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Navigating Equitable Technological Empowerment: Insights from Ghana and Rwanda on Digital Literacy and the Fourth Industrial Revolution

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ABSTRACT

The Fourth Industrial Revolution (4IR) is reshaping global economies and societies. Triggered by several factors including the COVID-19 pandemic, assuming its dynamics in developing countries will mirror those in wealthy economies is perilous. With its unique challenges and opportunities, Africa requires a tailored strategy for the 4IR. At the core of this strategy is achieving widespread digital literacy, a critical factor for technological empowerment and inclusive development. However, the urgent need for improved digital literacy in many parts of Africa poses a significant barrier to progress. This dissertation explores the key factors and strategies for fostering equitable technological empowerment across sub-Saharan Africa through digital literacy.

For this purpose, Ghana and Rwanda have been chosen as case studies. To answer this question, we compared the experiences a sample of students in tertiary institutions in both countries before their enrolment. We uncovered several critical constraints on achieving adequate digital literacy, thereby highlighting the necessary policy changes and practice reforms required for Africa to thrive in the 4IR context. Through this comprehensive analysis, the dissertation seeks to contribute to developing an Africa-wide 4IR strategy that leverages digital literacy as a cornerstone for sustainable growth and development.

The outcomes of this study have been conceptualized into a praxis model for 'Equitable Digital Literacy Community Centres.' This model, which offers a practical and actionable approach to implementing the required changes, aims to provide accessible, inclusive, and sustainable digital literacy training and resources to communities across sub-Saharan Africa.

Keywords: *Digital literacy, COVID-19 pandemic, Ghana, Rwanda, digital education, digital divides, inclusive innovation, inclusive education, lifelong learning, 4IR, social justice, and digital transformation.*

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CHAPTER ONE – INTRODUCTION AND PROBLEM STATEMENT

1.1 Introduction

As technology increasingly offers opportunities for a more interconnected global village, the likelihood that our risks are shared remains high. Since the initial reports of COVID-19 towards the end of 2019, which was later declared a pandemic by the World Health Organization in 2020, it became more apparent that we live in an interconnected world and that pandemics like COVID-19 know no borders (Schleicher, 2020). In particular, the pandemic continued to disrupt education systems all over sub-Saharan Africa, with some children receiving no education after governments closed schools as a strategy to stop the spread of the COVID19 virus (Adotey, 2021). The profound disruption of educational systems impacting over 1.6 billion learners during the course of the COVID-19 response reignited the call for a comprehensive societal approach towards education reform in the current post-pandemic era. However, the prevailing body of research exploring digital transformation and distance education frameworks has regrettably neglected to extensively consider the practical application and lived experiences of digitally marginalized learners within the African context.

During the COVID-19 pandemic, we noticed how advanced countries leveraged advancements in fields like the Internet of Things, robotics, and other cutting-edge technologies to transform their economies and societies. This transformation could be described as the Fourth Industrial Revolution (4IR). According to UNESCO, 32.2 million children (19 per cent) between 6 and 11 were out of school in sub-Saharan Africa due to COVID-19 and other factors (UNESCO Institute for Statistics, 2021). Before and during the intermittent shutdown of schools, countries in the sub-Saharan Africa region, such as Ghana and Rwanda, continued to face educational challenges at all levels. Access to computers, cost of data and lack of electricity were among the challenges learners in rural settings in these countries grappled with on a daily basis. Despite the presence of a substantial number of literate individuals and the availability of some educational technological resources in both Ghana and Rwanda, a considerable proportion of students or young individuals in these countries still lack the necessary access to basic digital technologies in their educationally disadvantaged environments. This can be attributed to government policies that hinder the widespread implementation of technological resources when compared to the better resourced cities of Kigali, Rwanda and Accra, Ghana.

Amid the ever-expanding digital landscape, the concept of digital literacy encompasses a range of skills, including technical expertise and the ability to discern valuable information online. The mastery of internet applications, enabling individuals to locate, critically analyse, evaluate, and effectively utilize information, is at the heart of this aptitude. Nevertheless, despite the increasing prevalence of the Internet, one cannot overlook the stark reality that rural communities in Ghana are confronted with limited access to digital resources. Consequently, the transformative power of the digital age remains elusive for these individuals. The term "rural" itself, prevalent in discussions surrounding both developed and developing nations, has engendered its own set of challenges. It has become a subject of fascination for diplomats, donor agencies, and researchers as they grapple with the burdensome task of digitizing these areas. This fascination extends to aspects such as healthcare provision, access to roadways, infrastructure, and telecommunication. The dichotomy between urban and rural areas serves as a popular framework for comprehending

the geographical landscape wherein national development initiatives often fail to yield the desired outcomes for those residing in rural communities (Ilogan and Carranza, 2015).

The snowballing of educational technology platforms, such as online learning sites and applications, provides a unique opportunity for learners to acquire digital skills, develop ideas, and pilot businesses on the Internet. Despite the possibilities and promises of educational technology, a record number of school pupils needed help accessing learning programs broadcasted remotely or digitally instituted to counter school closures during the COVID19 pandemic. As several waves of the COVID-19 pandemic continued to disrupt academic calendars and school sessions, it became necessary for governments and private institutions to respond to the threats to the educational sector, which was already bedevilled with several challenges to an inclusive, innovation-driven, and cost-effective approach (McCain, 2021).

This in turn fed into the narrative of the "new normal," a hybrid workplace and, perhaps, school environment. Thus, the COVID-19 pandemic presented a unique opportunity to redesign systems, including the educational system. Roy (2020) agrees and emphasizes that "historically, pandemics have forced humans to break with the past and imagine their world anew. The COVID-19 pandemic was no different. It was a portal, a gateway between one world and the next". This school of thought further emphasizes scholarly research on crisis management, resilience, and transformation (Boin & Hart, 2003). In his famous quote about taking advantage of a good crisis in the mid-1940s, former British Prime Minister Sir Winston Churchill was alluding to transformative crisis management (Churchill, 1946). A challenge worth considering in transformative crisis management is that of being prepared. When a crisis strikes, people panic, and finding the time and space to reflect on how to use the situation for advancement becomes challenging. The untapped potential of deploying and scaling social innovation in systems change during and after an era such as the COVID-19 pandemic is where my research question sits.

1.2 Research Question

Before the COVID-19 pandemic overwhelmed the headlines, there was an accelerating focus on the "Fourth Industrial Revolution" (4IR), including increasing attention to the importance of the 4IR for Africa and the potential for Africa to use 4IR skills to overcome the development gap (World Economic Forum, 2016; Manyika et.al, 2016; Liao et.al, 2017). However, it would be a mistake to assume that we can apply in Africa the model for the 4IR that is being used in, for example, Europe and the USA. Africa must implement a specialized plan to navigate the 4IR, given its distinct opportunities and challenges. The fundamental element of this plan must be to achieve comprehensive digital literacy, which is essential for technological empowerment and sustainable development across the continent, but which is lacking in many parts of Africa in comparison with other parts of the world, such as Europe and North America. This is important because the concept of the 4IR is founded on globalization and digital interactions unbounded by space. Education is a widely discussed and essential aspect of intervention programs such as this. There is compelling evidence to suggest that education plays a pivotal role in empowering individuals to navigate the challenges brought forth by digital transformations.

Both formal and informal educational systems recognize the significance of knowledge and skills in Science, Technology, Engineering, and Mathematics (STEM) fields. They have either targeted the provision of these skills within the STEM discipline or incorporated them as part of the general curriculum. The hope is that individuals who possess digital literacy can acquire the necessary

knowledge, skills, and comprehension of the fundamental principles underlying digital technologies. This, in turn, would enable them to effectively utilize the potential offered by the digital technology revolution. However, this idea presents certain challenges. Firstly, it fails to account for the diverse capabilities, opportunities, and desires of individuals around the world. Moreover, the increasing popularity of this notion indicates that it is focused more on those who are already capable and privileged, rather than on marginalized individuals and the world's poor. Decisions regarding inclusivity may be disregarded as a result. Hence, my research question is:

What are the key factors and strategies that will contribute to achieving equitable technological empowerment across sub-Saharan Africa through digital literacy, and in the context of the Fourth Industrial Revolution?

This study specifically examines Ghana and Rwanda as case studies to investigate the essential aspects and strategies that would facilitate the attainment of equitable technological empowerment through digital literacy in sub-Saharan Africa. The selection of these countries was based on their proactive approaches to technology and education, which offer unique insights into the difficulties and possibilities faced by the continent. Additionally, these two countries share a number of things in common especially when it comes to the features of their education system and policies related to enabling digital literacy. Though Ghana has made strides in successfully integrating digital literacy into its framework for education, it continues to navigate several challenges including inadequate infrastructure, shortfalls in teacher training and limited access to technology. Rwanda on the other hand, in addition to the considerable progress made in prioritizing technology and innovation in its development strategy, continues to grapple with barriers including rural-urban disparities and gender inequality.

1.3 Research strategy and approach

The research methodology for this study utilized a comprehensive multi-method approach, specifically within the qualitative paradigm. This approach combined field studies with an extensive literature review to offer a holistic understanding. As Aspers and Corte (2019) suggest, qualitative research involves interpretation and understanding; the German word used in describing the concept of understanding, or to perceive, know and grasp the nature and significance of a phenomenon is *verstehen*. The concept – *verstehen,* which emerged from German sociologist Max Weber, is pivotal in understanding the world of social sciences – specifically, sociology. This approach encompasses a "multi-method" aspect, entailing the collection and utilization of diverse empirical materials (Silverman, 2013). Thus, this methodology was crucial in facilitating understanding of the nuances around the challenges faced by both Ghana and Rwanda in successfully preparing its learners with digital literacy for the Fourth Industrial Revolution.

Qualitative research endeavours to explore, comprehend, describe, and often elucidate social phenomena from an insider's perspective (Coffey, 2018; Rauch, 2020). By analysing recorded lived experiences of communities, individuals, and groups, along with their interactions with their surroundings, a deeper understanding of how these entities perceive and shape their world is gained (Coffey, 2018). To achieve the research objectives, a comparative case study approach was adopted. This approach's roots can be traced back to Ancient Greece (Hantrais, 1995). Case studies serve exploratory, descriptive, or explanatory purposes, as emphasized by Yin (1994: 4) and Hantrais (1995). Yin (1994: 13) further defines a case study as an empirical inquiry that

investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and its context are intricate (Eisenhardt, 1989). Todd et al. (2004) underscores the advantages of employing various approaches and methods to enhance comprehension of the subjects under scrutiny. Moreover, the combination of multiple methods enhances the accuracy of identifying trends within the phenomenon being investigated, while also addressing a range of distinct research questions (Ilomäki & Lakkala, 2018).

1.3a Research Methods

According to Hantrais (1995), an extensive study of the scale that I undertook was inherently explanatory from the outset. It aimed to examine and elucidate the varying degrees of variability observed across different national samples. In alignment with this approach, the study employed the following data collection techniques for analysis.

The primary data source encompassed comprehensive details of education policies and practices within each respective country. This information was gathered through thorough desk research involving publicly accessible documents, as well as materials made available by education authorities. Additionally, interviews were conducted with students and internet café owners from each country to gather insights directly from those involved in the educational landscape.

The secondary data source involved semi-structured interviews. These interviews were conducted with two distinct groups: university students and individuals who owned or frequented Internet cafes in Ghana and Rwanda. This approach aimed to provide a multi-dimensional perspective, capturing viewpoints from students undergoing higher education and those who interacted with Internet cafes, which served as pivotal technology hubs in the community. Internet cafés, sometimes called cyber cafés, provide access to computers and the Internet for a fee. Although no longer popular in the developed world, Internet cafés played a huge role in providing people in the communities and countries I explored with access to the Internet, especially considering that many homes did not have access to computers or Internet connections.

