; respondents can answer in detail and qualify and clarify responses. In addition, unanticipated findings can be discovered (Cohen et al, 2018). It also permits adequate answers to complex issues. Furthermore, it allows for creativity, self-expression, and richness of detail and reveals a respondent's logic, thinking processes, and frame of reference.

The researcher asks closed questions and gives the respondent mostly fixed responses. This type of question has the advantage of being easier and quicker for respondents to answer if their response matches those provided (Cohen et al, 2018). Closed questions are straightforward to code (for computer processing) and do not discriminate unduly based on how respondents articulate (Goddard & Melville, 2006). Unfortunately, if the closed-ended questions are not set properly, they can cause different respondents to interpret the same words differently. Thus, it becomes difficult to ensure that respondents interpret the closed question as they intend to.

3.7.3 Observations

Non-participatory observation was employed to familiarise the researcher with the experiences of teachers and children in integrating ICT in teaching and learning for children with autism spectrum disorder in primary schools involved in the study. In

non-participatory observation, the researcher becomes a passive observer. It is just the systematic noting and recording of activities, behaviours and physical objects as an unobtrusive observer (Scott & Usher, 2011). This tool supported observation of teaching and learning without actively engaging in the learning process, allowing the researcher to gather insights into behaviours and interaction without affecting the activities associated with the teaching and learning facilities in all schools involved.

In conducting the observation, the researcher developed an observational protocol, which gave procedures for organising an observation (Appendix **D**). Through observation, the researcher generated information on teaching and learning facilities that are essential in the teaching and learning of children with autism spectrum disorder. Observation enabled the researcher to determine the status and effects of ICT in the teaching and learning process (Creswell & Plano Clark, 2018). The observation method eliminates subjective bias, and the information the researcher observes is related to current events. Additionally, observation usually consists of a detailed notation of behaviours and events and the context surrounding the events and behaviour (Ritchie, 2003; Dawadi et al, 2021). Data collected through observation were simultaneously analysed together with those collected through interviews.

3.8 Validity and Reliability

3.8.1 Validity

According to Oluwatayo (2012), content validity is achieved when instrument items adequately represent the study's variables and objectives. In line with this, the researcher reviewed all instruments with the supervisor and three educational experts

from the Faculty of Education at the Open University of Tanzania. The tools were administered after confirming their appropriateness and relevance to the study.

3.8.2 Reliability

In this study, the reliability of the research tools was ensured by pre-testing the data collection instruments. For the teacher's questionnaire, a test for reliability was measured using the Cronbach's Alpha (Table 3.2 and Appendix K).

Table 3.2: Reliability Statistics

Cronbach's Alpha	N of Items
.814	58

Source: Research data, 2024.

The reliability of the research instrument was assessed using Cronbach's Alpha, which yielded a coefficient of .814 for the 58 items. According to Gliem and Gliem (2003), a Cronbach's Alpha value above .80 indicates good internal consistency, suggesting that the items reliably measured related constructs in this study. This level of reliability exceeds the commonly accepted threshold of .70 in social science research (Tavakol & Dennick, 2011), thereby affirming the methodological rigor of the instrument. Such reliability is essential for ensuring that variations in responses reflect actual differences in participants' experiences and perceptions of ICT integration for children with autism spectrum disorder, rather than measurement errors. The high internal consistency of the instrument enhances the credibility of the findings and supports their use in informing evidence-based decisions in special needs education within the Tanzanian context. The purpose of pre-testing was to identify parts of the instrument package that were difficult for pre-test subjects to read or understand, or that they may have misinterpreted.

The researcher pre-tested the questionnaire for special needs education teachers. A total of 8 special needs education teachers from two primary schools in Dar es Salaam were pre-tested. Pre-testing aimed to test whether the instruments would obtain the responses required to achieve the research objectives, to test whether the content of the instruments is relevant and adequate, to test whether the wording of questions is clear and suited to the understanding of the respondents (Cohen et al, 2018; Oluwatayo, 2012). Answers from the pre-test provided a critical review of the instruments, which enabled improvements and successful implementation of changes.

Triangulation: In this study, the researcher compared the ICT facilitation in schools obtained through observation, experiences of teachers and pupils in applying ICT, and views of heads of schools and parents on challenges of integrating ICT in teaching and learning children with autism spectrum disorder. One important advantage of triangulation is that it can strengthen the conclusions or identify areas for further work (Johnson & Christensen, 2020). Triangulation in this study was restricted to using multiple data-gathering techniques to investigate the same phenomenon. It used different data sources from diverse respondents, including heads of schools, special needs education teachers, and parents. For instance, regarding the experiences of teachers and pupils with the use of ICT, both interviews and questionnaires were used to collect data from head teachers, teachers, and children with autism spectrum disorder. This helped the researcher collect data that helped verify and validate findings.

Credibility: To ensure the credibility of this study, the researcher adopted techniques that recommend prolonged field engagement. The researcher, therefore,

had a prolonged field engagement to understand factors that could have affected the credibility of the results, such as school culture, testing possible distortions of information by the respondents, and building the trust of the research participants. The researcher has also shown clearly that the selected research design consists of procedures and processes that were adhered to throughout the study. Observations of teaching and learning facilities and integration of ICT in the teaching and learning of children with autism spectrum disorder allowed the collection of sufficient data about the learners' learning. This practice, therefore, led to the collection of valid and reliable data.

3.9 Data Processing and Analysis

Since the study employed a mixed-methods approach, data analysis was conducted using a quantitative and qualitative paradigm, ensuring that the findings addressed the study objectives and research questions. The integration of information and communication technology (ICT) for children with autism spectrum disorder is a multifaceted process, and the analysis was designed to capture both analytical trends and rich, contextual information from the experience of stakeholders (teachers, parents, children). Quantitative component focused on specific variables such as adequacy of teaching and learning resources, and the extent of ICT integration in teaching children with autism spectrum disorder.

Quantitative data gathered through questionnaires were subjected to several stages of analysis to quantify the extent of ICT integration and the impact on teaching and learning outcomes for children with autism spectrum disorder. The quantitative

analysis focused on the following key variables: ICT integration, ICT resources availability, and challenges and opportunities. These variables were measured using structured questionnaires administered to special needs education teachers.

Raw data from the questionnaire for special needs education teachers were analysed using Statistical Package for Social Sciences (SPSS) Version 26, selecting, tabulating, classification, cleaning and entering into the software programme. The variable “adequacy of teaching and learning resources” in primary schools was measured on a four-point ordinal scale; very inadequate, inadequate, adequate and very adequate, based on registers of children with autism spectrum disorder and was analysed using descriptive statistics such as frequencies and percentages to determine the distribution of resources across schools. Similarly, the variable was meant to assess “integration of ICT in teaching and learning for children with autism spectrum disorder”. The application level was rated on a scale of four: strongly agree, agree, disagree, and strongly disagree.

The assessment of normality for the study variables was conducted using the Kolmogorov–Smirnov and Shapiro–Wilk tests. As shown in Table 3.3, the Shapiro–Wilk test, which is considered more reliable for small sample sizes ($n<50$), showed that for the majority of variables, the significance values were below the conventional threshold of 0.05.

Table 3.3: Tests of Normality for Study Variables

Variable	Kolmogorov–Smirnov Statistic	df	Sig.	Shapiro–Wilk Statistic	df	Sig.
Requirements for facilitating teaching and learning for CwASD	.196	36	.001	.921	36	.013
Adequacy of facilities in managing/enabling teaching and learning for CwASD	.129	36	.134	.945	36	.073
Attributes towards integration of ICT in teaching and learning for CwASD	.152	36	.034	.925	36	.017
Teachers' perceptions on integrating ICT in teaching and learning for CwASD	.152	36	.034	.925	36	.017
Teachers' experiences in integrating ICT for children with autism	.178	36	.006	.925	36	.018
Extent to which ICT facilities assisted children with autism	.187	36	.003	.895	36	.003
Frequency of pupils' interaction with ICT	.154	36	.030	.927	36	.021
Challenges of integrating ICT in teaching and learning for children with autism	.156	36	.027	.904	36	.004
Strategies adopted by schools to resolve ICT challenges in teaching and learning for children with autism	.214	36	.000	.894	36	.002

This indicated a rejection of the null hypothesis of normality, confirming that the data for these variables did not follow a normal distribution (Razali & Wah, 2011). Only the construct on *adequacy of facilities* ($p = .073$) recorded a significance level above 0.05, suggesting that this variable met the assumption of normality.

The predominance of non-normality among the study variables had direct implications for the choice of statistical techniques. Since most datasets violated the normality assumption, the application of parametric statistical methods such as Pearson's correlation coefficient, independent samples t-tests, or analysis of variance (ANOVA) was not methodologically appropriate for the majority of analyses (Ghasemi & Zahediasl, 2012). Instead, non-parametric statistical tests were deemed

more suitable, as they did not rely on distributional assumptions and were robust for ordinal, skewed, or non-normally distributed data (Pallant, 2020). Specifically, Spearman's rank-order correlation was identified as appropriate for examining relationships between variables.

The observed non-normality in most variables likely reflected the realities of ICT integration in Tanzanian primary schools, particularly in special needs education settings. Disparities in ICT infrastructure, inconsistent teacher training opportunities, variations in resource availability, and differences in policy implementation may have resulted in uneven patterns of ICT use and perceptions among respondents (Mnyanyi & Mbwette, 2011; UNESCO, 2021). Previous studies in low- and middle-income countries have also indicated that ICT adoption in special education was often constrained by limited funding, inadequate technical support, and a shortage of specialized assistive technologies suited for learners with ASD (Al-Azawei, et al., 2016; Chao, 2019).

Teacher experiences and perceptions regarding ICT were shaped by prior exposure to technology, the availability of contextualized learning resources, and institutional leadership support (Mwendwa, 2017). These factors appeared to contribute to the skewed nature of responses observed in the present study. By applying non-parametric statistical methods tailored to the characteristics of the data, the study ensured methodological rigor and validity in examining the integration of ICT in teaching and learning for children with ASD in Tanzania. This approach provided a more accurate representation of stakeholder perceptions, experiences, and challenges, thereby supporting evidence-based recommendations for policy and

practice in inclusive education.

Qualitative data analysis was based on themes derived from interviews with teachers and school administrators and classroom observations. The key qualitative variables explored included teachers' perceptions of ICT integration, resource provision challenges, and ICT tools' perceived effectiveness. The analysis was followed by a thematic analysis approach to identify patterns and themes across the interview data. The following four steps were followed: firstly, data were organised and prepared for analysis through transcribing interviews, and field notes from the classroom observations were reviewed. Secondly, the researcher re-read the data to understand the overall data. From there, the existing broad themes were listed. Thirdly, the researcher generated relationships among the established themes and other salient features within the themes. As such, the entire dataset was divided into classes. Fourthly, the researcher chose one category and related all the other categories to that category. A detailed analysis for each theme was conducted, and the research questions were written about afterwards.

3.10 Ethical Consideration

This study involved children with autism spectrum disorder. Their parents or legal guardians, and special needs education teachers in selected primary schools. As such, ethical considerations were critically important, especially given the children's vulnerability and the sensitivity of educational and personal data involved. In line with Ary et al (2010), who maintain that researchers should strike a balance between the demands placed on them as professional scientists in the pursuit of truth and their respondents' rights and values potentially threatened by the researcher, this study

adheres to a range of ethical protocols directly in the research context. These included informed consent from all participants (Appendix **E**), confidentiality, anonymity, access to data, equity, treaty obligations, basic human rights, analysis, and the production of findings.

3.10.1 Informed Consent and Voluntary Participation

One of the key ethical issues that researchers have included is informed consent. Since children with autism spectrum disorder encounter difficulties in understanding and communication, the researcher obtained informed consent from their parents or legal guardians before participation (Appendix E). Informed consent from children with autism spectrum disorder was tailored to the child's developmental level and communication abilities using appropriate tools such as simple aids and simplified language. This ensured the children's understanding and comfort. The study's purpose and procedures were clearly explained to teachers and school administrators, and they were invited to participate voluntarily, with the right to withdraw at any point without consequences. However, the researcher upholds the privacy and confidentiality of children with autism spectrum disorder and their families. This has been done to ensure all sensitive information obtained during the research process is well protected and data is anonymised and securely stored to prevent unauthorised access.

3.10.2 Confidentiality and Anonymity

The study involved collecting sensitive data concerning information and communication technology (ICT) in teaching children with autism spectrum disorder. Throughout the data collection process and presentation of the findings,

the respondents were assured of a reasonable level of confidentiality about any information they gave, that it would not be disclosed to anyone or used for any other purpose except for the intended research purpose of this study. All personal and institutional identifiers were removed during the data entry and reporting to protect participants. Codes were used instead of names, and all data were securely stored in password-protected files. This approach upheld confidentiality and anonymity, minimising risks of harm or stigma to children, their families, and school staff.

3.10.3 Protection of Vulnerable Participants

Recognising the vulnerability of children with autism spectrum disorder, the researcher took extra care to ensure that participation did not cause distress or discomfort. The rights and well-being of these children were prioritised throughout the research process. To ensure this, the researcher collected data in a familiar, non-threatening environment (their school settings) and conducted sessions at times that did not interfere with the learning or therapy routines.

3.10.4 Research Clearance Permit

Before data collection, the researcher obtained formal ethical research clearance from the Directorate of Research, Publications, and Postgraduate Studies at the Open University of Tanzania (Appendix **F**). Such clearance was important for introducing the researcher to various government authorities, including the Regional Administrative Secretary, District Administrative Secretary, District Executive Directors (Appendix **G**, **H**, **I & J),** ensuring compliance with institutional protocols. Upon entering schools, the researcher presented official research permits and obtained permission from head teachers of the selected primary schools before

engaging with participants. The researcher explained the research's purpose to school administrators and respondents. It persuaded them to participate willingly, and the research was voluntary in that respondents had the right to withdraw from the study at any time without any presumption.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This study sought to investigate the effectiveness of integrating ICT in enhancing the teaching and learning process for children with autism spectrum disorder in Tanzania. The study involved seven primary schools in the Dar es Salaam, Morogoro, and Arusha regions. This chapter analyses and presents the study findings from the interviews, questionnaires, and observations. The findings are analysed and presented according to specific objectives and questions.

4.2 Characteristics of Respondents

This section describes the characteristics of the respondents involved in the study; such a description is important in understanding their educational qualifications and working experiences. Therefore, the important characteristics covered included sex, qualifications, and years of working experience.

4.2.1 The Qualifications of Teachers Selected for the Study

The teachers' qualifications were essential in understanding their perspectives and insights into integrating ICT in teaching children with autism spectrum disorder. The researcher was more interested in validating facts about integrating ICT in enhancing the teaching and learning process for children with autism spectrum disorder. The qualifications of the teachers involved in the study are presented in Table 4.1.

Table 4.1: Respondents of the Study

Category	Qualification	Male		Female		Total
		F	%	F	%	
Head Teachers	Certificate/Diploma	1	33.3	2	66.6	3(42.9%)
	1st Degree	-	-	4	100	4(57.1%)
SNE Teachers	Certificate/Diploma	8	29.6	19	70.4	27(75%)
	1st Degree	2	22.2	7	77.8	9(25%)
Parents	N/A	10	41.7	14	58.3	24(100)

Table 4.1 presents the distribution of respondents according to category, academic qualification, and gender in the study on Integration of Information and Communication Technology (ICT) to Enhance Teaching and Learning for Children with Autism Spectrum Disorder (ASD) in Tanzania. Among the head teachers (n = 7), 42.9% (3) held a Certificate or Diploma, of whom 33.3% (1) were male and 66.6% (2) were female. The remaining 57.1% (4) possessed a first degree, all of whom were female. This indicates that a majority of head teachers had higher education qualifications, which may contribute positively to decision-making and policy support for ICT integration in ASD teaching.

The special needs education (SNE) teachers (n = 36) were predominantly Certificate/Diploma holders, representing 75% (27) of this group, with 29.6% (8) males and 70.4% (19) females. Those with a first degree accounted for 25% (9), with 22.2% (2) males and 77.8% (7) females. The large proportion of teachers with lower-level qualifications suggests a potential need for advanced ICT training to improve competence in using assistive technologies for children with ASD. The parents group (n = 24) had no academic qualification recorded (N/A), with 41.7% (10) males and 58.3% (14) females. This balanced participation of both genders is important for enhancing parental involvement in ICT-supported learning for children

with ASD, although their ICT literacy levels remain unknown.

Across all categories, female respondents outnumbered males, especially among head teachers with higher qualifications and SNE teachers. The respondent profile in Table 4.1 suggests that while leadership capacity exists through the presence of degree-holding head teachers, the effective integration of ICT for children with ASD may require upskilling SNE teachers and training parents to support technology use both in school and at home. Even though certificate teachers were the majority component in the selected primary schools, their experience in teaching children with autism spectrum disorder provided enough information required for this study.

4.2.2 Working Experiences of the SNE Teachers Involved in the Study

This section presents the working experiences of the respondents involved in this study. The information about teachers from all seven primary schools is presented in Table 4.2.

Table 4.2: Teaching Experience of SNE Teachers

	Years of experience	Frequency	Percent
i)	Less than 2 years	2	5.6
ii)	3 - 5 years	6	16.7
iii)	6 - 10 years	11	30.6
iv)	More than 11 years	17	47.2
	Total	**36**	**100.0**

Table 4.2 shows that nearly half of the SNE teachers (47.2%) had more than 11 years of teaching experience, followed by 30.6% with 6–10 years, 16.7% with 3–5 years, and only 5.6% with less than two years. This distribution indicates that the majority of teachers have substantial classroom experience, which can be advantageous in understanding the learning needs of children with ASD and adapting teaching

approaches accordingly. However, while extensive experience may enhance pedagogical skills, it does not necessarily guarantee proficiency in integrating Information and Communication Technology (ICT) into teaching. Experienced teachers may require targeted professional development to update their skills in using ICT tools and assistive technologies effectively for ASD education. Conversely, the small proportion of teachers with less than five years of experience may represent a limited infusion of digitally native educators who could bring innovative, technology-driven teaching strategies into the learning environment.

4.3 Teaching and Learning Environment for Children with autism Spectrum Disorder in Selected Primary Schools

The first objective of this study was to ascertain the teaching and learning environment for children with autism spectrum disorder in the selected schools. It was assumed that a conducive learning environment promotes and enhances teaching and learning. To obtain the information needed for this objective, the questionnaires, interview schedules, and observation plans facilitated the collection of the needed data. The data obtained are presented in Tables 4.3 and 4.4.

4.3.1 Availability of Teaching and Learning Resources

Table 4.3 summarises various teaching and learning facilities in the selected primary schools. The data was based on teachers' responses, with a rating scale of 1=Available and 2=Not Available.

Table 4.3: Availability of Teaching and Learning Facilities and Environment for Children with autism spectrum disorder in Selected Primary Schools

	T/L facilities & environment	Mean	SD
i.	Visual symbols and photographs to clarify verbal instructions	1.00	0.00
ii.	Audio-visual materials in a classroom	1.19	0.4
iii.	Letter trays	1.06	0.23
iv.	Desks for children with autism spectrum disorder	1.03	0.16
v.	Lockers, Baskets, or shelves used to store children's materials	1.25	0.43
vi.	Newspapers and magazines	1.42	0.5
vii.	Containers labelled with a word and a picture to explain the contents	1.22	0.42
viii.	Place to work	1.44	0.5
ix.	Lighting in the classroom	1.36	0.48
x.	Library area with cushions and floor mats	1.53	0.5

Note: 1 = Available; 2 = Not Available; SD = Standard Deviation

The findings in Table 4.3 indicate that the teaching and learning environment for children with autism spectrum disorder (ASD) in the surveyed Tanzanian primary schools is generally characterized by limited availability of specialized facilities. The lowest possible mean score of 1.00 for visual symbols and photographs to clarify verbal instructions (SD = 0.00) reflects uniform availability across all schools, suggesting a common recognition of the importance of visual aids in supporting comprehension for learners with ASD. Similarly, desks for children with autism spectrum disorder (M = 1.03, SD = 0.16) and letter trays (M = 1.06, SD = 0.23) show high availability with minimal variation, indicating that basic individualized workspace resources are consistently provided.