By employing these dual data collection techniques, the study aimed to offer a wholistic view into the policies governing the educational systems, practices, and the lived experiences of tertiary students and individuals engaged with Internet cafes across the two countries. This methodology aligned with the study's explanatory nature and facilitated the exploration of variations across the national samples.

1.3b Target Population and Sampling

The study delved into the experiential journey of university students. Thus, the study focused on their own experiences in schooling before entering higher education—in other words, their previous educational opportunities. I adopted a multi-case study approach involving a comparative analysis of Ghana and Rwanda. Multiple factors informed this selection: my affiliation with the African Institute of Mathematical Sciences organization, which conducted teacher training programs in these countries; and shared patterns of youth unemployment, educational attainment, and language policies within these nations. Patton (2015, p. 91) underlined the significance of "strategic case selection and purposeful sampling of rich information for in-depth study to document diversity."

To align with this approach, I employed purposive sampling in my research design. This deliberate sampling strategy enabled the intentional selection of individuals, events, and contexts based on the unique insights they provided, which might not have been attainable through other means (Maxwell & Bickman, 2009). This methodological choice was rooted in my aim to produce a study of high reliability and depth. In essence, by employing purposive sampling and conducting a multi-case study analysis, my research sought to comprehensively explore the nuanced landscape of digital literacy experiences among university students in the selected countries.

1.3c Data analysis

Multiple sources of data are the bedrock of case studies. To tackle the inquiries that arose from the literature and the research problems in the two nations, it was deemed most fitting to adopt qualitative research methods. Various qualitative research methods, including survey questionnaires and semi-structured interviews, were employed to gather data. The qualitative data was then scrutinized by identifying emergent themes and Vygotsky's models used in interpretation of the data. Three processes were adopted to analyse data throughout the entire study: collection, coding, and analysis of data (Glaser & Strauss, 1967). My primary data source, nonetheless, was semi-structured interviews. This approach ensured that the study delved into and elicited the genuine perspectives of the subjects under investigation, thereby homing in on the underlying reasons, processes, and timings that could not be easily addressed by alternative approaches.

1.3d Transferability & Risks

The distinct nature of the case study approach provides in-depth exploration opportunities for a specific case or cases (Eisenhardt, 1989, p. 546). This phenomenon presents opportunities for researchers to derive insights that may have been obscure. From this detailed basis, the study sought to provide valuable insights that could lead to developing solutions to some of the grand challenges for education in sub-Saharan Africa more generally; a collection of initiatives that seek to address developmental issues leveraging innovations for meaningful impact (Grand Challenges, n.d). There were a few risks in taking up this approach in my research. One such was the issue of funding. Such a cross-national project required a lot of resources to pull off. Another was the issue of accessing data that could be compared. In some cases, national records were not available. Moreso, concepts and research parameters could sometimes be difficult to harmonize.

To address these risks, I worked within two centres of excellence of the African Institute for Mathematical Sciences (AIMS) where I was the Acting Director of Communications and Senior Outreach Manager for the Global Network. Founded in Cape Town, South Africa, in the year 2003, AIMS is a network of Pan-African centres of excellence specializing in postgraduate training, research, and public engagement in mathematical sciences. Since its establishment, AIMS has been replicated in Senegal, Ghana, Cameroon, and Rwanda under the framework of the Next Einstein Initiative. AIMS has supplied Africa's STEM pipeline through its programs for students in courses such as the master's in mathematical sciences. This program includes a cooperative option with a direct link to industry. In the past 20 years, AIMS has trained over three thousand students from more than forty-six African countries. Students enrolled in AIMS in any of the five African countries benefit from full scholarships and close interaction with tutors and professors worldwide (AIMS, 2003).

AIMS has partnerships with institutions of higher learning in Africa and outside the continent, including Stellenbosch University, University of Cape Town, University of Ghana, University of Cape Coast, University of Rwanda, Imperial College London, Cambridge University, and Penn State University. AIMS relies on these partnerships as a source for Faculty from these institutions to volunteer to instruct the students. These volunteers are professors from the best universities in the world, including Nobel Prize and Fields Medal laureates. They are supported by resident tutors, mostly AIMS alums who have PhDs or are completing their PhDs.

AIMS Ghana was established in 2012 with support from the Government of Ghana as the third centre of excellence within the AIMS Network. The centre also became a UNESCO Category II Centre of Excellence and has in the past 11 years graduated over 600 students from more than 15 African countries. AIMS Rwanda was subsequently established in 2016 with support from the Rwanda Government as the fifth centre of excellence within the network. Since its establishment, AIMS Rwanda has graduated over 400 students from over 14 countries. The investments in both centres by the two governments forms part of their strategy to invest in STEM education for the advancement of both countries and the development of Africa. These two centres also form a part of the broader ecosystem for digital transformation and the advancements of 4IR in Africa.

AIMS boast of providing Africa's brightest minds with the skills needed to address Africa's grand challenges. Overall, the AIMS Network has trained over 3500 students from more than 40 countries on the African continent. The distribution of students from the continent shows a good representation from across every sub-region including North Africa, Southern African, Central Africa, East Africa and West Africa. Thus, the AIMS Network enabled me to draw some generalizations across the network from my two specific case studies in Ghana and Rwanda.

1.4 Research Ethics

Ethical clearance was sought from the University of Cape Town for this study. Ethical clearance was based on formal agreements to the project by the heads of institution in each country, and informed consent from interviewees. Participation in this research project was solely voluntary. Participants were required to complete a consent form and could ask any questions throughout the study. Upon request, participants received a copy of the formal dissertation proposal to fully understand the researchers' motivations and intentions. All responses from participants remained confidential and anonymous.

1.5 Conclusion

This Chapter provides a brief overview of the comprehensive multi-method approach utilized to understand the experiential journey of university students in their acquisition of digital literacy. We examined the impacts of COVID-19 pandemic in accelerating the utilization of digital technologies in responding to the closures of schools and the limitations thereof. By emphasizing the importance of not copying blindly when it comes to scaling innovation and technology especially in regard to the 4IR, a case was made for recognizing the significance of knowledge and skills in Science, Technology, Engineering, and Mathematics (STEM) fields as key to Africa's socio-economic advancement. Thus, for this to happen, we must first invest in enabling digital literacy. To identify and understand the gaps that exist in achieving digital literacy, we sampled participants from Ghana and Rwanda to explore the research question while examining limitations

to the study. Overall, this chapter indicates that Africa will have to contextualize the 4th Industrial Revolution to meet the continent's specific needs while remaining competitive with advanced nations. In the next chapter, we will examine the theoretical frameworks underpinning this study.

CHAPTER TWO: TECHNOLOGY, 4IR AND TOOLS FOR TEACHING & LEARNING

2.1 Introduction

This chapter reviews the theoretical framework and existing evidence that form the basis of this study - what are the key factors and strategies that contribute to achieving equitable technological empowerment through digital literacy and accessible education across Ghana and Rwanda? The focus of our research is to clarify this complex issue and to provide viable solutions. In order to build an understanding of the digital divide in sub-Saharan Africa, the proposed theoretical framework for this research was Grounded Theory (GT). Grounded Theory is an inductive method of constructing and verifying theories based on empirical evidence. The strategy employed here was crucial to analyse the digital divide through detailed interviews and field observation in an inductive and interpretative fashion, with the aim to deeply understand the issues associated and the process of change.

The study conducted in Rwanda and Ghana focused on the challenges and opportunities in technology accessibility and usage. The advances in Information and Communication Technology (ICT) over the past few decades have played a crucial role in achieving the Millennium Development Goals. For instance, Gink and Berenguer (2011) sought to investigate the impact of enhancing students' individual ICT skills in Peru and the overall pedagogy by providing them with increased access to computers and handheld devices in schools. The findings of their research revealed positive effects in various aspects related to individual ICT skills, such as an upsurge in self-reported learning engagement, the quantity of books consumed, and the quality of time spent on educational pursuits. Furthermore, the presence of ICT in educational institutions seemed to generate a heightened interest in the field of information science among more proficient technology users, who subsequently exhibited greater involvement in information-seeking activities.

However, many individuals in developing nations still face significant barriers in accessing ICT. Research has shown that this global digital divide is a result of the slow diffusion of ICT in certain regions, as well as disparities in income and education (Reddy et.al., 2022; Garcia-Escribano, 2020; and Signé, 2023). It is important to note that the digital divide goes beyond mere access, and encompasses social, economic, and cultural divides as well. Developing countries experience substantial impacts as a result, affecting their prospects of economic, social, and cultural development. Therefore, it is imperative for these nations to bridge this divide to keep up with the pace of the rest of the world. Various research studies and recommendations have put forth strategies to address this issue, including increased investments in global ICT infrastructure, technology subsidies involving commercialization and technological transfer initiatives, provision of free ICT access for educational purposes, and the establishment of relevant laws and standards (Signé, 2023; Werfhorst et.al., 2022; and Ingram, 2021).

With Grounded Theory research, diverse empirical databases typically constrain the inquiry process. Our strategy for development is the "comparative study" to clarify this complex issue. The objective of this study is to explore the key factors and strategies that will contribute to achieving equitable technological empowerment across Sub-Saharan Africa through digital literacy. We will also examine concepts such as educational technology, the Fourth Industrial Revolution, "4IR", and sociocultural theory when applied to language learning, considering that

Rwanda changed its language of instruction from French to English. In addition, we will examine innovation diffusion theory in learning, teaching strategies, and educational systems in Ghana and Rwanda.

Imagine being blindfolded and asked to imagine being in a classroom as a Grade One student, and the instruction comes to list a few things that one can find in the school. Some of the items likely to be listed include chalkboard, duster, textbooks, but only rarely a computer. Technology has evolved over the years, and, in this review, we will consider this evolution in determining new ways of applying these tools to enable effective lifelong learning. The Fourth Industrial Revolution began as we ushered in this century, building on the earlier digital revolution. 4IR represents a global shift in how we live, work, and interact with each other. Thus, this revolution's scale, scope, and complexity are different from what we have seen in the past. The core of the 4IR is the demand for a prepared, talented and digitally skilled workforce and not just for connected and intelligent devices and machines (Schwab, 2017; Doorsamy et.al.,2022).

As we have seen over recent years, the diffusion of emerging digital technologies is much faster and more widespread than the previous revolutions. For instance, the online education market is expected to reach $350 billion by 2025 as flexible learning technologies scale up (Research Markets, 2019; Adotey, 2021). This is just one industry out of the many more that exist. Thus, the goal of this chapter is to examine the theoretical frameworks and existing evidence that underpin this study. In this chapter, we will consider and synthesize key factors and strategies that contribute to bridging the digital divide in sub-Saharan Africa, with a particular focus on the comparative analysis of Ghana and Rwanda.

2.2 Purpose of the Literature Review

At the dawn of independence, African leaders were aware of the significance of education in promoting development. They believed that attaining universal primary education would contribute to lifting Africa out of poverty. With the help of religious organizations and other partners, governments established schools and employed teachers, resulting in an increase in school enrolment (Ajayi, 1996; Harber, 2002; Fägerlind & Saha, 1989). Presently, Africa boasts an average primary school enrolment rate exceeding 80%. Nevertheless, despite these accomplishments, the education system still grapples with lingering inequalities and inefficiencies.

The African Union acknowledges that the recent surge in enrolment conceals disparities and dysfunctionalities in various subsectors of education such as pre-primary, technical, vocational, and informal education (Africa Union, 2015). These areas remain significantly underdeveloped. It is widely acknowledged that African education and training programs suffer from subpar teaching and learning quality, as well as inequalities and exclusion at all educational levels. Although more children now have access to basic education, there remains a substantial number of children who remain out of school (Africa Union, n.d). According to a report by the United Nations Development Programme (2023), the unequal distribution of crucial facilities, including schools, contributes to income disparities. While quality education is crucial for social mobility and poverty reduction, it may not directly address income inequality. To tackle educational inequality, governments must heavily invest in child and youth development by

implementing appropriate education and health policies. Enhanced education quality leads to a more equitable distribution of skilled workers, fostering a fairer society with equal opportunities for all.