Other type of resources shows comparatively higher mean values approaching 2.00, indicating partial or inconsistent provision. For example, library areas with cushions and floor mats (M = 1.53, SD = 0.50) and places to work (M = 1.44, SD = 0.50) are less uniformly available, which may limit opportunities for sensory-friendly and comfortable learning spaces that are vital for children with ASD (Hume et al., 2021).

Likewise, lighting in the classroom (M = 1.36, SD = 0.48) varies considerably, which is significant given that lighting can influence sensory regulation and engagement in children with autism (Ashburner et al., 2013).

ICT-related resources, particularly audio-visual materials in the classroom (M = 1.19, SD = 0.40), are available to some extent but not universally. This partial integration of ICT suggests that while technology is recognized as beneficial for enhancing engagement and communication for children with ASD, its consistent implementation is lacking. The relatively higher mean for newspapers and magazines (M = 1.42, SD = 0.50) and containers labelled with words and pictures (M = 1.22, SD = 0.42) further highlights disparities in resource provision across schools. As such, the data suggests that while some foundational ASD-supportive resources, especially visual symbols, dedicated desks, and letter trays, are consistently available, the broader teaching environment, particularly in terms of sensory-friendly spaces and ICT integration, remains inconsistent. This variability in the availability of key facilities and environmental adaptations may influence the extent to which teaching and learning for children with ASD can be effectively enhanced through ICT and other supportive resources in Tanzanian primary schools. Some of the resources, such as desks, were extremely unfriendly to children with autism spectrum disorder.

4.3.2 Adequacy of Facilities and Environment for nabling T/L Process for Children with Autism Spectrum Disorder

The researcher ventured to assess the adequacy of the teaching and learning facilities and general learning environment for children with autism spectrum disorder in the

visited schools. Data was obtained through questionnaires, interviews, and observation and findings are presented in Table 4.4.

Table 4.4: Adequacy of Facilities and Environment for enabling T/L Process for Children with Autism Spectrum Disorder

	T/L facilities	Extremely Adequate		Adequate		Inadequate		Extremely Inadequate		Mean	SD
		F	%	F	%	F	%	F	%		
i)	Visual symbols and photographs for illustrations	0	0	23	63.9	11	30.6	2	5.6	2.42	0.6
ii)	Audio-visual materials in a classroom	5	13.9	12	33.3	16	44.4	3	8.3	2.47	0.84
iii)	Letter trays			13	36.1	23	63.9	0	0	2.64	0.48
iv)	Desks for children with autism spectrum disorder	12	33.3	18	50	6	16.7	0	0	1.83	0.69
v)	Lockers, Baskets, or shelves for storing children's materials	2	5.6	17	47.2	12	33.3	5	13.9	2.56	0.8
vi)	Newspapers and magazines	0	0	6	16.7	7	19.4	23	63.9	3.47	0.77
vii)	Labelled containers with words and a picture to explain the contents	0	0	9	25	26	72.2	1	2.8	2.78	0.48
viii)	Place to work	11	30.6	11	30.6	14	38.9	0	0	2.08	0.84
ix)	Lighting in the classroom	11	30.6	10	27.8	15	41.7	0	0	2.11	0.85
x)	Library area with cushions and floor mats	9	25	18	50	5	13.9	4	11.1	2.11	0.91

Note: 1 = Extremely adequate; 2 = Adequate 3 = Inadequate; 4 = Extremely inadequate
SD = Standard Deviation

The results in Table 4.4 reveal that the adequacy of facilities and the learning environment for enabling teaching and learning (T/L) for children with autism spectrum disorder (ASD) in the surveyed schools is generally low, with most resources rated as either adequate or inadequate, and very few considered extremely adequate.

Facilities that scored better include desks for children with autism spectrum disorder (M = 1.83, SD = 0.69), place to work (M = 2.08, SD = 0.84), lighting in the

classroom (M = 2.11, SD = 0.85), and library areas with cushions and floor mats (M = 2.11, SD = 0.91). These scores indicate that while these elements are relatively more adequate compared to others, they are still far from being consistently optimal across all schools. Adequate desks and dedicated working spaces are critical for supporting engagement and structured learning for children with ASD, while appropriate lighting and sensory-friendly library spaces contribute to a calm and focused learning environment.

Conversely, several key resources are largely inadequate. For example, newspapers and magazines recorded the highest mean (M = 3.47, SD = 0.77), showing that such literacy-supporting materials are mostly extremely inadequate. Similarly, labelled containers with words and pictures (M = 2.78, SD = 0.48), letter trays (M = 2.64, SD = 0.48), and lockers, baskets, or shelves (M = 2.56, SD = 0.80) are lacking, which may hinder the organization of learning materials in a way that supports independence and predictability for children with ASD. The shortage of visual symbols and photographs for illustrations (M = 2.42, SD = 0.60) and audio-visual materials (M = 2.47, SD = 0.84) is particularly concerning, given that visual aids and multimedia tools are foundational for communication, comprehension, and engagement in learners with ASD.

The findings indicate that the current teaching environments are not sufficiently equipped to fully meet the needs of children with ASD, particularly in integrating ICT to enhance learning. ICT tools often rely on the presence of foundational visual and organizational resources to be effective. Where such resources are inadequate,

the potential benefits of ICT, such as using multimedia for visual learning or interactive content for skill development, are significantly reduced. Therefore, improving the adequacy of these facilities, especially those directly linked to ICT use, is essential for creating an inclusive, supportive, and effective learning environment for children with ASD in Tanzania.

4.3.3 Views on Availability and Adequacy of Teaching and Learning Resources

The first research question examined how the teaching environment influences teaching and learning for children with autism spectrum disorder (ASD) in Tanzania. Analysis of participants' narratives, as summarized in Table 4.5, produced three main themes: Physical Classroom Environment, Resource Allocation and Management, and Teaching and Learning Resources. These themes reveal that the condition of classrooms, prioritization of resources in school budgets, and the adequacy and accessibility of specialized teaching aids all play a significant role in shaping the learning experiences of children with ASD.

The responses highlight both systemic and practical challenges, as well as a few enabling practices, that affect the inclusivity and effectiveness of the teaching environment. The theme of Physical Classroom Environment reflected concerns about deterioration of facilities, inappropriate furniture for children with ASD, and the need for spacious, movement-friendly environments.

Table 4.5: Views on Availability and Adequacy of Teaching and Learning Resources

Theme	Category	Example Quote
Physical Classroom Environment	Deterioration of facilities	Our classrooms' situation indicates deterioration of facilities.
	Inappropriate furniture for children with ASD	The Desks we use are ordinary and more suitable for children without ASD... Such children need an environment where they can move around comfortably.
	Need for spacious movement-friendly environment	Such children need an environment where they can move around comfortably.
Resource Allocation and Management	Lack of prioritization in budgeting for ASD resources	When we request resources for children with autism spectrum disorder, we find the Head Teacher is not interested in budgeting for a few of them.
Teaching and Learning Resources	Impact of resource inadequacy on special education	The inadequacy of teaching and learning resources makes special education more problematic.
	Inadequate visual learning resources	They need visual things... However, these resources are unavailable in the expected quantities because they are expensive.
	Potential for teacher-made resources	Similar resources could have been obtained with only a small amount of funds by enabling the special education teachers to innovate.
	Proper storage and accessibility of materials	Available teaching and learning materials... are kept in stores or any other proper places so children with autism... can use them easily.

As shown in Table 4.5, participants indicated that while classrooms may appear adequately furnished, the furniture is often not suited to the sensory and mobility needs of children with ASD, who benefit from opportunities for free movement. The deterioration of infrastructure further undermines efforts to create conducive spaces. This was further emphasised by one head teacher, who asserted:

> *Anyone who enters one of our classrooms can think that we have a sufficient furniture supply, but in reality, we are in trouble. The Desks we use are ordinary and more suitable for children without ASD. The children with autism spectrum disorder can hardly manage using conventional desks. The children with autism spectrum disorder need to be on regular movements. Such children need an environment where they can move around comfortably* (Head Teacher from School G).

The statement from the head teacher at School G illustrates that, despite classrooms appearing adequately furnished, the existing furniture does not meet the unique needs of children with autism spectrum disorder (ASD). The resources according to the respondent availed for learners with ASD included the needed newspapers and magazines, a conducive workplace, classroom, and library lighting, and cushions and floor mats for day rest. According to the respondent, the desks in use are conventional and better suited for learners without ASD, making it difficult for children with autism to use them effectively. The respondent further emphasized that children with ASD require regular movement and an environment that allows them to move around comfortably.

This observation underscores that the teaching environment, particularly the design and suitability of classroom furniture, plays a critical role in supporting or hindering learning for children with ASD. In relation to the integration of ICT, such physical constraints can limit the accessibility and effectiveness of assistive technologies and digital learning tools. ICT-based interventions often demand flexible spaces where learners can engage with devices and resources without being restricted by rigid seating arrangements. As highlighted by the respondent from School G, the absence of adaptive furniture and movement-friendly spaces may therefore reduce the potential benefits of ICT integration, ultimately affecting the teaching and learning process for children with ASD. The respondents indicated some difficulties in acquiring the resources needed. One teacher observed:

> *Teaching and learning resources are seriously inadequate here. For example, for children with autism spectrum disorder to learn, they need visual things. However, these resources are unavailable in the expected quantities because they are expensive. However, similar*

> *resources could have been obtained with only a small amount of funds by enabling the special education teachers to innovate and not necessarily by buying readymade items. In teaching various skills, adequate teaching and learning resources for pupils with autism are required to present the lessons' ideas, events, or contents* (Female teacher from School C).

The statement from the female teacher at School C reveals that teaching and learning resources for children with autism spectrum disorder (ASD) are critically inadequate, particularly in terms of the visual materials essential for their learning. The respondent stressed that such resources are vital for presenting lesson ideas, events, and content in a way that aligns with the learning needs of children with ASD. However, their unavailability in sufficient quantities is largely attributed to high costs. Importantly, the teacher pointed out that these challenges could be mitigated if special education teachers were empowered to innovate and produce materials locally, rather than relying solely on expensive, ready-made resources.

A teacher from a different school added that:

> *In my experience, and you might have observed yourself, our classrooms' situation indicates deterioration of facilities, and teachers fail to create a conducive learning environment for their pupils. However, it is gratifying that the available teaching and learning materials, such as baskets, exercise books, trays, plastic bags, can and are kept in stores or any other proper places so children with autism spectrum disorder can use them easily* (Head Teacher from School B).

The statement from the head teacher at School B points to a noticeable deterioration in classroom facilities, which undermines teachers' ability to create a conducive learning environment for pupils, including those with autism spectrum disorder (ASD). Despite this overall decline, the respondent acknowledged a positive aspect: the available teaching and learning materials, such as baskets, exercise books, trays, plastic bags, and cans, are properly stored in designated places, making them easily

accessible to children with ASD.

This highlights a mixed reality within the teaching environment. On one hand, the deterioration of facilities suggests limitations in sustaining an optimal physical and instructional space, which can hinder the effective integration of ICT and other specialized interventions. On the other hand, the organized storage and accessibility of existing materials reflect good classroom management practices, which are critical for learners with ASD, who often benefit from predictable, structured, and organized learning spaces. In the context of ICT integration, such organization can support smoother transitions between activities and more efficient use of digital tools, even in environments where facilities are in decline.

The theme of Resource Allocation and Management focused on the lack of prioritization in budgeting for ASD resources. Teachers reported, as indicated in Table 4.5, that requests for ASD-specific resources are frequently overlooked, both at school and district levels, resulting in persistent shortages. This lack of prioritization reflects broader systemic challenges in funding inclusive education and hampers teachers' capacity to meet the learning needs of children with ASD.

One teacher claimed that the situation is worse in primary schools, where head teachers are not aware of the essential requirements for children with autism spectrum disorder to promote their mastery of educational content delivered to them. One such teacher observed and reported:

> *In most cases, when we request resources for children with autism spectrum disorder, we find the Head Teacher is not interested in budgeting for a few of them. So, it is even worse when you claim the*

> *same to district education officials. The inadequacy of teaching and learning resources makes special education more problematic.* (Female teacher from School E).

The statement from the female teacher at School E underscores a critical barrier in creating an enabling teaching and learning environment for children with autism spectrum disorder (ASD), the lack of prioritization for resource allocation at both school and district levels. According to the respondent, requests for essential resources are often met with disinterest from head teachers, and the situation worsens when appeals are made to district education officials. This lack of budgetary commitment results in persistent inadequacy of teaching and learning materials, making the implementation of special education, including ICT integration, more challenging.

Finally, the theme of Teaching and Learning Resources covered the impact of resource inadequacy on special education, inadequate visual learning resources, potential for teacher-made resources, and proper storage and accessibility of materials. As outlined in Table 4.5, teachers noted that ASD learners require visual and tactile materials to effectively engage with lessons. However, such resources are often unavailable in sufficient quantities due to high costs. Some participants emphasized the potential for creating low-cost, teacher-made resources if given adequate support. The existence of organized storage systems for available materials was identified as a positive practice that aids accessibility for learners.

In the context of integrating ICT into teaching and learning for children with ASD, this lack of resources has significant implications. ICT-based approaches often rely on visual supports, such as digital images, videos, and interactive software, to

enhance comprehension and engagement. Without adequate visual and instructional materials, the potential of ICT to transform learning experiences for children with ASD is diminished. The respondent's suggestion to promote teacher innovation in resource creation indicates a sustainable pathway for strengthening the teaching environment, improving resource availability, and maximizing the impact of ICT integration in special education settings.

In the context of ICT-enhanced teaching and learning for children with ASD, such institutional reluctance to invest in resources can significantly limit progress. Effective ICT integration relies on foundational tools such as visual aids, adaptive devices, and sensory-friendly materials to complement digital interventions. Without these, even when ICT infrastructure is available, its pedagogical impact is diminished. The respondent's experience points to the need for stronger administrative support, policy enforcement, and targeted budgeting that recognizes the unique educational requirements of children with ASD, ensuring that resource provision is not treated as optional but as an essential component of inclusive education. These findings, summarized in Table 4.5, collectively illustrate that while certain practices support inclusion, the broader teaching environment remains constrained by infrastructural, managerial, and resource-related limitations, all of which directly influence the quality of teaching and learning for children with ASD.

4.4 Parents' and Teachers' Perception on Integrating ICT in Enhancing the Teaching and Learning for Children with Autism Spectrum Disorder

The second research question explored parents' and teachers' perceptions of integrating information and communication technology (ICT) in enhancing teaching

and learning for children with autism spectrum disorder (ASD) in Tanzania. The thematic analysis of participant responses, as summarized in Table 4.6, generated six main themes: Perceived Importance of ICT in Education, Need for Structured ICT Integration, Teacher Capacity Building, Support Systems for ICT Integration, and Concerns and Ethical Considerations. These themes reveal that while stakeholders recognize the transformative potential of ICT in modern education, especially for children with ASD, they also emphasize the need for deliberate planning, capacity building, and addressing potential socio-cultural and ethical concerns.

The researcher assumed that parents and teachers were important in ensuring ICT integration in teaching and learning for Children with autism spectrum disorder. To ensure the integration, parents and teachers' meetings are conducted in schools, and school board meetings discuss how children learn using ICT. Their perceptions were obtained through interviews. Findings are presented in Table 4.6.

The theme Perceived Importance of ICT in Education (Table 4.6) reflected strong agreement that ICT is now an indispensable component of modern teaching and learning. Participants highlighted that ICT not only defines contemporary education but also enables the acquisition of life skills relevant to economic and social development. Both parents and teachers acknowledged that if effectively integrated, ICT could improve learning experiences and outcomes for children with ASD.

Table 4.6: Views on Integrating ICT in Enhancing Teaching and Learning for Children with Autism Spectrum Disorder

Theme	Category	Example Quote
Perceived Importance of ICT in Education	ICT as an essential component of modern education	It is no longer possible nowadays to conceive how education can be delivered without ICT... ICT increasingly defines education.
	ICT as a tool for skill development and economic growth	ICT can potentially facilitate learners, even children with autism spectrum disorder, to obtain relevant life skills that support the economic and information development process.
Need for Structured ICT Integration	Whole-school ICT integration projects	It is crucial to have an ICT Integration Project for all primary schools... so that it becomes an integral system of teaching and learning.
	Provision of ICT tools to teachers	A special project would ensure all teachers teaching children with autism spectrum disorder have those facilities and can utilize them effectively.
Teacher Capacity Building	Training teachers on ICT integration for ASD learners	Teachers should be taught how to integrate the teaching of Children with autism spectrum disorder and ICT.
Support Systems for ICT Integration	Technical support services in schools	There is a need for technical support services in all schools... so that the integration of ICT becomes possible.
Concerns and Ethical Considerations	Risks of inappropriate content and socio-cultural issues	Children can access other contents which are uncultured and distort their discipline.
	Educators' attitudes towards ICT use	If teachers are reluctant to change, then nothing can be attained.

The respondents' perceptions, as reflected in Table 4.6, indicate strong support for integrating ICT into the teaching and learning process for children with autism spectrum disorder (ASD) in Tanzania. Both parents and teachers view ICT as a compulsory component of special needs education, recognizing its potential to transform learning experiences for children with ASD. They perceive ICT as a means of fostering self-reliance, enabling learners to develop independent skills necessary for daily functioning and future societal participation.

Respondents also emphasized that ICT can make learning more accessible and enjoyable, thereby making life easier for children with ASD. This aligns with global evidence that ICT facilitates differentiated instruction, visual learning, and

communication for children with developmental challenges. Moreover, participants believe that ICT integration supports the efficient attainment of educational goals, suggesting confidence in its capacity to improve teaching outcomes and enhance curriculum delivery.

However, the responses also highlight a note of caution: stakeholders stressed the need to preserve ethics and socio-cultural values when integrating ICT. This reflects awareness of potential challenges such as exposure to inappropriate digital content, over-reliance on technology, or the adoption of foreign cultural elements that may conflict with local norms. This perception suggests that while there is strong endorsement for ICT integration, it must be implemented in a way that safeguards the learners' holistic development and respects Tanzania's socio-cultural context. These perceptions reveal a positive but critically aware attitude among parents and teachers, supporting ICT as an essential enabler of teaching and learning for children with ASD, while advocating for ethical, culturally sensitive, and well-planned implementation.

Further the responses in Table 4.6 reflect a strong consensus among parents and teachers that integrating ICT into the teaching and learning process for children with autism spectrum disorder (ASD) is both essential and beneficial. Participants view ICT as compulsory in facilitating effective education for learners with ASD, indicating recognition of its role as a core instructional tool rather than an optional supplement. This perspective aligns with global and Tanzanian research that highlights ICT's capacity to enhance engagement, communication, and individualized learning for children with ASD.

Some respondents believed that integrating ICT in education for children with autism spectrum disorder is compulsory to keep pace with the development of science and technology of the 21st century. One parent strongly argued that:

> *From what I know, it is no longer possible nowadays to conceive how education can be delivered without information and communications technology (ICT). Looking at the global level, no one can access recent knowledge and skills from well-known scholars without interacting with ICT. So, it can be said that ICT increasingly defines education* (Male parent from Arusha).

The statement from the male parent in Arusha reflects a strong conviction that ICT has become an indispensable element of modern education, including for children with autism spectrum disorder (ASD). The respondent emphasized that, in today's interconnected world, access to up-to-date knowledge and skills from reputable scholars is virtually impossible without engaging with ICT. This perception aligns with the global trend where ICT is not merely an instructional aid but a defining feature of education itself.

In the context of integrating ICT to enhance teaching and learning for children with ASD in Tanzania, this view underscores the belief that technology is essential for bridging knowledge gaps, facilitating access to specialized learning resources, and connecting learners to best practices and innovations worldwide. For children with ASD, ICT can offer personalized, visually enriched, and interactive learning experiences that may not be achievable through traditional teaching methods alone. The respondent's perspective also suggests that excluding ICT from educational strategies risks marginalizing learners from the benefits of global knowledge exchange, thereby limiting their educational and developmental opportunities.

Other respondents also perceived that having children with autism spectrum disorder in primary schools is critical. Acquisition of knowledge and school for them opens the world and exploration ventures that reduce dependence in the future. The statement from the female parent in Morogoro highlights a reflective acknowledgment of the missed opportunities in her own schooling due to the absence of ICT, while recognizing the transformative potential it holds for today's learners, including children with autism spectrum disorder (ASD). She notes that, if carefully integrated into education, ICT can equip learners with relevant life skills that contribute to both economic participation and information society development.