One difficulty in Africa pertains to the low enrolment rates in secondary and tertiary education. Despite progress in primary education, enrolment in secondary and tertiary education lags. Compared to other regions, only a small percentage of African children are expected to pursue graduate and postgraduate studies (UNESCO, 2021; AFDB, 2020). Central and Eastern Africa exhibit the lowest enrolment levels, in contrast to Southern and North Africa where rates are highest. Addressing the disparities in education necessitates comprehensive strategies that bridge the digital and educational divide between developed and developing nations (World Bank, 21). Factors such as poverty, corruption, inequality, and low literacy rates hinder the cultivation of digital literacy skills (Transparency International, 2019). Therefore, it is imperative to implement strategies that comprehend and address these challenges in order to rectify these injustices. The Grounded Theory methodology, as advocated by Glaser (1992), can offer insights into the experiences and cultures of key stakeholders, enabling the identification and harmonization of the missing components essential for equitable education and digital literacy.

Extensive evidence substantiates the notion that heightened literacy rates contribute to greater macro-level growth, with an estimated increase of 7% economic growth and an improved standard of living. Consequently, in order to rectify the prevailing injustices and inequalities, it is imperative to implement strategies capable of comprehending and rectifying the digital and educational divide between developed and developing nations (Hanushek et.al., 2008; Van Dijk, 2006). However, the essential and missing components crucial to the establishment of equitable education and digital literacy constructs can only be comprehensively identified and harmonized through the application of a novel theory grounded in the experiences, processes, and cultures of the stakeholders. This is precisely the contribution offered by the Grounded Theory methodology advocated by Glaser (1992).

This literature review provides the justification for developing a Grounded Theory that elucidates the requirements for digital literacy and educational equity for developing countries, focusing on Ghana and Rwanda. The literature review presents relevant background information about educational equity, digital literacy, and the context from which insights arose. To present the most suitable theoretical framework for our phenomenon, we introduce the most prominent educational equity and digital literacy theories, illuminate the research gaps within our field, and underline a need for the Grounded Theory. Altogether, the literature review serves to expose the research gap, which our Grounded Theory aims to cover.

2.3 Background to Grounded Theory

In this section, we provide a brief discussion of grounded theory and how it has been applied in digital literacy and education in Africa. More extensive reviews of grounded theory in digital and educational literacies for African nations can be found in Sowe (2012) and Sowe, Law, & Paré (2018). The utilization of Grounded Theory entails a fusion of hermeneutical, inductive, and

confirmatory elements. From a hermeneutical standpoint, grounded theorists establish a correlation between established theories and the empirical data available (Charmaz, 2014). This necessitates an acute awareness of the substantive domain, as researchers remain mindful of the theoretical and empirical framework from which the theory originates. Throughout the stages of data collection and analysis, an inductive approach is employed. The objective is not to formulate or deduce hypotheses, but rather to generate concepts that pertain to the specific field of study (Glaser and Strauss, 1967). The process of theoretical sampling entails a juxtaposition of codes to enhance comprehension and achieve theoretical saturation. At a more abstract level, topic headings and categories are juxtaposed (Strauss and Corbin, 1998; Bryant and Charmaz, 2007). Lastly, during the confirmatory stage, grounded theorists actively engage with and explore potential issues. By scrutinizing any disparities or incongruities, they revisit existing theories (Glaser, 1992)

The principal objective of Grounded Theory is to systematically generate theory from data obtained through social research (Glaser and Strauss, 1967). Despite its appellation, there have been misconceptions regarding fundamental concepts of Grounded Theory. Grounded theorists have clarified that the aim of the theory is not to corroborate a preconceived theory – a process also referred to as ‘proving’. Rather, their objective is to generate new theory from data. Data is construed in a broad sense and refers to "anything to which a researcher can turn as a source of information or evidence" (Strauss and Corbin,1998). Consequently, Grounded Theory is particularly advantageous for the development of theories that possess the requisite grounding or suitability to emerge from naturally occurring data (Bryant and Charmaz, 2007).

2.3 a. Definition and Conceptualization of Digital Literacy

Digital literacy encompasses various dimensions and levels, embodying a comprehensive understanding and adept utilization of digital tools. It is an amalgamation of internal resources, instilling a belief in one's ability to exert control, and the confidence to pursue excellence, engage in self-care, and seek out reliable online content (fundamental aspects). This amalgamation rests upon the foundation of digital literacy basics while also requiring a commitment to self-regulation, which encompasses both self-care and safeguarding oneself as a digital user (Bawden, 2008; Bandura, 1997). The multifaceted and layered nature of digital literacy implies that it necessitates the effective integration of multiple resources and the ability to maintain equilibrium and preparedness across various facets of the digital realm (Eshet-Alkalai, 2004). Given that students attend school with the purpose of learning, it is imperative that the digital literacy of formal education extends beyond mere confidence in problem-solving proficiency within the digital sphere (Buckingham, 2007).

The level of digital literacy and inclusion is gradually evolving at a societal level in numerous developing nations, yet this progress has not fully permeated the formal educational setting (Unwin, 2009). Learners in developing countries continue to encounter numerous constraints, including poverty, child labour, deficient connectivity, and a lack of access to requisite digital devices essential for mastering the skills demanded in the 21st century classroom (Batool and Bilal, 2017). As we enter the era of the Fourth Industrial Revolution (4IR), it becomes crucial to integrate technological empowerment into mainstream education, catering to both those who have the opportunity to attend schools and those who are unable to do so, thereby ensuring inclusive

education for individuals residing in remote areas and street-connected children (UNESCO, 2017). This study is dedicated to addressing the crux of this issue.

2.3 b. Application of Grounded Theory in Digital Literacy Research

Centrally considering these learners in the study inherently acknowledged their active roles as creators of meaning who engage in collaborative learning and mutual negotiation to make sense of their unique experiences. This approach also allowed us to take into account how the distinct social, cultural, and ecological circumstances in which the participants found themselves might cultivate the digital literacy skills necessary to navigate an increasingly technology-driven world. Our preliminary investigation aimed to establish hypotheses and inform similar qualitative and interpretive analyses, with the goal of contrasting our findings with the cultural cognitive foundation advocated by and the socio-material practices of (Wenger, 1998; Leander and McKim, 2003). Additionally, Grounded Theory acknowledges the iterative nature of qualitative research, which naturally leads to the emergence of themes observed during analysis and the development of meaningful conclusions driven by the learner and broader regional objectives (Charmaz, 2014). The framework emphasized the importance of a collaborative partnership between stakeholders guided by shared goals and values to support learners' digital literacy through sustainable approaches, using the Connected Model as the theoretical basis. As a concept, the connected model as a theoretical basis refers to the approach that emphasizes the relationship between several nodes within a system (Cox, 2003).

In this study, Grounded Theory was utilized to examine how Africans utilize digital tools in education to promote social inclusion (Charmaz, 2006). The study also identified a significant gap in the theoretical methods used to study digital inequalities on the African continent (Warschauer, 2004). The findings from our participants were interpreted through themes (axial coding) and influenced the construction of meaning within our ecological framework. The research was conducted within the qualitative and constructivist paradigm, which is conducive to participant-driven themes crucial for understanding African digital literacy within the contemporary African educational landscape (Merriam and Tisdell, 2015).

2.4 The Fourth Industrial Revolution and Africa

During the growth of industries in the United Kingdom and across Europe in both the eighteenth and nineteenth centuries, Africa's role was primarily to provide raw agricultural materials such as coffee beans, cotton, sugar cane, cocoa, gold, diamonds, and copper. Countries such as Ghana, Ivory Coast, South Africa, and Rwanda were known exporters of some of these products (Amin, 1972; Sutherland, 2020). Some of the effects of the continent's division by colonial powers include the creation of "club-like" markets, schools, and services exclusive to their families and officers, and infrastructure for the sole purpose of mineral extraction. Hence, even half a century after the independence of many African countries, economic growth and industrialization remain a part of their mega challenges (Nunn, 2007; Sutherland, 2020).

Notwithstanding the limited institutions left behind by the colonial powers, the mega challenges confronting the continent must also be attributed to the style of governance, including the countless coup d'états, embezzlements by political leaders and people in authority who could have created systems and institutions to enable socio-economic empowerment, growth, and the well-being of

their people (Acemoglu and Robinson, 2012). In the world of modern physics, revolution is often described as "radical change of any kind." Throughout history and for many years to come, the world will continue to experience revolutions. In particular, futuristic ways of perceiving this world and groundbreaking technologies change social and economic systems. To understand the fourth industrial revolution and Africa's interest, we must first consider the previous revolutions (Schwab, 2017).

Table 1. Industrial revolutions, (Schwab, 2016).

Industrial Revolution	*Period*	*Characteristics*
First – 1st	1760 to 1840	Led by Great Britain and a shift from agrarian to mechanized production
Second – 2nd	Late 1800s to 1900	Led by the United States and a shift to production and distribution in massive quantities
Third – 3rd	The 1960s to late 1990s	Led by the United States and influenced by remarkable technological advances in computing and networks.
Fourth – 4th	The early 2000s – till date	Describes digital technologies' sophisticated and integrated nature and how they shape the world. This term was proposed and coined by Klaus Schwab, Founder & Executive Chairman of the World Economic Forum

Ward (2019) posits that remarkable events such as the mechanization of industries, including textiles, between mid to the later part of the 1700s led to the first industrial revolution and was spearheaded by Great Britain. Subsequently, after the American Civil War, the discovery of water, coal, and steam as sources of power led to the expansion and emergence of new industries, including steel manufacturing, electric power, and the refinery of petroleum products. Schwab (2017) both agrees with Ward (2019) and further states that this revolution was indeed the "profound shift in our way of living – the transition from foraging to farming – happened around 10,000 years ago…possible by the domestication of animals".

More importantly, Jevons (1931) argues that the essence of the second industrial revolution was "the search for exact knowledge, and the planning of processes: from the minutia, of manual operations (based on motion-study) to the lay-out of the machinery of a gigantic plant-even of a whole industry…". He goes on to further add that the movements that were built up around the second industrial revolution originated from the union of three "distinct trains of ideas which evolved with their corresponding actions."

Thus, accountancy evolved from the record of events in the past into an applied science that supported the businessman in his day-to-day proceedings. It led to the emergence of the profession of chartered accountancy. Jevon (1931) further highlights that applying results from the pure

sciences to attain safety and the economy of construction, including the building of bridges, ships, and boilers, formed the second train of ideas. Moreover, the continuous rise in competition among manufacturers and the widening market was the third idea that influenced this revolution.

By the 1960s, the third industrial revolution had begun. It was characterized by technological breakthroughs and advancements building on the previous revolutions. Schwab (2016) describes it as the "computer or digital revolution" era. At this point, the development of semiconductors, mainframe computing, personal computing, and the internet were all gaining momentum quickly. This latter ushered in the era in which we find ourselves and known as the fourth industrial revolution.

"Fourth Industrial Revolution", a term coined by Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, was first seen in the book he published titled “The Fourth Industrial Revolution” in 2016. Over the years, we have seen widespread use of the term to frame and analyse emerging and innovative technologies' impact on the world and the entirety of humanity. However, Sutherland (2020) argues that 4IR does not come "from the historical analyses." Instead, this concept emerges from a more recent "tradition of auto-cannibalism of business models." Today, business firms are reimaging their businesses ahead of their competitors to gain more profits and control of markets. While agreeing with Sutherland (2020) on the motive of businesses today, I believe one cannot speak about 4IR without crediting the significant gains made by the preceding revolutions and their influence on the latter. Schwab (2016), in his book "The Fourth Industrial Revolution," also alludes to the influence of the other revolutions on 4IR.

Philbeck and Davis (2019) believe that this concept "affirms that technological change is a driver of transformation relevant to all industries and parts of society." More so, framing plays a considerable role in determining and defining the cause of society's interaction with technology and its impact on the world at large. Schwab (2016), in his book, argues that this revolution's scale, scope, and complexity are different from what we have seen in the past. Thus, it entails the adoption of automation and cyber-physical systems, including the Internet of Things. In the past decade, emerging technologies such as artificial intelligence, educational technology, robotics, and cognitive science, among others, have signalled the start of the Fourth Industrial Revolution (Peccarelli, 2020).

Often, the concept of 4IR is mistaken to be synonymous with "Industry 4.0," which emerged in Germany between 2011 and 2015. The "Industry 4.0" initiative focused on enhancing manufacturing processes by applying digital technology to every aspect of the value chain (Philbeck and Davis, 2019). Hence, it is crucial to establish that the two terms are different. Whereas we have seen phenomenal progress in the global north in regard to the impact of 4IR on their economic development powering industry 4.0, there is little that can be alluded to be African in terms of the development of these technologies and how they enable industries on the continent despite the progress made by countries such as, Rwanda, Senegal, and Ghana among others in creating an enabling ecosystem for businesses to thrive (Sutherland, 2020).

According to the African Development Bank (AfDB et al. 2018), this technological progress, which is 4IR, provides a unique opportunity for emerging and developing economies such as Africa to experience rapid growth while increasing the levels of prosperity in a shorter period (AfDB et al., 2018). However, despite the phenomenal growth in access to technology and Africa's youth population, almost 16 million young Africans, around 13.4% of the total labour force of 15-24-year-olds, face unemployment (Mo Ibrahim Foundation, 2019). Martinez et al. (2012:2) and

Grantham-McGregor et al. (2007) estimate that 61 percent of children in Sub-Saharan Africa cannot meet their full development potential due to poverty.

Philbeck and Davis (2019) argue that "the ordinal prefix 'fourth' is important because this revolution is intended to drive strategic dialogue beyond the digital revolution," others describe it as the shift to an information age from an industrial one. Earlier predicted by The Third Industrial Revolution, 4IR seeks to build on the foundations set up by the data-driven foundations laid by the Third Revolution. Worth noting is that the transformation we see by the deployment of these technologies was built on by the passing of each revolution. Africa's role in The Fourth Industrial Revolution can only be significant if we prioritise building on the foundations of the digital revolution, which remains a mega challenge for the continent. Sutherland (2020) emphasizes that "Africa has almost exclusively been a taker of advanced technologies and related policies," often with little adaptation to the context of Africa or national requirements. In adopting these technologies to suit the African reality, there is a need for the continent to prioritize infrastructure (including digital), skills training, and intellectual property, areas where we continue to see a lack.

The slow pace in the rise of literacy levels on the continent, fuelled by the low levels of attainment at the primary school level, coupled with teacher training challenges and lack of infrastructure as well as the cost associated with schooling, continues to threaten the preparedness of school pupils for the future of work. Thus, less than 7 percent of students in primary schools are proficient in reading compared to the 14 percent in mathematics in Sub-Saharan Africa. Moreover, the learning gap between the poor and rich continues to widen even as pupils move up the education grades (Brown & Slater, 2018).

Hutchinson and Akileswaran (2019) argue that for Africa to be a significant player in the Fourth Industrial Revolution and beyond, countries in Africa will need to move from policy to action and pay critical attention to the systemic challenges. The root causes of these challenges hindering the rapid exchange of information spearheaded by the digital revolution, which relies heavily on basic infrastructure, include issues around the access of electricity, telecommunication systems, and literacy which was at the heart of the Second Industrial Revolution. We have seen growth in numbers over the years regarding access to electricity and telecommunication systems, education, and reduced barriers to literacy. However, the soaring unemployment rates and the lack of skilled labour continues to be a mega challenge for African governments.

Cuban et al. (2001) and Twining et al. (2013) have argued that two alternative explanations could be ascribed for transforming educational practices, especially at the primary level. One of these is the slow revolution, and the support for existing methods. Over time, many educational institutions have seen a lag in the implementation, with minor changes accumulating with time, creating a slow-motion transformation towards new ways of working. Secondly, the integration of new technologies in educational settings enhances the teaching and learning processes which serves as a catalyst for transforming education. In this case, the COVID19 pandemic has forced the gradual implementation of some of these transformative actions. Consequently, digital technology will significantly influence pedagogy, instruction, and curriculum, as witnessed during the COVID-19 and post-COVID era giving credence to the two explanations above (Swingler, 2021).

2.5 Vygotsky's Sociocultural Theory in Digital Literacy

Vygotsky (1978) defines sociocultural theory based on mental development through mediation. Thus, at all times, our human mind and everything is mediated primarily by linguistically based communication (Lantolf, 2002, p. 104). Vygotsky's sociocultural theory emphasizes that the development of a person's ability to think and reason is deeply influenced by their social interactions, the cultural setting in which they find themselves, the tools, and the resources available in their society (Vygotsky, 1978). The theory's emphasis on the Zone of Proximal Development (ZPD), the socio-cultural context, role of language, collaborative learning and technology as a mediating tool is relevant in addressing the research problem.

One of the well-known theories in child development is Vygotsky's sociocultural theory. In a bid to improve his teaching methods, he began exploring the relationship between the two concepts of development and learning. Vygotsky's sociocultural theory posits that human learning is a social process and that the origins of human intelligence are in culture or society. Thus, "every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, logical memory, and the formation of concepts. All the higher functions originate as actual relationships between individuals" (Vygotsky, 1978, p.57).

Sociocultural theory, as explained by Wu (1998), is a theory of conscious mental activity or competencies development. It further associates higher functional abilities to culture, cognition, and development. "Unlike the psychological theories that view thinking and speaking as related but independent processes, sociocultural theory views speaking and thinking as tightly interwoven" (Lightbown & Spada, 2006, p. 47; Alavinia et al., 2014 p154). Additionally, Azabdaftari (2013, p. 107) asserts that within the model for the interactionist approach, "knowledge is useful, and use creates knowledge." Conversely, "the distinction between 'use' of the L2 and 'knowledge' of the L2 becomes blurred" (Azabdaftari, 2013, p. 107). Vygotsky (1978) defines sociocultural theory as based on mental development through mediation.

Kao (2010) and Alavinia & Alikhani (2014) argue that, among the many schools of psychology, the social interactionist view is more compelling and has had a long-lasting effect on interpreting the processes of language learning and acquisition compared to others such as behavioristic, cognitive, constructivist, and humanistic perspectives. Consequently, Alavinia & Alikhani (2014) also argue that social interactionist psychologies have had a major influence on pedagogical research centred on empowering learners.

Vygotsky's concept of the Zone of Proximal Development (ZPD) stands out when we consider the application of his theory. The Zone of Proximal Development is described as the difference between what a learner can do without assistance and what they can accomplish with some guidance from an expert or a more knowledgeable other. The Zone of Proximal Development also sheds more light on the significance of social interactions and scaffolding in learning (Vygotsky, 1978). Community and language play a central plan in learning, and this is established in Vygotsky's concept mainly to serve as a guide for teachers in facilitating a learner's development. The other notable part of Vygotsky's theory is the role of play. He acknowledges that play enables development. Thus, teachers ought to provide young children with an opportunity to play, thereby allowing for a child's imagination to be stretched (Selwyn, 2011).

Social constructivism, defined by Vygotsky (1978), emphasizes individuals' active role in creating their knowledge (Davis et al., 2017). Van Wyk (2020) further defines socio-constructivism "as the social and cultural context of learning and the role that adults play in supporting learners." Vygotsky (1978) summarizes by stating that "while imitating their elders in culturally patterned activities, children generate opportunities for intellectual development. Initially, their games are recollections and reenactments of real situations; but through the dynamics of their imagination and recognition of implicit rules governing the activities they have reproduced in their games, children achieve an elementary mastery of abstract thought".

Scaffolding, as understood by Schweisfurth (2013, p. 23), is the "process of building from a lower starting level towards the learner's potential through the intervention of another." She further emphasizes that "sustained dialogue is central to the process of scaffolding, as is careful and understanding modelling by the teacher." In turn, Berk describes scaffolding as "a changing quality of support over a teaching session in which adults adjust the assistance they provide to fit the child's current level of performance" (Berk 2002, p. 261). Consequently, as competence increases, the amount of direct instruction given reduces and, through this process, students play an active role in the scaffolding process, not as receivers of information but as active learners. Hence, "their zone of proximal development should be maximized through the help of their peers and teacher in an integrated activity which is in line with the concept of Gradual Release of Responsibility or GRR" (Ellery, 2005, p.18).

Rix et al. (2009) laid out six distinctive features of learning by scaffolding that teachers in the classroom could deploy to support learners. These features are:

1. Record each learner's interest in the task.
2. Model how to complete the task by doing or demonstrating.
3. Where possible, reduce the number of steps needed to complete the task to enable learners to track their progress.
4. Manage frustration.
5. As often as possible, prioritize giving feedback to learners in a way they appreciate and comprehend.
6. Motivate learners to be involved and participate in a task.

Therefore, the success of scaffolding will be dependent on the dynamic between the teacher and learner in terms of collaboration to achieve the specified goals. Therefore, it is vital to ensure that scaffolding functions within the confines of the Zone of Proximal Development of each learner with the support of materials, technologies, and peers.

Kaplan and Baldauf (1997; 2007) have divided language-in-education policy into several focus points in their work. Even though language policy documents refer to questions of method, just a handful of academic studies of language planning and policy have considered method a specific focus, especially in drafting language-in-education policy. The focus areas of Kaplan and Baldauf's (1997; 2007) work in the language-in-education policy include access policy, personnel policy; community and curriculum policy; methods and materials policy; and resourcing policy. For instance, in Ghana and Rwanda, limited resources to teach subjects like mathematics and science are available. English authors and ideas predominantly develop existing materials on these subjects. Hence, developing resources in numerous Indigenous languages become less urgent and

more expensive. Therefore, this type of research into language-in-education policy is advantageous even as we consider enhancing literacy levels across the board. We cannot belabour the relevance of teacher-training Indigenous language-themed materials in the method-in-language policy.

Consequently, policies surrounding the development of language materials influence issues of method. Another consideration worth highlighting is the policy covering curriculum and assessment in regard to the methods of language teaching (Liddicoat, 2004). There is a unique opportunity to consider the role innovation could play in developing language policy. Specifically, how digitally enabled emerging technologies facilitate and influence how teaching, learning, and assessments in language learning and teaching empowers learners and teachers to be digitally literate. There are great opportunities to enhance the process of teaching and learning with the advent of technology which then helps to improve the lives of both teachers and learners. In addition, we will see improvement in the psychoeducational experience of learners while they acquire the 4IR skills needed for the jobs and future of work.

The application of Vygotsky's concept of the ZPD is complemented by the concept of self-regulation. Bronson (2000) avers that self-regulation involves cognitive, emotional and contextual factors that influence students' response to their environment. Zimmerman further argues that self-regulation "refers to learning that occurs when individuals are meta-cognitively, motivationally, and behaviourally active participants in their learning process" (Zimmerman, 1994, p. 3). Here, the teacher's goal is to ensure that students receive training that will enable them to become independent and active learners. Thus, when students become actively involved and aware, they develop self-regulation.