> *I might say we missed this opportunity when we were schooling. Currently, ICT can potentially facilitate learners, even children with autism spectrum disorder, to obtain relevant life skills that support the economic and information development process if they are carefully integrated into education.* (Female parent from Morogoro).

In the context of integrating ICT to enhance teaching and learning for children with ASD in Tanzania, this perception underscores the role of technology not only as an instructional tool but also as a means of preparing learners for independent living and active engagement in the modern economy. By facilitating access to tailored educational resources, adaptive learning platforms, and skill-based digital tools, ICT can bridge gaps in communication, vocational training, and socio-economic integration for children with ASD. The respondent's emphasis on careful integration reflects awareness that ICT must be implemented strategically to ensure that it addresses the specific learning needs of children with ASD while aligning with broader developmental goals.

The Need for Structured ICT Integration theme (Table 4.7) emphasized the necessity for comprehensive, whole-school ICT integration projects. A teacher from school G

further indicated ways in which the integration of ICT can become more profitable for teachers and children. They suggested introducing ICT use and development projects and facilitating ICT devices to teachers and children with autism spectrum disorder. In elaborating the usefulness of integrating ICT, one teacher commented that:

> *To provide quality primary education for children with autism spectrum disorder in Tanzania, it is crucial to have an ICT Integration Project for all primary schools. The project would deal with whole-school ICT development so that it becomes an integral system of teaching and learning in every primary school.* (Female teacher from School G).

The statement from the female teacher at School G emphasizes that achieving quality primary education for children with autism spectrum disorder (ASD) in Tanzania requires a dedicated ICT Integration Project implemented across all primary schools. She advocates for a whole-school ICT development approach, ensuring that technology is not treated as an isolated tool but as an integral component of the teaching and learning system. In the context of integrating ICT for children with ASD, this perspective underscores the need for systemic change, embedding ICT into curriculum delivery, teacher training, resource provision, and classroom practices. A whole-school approach would ensure consistency in ICT use, promote equitable access to digital learning tools, and create an environment where ICT-based strategies, such as visual learning software, interactive communication devices, and assistive technologies, are seamlessly integrated into daily instruction.

The respondent's view aligns with best practices in inclusive education, where technology is harnessed not just for academic purposes but also to support communication, social interaction, and life skills development for learners with

ASD. Head of school from School B cemented the idea positively by saying:

> *I know that various gadgets such as laptops, smartphones, and tablets are used in ICT. So, with deliberate intention, a special project would ensure all teachers teaching children with autism spectrum disorder have those facilities and can utilise them effectively* (Head Teacher form School B).

The statement from the head teacher at School B reflects a pragmatic understanding of the role of ICT devices, such as laptops, smartphones, and tablets, in enhancing teaching and learning for children with autism spectrum disorder (ASD). The respondent underscores that with deliberate planning and investment, a targeted project could ensure that all teachers working with children with ASD are equipped with these devices and trained to use them effectively. This perspective highlights two critical components for successful ICT integration: access to appropriate technological tools and teacher capacity building. For children with ASD, these devices can support individualized instruction, facilitate communication through assistive apps, and provide interactive, visually rich learning experiences that cater to their specific needs. However, the respondent's emphasis on deliberate intention suggests that without structured policy support, budget allocation, and systematic training, the mere availability of devices may not translate into meaningful educational outcomes.

In the Tanzanian context, this view reinforces the need for ICT integration strategies that go beyond infrastructure provision to include ongoing professional development, technical support, and pedagogical guidance for teachers, ensuring that technology is not only available but also purposefully and effectively used to improve learning experiences for children with ASD. This perception reflects an

understanding that without institutionalized ICT integration, efforts to enhance teaching and learning for children with ASD may remain fragmented and unsustainable. Participants envisioned such initiatives as systematic efforts to make ICT an integral part of teaching and learning, supported by the provision of appropriate devices such as laptops, smartphones, and tablets to teachers working with ASD learners.

Teacher Capacity Building (Table 4.7) emerged as a key requirement, with participants noting that teachers must be trained on how to effectively integrate ICT in lessons for ASD learners. Different from facilitating devices for teachers and children with autism spectrum disorder, other respondents focused on knowledge and skills for integrating ICT. This reflects the understanding that technology alone does not improve learning outcomes unless educators have the skills and confidence to use it purposefully. The following comments insisted on the same:

> *I think teachers should be taught how to integrate the teaching of Children with autism spectrum disorder and ICT. I can imagine the mixture's effectiveness in ensuring the learning of Children with autism spectrum disorder enables them to pursue primary education and higher education as well* (Female teacher from School C).

The statement from the female teacher at School C highlights the importance of equipping teachers with the skills to effectively integrate ICT into the teaching of children with autism spectrum disorder (ASD). She envisions that combining specialized instructional strategies for children with ASD with purposeful ICT integration can significantly enhance learning outcomes, enabling these learners not only to successfully complete primary education but also to progress to higher levels of education.

This perspective underscores the critical role of teacher professional development in ICT integration. For children with ASD, technology offers tailored instructional support through visual aids, interactive platforms, and assistive communication tools, but its impact depends heavily on teachers' ability to adapt and integrate these tools into lesson delivery. The respondent's emphasis on the "mixture's effectiveness" reflects an understanding that ICT alone is insufficient; it must be paired with autism-specific pedagogical approaches to create an inclusive, supportive, and motivating learning environment. In the Tanzanian context, this view supports the need for structured training programs that combine inclusive education pedagogy with practical ICT application, ensuring teachers can leverage technology to meet both academic and developmental needs of learners with ASD. Such an approach could bridge current gaps in teacher competence, enhance learning accessibility, and contribute to long-term educational progression for children with ASD.

The Support Systems for ICT Integration theme (Table 4.7) focused on the importance of technical support services in schools. Parents and teachers pointed out that without ongoing technical assistance, even well-equipped schools may fail to sustain effective ICT use in teaching children with ASD. A female parent in Dare-es-salaam suggested availing technical support to all schools to hasten ICT Integration. That not every school is well equipped with technological advancements. She shared her comment that:

> *In my opinion, there is a need for technical support services in all schools. So that the integration of ICT in teaching and learning for children with autism spectrum disorder becomes possible. If this is taken seriously, there is a higher possibility for such services to work more closely with teachers in primary schools*. (Female parent from Dar es Salaam).

The statement from the female parent in Dar es Salaam underscores the necessity of establishing technical support services in all schools to facilitate the integration of ICT in teaching and learning for children with autism spectrum disorder (ASD). She highlights that without reliable technical assistance, even well-intentioned ICT initiatives may face operational challenges, limiting their effectiveness.

This perspective draws attention to an often-overlooked component of ICT integration, sustainability through ongoing support. For children with ASD, the successful use of technology depends not only on the availability of devices and teacher competence but also on the consistent functionality of ICT infrastructure. Technical support services would ensure timely troubleshooting, maintenance of equipment, and guidance on using specialized applications or assistive technologies tailored to learners with ASD.

The respondent's view also suggests that closer collaboration between technical teams and teachers could enhance the quality of ICT use in the classroom. Such collaboration would allow educators to focus on pedagogy, knowing that technological issues can be addressed promptly, thereby minimizing disruptions to the learning process. In the Tanzanian context, integrating technical support into school systems could be a critical step toward ensuring that ICT becomes a dependable, embedded feature of inclusive education for children with ASD.

Finally, Concerns and Ethical Considerations (Table 4.7) reflected stakeholder awareness of the risks associated with ICT use, including children's potential exposure to inappropriate content and the influence of socio-cultural values. Despite

its importance, other parents were cautious about the impact of ICT integration in education. Some parents had an opinion on the careful utilisation of ICT devices for children with autism spectrum disorder. They said:

> *Despite the indisputable importance of ICT in education, many issues are clearly not understood sufficiently. I have some doubts on the integration of ICT for teaching and learning and their links with ethics and socio-cultural aspects. Although teachers are there to supervise, children with their inquisitive minds can access other contents which are uncultured and distort their discipline* (Male parent from Dar es Salaam).

The statement from the male parent in Dar es Salaam reflects a cautious perspective on the integration of ICT in teaching and learning for children with autism spectrum disorder (ASD), particularly regarding its ethical and socio-cultural implications. While acknowledging the undeniable importance of ICT in education, he expresses concern that its use may expose children, despite teacher supervision, to inappropriate or culturally incongruent content that could negatively influence their discipline and values. This perception highlights a critical consideration in ICT integration: the need for content regulation and ethical safeguards. For children with ASD, who may be more vulnerable to influence due to their developmental and communication differences, exposure to uncontrolled digital content could have both behavioural and social consequences. The respondent's emphasis on ethics and socio-cultural preservation suggests that ICT integration should go hand in hand with digital literacy education, parental engagement, and the use of filtering or monitoring systems to ensure safe and appropriate use.

In the Tanzanian context, these concerns underscore the importance of implementing ICT strategies that balance technological access with value-sensitive design—integrating tools, policies, and training that respect local cultural norms while still

providing enriching, inclusive, and supportive learning opportunities for children with ASD.

A parent in Morogoro also shared this view, who insisted on teachers' readiness to adopt new technologies. He notes:

> *I think we need to be completely aware of the factors that may influence the meaningful use of information and communication technology in education. One can be the educators' attitudes towards using technology in teaching. If teachers are reluctant to change, then nothing can be attained* (Male parent from Morogoro).

The statement from the male parent in Morogoro underscores the significance of educators' attitudes as a determining factor in the meaningful integration of ICT in teaching and learning for children with autism spectrum disorder (ASD). He stresses that even with adequate infrastructure and resources, progress will be limited if teachers remain reluctant or resistant to adopting technology in their instructional practices. This perspective aligns with research showing that teachers' openness to change, confidence in using technology, and belief in its pedagogical value directly influences the success of ICT initiatives. For children with ASD, whose learning often benefits from visually rich, interactive, and adaptive ICT tools, a teacher's positive attitude can be the catalyst for creative and consistent use of such resources. Conversely, reluctance or lack of interest among educators can result in underutilization of ICT, depriving learners of its potential benefits.

In the study context, the respondent's view points to the need for targeted professional development that not only imparts ICT skills but also fosters a positive mindset towards technology integration in special needs education. This could include exposure

to evidence-based practices, peer learning opportunities, and success stories demonstrating the impact of ICT on the learning outcomes and life skills of children with ASD. Additionally, participants stressed that educators' attitudes toward technology are critical, if teachers resist change, ICT initiatives are unlikely to succeed.

Teachers' and parents' opinions were mainly in favour of the integrating ICT into teaching and learning for children with autism spectrum disorder. They had positive perceptions of the effectiveness of ICT. They even caution on issues that can pull down the success of integrating ICT in teaching and learning processes.

4.5 Experiences of Teachers Regarding the Use of ICT in the Teaching and Learning Process for Children with Autism Spectrum Disorder

The third objective of this study was to examine teachers' experiences in integrating Information and Communication Technology (ICT) into the teaching and learning (T/L) process for children with autism spectrum disorder (ASD) in primary schools. The aim was to determine the extent to which teachers' professional experiences, prior training, and exposure to ICT influence their ability to adopt and apply technology effectively in inclusive classrooms. Recognizing that ICT offers unique opportunities for individualized instruction, visual support, and interactive engagement, the study sought to capture both the enabling and constraining factors shaping ICT use for learners with ASD.

Data were collected through questionnaires and interviews to obtain a comprehensive understanding of teachers' experiences. Quantitative findings (Table 4.7) present teachers' responses to specific attributes, such as the relevance of their

college specialisation, years of teaching experience, prior ICT knowledge, involvement in ICT resource selection, and the sufficiency of ICT facilities—while qualitative narratives provide deeper insights into how these factors play out in classroom practice. The integration of these two data sources offers a nuanced perspective, highlighting the intersection between teacher capacity and institutional support.

The section begins with an analysis of teachers' self-reported attributes toward ICT integration, revealing that while many teachers possess the skills, knowledge, and willingness to use ICT with children with ASD, structural challenges, such as insufficient resources and limited involvement in ICT decision-making, remain significant barriers. This is followed by an exploration of lived experiences, where teachers reflect on how ICT influences lesson preparation, learner engagement, collaboration, and instructional efficiency. Teachers' voices illustrate both the transformative potential of ICT and the persistent inequities in access, underscoring the need for targeted investment, participatory resource planning, and continuous professional development to maximize ICT's benefits for children with ASD.

4.5.1 Teachers' Self-Reported Attributes toward ICT Integration

The researcher sought to determine the extent to which teachers' professional experiences support the integration of Information and Communication Technology (ICT) in the teaching and learning (T/L) of children with autism spectrum disorder (ASD) in primary schools. Recognizing that teachers' backgrounds, skills, and exposure to ICT directly influence their capacity to use technology effectively in inclusive settings, this part of the study examined both personal and institutional factors that shape ICT integration. Data were obtained through questionnaires and

interviews, enabling the collection of quantitative measures of teachers' self-reported attributes alongside qualitative insights into their lived experiences.

Table 4.7 presents the results of this inquiry, focusing on five key attributes: relevance of college specialisation, teaching experience, prior ICT knowledge, involvement in ICT facility selection, and adequacy of ICT resources in schools. The analysis of these attributes is critical for understanding how teacher preparation and institutional support interact to influence technology adoption for learners with ASD. The findings reveal a mixed landscape, while teachers generally demonstrate the skills, prior knowledge, and willingness to integrate ICT, systemic constraints such as limited resource availability and minimal involvement in ICT procurement processes present significant barriers. These insights provide an evidence base for targeted interventions, including professional development, participatory decision-making, and resource investment, to strengthen ICT-enabled inclusive education for children with ASD.

Table 4.7: Teachers' Self-Reported Attributes toward ICT Integration

	Attributes	Strongly agree		Agree		Disagree		Strongly disagree		Mean	SD
		F	%	F	%	F	%	F	%		
i)	My area of specialisation at college enables me to interact with ICT	12	33	18	50	6	17	0	0	1.83	0.69
ii)	My experience in teaching enables the integration of ICT	21	58	14	39	1	2.8	0	0	1.44	0.55
iii)	Prior knowledge gained in ICT has enabled me to engage children with autism spectrum disorder in ICT	24	67	12	33	0	0	0	0	1.33	0.47
iv)	The head of school involves me in the process of selecting ICT facilities for children with autism spectrum disorder	10	28	13	36	13	36	0	0	2.08	0.8
v)	The school has a sufficient supply of ICT facilities that enable the integration of ICT in the T/L of children with autism spectrum disorder	6	17	14	39	16	44	0	0	3.11	1.06

Note: 1= Strongly agree; 2= Agree; 3= Disagree; 4= Strongly Disagree
(p = 0.05)

The data in Table 4.7 reveals that teachers' experiences with integrating ICT in teaching and learning for children with autism spectrum disorder (ASD) in Tanzania are shaped by both their professional preparation and the availability of resources. Most teachers agreed that their experience in teaching (M = 1.44, SD = 0.55) and prior ICT knowledge (M = 1.33, SD = 0.47) significantly enable them to use technology effectively with children with ASD. This suggests that teachers who have relevant ICT skills and classroom experience feel confident in applying these tools to support individualized instruction, communication, and engagement for learners with ASD. Similarly, over 80% agreed that their area of specialization at college allows them to interact with ICT (M = 1.83, SD = 0.69), indicating that pre-service training has, to some extent, prepared them for technology integration.

However, structural and resource-related challenges are evident. The involvement of teachers in selecting ICT facilities for children with ASD is limited (M = 2.08, SD = 0.80), suggesting that decision-making is often centralized, potentially resulting in the procurement of tools that do not align with classroom realities or specific learner needs. The most critical gap lies in the availability of ICT facilities (M = 3.11, SD = 1.06), where a large proportion of teachers reported that supply is insufficient, limiting the consistent and effective use of technology in their practice.

The findings indicate that while teachers generally possess the skills, experience, and willingness to integrate ICT for children with ASD, their efforts are constrained by inadequate involvement in resource selection and insufficient ICT facilities. Addressing these gaps through participatory decision-making and improved resource allocation could enhance the effectiveness of ICT integration in special needs

classrooms.

Some teachers argued that the use of ICT in colleges made them capable of using ICT. So, they had experiences before employment in the schools where they were working. Other teachers pointed out that the school administration involved them in the process of selection and purchasing of ICT facilities. Such engagements have increased their awareness of new inventions in ICT and motivated them towards the use of the facilities in teaching children with autism spectrum disorder.

4.5.2 Teachers Experience of Integrating ICT in Teaching

The teachers' experiences in the surveyed primary schools illustrate multiple ways in which Information and Communication Technology (ICT) supports teaching and learning for children with autism spectrum disorder (ASD). These experiences encompass the use of ICT as an instructional aid, a lesson preparation tool, and a means of fostering engagement and recreation for learners. Table 4.7 presents the aggregated perceptions of teachers, highlighting their views on the significance of ICT in facilitating lesson delivery, supporting task accomplishment, sourcing teaching content, designing instructional materials, and providing recreational opportunities for children with ASD.

The inclusion of both pedagogical and non-instructional uses of ICT in this analysis reflects a holistic understanding of its role in inclusive education. For children with ASD, ICT offers differentiated and interactive learning pathways, addresses diverse sensory needs, and enables teachers to adapt materials to individual learner profiles. The mean scores indicate a strong consensus among teachers on the value of ICT

across these domains, suggesting that its integration is perceived as essential not only for academic achievement but also for enhancing learners' social interaction, creativity, and overall school experience. These findings underscore the need for sustained investment in ICT resources and ongoing professional development to ensure that teachers can continue leveraging technology to meet the unique needs of children with ASD.

The teachers' experiences in the surveyed primary schools facilitated the integration of ICT in several ways. The experiences are presented in Table 4.8.

Table 4.8: Experiences of Teachers in Integrating ICT in the Teaching and Learning of Children with Autism Spectrum Disorder

	Teachers' perception	Mean	SD
i.	Integrating ICT in teaching and learning for children with autism spectrum disorder	1.22	0.42
ii.	Integrating ICT in teaching and learning for children with autism spectrum disorder to accomplish learning tasks easily.	1.58	0.5
iii.	Searching teaching contents/knowledge through the internet is helpful in the preparation of lessons (resources and contents)	1.39	0.49
iv.	ICT is highly essential in designing a variety of teaching-learning materials	1.53	0.5
v.	ICT is useful for entertainment and recreation purposes during leisure time	1.42	0.5

Key: 1= Strongly agree; 2= Agree; 3= Disagree; 4= Strongly Disagree ($p = 0.05$)

The results in Table 4.8 indicate that teachers hold highly positive experiences regarding the integration of ICT in teaching and learning for children with autism spectrum disorder (ASD). The strongest agreement is observed in the perception that integrating ICT into teaching and learning for children with ASD is important (M = 1.22, SD = 0.42), reflecting a strong consensus among teachers on the value of technology in supporting inclusive education. Teachers also agree that ICT facilitates the accomplishment of learning tasks for children with ASD (M = 1.58, SD = 0.50),

underscoring its role in simplifying instructional delivery, enhancing learner engagement, and providing alternative pathways for demonstrating understanding. The use of the internet for searching teaching content and lesson preparation (M = 1.39, SD = 0.49) is also strongly endorsed, indicating that ICT not only benefits learners directly but also support teachers in accessing diverse and up-to-date instructional resources.

Additionally, teachers recognize ICT as essential in designing a variety of teaching-learning materials (M = 1.53, SD = 0.50), which is particularly significant for children with ASD who require differentiated and visually engaging instructional approaches. Interestingly, teachers also value ICT for entertainment and recreational purposes during leisure time (M = 1.42, SD = 0.50), suggesting an awareness of its role in promoting social interaction, relaxation, and sensory engagement for learners with ASD. The findings show that teachers' experiences affirm ICT as a multifaceted tool that enhances lesson preparation, instructional delivery, task completion, and recreational activities for children with ASD. However, to fully realize these benefits, access to ICT resources and continuous teacher training remain critical.

Almost all teachers responded that ICT was an essential to teaching and learning for children with autism spectrum disorder. Teachers were using ICT in adopting varieties of learning experiences for children with autism spectrum disorder. ICT provided ways for children with autism spectrum disorder to accomplish learning tasks easily. The teaching and learning contents through the internet were helpful in the preparation of lessons, and most importantly, ICT was useful in entertainment

and recreation of the children during leisure time.