Vygotsky's theory of learning has significant implications for this study, showing how an inclusive classroom experience can be built on understanding the students' needs and the goals established within the learning environment. This means that the teacher must prioritize experience by utilizing prompts, technology, encouragement, play, and reminders appropriately and in the right amounts. Thus, over time, the student should be given a vote of confidence by being allowed to progressively do more on their own. Teacher assistance, in the form of scaffolding, is an essential tool to enable learning and problem-solving in situations where educators must actively interact with learners and support their learning journey; in terms of the priorities for this research study, language learning and the use of technology (Vygotsky, 1978).

2.6 Piaget's Constructivism Theory

Kami and Ewing (1996) argue that "constructivism, the view that much of learning originates from inside the child, has become increasingly popular in recent years". However, the term "construct" is often abused by many educators. Thus, it is crucial to establish that how a child constructs a writing system is unique from how they construct their mathematical understanding; following from this, the process of active discovery is then described as learning. Consequently, the role of the instructor shifts from drilling knowledge into students through repetition to facilitating the learning process through incentives and rewards. Hence, the teachers' role evolves into a facilitator who provides the necessary resources and guides learners to acquire new knowledge and modify the old to make room for new knowledge. In developing lesson plans, for example, teachers must

consider the knowledge that the learner currently possesses to structure, sequence, and present new material.

Piaget (1964) posits learning is modelling, transforming and having some understanding of the way an object has been constructed. More so, Piaget (1964) emphasized that knowledge is built by learners through their experiences and from their interactions with the world. These experiences are grouped into schema. Hence, the schema of learners goes through periods of adaptation either by assimilation or accommodating. The relevance of this theory in the context of 4IR where rapid technological advancements require individual's adept in digital skills cannot be over emphasized. Therefore, to answer the research question central to this study, there's a need to examine Piaget's theory in finding answers to the question at hand.

Van Wyk (2020) notes that the fundamental insight derived by Piaget was that "individuals construct their understanding and that learning is, therefore, a constructive process." From this, Piaget's Constructivism Theory has significantly contributed to how schools have organized their classrooms. Moreover, Piaget believed that the core objective of education is to empower children to learn how to learn and he opposed education approaches that "furnished" instead of "forming" learners' minds. Furthermore, Piaget believed that, by differentiating instruction and placing emphasis on understanding how children think, teachers can align their objectives with the existing identified competence of the children whom they are teaching (Van Wyk, 2020; Rix et al., 2009)

The constructivism theory of cognitive development proposed by Piaget includes four stages of development (Van Wyk, 2020; Piaget 1968):

1. **Sensorimotor stage (0 - 2 years) –** Children shift from instinctually dominated and undifferentiated emotions in their cognitive structures to a more organized set of concrete concepts and differentiated feelings. A known characteristic in this stage is that children become egocentric and do not consider other people's points of view.

2. **The preoperational stage (2 - 7 years)** typically spans five years and presents an opportunity for children to use language in the sense-making of reality. They also learn to name and identify objects. Children can communicate with others as their linguistic skills increase.

3. **Concrete operational stage (7 - 11 years) –** children begin to build logic in this stage. Children can conduct logical operations, especially with concrete objects and familiar events.

4. **Formal operational stage (12 years and onwards) –** as children enter this stage which lasts beyond their adolescent years, they can develop multiple skills, including performing complex and abstract intellectual operations. This stage also serves as a transition into a more effective and intellectual form of maturity. Thus, they can recognize and appreciate the point of view of other people and theirs.

In his theory, Piaget specifies that none of the stages of cognitive development can be missed. However, the rate at which children progress through the stages differ. In some cases, perhaps, some children may never attain later stages. Noteworthy is that children are not passive creatures waiting around to be filled with knowledge by someone. They are actively building their knowledge about the world around them. Hence, the best way to appreciate how children reason is to see things from their worldview. As learners in every classroom differ in regard to their

cognitive development level and academic knowledge, it is imperative to leverage innovative pedagogical approaches or differentiated instruction that empowers and addresses the learning needs of individuals (Piaget 1968).

Consequently, the insights obtained from Piaget's constructivism theory can be extended more broadly to education overall. Thus, the theory further emphasizes the importance of actively engaging learners to encounter experiences that help them build and adapt their schema thereby complementing Vygotsky's Constructivist Zone of Proximal Development.

2.7 Innovation Diffusion Theory in Learning

Rogers (1983) defines innovation as an idea, practice, or object viewed by an individual as new. Innovation Diffusion Theory was introduced in 1962 and was further developed by Rogers (1995). Rogers (1962) explains that this theory focuses on understanding why, how, and at what rate innovative ideas and technologies unroll in any given social system. Unlike other theories of change, innovation diffusion theory adopts an approach that considers change as an evolutionary process. Change is defined as the "reinvention" of services, products, and behaviours that are fit for purpose in addressing the needs of groups and individuals.

From this, Robinson (2009) argues that innovations change; diffusion is the process through which an innovation is communicated via specific channels over time among the members of a social system. In addition, Fichman (2000) sees diffusion as a process that involves how technology escalates within a system; the spread of views across multiple systems such as societies, institutions, organizations, and groups. Sahin (2006) argues that the whole theory of innovation diffusion can be broken down into four main elements: innovations, communication systems, time, and social systems.

The concept of innovation theory is a useful theoretical model for understanding why, and how, changes develop and are subsequently applied across education systems. Three relevant examples serve to illustrate this: approaches to teaching language; innovations in method at the policy level; and Information and Communication in teaching and learning.

Method in language-in-education policy often becomes clearly expressed when an existing instructional approach is controversial. An example is the attribution of poor academic performance due to the inability of learners to appreciate the use of L1 in instruction across elementary schools (Baker, 2001; Liao, 2000/2001; Liddicoat, 2004). Thus, the methods in language teaching are often placed under a critical lens when there is a perception that poor learning outcomes in language learning are a result of the challenges in teaching methods (Liddicoat, 2004). Following from this, innovation in method is widely adopted as the solution to poor teaching and learning, but often without reference to other factors that serve as a challenge to this assumption.

Innovation in method at the policy level arises when existing policies fail to recognise the complexity and context of how language is taught. Markee (1994; 1997) avers that several factors determine the practical impact of method change at the policy level. These include a teacher's language proficiency, the level of professionalism in teaching, and cultural dimensions including

learning and teaching styles, teacher and learner roles, and patterns of classroom interaction. However, several attempts both at the global (consider Kirkpatrick, 1984; Li 2001 for examples) and national level to change the methods of instruction through language policies have been barely successful (Liddicoat, 2004). In some cases, some experts attribute these low success rates to the lack of teaching and learning resources (Bronteng et al., 2020).

It is evident that more schools in the 21st century are utilizing Information Communication Technologies (ICTs) for teaching (Hardman 2019), and many schools in sub-Saharan Africa, have adopted the study of ICT into their curricula. Educators across the world have had to grapple with and, in some cases, be forced to use technology to deliver lessons because of the COVID-19 pandemic and its effects on school activities. However, in many institutions across sub-Saharan Africa, ICT is taught as a subject with either a lack of facilities for practice or issues around access to electricity and others. Consequently, many schools have now realized the importance of ICTs in teaching and learning and there has been a steady shift towards leveraging technology to prepare learners for the future of work, particularly by whipping up their interest in the endless possibilities one could achieve with digital skills (Van Wyk, 2020; Kale & Goh, 2014). But as Li and Ma (2011) and Hardman (2015) emphasize, ICTs can only help prepare learners for the future of work if they are utilized appropriately as a learning or teaching tool.

This is further complicated by a lack of agreement on the impact of ICTs on changing pedagogy (Hardman 2019). For example, Cassim (2010) argues that ICTs do not alter pedagogy whereas Webb and Cox (2004) and Bosamia (2013) propose that ICTs have a positive effect on pedagogy. In gaining clarity on this subject, it is crucial to consider the lens through which one views these arguments and to what extent we can hold space for multiple truths. Thus, when institutions and their educators embrace ICTs and emphasize its benefits, it furthers the pace at which adoption of ICTs happen which aligns with the theory's emphasis on the role of communication channels and the innovation-decision process.

Innovation Diffusion Theory thus provides a comprehensive framework to assess and explore the varying impacts of ICTs on pedagogy – helping us sort out all these conflicting claims for efficacy. Thus, by considering factors including complexity, compatibility, and relative advantage among others, the theory provides an explanation as to why some studies have found ICTs transformative and others have not. The theory also provides a basis to appreciate the relevance of the social system, the channels of communication and the innovation-decision process which determine the extent to which ICTs affect pedagogical practices.

2.8 a) Ghana's educational system

In this section, we endeavour to present a comprehensive portrayal of the current state of digital literacy and inclusive education in Ghana. As posited by Opekokewa (2010), the integration of technology within the African sphere, with particular emphasis on Ghana, assumes a position of paramount importance in propelling education forward as an integral component of the inclusive process. Considering Ghana's burgeoning role as a participant on the global stage, it is imperative that individuals acquire proficiencies in diverse facets of literacy, with a focus on digital aptitude, wherein they must navigate an environment that necessitates technological prowess (Norton,

2007). Correspondingly, Ololube (2011) expounds upon the contemporary predicaments that beset educational research, transcending the mere inadequacies in designing pedagogical methodologies, and encompassing the exploration of innovative means to employ technology as a facilitative tool for learning, while concurrently fostering comprehensive knowledge acquisition across all age cohorts.

Although the Ghanaian educational system was not designed to grapple with the predicament of overcrowded classrooms, it has become a standard phenomenon over time. Thus, it behoves on educational leaders to ensure amidst the non-ideal economic and learning infrastructural gaps to make the best of teaching and learning in the current environment (Adarkwah, 2010). The changing climate in Ghana requires a careful approach to education that takes into consideration the environmental challenges. Ololube (2009) discusses the rise of global e-learning, highlighting the need for practical solutions to complete tasks, solve problems, and use digital skills, despite unreliable power or sometimes no power and internet connections.

The roots of Ghana's educational system can be traced to its colonial and political past. Primary and secondary education is governed by the Ghana Education Service, which falls under Ghana's Ministry of Education. Takyi et al. (2019) and Akyempong et al. (2007) emphasize that the colonial era education system's goal was to enhance Christian missionaries' activities. Thus, the system was focused on the educational needs of the children of colonial government officials and European traders. In studying the development of education in Ghana, it is necessary to recognize the pioneering efforts of missionaries in education which set the basis for formal education. Opoku et al. (2015) argue that it is impossible to separate religion and education from each other in Ghana as in other countries: "each has existed to the benefit of the other since the 16th century".

Prior to the coming of early European traders and Islam to Ghana (previously known as Gold Coast), traditional religion ensured the transfer of indigenous knowledge from one generation to the other. Consequently, to empower Ghanaians for socio-economic transformation, huge investments were made by colonial and political authorities prior to and after independence. Agyeman et al. (2000) note that the primary goal of the 1951 Accelerated Development Plan in Ghana was shaped by the philosophy of enlightenment and "formations on modernity." That is, emphasis was placed on education to empower the people by providing equitable access to education so that the government could implement its programs and policies while leading the country to economic stability. This led to free-compulsory primary and middle school education, which Dr. Kwame Nkrumah introduced in 1960 (Akyempong et al., 2007). In bridging the barriers around access to education, this educational policy further sought to build schools in many communities regardless of their location to promote equity and access, as well as a scholarship program established to bridge the gap between Ghana's deprived northern regions and the south.

Although these interventions aided in bridging the gaps in access, they compromised the quality of provision and created an "expansion-quality dilemma" (Takyi et al., 2019). In addressing this recurring issue of quality and access several acts of parliament were passed, and committees were formed, to consider ways in which education could be reformed and become more responsive to needs. For instance, in 1961, a new educational Act was introduced. It empowered local educational authorities to address emerging issues around quality versus expansion (Akyeampong, 2008; Takyi et al., 2019). Similarly, the Dzobo Committee set up in the mid-1970s was established to respond to the rising challenges bedevilling Ghana's educational system. Some of the measures proposed by the committee included a change in the duration of pre-tertiary education to 12 years

from 17; more teaching hours; abolishing engagements with untrained teachers; and the efficient and effective management of the educational system (Takyi et al., 2019; Wilson & Samuel, 2013). Acheampong (2008) adds that the committee also stressed the importance of vocational and technical training at the Junior Secondary School level (Grade 7-9), as the committee believed it was necessary to make education "more work-oriented" (Takyi et al., 2019).

By 1996, education at the primary level had become compulsory and entrenched in the constitution of Ghana, and in law through the Free Compulsory Universal Basic Education (FCUBE) programme (Ghana, 1992). This was introduced in 1995 and promised universal education by 2005 with financial assistance from the World Bank. This bold attempt aimed at universal access, which had been a challenge in the 40 years before this program despite previous governments' attempts at expansion and equity. Both Watkins (2000) and Akyeampong (2009) agree that compulsory primary education is essential for basic public services; education generally should be a right and not a privilege. The compulsory element of the programme was to nudge parents to enrol their children for a complete primary education with fines as punishment for those who did not comply. Although many did not comply, it led to the loss of revenues for schools as a result of low enrolments (Akyeampong, 2009). Despite the barriers many children face to access education across Ghana, the enrolment numbers at the primary level from 1987 to 2021 indicate a consistent increase in enrolment figures (Ghana Statistical Service, n.d).

Several developments in the education sector in Ghana have occurred post-FCUBE. One, which has been touted as paving the way for Ghana to achieve the Sustainable Development Goals, is the Free Senior High School (Free SHS) Policy. Ghana is among several countries that have rolled out a "free" secondary education programme (Chanimbe & Dankwah, 2021). Goal 4: Quality Education, Goal 8: Decent Work and Economic Growth, and Goal 10: Reduced Inequalities are the goals the Free SHS Policy is believed to address (United Nations, 2015). More importantly, the issues regarding the low transition rate from primary school to senior high school have been resolved by implementing the policy (Amoako, 2019). Additionally, Ghana has also experienced improvements in literacy rates because of these reforms as seen below.

Table 2. Ghana's literacy rate, 2014

Sex	**Urban**	**Rural**	**National rate**
Male	80.9	53.0	67.3
Female	60.3	31.4	46.9
Total	69.6	41.7	56.3

Source: Ghana Statistical Service (2014).

Along with the educational system in Ghana, the language policy on education has undergone many reforms and transformations through the years. There are more than forty-six languages that are spoken in Ghana today. The role of language in an educational system cannot be overlooked, first, as a subject part of the curriculum and then a medium of instruction. It is relevant to consider

what we mean by language policy in this context. Weinstein (1980) defines language policy as "an accepted, long- term, sustained, and conscious attempt on the part of governments to alter the role of language in a society in order to solve communication problems." This definition by Weinstein emphasizes the role a well-planned language programme plays in addressing challenges of communication and how learning and teaching happen. Like most African countries, controversy around language as a subject in education and a medium of instruction is unavoidable. Ouedraogo (2000) believes the complexity of Africa's education and language issues is due to its "multi-ethnic, multilingual situation." Further, these issues become more difficult when the "adopted" language differs from existing Indigenous languages.

The presence of European settlers on Ghana's coast influenced its language policies as the settlers scrambled to coerce the people at the coast to use their language as the medium of instruction in their schools. In contrast, the missionaries, including the Wesleyan and Basel groups, believed in promoting a local language policy (Muib, 2017). Today, the medium of instruction in Ghana's school system remains English, as was the case during the colonial era, although in 2022 the government approved a change in policy, requiring that a complimentary Ghanaian language be studied till secondary school (Ameyaw-Akumfi, 2002). The government argued that rural schools abused the previous policy, and teachers in these schools never spoke English in class; as a result, students could not speak and write "good" English. There was also a lack of materials for Ghanaian languages to be used in teaching (Owu-Ewie, 2003).

The National Literacy Acceleration Programme (NLAP) was introduced in the 2009/2010 academic year after a baseline study indicated that only 18% of learners in grade three could read the text in their school's Ghanaian language (Ministry of Education, 2010). It was a follow-up to an initial assessment conducted in 2007 to ascertain the minimum English competency of learners. This assessment also revealed that only 26% of learners had achieved minimum English competency. The NLAP proposed that a familiar local language, the most common language spoken within the community in which the school is located, should be used for the first five years (Kindergarten to Grade 3) of schooling and 11 major languages out of the 46 spoken languages were selected for this purpose alongside English. The NLAP also proposed that the medium of instruction should switch to English from Grade 4 onwards (Bronteng et al., 2020). Nevertheless, some of the challenges that caused a shift to English only as a medium of instruction continue to persist, and some parents continue to express concerns about teachers' ability to teach reading in the mother tongue language of students (Tetteh et.al., 2015).

Despite the investments made by successive governments to promote equity and increase access to primary education, as well as noteworthy progress amidst numerous challenges, close to 265,200 children of primary school age were out of school in 2020 (Sasu, 2021). In response, the Complementary Basic Education (CBE) Program, which was piloted in Northern Ghana 1995, was scaled across the nation and launched in 2014 to ensure all children have access to CBE, with an emphasis on promoting girl child education with an accelerated learning programme to provide literacy and numeracy to children between 8 and 14 and classes in the mother tongue of the learners. Funded by the U.K. and U.S. Governments to a tune of £27.9 million, the CBE programme sought to build a sustainable approach towards achieving universal primary enrolment. Furthermore, evidence from the outcomes of the programme will help understand the barriers out-of-school children face in accessing the programme and the programme's sustainability (University of Cambridge, n.d.).

Daly et al. (2021) and Carter et al. (2020a) conducted reviews of research on the CBE program, discovering that children who switch to a different language environment struggle more with learning basic reading and writing skills compared to peers who continue to learn in their native language. Their study aimed to explore differences among children who couldn't maintain foundational literacy skills in their mother tongue within the CBE program. They also investigated potential language distance variations between different languages. However, Daly et al. (2021) did not include an analysis of the language learning process itself. Factors such as teachers' language proficiency and students' attitudes significantly influence this learning process.

Overall, Ghana's schooling system underscores the continuous efforts to expand access while enhancing quality in other to prepare learners for future challenges especially in the globally competitive environment we see today. Policies such as Free Compulsory Universal Basic Education (FCUBE) program coupled with programs interventions in terms of the structure of the education system, language of instruction, curriculum and how the challenges schools confront are dealt with provides some insight into the priorities of the country when it comes to education.

2.8 b) Rwanda's educational system

Historically, Rwanda's geographical predicament as a landlocked country has impeded its access to the global marketplace. Nevertheless, the country has fervently pursued a path of economic advancement, technological innovation, social progress, and the fortification of its healthcare system by making investments in ensuring quality education becomes a right and not a privilege, all to achieve sustained and far-reaching development (Dieu et al., 2022). Societies that value and support their teachers and the public education system tend to provide quality education to their learners, and the status and morale of teachers are high (Power, 2015). Furthermore, teachers' education, ability, and experience, along with small class sizes and lower teacher ratios, can be associated with significant increases in students' achievement and quality education (Darling-Hammond, 1998).

Rwandan education aims to transform its citizens into skilled human capital for the country's socio-economic development by ensuring equitable access to quality education. This focus includes combating illiteracy, promoting science and technology, fostering critical thinking, and instilling positive values. Similarly, the Rwandan Education Sector aims to guarantee all Rwandans access to quality, equitable, and practical education (MINEDUC, 2010). The government of Rwanda is committed to combating ignorance and illiteracy and providing human resources beneficial for socio-economic development through the education system, aligning with the Sustainable Development Goal of poverty reduction and the improvement of population well-being (MINEDUC, 2003a). The most recent strategy, outlined in the National Strategy for Transformation (NST1), emphasizes the development of a knowledge-based economy (Republic of Rwanda, 2017).

Additionally, Rwanda has made significant strides in improving education since the start of the new millennium. The country abolished school fees in 2003 to expand access (Joseph et al., 2012). In 2007, it empowered Special Educational Needs and Inclusive Education (MINEDUC, 2018a), followed by initiatives in Adult Education (MINEDUC, 2014) and Technical and Vocational Education and Training (TVET) in 2008 (MINEDUC, 2008). The introduction of fee-free and

compulsory Nine Years Basic Education (9YBE) in 2009 and its extension to Twelve Years Basic Education (12YBE) in 2012, supported by community involvement through Umuganda for additional classroom construction, marked further progress. The transition from the traditional Knowledge-Based Curriculum (KBC) to the Competency-Based Curriculum (CBC) has provided students with a stronger foundation in core literacy and numeracy skills (The Commonwealth Education Hub, 2021).

The first school established in Rwanda in 1900 was by the Roman Catholic missionaries. Thus, by the 20th century, western education had begun spreading across Rwanda. This was primarily pioneered by Christian missionaries who had begun building churches and schools in the region. Both the German and Belgian colonial governments gave up control over education to the religious institutions. Hence, most of the schools in Rwanda by independence in 1962 were owned by either the Catholic or Protestant churches. The post-colonial government that assumed power after independence expanded the role of government in education by subsidizing many of these schools. They did not have an interest in monopolizing education (Trines, 2019).

Between 1962 and 1994, the governments that ruled Rwanda established a public education system (Trines, 2019). They also developed a national curriculum and created Rwanda's first tertiary institutions. Some of their successes include increasing access by out-of-reach communities to education. For instance, the elementary gross enrolment ratio (GER) by 1990 was 65 percent, an increase from 46 percent in 1973. However, despite the progress made in education in Rwanda at the time, the Hutu-dominated governments, through their education policies, had intensified conflicts between Hutus and Tutsis, following the policies of the era of the colonial rulers. For instance, admission into both public and government-assisted educational institutions was based on ethnic and regional quotas, while the school curricula propagated anti-Tutsi propaganda (McLean Hilker, 2011).

Obura (2003) highlights four significant milestones in the history of Rwanda's education since independence; the beginning of national education by 1960, the mid-1970 educational reform, revision of the reform in 1991, and the post-war developments (Table 3).