The researcher further wanted to establish the frequency of integration of ICT in teaching children with autism spectrum disorder. Teachers were required to respond to the question, which needed them to tell how often they integrated with ICT in teaching the selected contents, as indicated in Table 4.9.

Table 4.9: Frequency of Using ICT in Teaching for Children with Autism Spectrum Disorder

	Learning content(s)	Very rare		Sometimes		Often		Very often		Mean	SD
		F	%	F	%	F	%	F	%		
i)	Arithmetic/Number skills	17	47.2	18	50	1	2.8	0	0	1.56	0.55
ii)	Social-related contents	12	33.3	18	50	6	16.7	0	0	1.83	0.69
iii)	Health-related contents	12	33.3	24	66.7	0	0	0	0	1.67	0.47
iv)	Communication skills	4	11.1	28	77.8	4	11.1	0	0	2	0.47
v)	Vocational skills	5	13.9	24	66.7	7	19.4	0	0	2.06	0.58

Note: 1= Very rare; 2= Sometimes; 3= Often; 4= Very often
(p = 0.05)

The results in Table 4.9 show that the frequency of ICT use in teaching children with autism spectrum disorder (ASD) varies considerably across different learning content areas, with most applications falling in the “very rare” to “sometimes” range rather than regular or intensive use. ICT is used least frequently for arithmetic/number skills (M = 1.56, SD = 0.55), where nearly half of the teachers (47.2%) report very rare use and only 2.8% report often using it. This indicates that despite ICT’s potential to enhance numeracy through interactive visual aids and educational software, it remains underutilized in this area. Health-related content (M = 1.67, SD = 0.47) and social-related content (M = 1.83, SD = 0.69) also see low levels of ICT integration, suggesting missed opportunities for technology to support

social skills training, health education, and adaptive behaviors, areas that are often priorities for learners with ASD.

ICT is used more frequently for communication skills (M = 2.00, SD = 0.47) and vocational skills (M = 2.06, SD = 0.58), with a majority of teachers using technology sometimes in these domains. This is significant given that communication and vocational skills are core functional areas for children with ASD, and ICT offers tailored tools such as speech-generating devices, communication apps, and virtual simulations for vocational training. The data suggests that ICT use in teaching children with ASD in Tanzania is sporadic and content-specific, with greater emphasis placed on communication and vocational training than on numeracy, social, or health-related content. This pattern points to the need for targeted professional development and resource provision to promote balanced and consistent ICT integration across all curriculum areas to maximize its benefits for learners with ASD.

4.5.3 Teachers' Experiences with ICT Integration

The qualitative data from interviews revealed a range of teacher perspectives on the integration of Information and Communication Technology (ICT) in teaching and learning for children with autism spectrum disorder (ASD). Analysis of these narratives generated themes and categories that reflect both the benefits and challenges of ICT use, as well as its impact on learners, teachers, and instructional practices. These themes, summarized in Table 4.10, provide a deeper understanding of the lived experiences behind the quantitative findings presented earlier.

The third research question examined teachers' experiences of using information and communication technology (ICT) to enhance teaching and learning for children with autism spectrum disorder (ASD) in Tanzania. Thematic analysis of the responses, as summarized in Table 4.10, produced six main themes: Perceived Benefits of ICT for Teaching and Learning, Impact of ICT on ASD Learners, Barriers to ICT Integration, Instructional Relevance of ICT, Professional Development through ICT, and Learning Outcomes from ICT Integration. These themes capture both the opportunities and challenges teachers encounter when applying ICT in the classroom, highlighting its potential to transform teaching practices, engage learners, and promote professional growth, while also exposing persistent infrastructural and resource gaps.

Table 4.10: Teachers' Experiences with ICT Integration

Theme	Category	Example Quote
Perceived Benefits of ICT for Teaching and Learning	Simplification of teaching tasks and reduced workload	Teaching nowadays has been simplified since everything has gone digital. The increasing application of ICT... reduced the teaching load.
	Curriculum integration of ICT to enhance learning	The curriculum integrates ICT into the teaching and learning process and provides children with opportunities to use modern technology.
Impact of ICT on ASD Learners	Deepened understanding of topics	ICT helps children develop a deep understanding of the topics taught in schools.
	Increased interest and engagement in learning tasks	Most pupils with ASD are usually interested in learning tasks that are directly linked to ICT.
Instructional Relevance of ICT	Adapting materials for ASD learners	ICT is very useful in preparing lessons and instructions relevant to children with autism spectrum disorder.
Professional Development through ICT	Enhanced teacher knowledge, skills, and collaboration	Teaching and learning with the integration of ICT enhances professional development among teachers... influences collaboration with peers.
Learning Outcomes from ICT Integration	Active involvement, thinking skills, authentic environments	ICT may integrate and benefit greatly in learning outcome including children's active involvement... thinking skills... and collaborative learning.

The theme Perceived Benefits of ICT for Teaching and Learning (Table 4.10) revealed that teachers consider ICT a valuable tool for simplifying teaching tasks, reducing workload, and enriching the curriculum. The integration of ICT in lesson delivery provides children with opportunities to explore modern technology and supports active, student-centred learning. Teachers consistently highlighted the perceived benefits of ICT for teaching and learning, noting that technology has simplified instructional tasks, reduced workload, and enhanced the delivery of curriculum content. They recognized that integrating ICT into the curriculum creates opportunities for children to interact with modern technology, thereby supporting more engaging and relevant learning experiences.

Teachers appreciated that ICT to have improved their work, and teaching has become more effective. One teacher commented that:

> *I want to comment on the benefits of technological advancement in education. Sometimes the head teacher assigns some of us to inquire about ICT facilities. I have realized that teaching nowadays has been simplified since everything has gone digital. The increasing application of ICT in the education system has reduced the teaching load and the burden of assisting children in schools. The curriculum integrates ICT into the teaching and learning process and provides children with opportunities to use modern technology to enhance their learning in all subjects* (Female teacher from school D).

The statement from the female teacher at School D reflects a positive experience with the integration of ICT in teaching and learning for children with autism spectrum disorder (ASD). She notes that technological advancements have simplified teaching, reduced the workload on teachers, and eased the process of assisting children in schools. Her observation that “everything has gone digital” underscores the growing role of ICT in modern education and its ability to

streamline instructional delivery.

The respondent also highlights that ICT integration within the curriculum provides children with opportunities to engage with modern technology across all subjects. For learners with ASD, such exposure can be particularly beneficial, as digital tools can offer visual, interactive, and individualized learning experiences that support comprehension, communication, and skill acquisition. Furthermore, her experience in being assigned to inquire about ICT facilities indicates that some level of teacher involvement in resource acquisition is present, potentially fostering a sense of ownership and alignment between classroom needs and technology provided. The statement demonstrates that when ICT is embedded into the curriculum and supported by access to facilities, it can enhance both teacher effectiveness and learner engagement, making the teaching and learning process more efficient and inclusive for children with ASD.

Impact of ICT on ASD Learners (Table 4.10) reflected teachers' observations that ICT enhances pupils' understanding of subject content and sustains their interest in learning. Many learners with ASD were noted to engage more with tasks linked to technology, suggesting that ICT can be a powerful motivator and a pathway to improved learning outcomes. In terms of the impact of ICT on ASD learners, teachers observed that digital tools deepen learners' understanding of academic topics and increase their interest and engagement, particularly when tasks are directly linked to technology. This aligns with inclusive pedagogical principles that prioritize learner-centred approaches and individualized support. However, the narratives also surfaced barriers to ICT integration, with the most prominent being

the shortage of ICT facilities in public schools. Such resource constraints hinder consistent and equitable implementation, limiting the full potential of technology in inclusive classrooms. A head teacher at primary school **E,** who also specialised in children with autism spectrum disorder, demarcated one of the common utilities of ICT for teachers, he said:

> *ICT is very useful in preparing lessons and instructions relevant to children with autism spectrum disorder, since most of the materials in the literature we have were not meant for our children. Since college, I developed the ability to handle materials via the internet and other sources in the library. Some of the available resources are for the grown-up learners. Similarly, in other places, children with ASD use digital cameras, which is really surprising because, from personal observations, only teachers in our schools are the ones using smartphones with digital cameras* (Head Teacher from School E).

The statement from the head teacher at School E highlights the critical role of ICT in preparing lessons and instructional materials tailored to the needs of children with autism spectrum disorder (ASD). She points out that much of the existing literature and resources were not originally developed for learners with ASD, making ICT an essential tool for sourcing, adapting, and creating relevant content. Her experience since college in using the internet and library resources reflects how prior ICT exposure can empower educators to bridge the gap between generic educational materials and the specific learning needs of children with ASD. Although, as indicated in Table 4.10, there was an agreement among teachers and parents on the integration of ICTs, other respondents showed a degree of difficulty in the preparation of lessons for children with autism spectrum disorder, as most of the available literature was not meant for them, while other ICT gadgets were meant for grown-up learners.

The respondent also observes a disparity in ICT usage, noting that in some settings, children with ASD actively use digital devices such as cameras, while in her context, such tools are predominantly used by teachers. This suggests a missed opportunity for learner-centred ICT engagement, where technology could be placed directly in the hands of students to support skill development, self-expression, and active participation in the learning process. The statement reinforces that while teachers have developed ICT competencies to adapt instructional materials, there is a need to extend ICT access and usage to children with ASD themselves. Doing so would not only align with inclusive education principles but also enhance the integration of technology as a learning and communication tool rather than solely as a teacher's resource.

Teachers further emphasized the instructional relevance of ICT, describing how it enables the adaptation of learning materials to meet the specific needs of children with ASD. This flexibility is vital given that many traditional resources are not designed for learners with diverse needs. The integration of ICT also emerged as a catalyst for professional development, enhancing teachers' knowledge, skills, and collaboration with peers. This professional growth contributes to improved instructional quality and the sharing of innovative practices.

Teachers linked ICT use to positive learning outcomes, such as fostering active learner involvement, developing thinking skills, creating authentic learning environments, and promoting collaborative learning. These outcomes underscore ICT's multifaceted role in enhancing both cognitive and social development for learners with ASD. Findings provide a nuanced picture of how ICT shapes the

teaching and learning process in inclusive education settings, offering insights into strengths to build on and gaps that require targeted interventions.

Instructional Relevance of ICT (Table 4.10) emphasized that ICT allows teachers to adapt and prepare instructional materials that are more suited to the needs of children with ASD, especially where conventional materials are irrelevant or inaccessible. The statement from the male teacher at School F emphasizes that integrating ICT into teaching and learning not only benefits students with autism spectrum disorder (ASD) but also contributes significantly to teachers' professional development. He highlights that ICT integration enhances teachers' knowledge and skills, making instructional tasks more efficient and manageable.

> *With no doubt, teaching and learning with the integration of ICT enhances professional development among teachers. This also influences the effectiveness of collaboration with peers for children with autism spectrum disorder. Improved knowledge and skills in teaching with ICT simplify the tasks of teachers* (Male teacher from school F).

The respondent also points out that the use of ICT fosters collaboration with peers, which is particularly relevant for children with ASD, as collaborative learning can promote social interaction, communication, and teamwork skills. Finally, Learning Outcomes from ICT Integration showed that ICT use can promote active involvement, develop higher-order thinking skills, create authentic learning environments, and foster collaboration among learners. Teachers affirmed that these outcomes are particularly valuable for ASD learners, who often require interactive and engaging approaches.

This suggests that ICT can serve as both a teaching tool and a bridge for social inclusion when integrated into group activities or peer-assisted learning tasks. The

teacher's experience reflects that ICT integration yields dual benefits: improving the quality of teaching through skill enhancement and creating opportunities for collaborative, inclusive learning environments. This aligns with the broader goal of ICT in special education, to empower teachers while simultaneously enriching the learning and social experiences of children with ASD.

The theme Professional Development through ICT highlighted that integrating ICT not only benefits learners but also builds teachers' skills, confidence, and capacity to collaborate with peers. The findings suggest that ICT integration in ASD education offers significant pedagogical benefits but requires strategic investment in infrastructure, teacher training, and sustained technical support to realize its full potential. Some teachers were generally supporting the use of integration of information and communication technology (ICT) in teaching and learning of children with autism spectrum disorder, highlighting its potential to enhance engagement and individualised learning. However, one teacher offered a contrasting perspective, stating that:

> *From what I know, computers and other information and communication technologies (ICT) considerably enrich the teaching and learning of subjects. There are ways in which they may integrate and benefit greatly in learning outcome including children's active involvement in their learning, development of children's thinking skills, authentic environments, children's interest and engagement in learning and collaborative learning.* (Female teacher from School B).

The statement from the female teacher at School B reflects a strong awareness of the multifaceted benefits of integrating ICT into teaching and learning for children with autism spectrum disorder (ASD). She emphasizes that computers and related technologies can significantly enrich the learning process across subjects by

promoting active learner involvement, fostering the development of thinking skills, and creating authentic learning environments.

The respondent also points out that ICT has the potential to increase children's interest and engagement in learning, a factor particularly important for learners with ASD, who often respond well to visually stimulating, interactive, and individualized instructional approaches. Furthermore, her mention of collaborative learning highlights ICT's role in supporting peer interaction and social skill development, which are core areas of need for children with ASD. The statement underscores that ICT integration goes beyond delivering content, it transforms the learning experience into an engaging, skill-building, and socially enriching process. This aligns with inclusive education principles in Tanzania, where the goal is to create supportive, stimulating, and interactive environments that cater to the diverse needs of all learners, including those with ASD. Data gathered on teachers' experiences, revealed that most teachers agree that the technology they currently use in their classrooms positively influences their teaching and learning for children with autism spectrum disorder. Therefore, successful integration of ICT in the teaching-learning process, among other things, is dependent on the lesson preparation by teachers and the actual involvement of children with autism spectrum disorder in all learning tasks.

4.6 Children with Autism Spectrum Disorder: Experiences in the Integration of ICT in their Learning Processes

In the fourth objective, the researcher intended to examine the experiences of children with autism spectrum disorder's experiences in ICT integration in their learning processes. The knowledge about the experiences of children with autism

spectrum disorder was paramount in this study since they were the central point of investigation. The researcher wanted to establish the extent to which children with autism spectrum disorder are engaged in learning through ICT. Findings are presented in Table 4.11.

Table 4.11: Frequency of Pupils' Interaction with the ICT

S/N	Means of integration	Mean	SD
i.	Computer games	2.17	0.91
ii.	Photoshop	2.33	0.828
iii.	Searching/browsing the internet	2.42	0.649
iv.	Digital library	2.83	0.697
v.	Forums and blogs	2.97	0.56
vi.	Social networking	2.92	0.692

Note: 1= Very often; 2= Often; 3= Rare; 4= Not at all
(p 0.05)

The results in Table 4.11 indicate that children with autism spectrum disorder (ASD) in the surveyed Tanzanian schools interact with ICT at varying frequencies, with most activities falling between often and rare. The highest engagement is observed in computer games (M = 2.17, SD = 0.91), suggesting that learners with ASD are more frequently involved in game-based ICT activities. This aligns with global evidence that educational games can promote attention, motivation, and skill acquisition for children with ASD through interactive and visually engaging formats. Moderate interaction is reported for Photoshop (M = 2.33, SD = 0.828) and searching/browsing the internet (M = 2.42, SD = 0.649), indicating that some pupils use ICT for creative tasks and information retrieval, though not as regularly as games. These activities have potential to enhance creativity, digital literacy, and independent research skills if structured and guided appropriately.

Lower interaction is noted for digital libraries (M = 2.83, SD = 0.697), forums and blogs (M = 2.97, SD = 0.56), and social networking (M = 2.92, SD = 0.692),

suggesting limited engagement with online academic resources and collaborative platforms. This could be due to lack of access, limited digital skills, or the absence of structured programs encouraging such use. Yet, these platforms could offer significant benefits for children with ASD, including improving reading comprehension, social communication, and participation in safe, moderated digital communities. Data suggests that while children with ASD have some experience using ICT, particularly in interactive and entertainment-based formats, their engagement with more academic, collaborative, and knowledge-building ICT tools remains limited. Expanding access, providing targeted training, and integrating these tools into the curriculum could enhance both learning outcomes and social participation for learners with ASD.

Teachers agreed that children with autism spectrum disorder did not interact directly with ICT in the subject taught in schools, but in other related tasks. This teacher demonstrated such integration:

> *Aaah! In this school, we don't use computers directly in teaching children with autism spectrum disorder, but in developing motor skills computers assist teachers in enabling movements of children. Teachers design learning tasks mostly related to tactile orientations. Usually, children with autism spectrum disorder isolate themselves from others, so they need more social skills rather than sitting in front of computers* (Female teacher from school B).

The statement from the female teacher at School B highlights that, in her school, computers are not directly used for academic instruction for children with autism spectrum disorder (ASD) but rather as tools to support motor skills development. She explains that teachers design learning tasks involving tactile orientations to stimulate movement and physical engagement, reflecting an understanding that ICT can be

applied beyond traditional screen-based learning to support physical and sensory development.

The respondent also points out that many children with ASD in her context tend to isolate themselves from peers, which creates a greater need for social skills development rather than extended time in front of a computer. This perspective emphasizes that ICT integration for children with ASD should be purposeful and responsive to their holistic developmental needs, balancing technology use with activities that foster interpersonal interaction and real-world social engagement. The statement suggests that while ICT has valuable applications in enhancing motor skills for children with ASD, its integration should be complemented with structured social learning opportunities to address the tendency toward isolation and to promote broader developmental outcomes.

A teacher from school C said that children with autism spectrum disorder used ICT facilities such as television mostly for recreation purposes. She put it this way:

> *At our school, children with autism spectrum disorder enjoy watching television (TV) programs. Most of them are watching documentaries on the success of fellow children with ASD. Otherwise, they watch cartoons and other TV programmes, which are very entertaining and educating.* (Female teacher from school C).

The statement from the female teacher at School C highlights that children with autism spectrum disorder (ASD) at her school actively engage with television (TV) programs as part of their learning and recreational experiences. She notes that many of these children enjoy watching documentaries showcasing the success of fellow children with ASD, which can serve as powerful motivational tools, fostering self-confidence, aspiration, and a sense of belonging.

In addition to documentaries, pupils also watch cartoons and other TV programs that are both entertaining and educational. This reflects the dual role of visual media in supporting learning for children with ASD—providing enjoyment while also reinforcing cognitive, language, and social skills. For learners who often respond well to visual and auditory stimuli, such programming can enhance engagement, comprehension, and memory retention. The statement suggests that integrating carefully selected TV content into the teaching and learning process can be an effective ICT-based strategy for children with ASD, provided that content is age-appropriate, culturally relevant, and aligned with educational goals.

Several teachers' contributions supported the argument that children with autism spectrum disorder learnt better in classes well equipped with ICT facilities. Teachers from different schools shared a similar opinion, and one of them commented that:

> *I have witnessed that ICT helps children with ASD engage in time-demanding learning activities. It is so, only if the teacher engages the children with play and some academic tasks, can they concentrate for a longer time. The good of ICT integration is that children with autism spectrum disorder can accomplish tasks working at their own pace.* (Female teacher from school E).

The statement from the female teacher at School E emphasizes that ICT can effectively help children with autism spectrum disorder (ASD) sustain attention in time-demanding learning activities, provided that teachers combine its use with engaging play and academic tasks. She notes that such integration supports longer concentration spans, which is often a challenge for many learners with ASD. Importantly, the respondent highlights that ICT allows children with ASD to work at their own pace, accommodating their individual learning speeds and reducing the pressure associated with rigid classroom timelines. This flexibility is crucial for

fostering confidence, reducing anxiety, and enabling mastery of skills in both academic and developmental areas. The statement demonstrates that when ICT is purposefully integrated into a well-structured and engaging teaching approach, it can enhance focus, promote self-paced learning, and improve task completion for children with ASD, key factors in creating an inclusive and supportive educational environment.

A teacher from school F added more on favourable programmes where children were more interested in watching. She emphasised that television played a great role in relating learning to real-life. The informant said:

> *The television programmes such as 'Akili', which are in Kiswahili, are very essential to our children. They give thought and purpose to living as other children in a community. Occasionally, children ask teachers and supportive staff to connect the television for them to watch 'Akili' cartoon.* (Female teacher from school F).