Table 3. Milestones in Rwanda's education history since independence (Obura, 2003)

Milestone	Primary	Notes	Secondary	Notes	Comments
1. At Independence (1962/1963)	Six years	Official entry age: 7 years	Middle schools 2 or 3 years	Three training sections: agriculture/skills for boys, home economics for girls, craft training	During this period, education in Rwanda experienced a continuation of pre-independence curricula.
1966 Education Act	Two cycles (3+3)	A brief experiment with the 4+2 cycle. Double shifts in P1-3. Introduction	OR Full secondary education 5,6, or 7 years	Four options in Grade 10 were available: general education, classics, teacher training, and	

		of national curriculum introduced—for instance, history.		technical education. Churches predominantly ran secondary schools.	
2. Reform (1977/1978) a **To ruralize, vocationalize, democratize education; stress mother tongue (M.T.) [b] and local culture**	Eight years Three cycles: 3+3+3	Mother tongue medium of instruction in P1-6. Outcomes-based curriculum	New 3-year post-primary cycle: three years post-primary programme in rural and craft skills; and secondary school for few	Post-primary is still run mainly by churches. Secondary: general education, teacher-training schools, technical schools	During this period, the reform aimed at halting double shifts continued with 20% girls/25% boys reached by Grade 6. Ethnic and regional quotas were formalized and reinforced.
3. Reform revision (1991/1992)	Six years	The policy was unchanged. Same curriculum progression. P7/8 phased out between 1991-1993	The junior secondary was the 3-year cycle for all. Three years post-primary programme in rural and craft skills halted.	Post-primary is still run mainly by churches.	During this period, the reforms were seen to be negligible and did not eliminate ethnic quotas
4. Post-war Rwanda 1. **September 1994**	Six years Two cycles	Mother tongue P1-3 French or English P4-6	Junior secondary expanded; senior secondary specialization continues	Crisis: 33% of teachers qualified. Rapid private school expansion (43%). Increased bursaries by the government	During this period, Rwanda emerged from the genocide against the Tutsis, which saw up to a

					million Tutsis being murdered by Hutus.
*a - Reform enacted 1978/1979 and gazette by 1985 (MOESTSR, 2000:22) *b - Mother tongue, which is Kinyarwanda					

It is important to note that by 1994, when the civil war in Rwanda came to an end, more than half of Rwandan schools were non-functional. It is estimated that half of the population of elementary school teachers were either killed or displaced during the genocide against the Tutsis. Many of them became refugees outside Rwanda (Akresh, 2008; McLean, 2011). Rwanda's progress in reconstructing and improving its educational system over the past 25 years is impressive despite the turmoil. The Rwanda Basic Education Board under the Ministry of Education (MINEDU) has oversight of the Basic Education system, which is composed of pre-primary, primary, secondary education, and non-formal education (also referred to as Adult Basic Education). By 2003, Rwanda had achieved almost full participation in elementary education, with a gross enrolment ratio (GER) in 2013 reaching a 100 percent. Thus, the introduction of free elementary education in 2003, and free primary education until grade nine by 2007, coupled with other policies, ensured that Rwanda was on track to achieving its educational aspirations (Trines, 2019).

Despite this progress, the results from a national assessment conducted in 2014 showed that most children in primary school did not acquire the appropriate literacy and numeracy skills for their age. "A few small-scale Early Grade Reading Assessments (EGRA), which along with national-level tests, indicate that learning outcomes are low with majority children in primary school not acquiring age-appropriate literacy and numeracy skills" (USAID, 2014; World Bank, 2018). Furthermore, the 2011 EGRA revealed that only 45 percent of grade 2 and grade 5 students could meet their grade-level expectations in Kinyarwanda and English, respectively. The 2017 Learning Achievement in Rwandan Schools assessment conducted by the Rwandan Education Board assessment revealed that only 54 percent of grade 3 pupils in Kinyarwanda and 59 percent in mathematics reached expected grade-level benchmarks (REB, 2018).

In 2015, a Competence-Based Curriculum (CBC) was launched in Rwanda to replace the knowledge-based curriculum. The Competence-Based Curriculum (CBC) movement began in the United States of America in the 1970s (Ford 2014). It later expanded to Germany and the United Kingdom, and Australia in the 1980s and 1990s, respectively (Likisia, 2018). Like several European countries that adopted this curriculum (see Finch and Crunkiton, 1999), many developing countries, including Ethiopia, Nigeria, Tanzania, Zambia, have also adopted CBC and tailored it to the needs of their countries (Nsengimana et al., 2020; Murararaneza et al., 2017; Ngendahayo & Askell-Williams, 2016).

The transition from the knowledge-based curriculum was intended to ensure that students were prepared and equipped with knowledge creation and application skills. In addition, CBC aimed to enable students to develop independent, lifelong learning habits and apply the skills acquired for real-life situations (Ngendahayo & Askell-Williams, 2016). More so, CBC in Rwanda is centred on higher-order and critical thinking skills. By developing understanding and enabling effective learning, school-aged children can apply their skills to solve complex problems through critical

and deep thinking (REB, 2015). Nsengimana (2021) also emphasized that competency-based education (CBE) evolved from the CBC. CBE refers to the amalgamation of integrated learning, which combines knowledge, attitudes, and procedures defined in action and experience (Muñozi and Herrera, 2017). Kouwenhoven (2003) and Sudsomboon (2007) agree that CBE is one of the ways to build bridges between the workplace and education and can contribute to the reduction of unemployment caused by the skills gap in the labour market today.

By the end of 2008, major international news outlets had begun to focus their lenses on Rwanda as it had announced that it had discarded French as one of its three official languages. Hence, Kinyarwanda and English were the only two official languages (McCrummen, 2008; National Public Radio, 2008). Consequently, the school system begun by the Belgian colonial powers no longer used French as a medium of instruction across all levels of the educational system, including schools and universities. The shift is believed to have been inspired by Rwanda's desire to play a leading role in the world economy, especially as English remains the leading language of science, technology, and economic development. (Gahigi, 2008; Samuelson & Freedman, 2010).

The Rwandan government has argued that the rationale behind the move to English as the language of instruction in school was economic. It emphasized that the goal was to enable regional integration and facilitate entry into the global market of its citizens. Gahindiro (2007) argues that though several reports indicate buy-in by the general populace, the case, in reality, is that criticism of government policy is not tolerated. Thus, it is likely that political dissidents who lived in Rwanda prior to the 1994 genocide against the Tutsis are Francophone, and they may feel marginalized by the government's shift to English. The Rwandan government has dismissed these accusations that were raised in the past. Samuelson and Freedman (2010) argue that the Rwandan conflict can be considered an identity conflict. They describe identity conflicts as being driven by factors such as economic disparities, class conflicts, language differences, and unequal access to public goods, including higher education and white-collar jobs.

However, for this study, we must consider and examine the assertion that acquiring English language skills at an early stage at the expense of L1 literacy will enable Rwanda to prepare its people for the globalized economy. Rwanda is not the only country in Africa and worldwide to adopt this education approach. Countries such as Ghana, Mali, Botswana, and Namibia are among others that have adopted this approach. Globally, countries such as China, Pakistan, and South Korea have increased the status of English as a medium of instruction (Samuelson & Freedman, 2010).

2.9 Conclusion

The researcher in this chapter sets out the conceptual framework for this study by discussing each section. The researcher sets the conceptual framework by discussing Grounded Theory, the Fourth Industrial Revolution, Vygotsky's Sociocultural Theory in Language Learning, Piaget's Constructivism Theory, and Innovation Diffusion Theory and how it relates to the study which delves into the factors and strategies contributing to achieving equitable technological empowerment through digital literacy and accessible education across Ghana and Rwanda. We also examine the educational systems of Ghana and Rwanda in detail – considering the aspirations of both countries when it comes to preparing its learners for work. In Chapter Three the study focuses on the research design used for this study and the motivation behind this choice.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.0 Introduction

The second chapter of this study provided a comprehensive overview of the various dimensions and levels of digital literacy, including its internal and self-regulatory aspects, and the importance of digital literacy in formal education. We examined the literature on grounded theory, technology, 4IR, and tools for teaching & learning. By examining Vygotsky's sociocultural theory and Piaget's constructivism theory, we also ascertained how the foundational levels of education influence learners' ability to acquire critical understanding and improve their communicative skills. Findings from this study will advance the body of research aimed at improving digital literacy and achieving equitable technological empowerment across sub-Saharan Africa.

The unemployment statistics in Africa are spiralling at an alarming rate as opposed to opportunities available for young people who are desirous of making something meaningful out of their lives. Often conversations about the opportunities within the fourth industrial revolution do not take into account the peculiarities of the African environment. Hence, this study takes a deep dive into that the fourth industrial revolution means for African youth and further explores the theme of reskilling for the future of work. As Hardman (2019) argued, 21st-century schools are leveraging Information Communication Technologies (ICTs) for teaching, which presents a unique opportunity to mainstream digital literacy across all levels of education to ensure learners are prepared to take their place in the rapidly changing and competitive world driven by cutting-edge and ever-evolving technologies.

Therefore, Chapter 3 takes a deep dive into the details of this study's research strategy and methodology. Thus, aspects of research design, including data collection methods, methodology, sampling, analysis, and ethics, are explored, and explained. More so, it also expatiates the instruments and procedures of this research and concludes the chapter with a summary.

3.1 Research design

Smith (1976) defines design as a carefully arranged scheme for experimenting. Thus, the design of an experiment refers to the selection and arrangement of conditions. Therefore, a research design is a plan that involves a shift from philosophical assertions to identifying and selecting respondents, methods, and tools for collecting data and analysing the data. Thus, the skills and competencies of the researcher influence the research design process (Nieuwenhuis, 2016). In addition, the research design is the binder that firmly grounds the research project together. More importantly, it allows for data gathering concerning the problem being studied to be conducted accurately and economically (Kabir, 2016).

Consider the research design presented below:

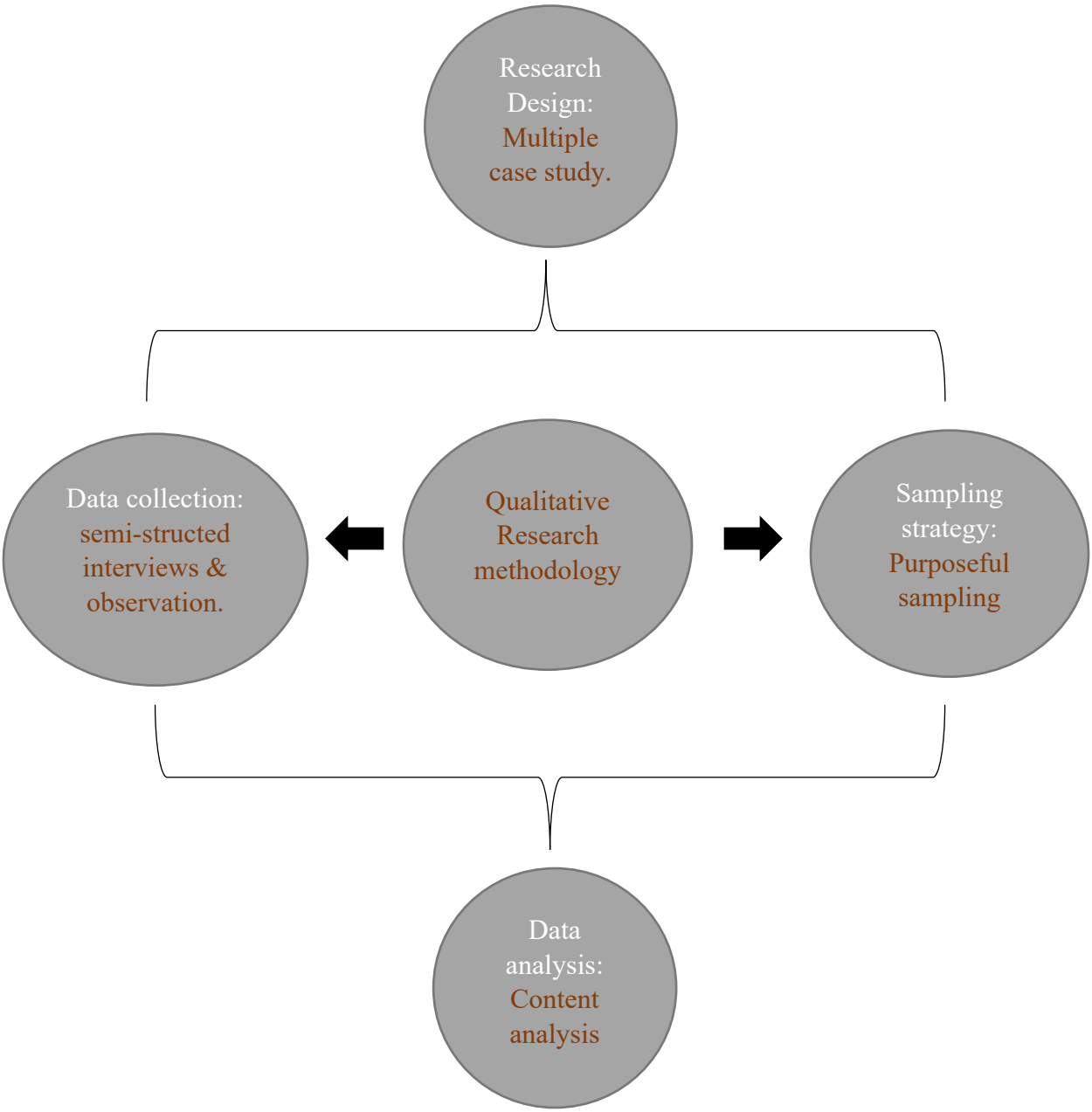

Figure 1: Research design

For this study, the qualitative research method was used. It followed the multiple case study approach and was influenced by the research question, the format and type of data collected, and the data collection process. Creswell (2013) posits that a case study is marked by a real-life exploration of a case or cases where multiple data sources are collected to provide an in-depth description of the issue. Yin (2018) describes case study research as "an empirical method that investigates a contemporary phenomenon in-depth in a real-world context." As a method, it is truly

relevant when investigating unclear boundaries between a phenomenon and the context within with the phenomenon exists (Rini, 2019).