The statement from the female teacher at School F highlights the value of culturally and linguistically relevant ICT resources, specifically Kiswahili television programmes such as "Akili", in supporting the learning and social development of children with autism spectrum disorder (ASD). She notes that these programmes not only entertain but also "give thought and purpose to living as other children in a community", suggesting that they help foster a sense of belonging, social awareness, and life skills. The fact that children themselves request to watch "Akili" reflects their interest and intrinsic motivation, which is a critical factor in sustaining engagement and participation in the learning process.

The use of content in Kiswahili further ensures accessibility and cultural resonance, enabling children with ASD to connect learning experiences to their everyday life

and community context. The interaction of ICT in teaching children with autism spectrum disorder from the perceptions of parents and teachers elicits positive feelings, whereas communication with children with ASD can be improved. The more they interact with ICT facilities, the more children with autism spectrum disorder become familiar with the behaviour of some computer-related programs. Then, with little training, children with autism spectrum disorder master the intended learning tasks.

4.7 Challenges and Opportunities of Integrating ICT in Enhancing the Teaching and Learning of Children with Autism Spectrum Disorder

The fifth objective of the study was to explore the challenges and opportunities of integrating ICT in enhancing the teaching and learning of children with autism spectrum disorder. The researcher wanted to establish the challenges and opportunities of integrating ICT in teaching and learning of children with autism spectrum disorder in primary schools. Through questionnaires and interviews, challenges and suggestions for addressing challenges were obtained from teachers. Findings are presented in Table 4.12.

The results in Table 4.12 reveal that integrating ICT in teaching and learning for children with autism spectrum disorder (ASD) in Tanzania faces both systemic and classroom-level challenges, many of which directly impact the effectiveness and sustainability of ICT use. The most frequently cited challenges include the lack of sufficient ICT facilities to meet lesson requirements ($M = 1.53$, $SD = 0.77$) and an insufficient number of ICT devices for children in classes ($M = 1.58$, $SD = 0.50$).

Table 4.12: Challenges of Integrating ICT in Enhancing the Teaching and Learning of Children with Autism Spectrum Disorder

Challenges	Always		Sometimes		Never		Not Applicable		Mean	SD
	F		%		F		%			
i) Lack of sufficient ICT facilities to address the lessons' requirements	23	63.9	7	19.4	6	16.7	0	0	1.53	0.77
ii) Insufficient number of ICT facilities for children in classes	15	41.7	21	58.3	0		0	0	1.58	0.5
Poor iii) Poor internet connection	21	58.3	9	25	6	16.7	0	0	1.58	0.77
iv) Inability to effectively conduct lessons through ICT	9	25	24	66.7	3	8.3	0	0	1.83	0.56
v) Difficulty in making children engage in learning with ICT	14	38.9	17	47.2	5	13.9	0	0	1.75	0.69
vi) Difficulties in financing educational needs for children with autism spectrum disorder	15	41.7	21	58.3	0	0	0	0	1.58	0.5
vii) Lowly motivated teachers	11	30.6	8	22.2	13	36.1	4	11	2.28	1.03

These constraints limit equitable access and hinder opportunities for personalized learning, an essential component for meeting the diverse needs of learners with ASD. Additionally, poor internet connectivity (M = 1.58, SD = 0.77) further restricts the use of online resources, interactive platforms, and real-time communication tools, reducing the potential benefits of ICT in lesson delivery.

Financial constraints are also significant, with difficulties in financing educational needs for children with ASD (M = 1.58, SD = 0.50) consistently reported. This not only affects the acquisition of ICT devices but also limits investment in supportive infrastructure, software, and training. The inability to effectively conduct lessons through ICT (M = 1.83, SD = 0.56) suggests a need for ongoing teacher professional development to strengthen ICT pedagogical integration skills. Classroom-specific

challenges include difficulty engaging children in ICT-based learning (M = 1.75, SD = 0.69), which may stem from a lack of appropriate content, limited adaptation to learners' sensory and cognitive needs, or insufficient teacher facilitation strategies. Low teacher motivation (M = 2.28, SD = 1.03), while rated less severe than other factors, remains an important barrier, as sustained enthusiasm and commitment are key to successful ICT integration.

Taken together, the data shows that the integration of ICT for children with ASD is constrained by inadequate infrastructure, resource shortages, financial limitations, connectivity issues, and pedagogical challenges. However, addressing these challenges presents opportunities for improvement, such as investing in cost-effective ICT solutions, expanding teacher training, developing culturally and linguistically relevant digital content, and strengthening infrastructure, to fully harness ICT's potential in enhancing the teaching and learning process for children with ASD. In addition to quantitative results, qualitative results indicated similar results in common challenges. For example, some teachers demonstrated hardship in meeting the goal of integrating ICT because their schools suffered from other common teaching and learning resources. One teacher reported that:

> *Although you needed to know more about the ICT integration, our school is facing an acute shortage of teaching and learning resources. In this school, we are facing an intense shortage of essential teaching-learning resources, including materials for decorating our learning environment and ready-made resources. As such, we only depend on a few papers/manila sheets that teachers make.* (Female teacher from school C).

The statement from the female teacher at School C highlights a critical resource gap that directly limits the effective integration of ICT in teaching and learning for

children with autism spectrum disorder (ASD). She notes that the school faces an acute shortage of essential teaching and learning materials, including those needed to create stimulating and visually supportive learning environments. Without adequate ready-made resources or diverse instructional materials, teachers are left to rely almost entirely on self-made items, such as a few papers or manila sheets. In the context of ICT integration, this scarcity poses a significant challenge.

ICT-based teaching for children with ASD often requires complementary visual aids, interactive materials, and well-prepared environments to reinforce digital learning. The absence of these resources can reduce the effectiveness of ICT tools, as learners with ASD benefit most when technology use is paired with tangible, structured, and sensory-supportive materials. The respondent's experience underscores the need for targeted resource provision alongside ICT infrastructure. Addressing such shortages, through budget allocation, innovative low-cost material production, and teacher capacity building, would not only enhance the learning environment but also maximize the benefits of ICT integration for children with ASD.

It was also found that teaching in primary schools (particularly in public schools) had difficulties in handling children with autism spectrum disorder. Teachers were few, thus supporting learning for children with autism spectrum disorder became complicated. On these issues, two teachers from school B and school D had the following to say:

> *In this school, we do face a shortage of teachers. The international standards require one teacher to work with or assist one autistic child. In this centre, we have more than seventy children with autism spectrum disorder who get services from four teachers only* (the Head teacher from school D).

The statement from the head teacher at School D highlights a severe shortage of teaching staff as a major barrier to effectively integrating ICT in teaching and learning for children with autism spectrum disorder (ASD). He points out that, according to international standards, the ideal ratio is one teacher per child with ASD, yet in his centre, over seventy children are served by only four teachers.

This disproportionate teacher–pupil ratio has significant implications for ICT integration. Effective use of technology with children with ASD often requires individualized instruction, close monitoring, and tailored support to match learners' cognitive, sensory, and communication needs. With such a high caseload per teacher, providing individualized ICT-based interventions becomes challenging, and the potential benefits of technology, such as differentiated learning, assistive communication tools, and interactive skill-building programs—may not be fully realized. The respondent's experience underscores the importance of addressing human resource constraints alongside ICT investment. Even with adequate ICT facilities, a shortage of teachers limits the ability to personalize learning, supervise ICT use, and ensure that technology is meaningfully integrated into each child's educational experience.

Similarly, it was found that teachers face challenges in using ICT to teach children with autism spectrum disorder and other learning difficulties, primarily due to the disruptive behaviours of these children. This was mentioned by one teacher, who said:

> *Integration of ICT for children with autism spectrum disorder who have difficulties in communication, emotional and behavioural difficulties, and other individual learning needs further the use of*

> *teaching via ICT facilities. These children sometimes become chaotic, sometimes when each child in a classroom portrays behaviour contrary to the instruction given by the teacher. So, uniform lesson delivery is hard* (Male teacher from school B).

The statement from the male teacher at School B underscores a classroom management challenge in integrating ICT for children with autism spectrum disorder (ASD), particularly those with communication difficulties, emotional and behavioural challenges, and diverse individual learning needs. He notes that these children may sometimes exhibit disruptive or chaotic behaviour, especially when multiple learners respond in ways that conflict with the teacher's instructions.

This variability in behaviour makes uniform lesson delivery difficult, which has direct implications for ICT integration. ICT-based teaching for children with ASD often requires flexibility, differentiated pacing, and individualized engagement strategies. When behavioural and communication challenges are not addressed alongside ICT use, the effectiveness of technology as a learning tool can be reduced, and the learning environment may become less structured. The respondent's observation highlights that successful ICT integration for learners with ASD must be accompanied by specialized classroom management approaches, such as structured routines, visual schedules, adaptive seating arrangements, and the use of personalized ICT tools. This would help balance technological engagement with behavioural support, ensuring that technology serves as an enabler rather than being overshadowed by classroom disruptions.

Teachers also needed training on ICT integration, but it was even harder since most of them had to access materials through a phone. One teacher said that:

> *The lack of on-the-job training makes it more difficult for teachers to accomplish their duties effectively. We need refresher courses to acquire modern techniques for assisting children with autism spectrum disorder. In teaching and interacting with children with autism spectrum disorder, teachers must be careful that these learners do not concentrate on instruction for too long. They must alternate between various tasks instead of one boring task* (Male teacher from school E).

The statement from the male teacher at School E points to the lack of on-the-job training and refresher courses as a significant barrier to effectively integrating ICT in teaching and learning for children with autism spectrum disorder (ASD). He emphasizes the need for professional development to equip teachers with modern techniques for supporting these learners, including strategies tailored to their communication, behavioural, and sensory needs.

The respondent also highlights an important pedagogical consideration: children with ASD may struggle to maintain focus on a single instructional activity for extended periods. To sustain engagement, teachers need to alternate between various tasks, which in the context of ICT integration could mean blending digital activities with hands-on, movement-based, or social interaction tasks. This approach can help prevent monotony, reduce frustration, and optimize learning outcomes. The teacher from school E statement underscores that without continuous training, teachers may lack the adaptive strategies necessary to use ICT effectively for children with ASD. Providing regular refresher courses and targeted ICT pedagogical training would not only strengthen teachers' technical competence but also enhance their ability to design varied, engaging, and developmentally appropriate lessons for learners with ASD.

A teacher from school A cautioned on the danger of harm if children with autism spectrum disorder are left alone interacting with ICT facilities. He cautioned that:

> *The use of ICT, if not properly controlled, can lead children to engage in cyberbullying, look at indecent content, become distracted in lessons, and damage their devices. Our children with autism spectrum disorder have capacities that enable them to engage in some tasks other than those assigned by the teacher. To avoid such repercussions, we tend to be much careful when involving our children with autism spectrum disorder in using ICT facilities* (Head Teacher from school A).

The statement from the head teacher at School A highlights digital safety and classroom management concerns as significant challenges in integrating ICT for children with autism spectrum disorder (ASD). He notes that without proper control, ICT use can expose learners to risks such as cyberbullying, exposure to indecent content, distraction from lessons, and potential damage to devices. The respondent further observes that children with ASD often possess the capacity to engage in tasks unrelated to the teacher's instructions, which increases the likelihood of misuse or off-task behaviour during ICT-based activities. This risk awareness has led teachers at the school to exercise heightened caution when involving these learners in ICT use, prioritizing close supervision and controlled access to technology.

In the context of ICT integration, the statement underscores the need for structured usage policies, monitoring systems, and digital literacy education to ensure safe, purposeful engagement with technology. It also points to the importance of using secure, age-appropriate, and autism-friendly applications that minimize opportunities for exposure to harmful content while maximizing learning benefits. Without these safeguards, the potential advantages of ICT for enhancing teaching and learning for children with ASD could be undermined by avoidable risks. The researcher was also

interested in finding possible options and solutions to the challenges mentioned by teachers. It was assumed that teachers were working with children with autism spectrum disorder daily, so they could have suggestions for making changes at the working stations. The proposed ways of resolving challenges are presented in Table 4.13.

Table 4.13: Proposed Ways of Resolving Challenges of ICT Use in Teaching and Learning for Children with autism spectrum disorder

	Proposed solution(s)	Very effective		Effective		Not Effective		Mean	SD
		F	%	F	%	F	%		
i)	Sharing of ICT facilities among teachers and schools	11	30.6	25	69.4	0	0	1.69	0.46
ii)	Borrowing from others	12	33.3	18	50	6	16.7	1.83	0.69
iii)	Invite an ICT specialist	12	33.3	23	63.9	1	2.8	1.69	0.52
iv)	Modem/mobile portable hotspot	10	27.8	26	72.2	0	0	1.72	0.45
v)	Application of varieties of T/L methods	14	38.9	21	58.3	1	2.8	1.64	0.54

Note: 1= Very effective; 2= Effective; 3= Not Effective; T/L= Teaching and learning.

The results in Table 4.13 indicate that teachers and stakeholders perceive multiple strategies as effective in addressing the challenges of ICT integration in teaching and learning for children with autism spectrum disorder (ASD), with most solutions rated between very effective and effective. The highest-rated strategy is the application of a variety of teaching and learning methods (M = 1.64, SD = 0.54), reflecting the recognition that ICT integration for children with ASD should be complemented with diverse instructional approaches to cater to different sensory, cognitive, and behavioural needs. This aligns with best practices in special education, where multimodal teaching, combining ICT tools with hands-on activities, visual aids, and interactive tasks, can enhance engagement and learning outcomes.

Sharing ICT facilities among teachers and schools (M = 1.69, SD = 0.46) and inviting ICT specialists (M = 1.69, SD = 0.52) are also considered highly effective, suggesting a collaborative and capacity-building approach to overcoming infrastructure and skill gaps. Sharing resources can optimize utilization in contexts where ICT facilities are scarce, while ICT specialists can provide technical expertise, training, and guidance tailored to the needs of children with ASD. Other solutions such as using modem/mobile portable hotspots (M = 1.72, SD = 0.45) address connectivity challenges, enabling access to online educational content and communication platforms in areas with unreliable internet. Borrowing from others (M = 1.83, SD = 0.69) is viewed as less effective compared to other strategies, likely due to issues of sustainability, reliability, and accessibility.

The findings indicate that a combination of pedagogical diversification, resource sharing, specialist involvement, and improved connectivity can effectively address the challenges of ICT integration for children with ASD. The emphasis on collaborative and adaptive approaches reflects an understanding that ICT integration in Tanzanian special education requires both technological and human-centred solutions. Involving stakeholders from within communities and donors was advised to ensure that ICT facilities are available in schools. One teacher put it this way:

> *The government should be encouraged to recognise the necessity of using ICT in teaching and learning through the application of ICT. This can be linked well with the learning of children with autism spectrum disorder outside school because most parents were eager to support the move to ensure that they use ICT in learning* (Female teacher from school G).

The statement from the female teacher at School G emphasizes the importance of government recognition and support for integrating ICT into teaching and learning

for children with autism spectrum disorder (ASD). She points out that formal acknowledgment of ICT's role in education could strengthen its adoption in schools and extend its benefits to learning outside the classroom, where continuity and reinforcement are crucial for children with ASD.

The respondent also highlights a positive opportunity, parental eagerness to support ICT use. This suggests that with proper policy backing, schools could collaborate more effectively with families to ensure that ICT tools and strategies used in the classroom are reinforced at home, thereby enhancing learning outcomes. Such an approach could help bridge the gap between school-based instruction and home-based learning, making ICT a consistent part of the child's developmental environment. Teacher from school G statement underscores that policy commitment, parental involvement, and cross-context ICT application are key opportunities for enhancing the educational experiences of children with ASD in Tanzania. When these elements are aligned, ICT integration can become more sustainable, impactful, and inclusive.

A teacher from school C suggested on teachers' training on using ICT to strengthen their teaching capability. It was presented with experiences that many teachers in their professional development had fewer opportunities to interact with the extensive use of ICT. Thus, it was thought to be essential to plan for training. One respondent commented that:

> *I suggest that the head of schools should organise and facilitate suitable ICT training for teachers. Schools should liaise with relevant support services so that teachers can be competent in*

> *using ICT in teaching. Their task should not end in facilitating training; it is high time for heads of schools to ensure ICT integration practices in teaching* (Female teacher from school C).

The statement from the female teacher at School C highlights the need for structured and ongoing ICT capacity-building as a key opportunity for enhancing teaching and learning for children with autism spectrum disorder (ASD). She emphasizes that school heads should not only organize and facilitate suitable ICT training for teachers but also ensure the actual integration of ICT into classroom practices. Her call for schools to liaise with relevant support services reflects the importance of collaborative partnerships, with ICT specialists, educational agencies, and other stakeholders, to provide technical guidance, pedagogical support, and up-to-date training resources. This approach would help teachers develop both the technical competence and pedagogical skills necessary to adapt ICT tools to the unique needs of children with ASD.

The teacher from school C statement underscores that teacher training must be purposeful, continuous, and directly linked to classroom implementation. Without active follow-up and accountability from school leadership, ICT training risks becoming a one-off event rather than a sustained practice that transforms teaching and learning for children with ASD. Generally, improvements are needed so that the integration of ICT becomes successful. Attaining significant success in teaching and learning children with autism spectrum disorder depends on the qualifications of teachers and the financial aspects. For teachers and supporting staff to be qualified and assist in integrating ICT, there is a need for training to make informed decisions

regarding the technological needs of all students, including those with special needs.

4.8 ICT Integration Variables for Children with Autism Spectrum Disorder

The Spearman's rho correlation analysis was conducted to examine the relationships among variables related to teachers' perceptions, experiences, and institutional factors influencing the integration of Information and Communication Technology (ICT) in the teaching and learning (T/L) of children with autism spectrum disorder (ASD). As shown in Table 4.14, the correlation coefficients reveal several strong and statistically significant associations, both positive and negative, indicating that the extent to which ICT is effectively integrated depends on a combination of resource availability, teacher attributes, and school-level practices.

A Spearman's rho correlation was conducted to examine relationships among variables related to ICT integration in teaching children with autism spectrum disorder (ASD) (Table 4.13). The adequacy of facilities was strongly and positively correlated with teachers' perceptions on integrating ICT ($r = .762$, $p < .01$) and with the frequency of pupils' interaction with ICT ($r = .611$, $p < .01$). Similarly, the requirements needed to facilitate T/L were positively associated with the frequency of pupils' ICT interaction ($r = .775$, $p < .01$). Teachers' experiences were moderately correlated with the ways schools resolve ICT-related challenges ($r = .492$, $p < .01$).

Table 4.14: Spearman's rho Correlations among ICT Integration Variables for Children with Autism Spectrum Disorder

Variable	1	2	3	4	5	6	7	8	9
1. Availability of T/L for CwAS	—	.724**	.582**	.582**	.355*	−.010	.775**	−.745**	.281
2. Adequacy of T/L process for CwASD		—	.762**	.762**	.397*	.196	.611**	−.749**	.395*
3. Teachers' perception on integrating ICT			—	1.000**	.258	.219	.509**	−.697**	.346*
4. Teacher attribute towards integration of ICT in T/L for CwASD			1.000**	—	.258	.219	.509**	−.697**	.346*
5. Teachers Experiences					—	−.043	.345*	−.085	.492**
6. Extent to which the ICT facilities assist CwASD						—	−.125	−.035	−.259
7. Frequency of pupils' interaction with the ICT							—	−.649**	.189
8. Challenges of integrating ICT in the T/L								—	−.154
9. Strategies school adopt in resolving the challenge of ICT use in T/L for CwASD									—

Negative correlations were observed between challenges in integrating ICT and adequacy of facilities ($r = -.749$, $p < .01$), teachers' perceptions ($r = -.697$, $p < .01$), and frequency of pupils' interaction with ICT ($r = -.649$, $p < .01$). These results indicate that higher adequacy of facilities and positive teacher attributes are associated with better ICT integration, whereas greater challenges correspond with reduced teacher perceptions and learner engagement.

The chapter analysed and presented data about the objectives of the study. In this chapter, data are presented using descriptive statistics, including frequencies and percentages, and presented in tables. In contrast, others take the form of direct quotations to present the voices of teachers and parents. The study revealed that primary schools involved in this study suffered from an insufficient supply of teaching and learning resources and an environment that discourages the teaching and learning processes for children with autism spectrum disorder. On the perceptions, all respondents had positive perceptions of the effectiveness of ICT.

The results in this chapter further indicate that most teachers agree that ICT integration positively influenced learning in children with autism spectrum disorder. The respondents were even aware of issues that can hinder the successes of integrating ICT in teaching and learning processes. Thus, it was encouraged that more teachers were required to support learning for children with autism spectrum disorder in primary schools.

CHAPTER FIVE

DISCUSSION OF FINDINGS

5.1 Introduction

Guided by the Technology Acceptance Model (TAM) and constructivist learning theory, this study examined how the school environment, stakeholder perceptions, teachers' and learners' experiences, and systemic conditions shape the integration of information and communication technology (ICT) to enhance teaching and learning (T/L) for children with autism spectrum disorder (ASD) in Tanzania. In TAM terms, perceived usefulness, perceived ease of use, and facilitating conditions map closely onto our conceptual framework's independent variables (stakeholders' support, facilitating factors for ICT adoption, school environment for ICT integration, teachers' experiences, and children's experiences) and intervening variables (collaboration among government, education stakeholders, and parents) that culminate in improved T/L for children with ASD (Davis, 1989; Venkatesh & Davis, 2000). Constructivism complements TAM by emphasizing active, authentic, socially mediated learning; ICT affords multimodal representation, scaffolding, and collaboration well-suited to ASD learners' needs (Jonassen, 1999; Tam, 2000; Ertmer & Newby, 2013).

5.2 Teaching and Learning Environment for Children with Autism Spectrum Disorder in Selected Primary Schools

The first objective of this study was to ascertain the teaching and learning environment for children with autism spectrum disorder in selected schools. Findings indicate that the school environment, including device availability,

connectivity, assistive software, technical support, and leadership, strongly conditions classroom use. Empirical studies in Tanzania consistently report gaps in infrastructure and on-site support that suppress sustained pedagogical integration (Kayombo & Mlyakado, 2016; Kihoza et al., 2016; Mwalongo, 2011; Mtebe & Raphael, 2018). International reviews similarly warn that inclusive ambitions falter without coordinated policy, resourcing, and monitoring (UNESCO, 2020; WHO & World Bank, 2011). In TAM terms, weak facilitating conditions depress perceived ease of use; constructivistically, they reduce opportunities for hands-on, iterative practice that ASD learners require.

Across most primary schools studied, the teaching–learning environment was materially inadequate: classrooms and libraries lacked newspapers/magazines, appropriate workspaces and lighting, and even cushions or floor mats. Funding shortfalls were the proximate cause, with teachers noting that modest allocations could at least enable locally produced low-cost resources (Kangalawe, 2024; Chamshama & Mnyanyi, 2024; Mtahabwa & Rao, 2010). Beyond scarcity, fit-for-purpose design was a core problem. Standard desks designed for neurotypical learners did not accommodate ASD-related sensory, behavioural, and motor needs, restricting self-regulatory movement and raising discomfort and anxiety (American Psychiatric Association, 2013; Lobato-Ruiz et al., 2025; Sadaf et al., 2020). Empirical work shows that flexible layouts, adjustable furniture, open spaces, and sensory zones, enhance engagement, reduce challenging behaviours, and improve task performance for learners with ASD (Ashburner et al., 2014; Humphrey & Lewis, 2008; Mostafa, 2015; Sheykhmaleki et al., 2021).

These school-level realities mirror a policy–practice gap reported in Tanzania: despite ETP (URT, 2014 R.E. 2023) commitments to inclusion, many schools still operate "one-size-fits-all" environments that hinder specialized pedagogy and the integration of ICT and assistive tools, which require flexible spaces and reliable power access (Chamshama & Mnyanyi, 2024; Kangalawe, 2024). International guidance reinforces the same direction: environments for ASD learners should minimize sensory overload, support safe movement, and use predictable spatial organization—with ICT (e.g., tablets, visual schedules, interactive displays) complementing these adaptations (UNICEF, 2021). Critically, visual supports (pictorial schedules, communication boards, flashcards) remain foundational for comprehension, communication, and anxiety reduction; their absence undermines both low-tech instruction and high-tech ICT use (Ennis-Cole, 2015; Gallardo-Montes et al., 2023; Nikolopoulou, 2022; Rao & Gagie, 2006; Sriyanti & Baharullah, 2024).

In sum, even where furniture is quantitatively "adequate," qualitative autism-friendly adaptations are lacking. Progress on Objective 1 therefore requires shifting from generic provisioning to Universal Design for Learning (UDL) principles, flexible seating, sensory-aware spaces, and integrated ICT—to prevent the de facto exclusion of children with ASD within mainstream classrooms (Rao, et al., 2023; UNICEF, 2021).

5.3 Parents and Teachers' Perceptions on Integrating ICT in Enhancing the Teaching and Learning for Children with Autism Spectrum Disorder

In the second objective, the researcher wanted to identify parents' and teachers' perceptions on integrating ICT in enhancing the teaching and learning for children

with autism spectrum disorder. Parents and teachers generally endorse ICT as essential to contemporary, inclusive pedagogy and as a pathway to skill development and independence for children with ASD, positions aligned with perceived usefulness (Msuya, 2016; Mwalongo, 2011; Chigona, 2015; UNESCO, 2020). At the same time, stakeholders raise concerns about teacher preparedness and content safety, underscoring the need for professional development and governance (Al-Zaidiyeen et al., 2010; Mtebe & Raisamo, 2014). Within TAM, supportive attitudes can translate into adoption when ease-of-use barriers are addressed via training and reliable school-level support (Venkatesh & Davis, 2000).

Parents and teachers in Tanzania expressed strongly positive perceptions of integrating ICT to enhance teaching and learning for children with ASD, consistently framing technology as essential for improving engagement, communication, and individualized instruction, a view echoed by Tanzanian and international evidence (Mnyanyi & Mbwette, 2011; Knight et al., 2013; Bouck et al., 2020; Shogren et al., 2024). Stakeholders also emphasized ICT's role in building life and vocational skills linked to self-reliance and social inclusion, aligning with local studies on assistive/educational technologies (Ngonyani & Mnyanyi, 2021) and systematic reviews that show technology reduces participation barriers for learners with ASD (Knight et al., 2013; Bouck et al., 2020).

Participants advocated structured, whole-school integration—rather than ad hoc pilots, supported by clear policy, resourcing, and monitoring (UNESCO, 2019, 2020) and cautioned that fragmented efforts exacerbate inequities (Seegobin, 2024). This systems view is consistent with African evidence that planning plus governance

are prerequisites for sustainable impact (Agyei & Voogt, 2012). Central to implementation was teacher capacity: hardware alone is insufficient without educators' competence and confidence to embed technology within autism-informed pedagogy (Alnahdi, 2014; Ngeze, 2017; Parette & Blum, 2015). Calls for professional development that integrates ICT skills with ASD-specific strategies mirror findings that learning gains depend on intentional instructional design and teachers' technological–pedagogical knowledge (Agyei & Voogt, 2012; Parette & Blum, 2013).

Stakeholders further underlined the need for reliable technical support; without routine maintenance and troubleshooting, even well-equipped schools struggle to sustain classroom use (Chigona et al., 2011; Agyei & Voogt, 2012; UNESCO, 2015, 2020). While supportive, respondents raised ethical and socio-cultural concerns (e.g., exposure to inappropriate content), reinforcing the importance of digital literacy, content filtering, and acceptable-use policies (Mtebe & Raisamo, 2014). They also identified educators' attitudes as pivotal, resistance to change can blunt integration despite adequate infrastructure, consistent with evidence that openness predicts technology use (Al-Zaidiyeen et al., 2010; Msuya, 2016).

Complementing these perspectives, studies document high technology affinity among many children and adolescents with ASD, with reported uses that foster independence, social opportunities, and anxiety reduction (Papageorgiou, 2020; Hedges et al., 2018). At the same time, school-based research in the region cautions that access and training shape frequency and the depth of pedagogical change—teachers often use ICT to extend existing practices rather than transform them unless

supported to do so (Mwalongo, 2011). When properly implemented, however, ICT can enhance instructional effectiveness and efficiency for both teachers and students (Ngozi, Etonyeaku, & Ofoegbu, 2013). Overall, parents' and teachers' perceptions point to a coherent implementation agenda: policy-anchored school-wide integration; ongoing teacher professional development that couples ICT with ASD-informed pedagogy; dependable technical support; and ethical safeguards aligned with local values—an agenda consistent with global guidance on inclusive education (UNESCO, 2020; WHO, 2011).

5.4 Experiences of Teachers Regarding the Use of ICT in the Teaching and Learning Process for Children with Autism Spectrum Disorder

The third objective sought to examine teachers' experiences of children with autism spectrum disorder regarding the use of information and communication technologies (ICT) in the teaching and learning process. Teachers' experiences clustered around prior exposure to ICT and access to targeted professional learning. Evidence from East and Southern Africa shows that design-team and TPACK-oriented programs build teachers' capacity to move from episodic to routine, purposeful use (Agyei & Voogt, 2012; Alayyar et al., 2012; Kihoza et al., 2016). Tanzanian studies likewise call for school-embedded coaching and technical support to align ICT with ASD-specific pedagogy (Nteze, 2017; Mtebe & Raphael, 2018). Such experiences elevate perceived ease of use and demonstrate classroom usefulness, thereby strengthening technology acceptance (Davis, 1989).

Teachers reported multiple pathways for acquiring ICT experience: prior exposure to ICT tools, routine teaching tasks requiring computers and internet use, and pre-/in-

service preparation in teacher colleges and universities tied to career advancement. In classrooms, they used ICT to create varied learning experiences for children with ASD, to ease task completion, and, secondarily, for leisure/relaxation; perceived benefits included more efficient lessons, time savings, and gains in communication and social skills (Roblyer & Doering, 2010). However, teachers with limited experience felt constrained in effective ICT use, echoing evidence that while many can deploy discrete strategies (e.g., comic strips, computers, literacy/numeracy techniques, pen profiles, IEP alignment), confidence and depth of integration vary widely (Chatfield, 2012).

Across accounts, teachers articulated concrete implementation strategies that align with ASD-informed pedagogy and leverage ICT: pairing card/visual communication with computer tools; using keyboards for communication; employing computer-aided art; and relying on word processors to support drafting and error correction—approaches consistent with prior studies on ICT-supported instruction (Carnahan et al., 2009; Hohlfeld et al., 2010; Ngozi et al., 2013). Empirical findings that keyboard and presentation (PowerPoint) skills correlate with literacy outcomes (reading, writing, mathematics) underscore the case for embedding keyboard training as an instructional target, not just a medium (Al-Gawhary & Kambouri, 2012). Finally, application design matters: images alone are often insufficient; the presence of written language within tools can further scaffold understanding for many learners with ASD, especially in school contexts (Vellon & Virnes, 2013).

Teachers' experiences suggest a promising, but uneven, trajectory: where exposure, targeted training, and purposeful strategies converge, ICT supports meaningful

participation and skill development for learners with ASD. Where exposure is thin, integration tends to be shallow or incidental, reinforcing the need for ongoing professional learning that couples ASD-specific pedagogy with practical ICT design and use.

5.5 Children with Autism Spectrum disorder Experiences in Integration of ICT in their Learning Processes

In the fourth objective, the researcher intended to examine the experiences of children with autism spectrum disorder in the integration of information and communication technology (ICT) in their learning processes. The international ASD literature documents gain in engagement, communication, and task completion when technology is individualized and instructionally embedded (Fletcher-Watson et al., 2016; Knight et al., 2013; Ramdoss, et al., 2011). Research highlights the value of virtual manipulatives, visual schedules, and augmentative and alternative communication (AAC) applications, with benefits for foundational literacy and numeracy (Bouck, et al., 2016). Regional evidence (e.g., Rwanda) further underscores the promise of localized digital content and adapted tools, provided teachers mediate their use (Ntalindwa et al., 2019, 2022). Constructivist principles explain these effects: ICT supports authentic, scaffolded activities and social collaboration tailored to ASD profiles.

The findings related to Objective Four, which sought to examine the experiences of children with autism spectrum disorder (ASD) in using ICT to enhance the teaching and learning process, revealed that pupils in the surveyed Tanzanian primary schools were generally less familiar with ICT for academic purposes. Although ICT facilities

were occasionally used to access learning materials, their application was more frequently oriented towards recreational and motor skill activities such as watching documentaries, wildlife programmes, cartoons, and other educational videos. While such uses fostered engagement and supported aspects of motor development, they were less connected to the core academic areas of reading, writing, and arithmetic (3Rs). This observation contrasts with studies such as Konstantinidis, et al., (2009), which demonstrated that children with ASD respond positively to computer-based educational methods due to the predictable and judgement-free nature of such environments.

The findings in objective four of the study partially align with those of Lorenzo et al. (2016), who noted that ICT can support the development of social and motor skills in children with ASD, but cautioned that excessive focus on these areas may limit engagement with core academic objectives. Similarly, research by Virnes et al. (2015) and Cheng et al. (2010) has shown that targeted ICT tools, including assistive technologies, portable devices, and virtual collaborative environments—can enhance social competence, empathy, and engagement when purposefully integrated into pedagogy. The COSPATIAL project (Cobb et al., 2010) also illustrates ICT's potential to promote social skills among children with ASD, though challenges remain in ensuring that such technologies are equally effective in supporting academic learning.

From the perspective of the Technology Acceptance Model (TAM), the patterns of ICT use identified in this study suggest that while these technologies may be perceived as enjoyable and easy to use (perceived ease of use), their perceived

usefulness for advancing academic learning is limited under current practices. The absence of strong curricular alignment and the predominance of ICT use for entertainment rather than structured educational tasks weaken its role as a tool for achieving core learning outcomes.

In relation to Constructivist Learning Theory, the findings indicate that ICT use in the surveyed schools often lacked structured, learner-centred activities designed to help children actively build knowledge through meaningful interaction. Instead, the reliance on passive entertainment reduced opportunities for children with ASD to construct understanding in literacy and numeracy through active engagement. The study's conceptual framework, which links ICT availability, teacher facilitation, and learner engagement to improved learning outcomes, highlights that this pathway was weakened by the absence of deliberate integration of ICT into targeted academic activities, inadequate teacher mediation, and limited resources.

Overall, the findings underscore that although ICT holds considerable potential to enrich the learning experiences of children with ASD, particularly in developing social and motor skills, this potential is not being fully realised in Tanzanian primary schools. To align practice with the theoretical foundations and conceptual framework guiding this study, there is a need to shift ICT use from predominantly recreational functions to structured, curriculum-linked applications that actively engage learners and promote measurable academic progress. Achieving this will require targeted resource provision, sustained teacher capacity building, and the strategic alignment of ICT activities with both academic and social learning objectives.

5.6 Challenges and Opportunities of Integrating ICT in Enhancing the Teaching and Learning for Children with Autism Spectrum Disorder

The fifth objective of the study was to explore the challenges and opportunities of integrating information and communication technology (ICT) in enhancing the teaching and learning of children with autism spectrum disorder. Challenges span resource scarcity, maintenance gaps, uneven teacher preparation in ASD-informed ICT, and governance issues (procurement without user input; digital safety) (Kayombo & Mlyakado, 2016; Mtebe & Raisamo, 2014; Mwalongo, 2011; UNESCO, 2020). Yet opportunities are clear. Policy scaffolds exist (United Republic of Tanzania [URT], 2016, 2018).

Professional learning models that integrate pedagogy, content, and technology (TPACK) have demonstrated effectiveness (Agyei & Voogt, 2012; Alayyar et al., 2012). Evidence-informed selection of tools (AAC apps, virtual manipulatives) and culturally relevant content can align with constructivist, task-based approaches. Building school-based technical support and engaging parents in digital citizenship strengthens facilitating conditions and collaboration, increasing the likelihood that ICT yields durable benefits for ASD learners (UNESCO, 2020; WHO & World Bank, 2011).

The findings revealed a combination of systemic, technical, and pedagogical constraints that limit effective implementation. The most pressing challenges included insufficient funding to meet the educational needs of children with ASD, a shortage of ICT facilities adequate for lesson requirements, an insufficient number of devices for classroom use, and unreliable internet connectivity in almost all public

schools surveyed. These deficiencies not only limited the availability of digital resources but also hindered the consistent use of ICT in lesson delivery. Teachers reported that the limited funding at school level was a primary barrier to sustaining ICT integration, while technical limitations were compounded by the unique needs of children with ASD, such as difficulties in communication, emotional regulation, and behavioural management, which can complicate the use of technology in teaching.

These findings align with Ntalindwa et al. (2019), who observed that disruptive behaviours in inclusive classrooms can undermine the implementation of competence-based curricula, especially in settings where there is a shortage of special education teachers, insufficient ongoing training, and limited multidisciplinary collaboration with professionals such as physicians and behavioural psychologists. The results also resonate with Geraldina's (2015) conclusion that most primary school teachers had limited knowledge of ASD due to a lack of in-service training and professional development opportunities, both for special needs education teachers and for general teachers working with autistic learners in mainstream classes.

Teachers in the current study proposed practical solutions, including resource sharing between schools, seeking regular technical support, and organising ICT-focused training workshops. These suggestions reflect the insights of Bingimlas (2009), who identified lack of confidence, competence, and resource access as key barriers to technology integration. In this context, successful ICT integration requires a holistic approach that ensures adequate hardware and software provision, sustained

professional development, sufficient instructional time, and responsive technical support.

From the perspective of the Technology Acceptance Model (TAM), the challenges identified affect both perceived usefulness and perceived ease of use—two critical determinants of technology adoption. Limited resources and insufficient training reduce teachers' confidence and capacity to apply ICT tools effectively, thereby diminishing their perception of ICT's value in achieving learning outcomes for children with ASD. Without targeted support to improve these factors, the likelihood of sustained and effective ICT adoption remains low.

The Constructivist Learning Theory further underscores that meaningful ICT integration for children with ASD requires active, learner-centred engagement that is responsive to their unique needs. However, the current context reveals that technological and resource barriers, alongside a lack of tailored pedagogical strategies, inhibit the creation of adaptive learning environments. The study's conceptual framework highlights the interplay between resource adequacy, teacher preparedness, and learner engagement as central to improved outcomes. When ICT provision is inadequate and teachers lack the skills or support to adapt technology to diverse needs, the pathway to effective integration is disrupted.

Moreover, the challenge of addressing individual learner needs is amplified in the case of ASD, where a "one-size-fits-all" design approach is ineffective (Cobb et al., 2010). To ensure ICT tools are relevant and inclusive, system designers must have a deep understanding of learners' cognitive, social, and cultural contexts. Incorporating

national culture and local knowledge into educational content—such as through culturally relevant online games, videos, and social media campaigns—can promote both cultural identity and learner engagement (Luckevich, 2008).

Generally, findings indicate that while ICT holds significant potential for enhancing learning for children with ASD, its effective integration is constrained by a combination of inadequate infrastructure, limited teacher training, behavioural management challenges, and insufficient adaptation of educational technologies to local contexts and individual needs. Addressing these issues will require coordinated investment in resources, targeted professional development, stronger technical support systems, and culturally responsive content design to create a sustainable and inclusive ICT integration model.

Overall, the study reveals strong perceived usefulness among parents and teachers, but variable ease of use and facilitating conditions. Addressing infrastructure, technical support, and ASD-focused professional development should increase behavioural intention and actual use (Davis, 1989; Venkatesh & Davis, 2000). Constructivist alignment matters: when ICT enables authentic, scaffolded, collaborative tasks, learners with ASD gain multiple routes to understanding and participation (Ertmer & Newby, 2013; Jonassen, 1999). Within the study's conceptual framework, independent variables (stakeholder support, facilitating factors, school environment, teacher and child experiences) operating through intervening collaboration among government, educators, and parents lead to the dependent outcome, improved teaching and learning for children with ASD.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter concludes the study and presents its contribution to the knowledge and experiences about integrating ICT in enhancing the teaching and learning process for children with autism spectrum disorder in Tanzania. The chapter constitutes four major sections: summary of the study's major findings, conclusions drawn based on the key findings, contributions of the study, and recommendations for action and future research.

6.2 Summary of the Major Findings

The following is a summary of the key findings of the study:

6.2.1 The Teaching and Learning Environment for Children with autism spectrum disorder in Primary Schools

As the first objective is concerned, it was found that teaching and learning facilities/environment in almost all primary schools were unavailable. There was an acute shortage of newspapers and magazines, a lack of sufficient workplace space, and lighting in the classroom and library area, with cushions and floor mats.

6.2.2 Parents' and Teachers' Perception on Integrating ICT in Enhancing the Teaching and Learning For Children with Autism Spectrum Disorder

The researcher intended to identify the perception of parents and teachers on integrating ICT in the teaching and learning of children with autism spectrum disorder. It was revealed that most parents and teachers had views that the

integration of ICT in the teaching and learning of children with autism spectrum disorder was inevitable. They favoured integrating ICT in teaching and learning for children with autism spectrum disorder.

6.2.3 Experiences of Teachers of Children with Autism Spectrum Disorder Regarding the Use of ICT in the Teaching and Learning Process

It was found that teachers acquired experiences of using ICT in various ways. These include prior knowledge of utilizing ICT facilities, their experiences in teaching where several tasks require them to work with computers and the internet, and others have integrated with ICT in teachers' colleges and Universities as a means of fulfilling requirements of their career development.

6.2.4 The Children with Autism Spectrum Disorder's Experiences about the Use of ICT in their Teaching and Learning Process

It was found that teaching children with autism spectrum disorder in the surveyed primary schools involved less ICT. They occasionally used ICT facilities to acquire learning material and entertainment through watching cartoons and other educational programmes.

6.2.5 The Challenges and Opportunities of Integrating ICT in Enhancing the Teaching and Learning of Children with Autism Spectrum Disorder

The study evident that most challenging issues include a lack of sufficient funds for the purchase of educational needs of children with autism spectrum disorder, a lack of sufficient ICT facilities to address the teaching and learning requirements, an insufficient number of ICT facilities for children in classes, and a very poor internet

connection in almost all public schools involved in this study.

6.3 Conclusions

In light of the findings from the study, the following conclusions were made: Firstly, the teaching and learning environment for children with autism spectrum disorder in the studied primary schools is inadequate for effectively integrating information and communication technology (ICT). The limited availability of essential information and communication technology (ICT) resources and a lack of appropriate learning environments hinder the potential for information and communication technology (ICT) integration in these schools. Even though some ICT facilities were available, these were not sufficient in number or in quality to cater to the needs of children with autism spectrum disorder in class. As a result, these children lacked the opportunities for meaningful engagement with ICT in their learning processes. The shortage of specific resources such as visual aids, appropriate furniture, and adequate technological tools severely restricted teachers' ability to incorporate ICT into daily lessons effectively.

Secondly, while many teachers possess prior knowledge and experience with ICT, the practical integration of these technologies in teaching children with autism spectrum disorder remains challenging. It was evident that most teachers had experience in using ICT in teaching and securing learning resources for their children. Although teachers understood the benefits of information and communication technology (ICT) for enhancing learning, they failed to integrate children into learning through ICT due to the nature of the learning environment. It was observed that a lack of facilities made it difficult to engage children in

individual assignments and learning using ICT facilities in the classrooms.

Thirdly, despite the perception of parents and teachers favoring ICT integration, significant challenges persist in implementing these technologies effectively. Parents and teachers acknowledge the benefits of information and communication technology (ICT), including its potential to foster greater independence, improve social skills, and enhance learning experiences for children with autism spectrum disorder. However, the study identified key barriers such as insufficient ICT facilities, inadequate teacher training on ICT integration, and a lack of technical support. Furthermore, internet connectivity in many schools makes the problem even worse. These challenges ultimately prevent the realization of the full potential of ICT in supporting children with autism spectrum disorder in their learning environments.

Finally, to improve ICT integration in teaching children with autism spectrum disorder, substantial investments in resources and infrastructure are required. This includes ensuring an adequate supply of ICT facilities suitable for children with autism spectrum disorder, training teachers in ICT integration strategies, and establishing reliable internet connectivity. The findings highlight the need for more robust and supportive infrastructure to create a conducive learning environment for children with autism spectrum disorder. However, there must be a concerted effort from educational authorities to allocate sufficient funds and resources to support the ICT integration in primary schools, particularly those catering to special needs.

6.4 Contribution of the Study

Based on the research findings, the study makes significant contributions to special education and the integration of information and communication technology (ICT) in

teaching children with autism spectrum disorder, particularly in the context of Tanzania primary schools. The contributions of this study are presented in terms of knowledge, practice, theory, and policy.

6.4.1 Contribution to Knowledge

The study contributes to existing knowledge by providing empirical evidence on the challenges and opportunities of integrating information and communication technology (ICT) to educate children with autism spectrum disorder in Tanzania. While the previous studies have examined information and communication technology (ICT) in education, this research focuses specifically on the context of special education and the unique needs of children with autism spectrum disorder. The findings have revealed that integration of information and communication technology (ICT) in the primary schools was ineffective due to a lack of support for the teaching and learning environment, which includes inadequate teaching resources, insufficient teacher training, and poor infrastructure.

This knowledge is crucial for informing future research on ICT integration in special education, particularly in developing countries with limited resources. Moreover, the study expands our understanding of how information and communication technology (ICT) can be utilized to support individualized learning for children with autism spectrum disorder, particularly in developing social and motor skills. The findings emphasize the need for more tailored approaches to ICT usage that align with the specific learning needs of children with autism spectrum disorder. This adds new insights to the literature on ICT in special education.

6.4.2 Contribution to the Practice

The findings indicate that most teachers are well equipped with the knowledge and experience of using information and communication technology (ICT) in teaching. The study highlights the potential for achieving the expected competencies among teachers and children with autism spectrum disorder, supported by existing opportunities. It also emphasized the need for teacher development programmes to include comprehensive training in ICT applications.

By identifying gaps in teacher readiness and classroom infrastructure, the research offers practical recommendations for improving ICT integration in special education settings. The study underscores the importance of making information and communication technologies (ICT) accessible to teachers and students by enhancing infrastructure, such as computers, internet connectivity, and specialized tools for children with autism spectrum disorder. Furthermore, the educational system is urged to embrace information and communication technology (ICT) integration across all levels, regardless of learners' age or needs. This includes ensuring that all stakeholders - teachers, parents, and children have the necessary resources and support to use technology in the learning process.

6.4.3 Contribution to Theory

The study contributes to the theoretical understanding of information and communication technology (ICT) integration in education, particularly within special education. The findings align with constructivist learning theory, emphasizing the importance of active learning and individual engagement with learning materials. By showing how ICT can support individualized learning tasks for children with autism

spectrum disorder, the study provides theoretical insights into how technology can foster greater learner independence and engagement in special education settings.

However, the study advances the Technological Acceptance Model (TAM) by applying it to the context of special education for children with autism spectrum disorder. The theory demonstrates how teachers' attitudes toward information and communication technology (ICT) and their perceived usefulness and ease of use directly affect their willingness to integrate ICT into their teaching practices. This theoretical contribution adds a layer of understanding to the factors influencing technology acceptance in educational settings for children with special needs.

6.4.3 Contribution to Policy

This study makes an important contribution to policy, particularly regarding information and communication technology (ICT) integration in primary schools that serve children with autism spectrum disorder. The findings emphasize the need for a comprehensive policy that supports integrating information and communication technologies (ICT) into special education. It suggests that policymakers must allocate sufficient funding to acquire information and communication technology (ICT) resources and train teachers in ICT and special education techniques.

The study also calls for the development of national and local policies that prioritize inclusive education, ensuring that children with autism spectrum disorder are not only provided with basic educational services but are also equipped with the tools and support what they need to thrive in a technology-enhanced learning environment. This draws the attention of the government and private school owners

to the fact that without improving ICT-related facilities and the teaching-learning environment, the integration of ICT in education cannot be fully realised. Furthermore, budgeting for children with autism spectrum disorder should consider that these learners often work more efficiently when working and learning individually. Therefore, a sufficient supply of teaching and learning resources is essential.

Moreover, the study found that both parents and teachers view the integration of information and communication technology (ICT) in the teaching and learning of children with autism spectrum disorder as essential for achieving their learning objectives. Consequently, the study suggests that investment in information and communication technology (ICT) integration will likely be realized soon. However, planning to develop primary education provision for children with autism spectrum disorder must involve all key stakeholders, such as the central government, ministries responsible for education and persons with disabilities, internal and external donors, and other interested parties. This collaborative approach will ensure sustainable support for the ICT facilities and other resources necessary to provide quality education for children with autism spectrum disorder.

6.5 Recommendations

Based on the presented results, discussion, and conclusions, several issues need to be addressed to enable the integration of ICT in the teaching and learning of children with autism spectrum disorder:

6.5.1 Recommendations for Action

The study revealed that integrating information and communication technology (ICT) in primary schools for children with autism spectrum disorder is ineffective

due to insufficient resources, inadequate teacher preparation, and a lack of suitable infrastructure. To address these challenges, the following actions are recommended;

(i) Provision of adequate ICT facilities

Findings: The study found that ICT resources in the surveyed schools were inadequate. Teachers and students lacked sufficient access to both hardware and software, impeding the effective use of ICT in teaching and learning for children with autism spectrum disorder.

Recommendation: School owners (Government and private owners) should establish initiatives to ensure a sufficient supply of school ICT facilities. The facilities found in surveyed primary schools were insufficient for the integration of ICT in teaching and learning to take place. The ICT resources required in schools include hardware (computers, tablets) and software (for example, educational apps for children with autism spectrum disorder). Providing adequate ICT infrastructure is crucial for supporting individualized learning, which is essential for children with autism spectrum disorder.

(ii) Professional Development Focused on ICT Application

Findings: The study identified that while most teachers had some experience with ICT, their ability to integrate technology effectively into teaching was limited due to insufficient technical training and resources.

(iii) **Recommendations:** There is a need for deliberate professional development emphasizing ICT application, specifically for teachers working with children with autism spectrum disorder. Teachers should be given access to technical support and opportunities to enrol in online courses that improve their proficiency

in using ICT tools. Moreover, the number of students per ICT facility should be minimized to enhance individualized learning, which is particularly important for children with autism spectrum disorder who thrive on personalized instruction.

(iv) Ensuring Reliable and Affordable Internet Access

Findings: A significant challenge identified in the study was the lack of reliable internet access, which hindered teachers and students from effectively using online resources for teaching and learning.

Recommendation: The government should develop mechanisms to ensure reliable and affordable school internet access. With stable internet, children with autism spectrum disorder and special education teachers can access educational materials, engage in online learning, and enhance collaboration between school and home environments.

(v) Incorporation of Assistive Technologies

Findings: The study highlighted that, children with autism spectrum disorder in the surveyed schools had limited access to assistive technology, crucial for supporting their communication and social skills development.

Recommendation: It is crucial to integrate assistive technology into the teaching and learning environment for children with autism spectrum disorder. Such technologies can help improve communication, social interaction, and learning outcomes. Schools should invest in assistive devices, such as communication boards, speech generating devices, and other tools that support the unique learning needs of children with autism spectrum disorder.

6.5.2 Recommendations to the Policy Makers

The findings of the study suggest that while there is potential for ICT to improve the education of children with autism spectrum disorder, several barriers remain, particularly in terms of access to resources and professional support. The following recommendations are made to policymakers to address these barriers:

(i) Ensure Accessibility and Affordability of ICT Tools and Resources

Findings: The study found that both ICT tools and learning resources were insufficient in schools, and there was a lack of affordability for families of children with autism spectrum disorder.

Recommendation: As the number of autism children with autism spectrum disorder is increasing, policymakers should ensure that ICT tools and resources are accessible and affordable for both educational institutions and families of children with autism spectrum disorder. This may involve implementing subsidies, grants, or partnerships with technology providers to make devices and software more readily available to schools and families. Such initiatives will help reduce the financial burden on schools and families, making ICT tools more accessible.

(i) Comprehensive Training Programs for Educators

Findings: The study revealed that while teachers were knowledgeable about information and communication technologies (ICT), they lacked the necessary training to integrate them effectively into their teaching practices, especially for children with autism spectrum disorder.

Recommendation: Policymakers should implement comprehensive training programs for teachers and other educators, focusing on how to utilize ICT tools to

teach children with autism spectrum disorder effectively. These programmes should cover both autism, specific teaching methodologies, and proficiency. This training should ensure teachers remain updated with new technologies and teaching methods.

(ii) Incorporate ICT into Individualized Education Plans (IEPs)

Findings: The study showed that ICT was not systematically incorporated into individualized Education Plans (IEPs) for children with autism spectrum disorder in the surveyed schools. The lack of personalized planning for ICT integration hindered the effective use of technology for each child's unique learning needs.

Recommendation: Policymakers should ensure that ICT is seamlessly integrated into individualized Education Plans (IEPs) for children with autism spectrum disorder. Educators, therapists, and parents should collaborate to select appropriate ICT tools that align with each child's learning goals and preferences. This approach ensures that information and communication technologies (ICT) are used to personalize to address each child's needs.

(iii) **Enhance Communication and Collaboration Among Stakeholders**

Finding: The study found that collaboration between teachers, parents, and other stakeholders was essential but not always optimized, which limited the effectiveness of ICT integration for children with autism spectrum disorder.

Recommendation: Policymakers should enhance communication and collaboration among educators, therapists, parents, and other stakeholders through ICT platforms. These platforms can facilitate sharing resources, updates on progress, and continuous

monitoring of the child's development. Improved communication will help ensure that all stakeholders are aligned in supporting the child's learning.

These recommendations, grounded in the study's findings, emphasize improving access to information and communication technology (ICT) resources, teacher training, and personalized learning for children with autism spectrum disorder. Addressing these key areas makes it possible to create a more inclusive and effective educational environment for children with autism spectrum disorder in Tanzania.

6.5.2 Recommendations for Further Research

Based on the findings and limitations of the current study, several directions for further research are recommended. These recommendations aim to broaden the scope of understanding and address gaps identified in the study, ensuring a more comprehensive exploration of ICT integration in the education of children with autism spectrum disorder and other learners with disabilities.

(i) Exploration of ICT Integration for Other Learners with Disabilities

Justification: This study focused on integrating ICT in teaching and learning for children with autism spectrum disorder in primary schools. While the findings provide valuable insights into the use of ICT for this specified group, there is a growing need to explore the broader implications of ICT for other learners with disabilities. Children with various learning needs, such as those with intellectual disabilities, hearing impairments, or physical disabilities, may benefit from ICT integration. Still, the effectiveness, challenges, and support requirements could vary significantly across different disabilities.

Recommendation: Future research should expand the scope to explore integrating information and communication technology (ICT) in the teaching and learning processes for other categories of learners with disabilities in Tanzania. Such studies could investigate how information and communication technology (ICT) tools and resources cater to the diverse needs of students with different disabilities, identify challenges specific to each group, and highlight effective strategies that could be applied across various disabilities. This would provide a more inclusive approach to using information and communication technology (ICT) in education, supporting the development of educational policies and practices that promote equity for all learners with disabilities.

(ii) Inclusion of Secondary Schools in Information and Communication Technologies (ICT) Integration Studies for Students with Autism

Justification: This study was limited to primary schools, focusing on the experiences of teachers, parents, and children with autism spectrum disorder in integrating ICT in the classroom. While primary schools form the foundation of education, secondary schools face distinct challenges and opportunities regarding ICT integration for students with autism. Secondary education involves more specialized content and greater academic expectations, and the transition from primary to secondary school can be particularly challenging for children with autism spectrum disorder. Understanding the role of ICT in these transitions and how it can enhance learning in more complex subjects is crucial for fostering continuous educational development.

Recommendation: Future research should extend the focus to secondary schools, investigating the integration of ICT in the teaching and learning for students with

autism at this level. Research in secondary schools could explore how secondary school teachers adapt their teaching strategies using information and communication technology (ICT) to support students with autism in an environment that requires greater independence and self-regulation. This research could also explore the role of information and communication technology (ICT) in preparing students with autism for higher education and vocational training.

(iii) Longitudinal Studies on the Impact of ICT on the Academic Performance and Social Skills of Children with autism spectrum disorder

Justification: While this study provides a snapshot of the current situation regarding ICT integration, longitudinal studies are needed to examine the long-term impact of ICT on the academic performance, social skills, and emotional development of children with autism spectrum disorder. Given the slow and often gradual progress in the development of children with autism spectrum disorder, it is essential to track how ICT tools affect their learning over an extended period.

Recommendation: Further research should adopt a longitudinal approach to study the sustained effects of ICT integration on children with autism spectrum disorder over several years. This research could assess improvements in areas such as communication, social interaction, academic achievement, and behavioural regulations, providing a more comprehensive view of the benefits and limitations of information and communication technology (ICT) for children with autism spectrum disorder. Longitudinal studies would offer critical insights into whether the benefits of information and communication technologies (ICT) in education persist, increase, or diminish over time, and how these tools can be optimized for long-term success.

These expanded recommendations provide a comprehensive framework for further research that builds on the present study's findings. By addressing these key areas, future research can contribute to a deeper understanding of information and communication technology (ICT) integration, particularly for children with autism spectrum disorder, and offer valuable insights for improving educational practices, policies, and outcomes.

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APPENDICES

Appendix A: Questionnaire for Special Needs Education Teachers

I am ***Bilhuda S. Chamshama***, Ph.D in Education student at Open University of Tanzania. As a requirement for partial fulfilment of the program; I am conducting research on, ***"Integration of ICT to Enhance Teaching and Learning for Children with Autism Spectrum Disorder in Tanzania".*** I kindly request you to respond to the questions freely and to the best of your knowledge. There is no wrong answer. Information gathered will be used solely for academic purposes only and will be treated with the greatest confidentiality possible.

Thanking you in advance.

A: General Information:

Please put a tick (√) against appropriate response

1. Region _____
2. Name of School _____
3. Qualification and area of specialization
   1.1 Certificate/Diploma - Area of specialization _____
   1.2 Bachelor Degree - Area of specialization _____
   1.3 Master's Degree - Area of specialization_____
   1.4 Any other, please specify _____
4. Gender [ ] Male [ ] Female
5. Years of experience:

[ ] Less than 2 years [ ] 2 to 5 years [ ] 5 to 10 years [ ] above 10 years

B: Examination of Teaching and learning (T/L) environment for children with autism spectrum disorder (CwASD) in Tanzania

6. What requirements **MUST** be available in order to facilitate teaching and learning (T/L) for children with autism (CwASD)? Please tick the availability of appropriate items.

S/N	Item	Available	Not available
i.	Visual symbols and photos to clarify verbal instructions		
ii.	Audio-visual materials in a classroom		
iii.	Letter trays		
iv.	Desks for children with autism spectrum disorder		
v.	Locker, Baskets or shelves used to store children materials		
vi.	Newspapers and magazines		
vii.	Containers labelled with a word and a picture to explain the contents		
viii.	Place to work		
ix.	Lighting in the classroom		
x.	Library area with cushions and floor mats		

7. How adequate are the facilities in managing/enabling T/L process for children with autism spectrum disorder? (Please tick appropriate response)

S/N	Item	Extr. Adequate	Adequate	Inadequate	Extr. Inadequate	Not Applicable
i.	Visual symbols and photos to clarify verbal instructions					
ii.	Audio-visual materials in a classroom					
iii.	Letter trays					
iv.	Desks for children with autism spectrum disorder					
v.	Locker, Baskets or shelves used to store children's materials					
vi.	Newspapers and magazines					
vii.	Containers labelled with a word and a picture to explain the contents					
viii.	Place to work					
ix.	Lighting in the classroom					
x.	Library area with cushions and floor mats					

8. Please, comment on your attribute towards integration of ICT in T/L for children with autism spectrum disorder.

S/N	Attribute	Strongly Agree	Agree	Disagree	Strongly disagree
i.	Your area of specialization at college enables you to interact with CwA				
ii.	Your experience in teaching enables you to interact with CwA				
iii.	Prior knowledge gained in ICT have enabled you to engage CwA				
iv.	The school authority involves you in the process of selection of T/L materials				
v.	The school have enough facilities that enables integration of ICT in T/L of CwA				

C: Assessment of teachers' perception on integrating ICT in enhancing the teaching and learning for children with autism spectrum disorder

9. The following statements describe experiences of teachers in integrating ICT in the teaching and learning of children with autism spectrum disorder. Please put a tick (√) against each statement under the appropriate column to indicate your level of agreement with it.

	Teachers' perception	Strongly Agree	Agree	Disagree	Strongly disagree
i	Integrating ICT in T/L for CwA allows adoption of varieties of learning experiences to Children.				
ii	Integrating ICT in T/L for CwA to accomplish learning tasks easily.				
iii	In preparation of lessons i.e Searching teaching contents/knowledge through internet				
iv	ICT is highly essential in designing varieties of T-L materials				
v	For entertainment/recreation purposes at leisure time				

D: Examining experiences for teachers of children with autism spectrum disorder regarding the use of ICT in the teaching and learning process

10. How frequently do you employ ICT in managing T/L for the following contents?

S/N	Learning content	Very rare	Sometimes	Often	Very often	Not Applicable
i	Arithmetic/Number skills					
ii	Social related content					
iii	Health related content					
iv	Communication skills					
v	Vocational skills					

E: Examine the children with autism spectrum disorder experiences about the use of ICT in their teaching and learning process

11. Identify the extent to which the ICT facilities assist CwA in learning the following contents. (Please specify the extent of application by assigning numbers according to the following scales: 1= Very useful; 2= Useful; 3=Not Useful; 4=Not useful at all; 5=Not applicable

	Facility	Arithmetic	Social related content	Health	Communication skills	Vocational Skills
i.	TV set					
ii.	Computer					
iii.	Internet					
iv.	Mobile gadgets					
v.	Projector					
vi.	Scanner					

12. Please specify the frequency of pupils' interaction with the ICT

S/N		Very often	Often	Rare	Not at all
i.	Computer games				
ii.	Photoshop				
iii.	Searching/browsing internet				
iv.	Digital library				
v.	Forums and blogs				
vi.	Social networking				

F: Challenges of integrating ICT in enhancing the teaching and learning of children with autism spectrum disorder

13. The following statements describe challenges of integrating ICT in the teaching and learning of children with autism spectrum disorder. Please put a tick (√) against each statement under the appropriate column to indicate your level of agreement with it.

	Challenges	**Always**	**Sometimes**	**Never**	**N/A**
i	Lack of sufficient ICT facilities to address the lessons requirements				
ii	Insufficient number of ICT facilities for children in classes				
iii	Poor internet connection				
	Inability to effectively conduct lessons through ICT				
iv	Difficulty in making children engage in learning with ICT				
v	Difficulties in financing educational needs for children with autism spectrum disorder				
vi	Lowly motivated teachers				
vii	Any other *(please specify)* _____ _____ _____				

14. What ways does the school adopt in resolving the challenge of ICT use in T/L for CwASD?

S/N	Solutions	Very effective	Effective	Not effective
i.	Sharing of facilities			
ii.	Borrowing from stakeholders			
iii.	Invite ICT specialist			
iv.	Modem/mobile portable hotspot			
v.	Application of varieties of T/L methods			

Appendix B: Unstructured Interviews for Head of Schools

I am ***Bilhuda S. Chamshama***, Ph.D in Education student at Open University of Tanzania. As a requirement for partial fulfilment of the program; I am conducting research on, ***"Integration of ICT to Enhance Teaching and Learning for Children with Autism Spectrum Disorder in Tanzania".*** I kindly request you to respond to the questions freely and to the best of your knowledge. There is no wrong answer. Information gathered will be used solely for academic purposes only and will be treated with the greatest confidentiality possible.

Thanking you in advance.

Starting time _____

School/Station_____ District _____

A: General information (Fill-in and/or put a tick **[**√ **]** where applicable)

1. Gender of respondent(s) Male [ ] Female [ ]
2. Title/Rank of respondent _____
3. Level of education

   Certificate in Education [ ] Diploma [ ] Degree [ ] Post Graduate [ ]

B: Issues in Integration of ICT in Teaching and Learning for Children with autism spectrum disorder in Tanzania

4. In your views, what do you know about integration of ICT in teaching and learning for children with autism spectrum disorder?
5. What is the status of teaching and learning environment for children with autism spectrum disorder at your school?
6. Are the teaching and learning sufficient and appropriate for children with autism spectrum disorder?
7. How ICT is integrated (opportunities) in teaching and learning for children with autism spectrum disorder?
8. Is there any involvement of stakeholders in teaching and learning for children with autism spectrum disorder?

9. What is the concern of stakeholders in integrating ICT in the teaching and learning for children with autism spectrum disorder?
10. What pertinent challenges of integrating ICT in the teaching and learning of children with autism spectrum disorder?
11. How do you address those challenges of integrating ICT in the teaching and learning of children with autism spectrum disorder?
12. What experiences that are essentially influencing effective teaching and learning process?
13. What framework on ICT integration in the teaching and learning process for children with autism spectrum disorder to be put in place?
14. What are your views/concern regarding education for children with autism spectrum disorder in Tanzania?

Appendix C: Interview Guide for Parents

I am ***Bilhuda S. Chamshama***, Ph.D in Education student at Open University of Tanzania. As a requirement for partial fulfilment of the program; I am conducting research on, ***"Integration of ICT to Enhance Teaching and Learning for Children with autism spectrum disorder in Tanzania".*** I kindly request you to respond to the questions freely and to the best of your knowledge. There is no wrong answer. Information gathered will be used solely for academic purposes only and will be treated with the greatest confidentiality possible.

Thanking you in advance.

Date _____ Starting time _____

School/Station_____ District/Region _____

A: General information (Fill-in and/or put a tick **[**√ **]** where applicable)

15. Gender of respondent(s) Male [ ] Female [ ]
16. Level of education

    Certificate in Education [ ] Diploma [ ] Degree [ ] Post Graduate [ ]

B: Issues in Integration of ICT in Teaching and Learning for Children with autism spectrum disorderin Tanzania

17. Basing on your knowledge, what is the achievement/status gained in provision of primary education to children with autism spectrum disorder?
18. In your views, what do you know about integration of ICT in teaching and learning for children with autism spectrum disorder?
19. Are the teaching and learning sufficient and appropriate for children with autism spectrum disorder?
20. How ICT is integrated (opportunities) in teaching and learning for children with autism spectrum disorder?
21. Are there any involvement of stakeholders in teaching and learning for children with autism spectrum disorder?

22. What is the concern of stakeholders in integrating ICT in the teaching and learning for children with autism spectrum disorder?
23. What experiences that are essentially influencing effective teaching and learning process?
24. Comment on any appropriate strategies of ICT integration in the teaching and learning process for children with autism spectrum disorder to be put in place?
25. What are your views/concern regarding education for children with autism spectrum disorder in Tanzania?

Appendix D: Teaching and Learning Environment Checklist

A: General Information:

Please put a tick **(√)** against appropriate response

1. Region_____
2. Name of school _____

B: Observation of Teaching and learning (T/L) environment for children with autism spectrum disorder

3. Indicate the available teaching and learning (T/L) for children with autism spectrum disorder? Please tick **(√)** on the available items.

S/N	Item	Available	Not available
i.	Visual symbols and photos to clarify verbal instructions		
ii.	Audio-visual materials in a classroom		
iii.	Letter trays		
iv.	Desks for children with autism spectrum disorder		
v.	Locker, Baskets or shelves used to store children's materials		
vi.	Newspapers and magazines		
vii.	Containers labelled with a word and a picture to explain the contents		
viii.	Place to work		
ix.	Lighting in the classroom		
x.	Library area with cushions and floor mats		

Appendix E: Consent of Participation

Dear respondents,
I am a PhD student at the Open University of Tanzania, as part of the requirements for the award of this degree, I am undertaking a study on *"_____."* I kindly request you to take part in my study by providing the required information.

As you agree to take part in the research process, I would like to assure you the following: First, there are no wrong answers. All information provided will be treated fairly with great respect. Secondly, your identity and that of your school will be concealed so that nobody knows who gave the information. If you take part in interviews your record and some direct quotes may be made out of it. Third, all information you provide will be used accordingly to the purpose of this study and further publications only. Nobody else, except the researcher, will access your information. Fourth, it is important to understand that whenever you feel irritated, you can withdraw from participating, and you have freedom to answer or not to answer some questions. However, I encourage you to respond to all questions. Lastly, this consent form will be kept by the researcher himself and will remain out of reach of other people.

Kindly let me know if you have accepted to take part in my study by writing your full name and signing the consent agreement in the end of this form.

Thank you.
I _____, have read and understand the above explanation and the nature of the study as well as my role as a respondent.

I declare that my acceptance to participate in this study completely voluntary, and that, I shall decline from answering any question and/or withdraw from participating, if I feel irritated. I also understand that the identity of my institution and I will remain strictly confidential and all information will be used as per agreement, and that I will always remain anonymous whenever quoted. I accept to be recorded. Thus, to this end with my own consciousness, I agree to take part in this study.

_____ ____/____/_____
Signature Date

Appendix F: OUT Permit letter for Regional Administrative Secretary

THE OPEN UNIVERSITY OF TANZANIA
DIRECTORATE OF POSTGRADUATE STUDIES

P.O. Box 23409
Dar es Salaam, Tanzania
http://www.openuniversity.ac.tz

Tel: 255-22-2668992/2668445
ext.2101
Fax: 255-22-2668759
E-mail: dpgs@out.ac.tz

Our Ref: PG201404226 **Date: 18th October 2018**

To Whom It May Concern.

RE: RESEARCH CLEARANCE

The Open University of Tanzania was established by an act of Parliament No. 17 of 1992, which became operational on the 1st March 1993 by public notice No. 55 in the official Gazette. The act was however replaced by the Open University of Tanzania charter of 2005, which became operational on 1st January 2007. In line with the later, the Open University mission is to generate and apply knowledge through research.

To facilitate and to simplify research process therefore, the act empowers the Vice Chancellor of the Open University of Tanzania to issue research clearance, on behalf of the Government of Tanzania and Tanzania Commission for Science and Technology, to both its staff and students who are doing research in Tanzania. With this brief background, the purpose of this letter is to introduce to you **Ms.Bilhuda Shelimoh Chamshama Reg No: PG201404226** pursuing **Doctor of Philosophy in Education,(PhD- Education).**We here by grant this clearance to conduct a research titled ***"Integration of ICT for enhancing Teaching and Learning of children with Autism in Tanzania.*** 'She will collect her data at Mazimbu Primary School in Morogoro region from 1st November 2018 to 30th January 2019.

In case you need any further information, kindly do not hesitate to contact the Deputy Vice Chancellor (Academic) of the Open University of Tanzania, P.O. Box 23409, Dar es Salaam. Tel: 022-2-2668820.We lastly thanks you in advance for your assumed cooperation and facilitation of this research academic activity.
Yours sincerely,

Prof. Hossea Rwegoshora
For: VICE CHANCELLOR
THE OPEN UNIVERSITY OF TANZANIA

Appendix G: Research Permit - Morogoro Municipal

HALMASHAURI YA MANISPAA MOROGORO

Simu/Nukushi Na: 023 – 2614727
Barua pepe: info@morogoromc.go.tz
Tovuti: www.morogoro.go.tz
Unapojibu taja:

Ofisi ya Mkurugenzi wa Manispaa,
S.L.P 166,
MOROGORO,
TANZANIA

Kumb. Na: E. 10/MMC-24/Vol.III/91 — 16 Oktoba, 2019

Ms. Bilhuda Shelimoh Chamshama,
The Open University of Tanzania

Yah: **KIBALI CHA KUFANYA UTAFITI**

Nakiri kupokea barua toka ofisi ya Mkuu wa Wilaya ya tarehe 10/10/2019 inayohusu maombi ya kibali cha kufanya Utafiti katika shule ya Msingi Mazimbu 'A' na Mazimbu 'B', utafiti unaohusu "***Integration of ICT for enancing Teaching and Learning of Children with Autism in Tanzania***"

Napenda kukujulisha kuwa Kibali kimetolewa.

A.H. Buhety
Kny: **MKURUGENZI WA MANISPAA**
MOROGORO

K.N.Y. MKURUGENZI WA MANISPAA
MOROGORO

Nakala:
1. Mwalimu Mkuu,
   Shule ya Msingi Mazimbu 'A'
   Manispaa ya Marogoro
2. Mwalimu Mkuu,
   Shule ya Msingi Mazimbu 'A'
   Manispaa ya Morogoro

- *Tafadhali mpeni ushirikiano*

Barua zote ziandikwe kwa Mkurugenzi wa Manispaa Morogoro

Appendix H: Research Permit - Arusha Municipal

UNITED REPUBLIC OF TANZANIA
PRESIDENT'S OFFICE
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

Telegrams: **"REGCOM"**
Telephone:**2545608/2544950/2544802**
Fax No. **2545239/254486**
E-Mail: ras@arusha.go.tz
E-Mail: *ras.arusha@tamisemi.go.tz*
Website: *www.arusha.go.tz*
In reply please quote:
Ref. No. FA.195/232/01'L'/34

REGIONAL COMMSSIONER'S OFFICE,
P.O. Box 3050,
ARUSHA.

04 February, 2019

District Administrative Secretary,
Arusha District,
P. O. Box 1,
ARUSHA.

RE: RESEARCH PERMIT

Reference is hereby made to the letter dated 29th January, 2019 from Vice Chancellor- The Open University of Tanzania concerning the above underlined subject.

I hereby taking this opportunity to introduce to you **Ms. Bilhuda Shelimoh Chamshama** from The Open University of Tanzania at the moment conducting a research titled **" *Intergration of ICT for enhancing Teaching and Learning of children with Autism in Tanzania."***

The above has been granted permission to conduct his research in ***Arusha region*** from **31 January, 2019 to 30th June, 2019.**

Due to this, you are requested to render any necessary Administrative Assistance to enable her to accomplish the intended objective of his research.

Thank you for your cooperation.

Polycarp L. Nkuyumba
For: **REGIONAL ADMINISTRATIVE SECRETARY**
ARUSHA

Copy to:
Ms. Bilhuda Shelimoh Chamshama

Appendix I:

Research Permit - Kinondoni Municipal

KINONDONI MUNICIPAL COUNCIL

ALL CORRESPONDENCES TO BE ADDRESSED TO THE MUNICIPAL DIRECTOR

Tel: 2170173
Fax: 2172606

In reply please quote:
Ref. KMC/ED/U.21/13/VOL. 3/226

MUNICIPAL DIRECTOR,
KINONDONI MUNICIPAL COUNCIL,
P. O. BOX 31902,
2 BARABARA YA MOROGORO,
14883 DAR ES SALAAM.
Date: 13th May 2019.

Ward Education Officer – Msasani and Kijitonyama.
KINONDONI MUNICIPAL.

RE: INTRODUCING MISS. BILHUDA SHELIMOH CHAMSHAMA

Refer the above heading.

With reference to the letter Ref. **KMC/R.18/1** dated on **25th April, 2019** titled as Research permission.

I'm delighted to introduce to you student from the Open University. She has been granted a permit by the Municipal Director to conduct a research **Titled" Intergration of ICT for Enhancing Teaching Learning of Children with Autism in Tanzania** to your school from **29th April to 30th June, 2019.**

Upon receive this letter, She is responsible to report to the **Head teacher of Mbuyuni and Sinza Maalum Primary School for recommencement of her research.**

During the period of research, she required to obey rules and regulations of school respectively.

.....
P.P Kiduma S. Mageni
For: **THE MUNICIPAL DIRECTOR**
KINONDONI.

Cc: HEAD TEACHER OF MBUYUNI AND SINZA MAALUM PRIMARY SCHOOLS

MISS BILHUDA SHELIMOH CHAMSHAMA.

Appendix J: Research Permit - Ilala Municipal

HALMASHAURI YA MANISPAA YA ILALA

BARUA ZOTE ZIPELEKWE KWA MKURUGENZI WA MANISPAA

S.L.P. No. 20950
Simu Na. 2128800
2128805
Fax Na. 2121486

OFISI YA MKURUGENZI
1MTAA WA MISSION
S.L.P. 20950
11883 – DAR ES SALAAM

Kumb. Na. IMC/CR.7/VOL.IV/141

28 Januari, 2019

Mwalimu Mkuu,
Shule za Msingi Al-Muntaziri, Msimbazi Mseto na Airwing,
S.L.P 20950,
DAR ES SALAAM.

YAH: **KUMTAMBULISHA NDUGU BILHUDA SHELIMOH CHAMSHAMA**

Hasika na mada tajwa hapo juu.

Idara ya Elimu Msingi imemruhusu Mwanachuo kutoka **Chuo cha Open University of Tanzania** kufanya utafiti juu ya **Intergration of ICT in Teaching and Learning for Children with Autism in Tanzania** katika shule zenu.

Mafunzo haya yataanza tarehe **25/01/2019** hadi tarehe **30/06/2019**.

Tafadhali mpokeeni na mpeni ushirikiano ili aweze kukamilisha sehemu ya mafunzo yake.

Nawatakia kazi njema.

S. Msechu
Kny: AFISA ELIMU MSINGI
HALMASHAURI YA MANISPAA YA ILALA

Kny: AFISA ELIMU MSINGI
MANISPAA YA ILALA

Appendix K: Item-Total Statistics

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Region	110.33	124.114	.694	.796
Name of School	107.61	118.702	.352	.819
Level of Education	111.14	140.466	-.034	.816
Sex	110.67	143.771	-.337	.821
Teaching experience	109.19	140.504	-.048	.821
Symbols and photos	111.39	140.302	.000	.815
Audio-visual resources	111.19	135.990	.443	.809
Letter trays	111.33	139.314	.170	.814
Desks	111.36	140.009	.067	.814
Baskets & shelves	111.14	137.323	.271	.812
Newspapers/magazine	110.97	139.342	.060	.815
Containers	111.17	139.229	.090	.814
Working space	110.94	136.225	.325	.810
Lighting	111.03	135.513	.401	.809
Library area	110.86	131.780	.711	.803
Symbols & photos	109.97	136.942	.212	.812
Audio-visual resources	109.92	137.793	.091	.816
Letter trays	109.75	135.850	.371	.810
Desks	110.56	134.883	.305	.810
Baskets & shelves	109.83	130.086	.518	.804
Newspapers/magazine	108.92	128.250	.653	.800
Containers	109.61	133.273	.607	.806
Working space	110.31	123.647	.853	.793
Lighting	110.28	124.663	.781	.795
Library area	110.28	125.863	.659	.798
College training enables integration	110.56	136.311	.215	.812
Teaching experience enables integration	110.94	131.997	.624	.804
Using ICT knowledge	111.06	133.768	.570	.806
Involved by authority in selection of ICT	110.31	133.247	.344	.809
Sufficient ICT for T/L	109.28	122.778	.696	.795

of CwA				
Understand easily	111.17	139.457	.067	.815
Accomplish tasks easily	110.81	137.304	.234	.812
Preparation of lessons	111.00	135.143	.428	.809
Designing T/L materials	110.86	131.952	.696	.804
Recreation purposes	110.97	136.371	.315	.811
Number skills	110.83	141.743	-.132	.819
Social contents	110.56	139.797	.001	.817
Health/hygiene contents	110.72	140.835	-.067	.817
Communication skills	110.39	139.044	.091	.814
Vocational skills	110.33	135.257	.347	.810
Computer games	110.22	125.892	.665	.798
Photoshop	110.06	126.054	.729	.797
Browsing internet	109.97	132.256	.511	.805
Digital library	109.56	132.825	.435	.807
Forums & blogs	109.42	134.821	.397	.809
Social networking	109.47	128.828	.700	.800
Insufficient ICT facilities for teaching	110.86	150.980	-.593	.833
Lack of ICT for CwA	110.81	146.047	-.496	.824
Poor internet connection	110.81	152.218	-.658	.834
Inability to conduct ICT lessons	110.56	144.483	-.334	.823
Difficulty in engaging CwA	110.64	141.209	-.084	.819
Less finance CwA needs	110.81	145.475	-.450	.824
Lowly motivated teachers	110.11	143.987	-.192	.827
Sharing IC facilities	110.69	139.190	.081	.815
Borrowing from others	110.56	148.140	-.491	.829
Invite ICT specialist	110.69	132.561	.618	.805
Use mobile hotspot	110.67	135.486	.436	.809
Apply variety of T/L methods	110.75	135.621	.347	.810