Considering the nature of my research, which is a qualitative study, it was necessary to use the case study approach in probing the research questions. According to Denscombe (2010), any research's success is subject to one's ability to identify the right strategy that allows access to suitable data sources, contexts, documents, people, and events. Swanborn (2010, p.12) describes a case study as the study of a "social phenomenon carried out within the boundaries of one social system (the case), or within the boundaries of a few social systems (the cases), such as people, organizations, groups, individuals, local communities or nation-states, in which the phenomenon to be studied enrols."

The case study method is one of the most used methods within social science for understanding present-day phenomenon both in a formal and informal context. It is necessary to establish the uniqueness of this study and the factors being investigated at the beginning. Thus, a multiple case study method compares innovation in language policy and digital inclusion across two sub-Saharan countries (Ghana and Rwanda). Also, to deeply understand individuals' experiences – the past, present, and future – qualitative research presents a unique opportunity to appreciate the social constructions in the world through data collection and analysis (Breiling, 2017).

Also, a case study allows the pliability of techniques in collecting data for the analysis (Yeboah, 2020). Conversely, this method is often criticized for the generalizations made by its findings. Therefore, a researcher must indicate similarities or contrasts with other cases of its type to disallow inappropriate generalization (Denscombe, 2010).

For this study, three essential data collection methods were used. They were document review, focus group discussion, and one-on-one semi-structured interviews. The interviews and group discussions focused on conversations with carefully selected groups of people, and the document review focused on analysing websites, reports, curricula, and studied cases (Guthrie, 2010; Yeboah, 2020). Guthrie (2010) and Denscombe (2010) posit that interviewing critical informants requires a deliberate selection criterion as the respondents possess a depth of understanding the situation and insights because of their experiences or positions.

To draw out insights from the experiences and views of the participants, I had to utilize interviews instead of observations and questionnaires (Denscombe, 2010). The blended approach to interviewing was used with restrictions due to the coronavirus pandemic easing in some countries. This included some online video interviews and in-person interviews. Regardless of the challenges in online video interviews, such as data costs to the participants and bandwidth issues, which could sometimes take a lot more time, they are as good as in-person interviews or the experience on the telephone and are cost-effective in terms of traveling cost (Yeboah, 2020). The blended approach of online video and in-person interviews provided a much richer experience than telephone interviews.

3.2 Population and sampling

To recruit participants for this study, I sought approval from the ethics committee at the Faculty of Commerce, University of Cape Town. Considering the study was a comparison of cases in Ghana and Rwanda participants were drawn from these countries. Palinkas et al. (2015) emphasize that "purposeful sampling is widely used in qualitative research for the identification and selection of information-rich cases related to the phenomenon of interest." Thus, purposive sampling as a sampling technique is deliberately used by researchers to select participants because they know something about the participant that is valuable to the study (Yeboah, 2020).

In this study, purposive sampling was a reliable technique to identify participants who utilize information technology products in their education to gather educated opinions and informed views on the topic of the study. One of the significant setbacks of this sampling technique is that the researcher could be biased in selecting participants for the study (Etikan, 2016; Yeboah, 2020). Romney et al. (1986) posits that a large sample size in purposive sampling could make extracting thick, rich data difficult. Conversely, Sandelowski (2010) notes that a small sample size could make it difficult to achieve data saturation. Whereas there are no rules in determining the sample size in the research design of a qualitative study, the decision of sample size must be based on what the researcher wants to know. The purposive sampling technique was used to recruit thirty-six participants. The participants were categorized into three groups described below:

> *Group 1 – Education key informants*: The criteria included students studying for either an undergraduate or post-graduate degree and are required to use computers. The two academic institutions included African Institute of Mathematical Sciences and the University of Pretoria.
>
> *Group 2 – Non-education key informants:* The criteria included internet café owners who run tech hubs and engage in non-profit or profit technology literacy programs.
>
> *Other considerations*: Participants from low-income families are beneficiaries of a scholarship program that allowed them to pursue programs in a higher-ed institution.

The table below indicates the descriptions of the eighteen participants:

Group	Average age	Number of years of experience	Educational Background
Non-education key informants (6)	35 years	4-15 years	Diploma and First Degree
Education key informants (12)	20 years	0-4 years	Diploma and First Degree

Table 3: Description of Participants of the study

3.3 Instruments and data collection techniques

Research is typically conducted to uncover added information and to address boiling questions that often occupy our minds and shape how we think and see society in our quest to be the change

we desire in the world by affecting it. The primary goal of this research was to uncover the relationship between young people and technology in relation to reskilling for the future. Nieuwenhuis (2016) posits that qualitative studies often do not consider collection and analysis of data as distinct processes. They are considered cyclical and nonlinear processes that are ongoing. Hence, for this study – data was collected through interviews and document reviews.

3.4 Data Analysis

The transcripts of the interviews were first imported into QDA Miner Lite. The software was used to conduct a content analysis of the data. Codes were developed based on themes that emerged from the data (Braun and Clarke, 2006). These codes were organized into categories and subcategories. The initial coding process involved reading the transcripts to identify keywords and phrases that were relevant to the research questions. These were then grouped together into codes. For example, the code "student engagement" was created to capture teachers' perceptions of how technology impacted student engagement in the classroom.

As the analysis progressed, the codes were refined and revised as new themes emerged from the data. The software allowed for easy organization and manipulation of the codes, which facilitated the analysis process. Once the codes had been established, the software was used to generate reports and visualizations of the data. This included frequency tables, word clouds, and bar charts. These visualizations helped to identify patterns and trends in the data and provided a more comprehensive understanding of the teachers' experiences and perceptions.

The software was also used to identify connections between different codes and categories. This helped to identify overarching themes and relationships between various aspects of the data. Following the initial coding and organization of the data, the software was used to conduct a more detailed analysis of the data. This involved exploring the relationships between codes and categories in more depth and identifying any discrepancies or contradictions in the data.

One feature of QDA Miner Lite that was particularly useful in this process was the ability to generate matrices. These matrices allowed for a more nuanced examination of the data by allowing the researcher to compare and contrast different codes and categories. For example, a matrix could be generated that compared different teachers' perceptions of the impact of technology on student engagement. Through this process, several key themes emerged from the data. These included the benefits and challenges of using technology in the classroom, the impact of technology on student learning, and the role of technology in fostering student engagement.

The software was also used to generate quotes from the transcripts that exemplified these themes. These quotes were used to support the analysis and provide a more vivid illustration of the teachers' experiences and perceptions. Throughout the analysis process, the researcher maintained a reflexive stance, constantly reflecting on their own assumptions and biases. The software allowed for this reflexivity by allowing the researcher to easily return to the data and modify the coding, as necessary.

QDA Miner Lite was an invaluable tool for analysing the qualitative data in this study. The software allowed for a systematic and thorough analysis of the data, while also facilitating reflexivity and exploration of the data.

3.5 Ethics

Prior to conducting the study, ethical clearance for the study was sought and approved by the University of Cape Town Commerce Faculty Ethics in Research Committee. The process involved providing a detailed submission of relevant documents to the ethics committee which was subsequently reviewed and approved via the Commerce Faculty's submittable platform, and a letter issued to the effect. The documents included a research proposal detailing the topic, research design, methodology, and a data management plan. Additionally, a letter of recommendation was also attached to the submission with prior approval by the research supervisor. Participation in the study was voluntary and participants were informed that the data collected will solely be used for the study and nothing else. Hesse-Biber (2017) argues, the moral integrity of any research is hinged on its ability to ensure that outcomes of the study are trustworthy. Hence, the study adhered to O'Leary (2010) recommendations which include obtaining consent from respondents, protection respondents from harm and subsequently anonymizing data and maintaining confidentiality.

3.6 Conclusion

In this chapter, we examined the research design for this study. Grounded in qualitative methodology and the multiple case study approach, the study effectively enabled an in-depth exploration of the research questions. By adhering to established frameworks and methodologies, such as those proposed by Creswell (2013) and Yin (2018), the study successfully investigated the complex phenomena of innovation in language policy and digital inclusion across Ghana and Rwanda. The strategic use of purposive sampling, as endorsed by Palinkas et al. (2015), ensured the selection of information-rich participants, thereby enhancing the validity and reliability of the findings. The integration of various data collection methods, including document reviews, focus group discussions, and semi-structured interviews, allowed for a comprehensive understanding of the subject matter. The use of QDA Miner Lite for data analysis facilitated a systematic and thorough examination of the data, uncovering key themes and patterns that provided valuable insights into the impact of technology on education and reskilling for the future. In Chapter 4, we will examine into depth the data obtained from the study as analysed.

CHAPTER FOUR: DATA ANALYSIS

4.0 Introduction

Qualitative data analysis was conducted on the data collected from participants in Ghana and Rwanda. The analysis aimed to identify common themes and patterns in the participants' responses, to gain a deeper understanding of their perceptions and experiences related to the topic under investigation. The data was analysed using a thematic analysis approach, which involved identifying, analysing, and interpreting patterns of meaning across the data set. The analysis was conducted in several stages, including data familiarization, coding, theme generation, and final interpretation.

During the data familiarization stage, all transcripts were read and re-read to become familiar with the data and gain a general sense of the content. Next, initial coding was conducted to assign labels to sections of the data that related to specific concepts, ideas, or themes. The initial codes were then grouped into broader themes. The themes were reviewed and refined to ensure they accurately reflected the content of the data, and that they were mutually exclusive and collectively exhaustive.

After generating the final themes, the researcher conducted a final interpretation of the data, examining the relationships between the themes and the overall meaning they conveyed. The results of the analysis revealed several primary and secondary themes. The primary themes include initial experience, challenges, the urge to explore, ICT curriculum, influence on a career path, internet cafés, and early access. Access to more diverse and advanced technology, government, research, application support for visa lottery, training, and duration were among the secondary teams identified.

Category	**Code name**
Introduction to the use of computers	Initial experience Challenges Urge to explore
ICT Curriculum	ICT Curriculum
Access to technology and connectivity	Influence on career path. Internet cafés
Digital literacy	Early access Access to more diverse and advanced technology Government
Support Services (for example; Innovation Hubs etc.)	Research Application support i.e., US visa lottery Training Duration

1. Introduction to the use of computers: This category refers to the first experience that participants had with computers. This category has subthemes that include participants' initial experiences, challenges, and whether they had the urge to explore.
2. ICT Curriculum: This theme generally refers to the content and structure of digital literacy. It includes the topics that are covered, the methods of instruction that are used, and the learning outcomes that are expected.
3. Access to technology and connectivity: This category refers to the ability of participants to obtain the resources and opportunities that they need to participate in various activities or programs on digital literacy. Access can also refer to physical accessibility, such as ensuring that individuals with disabilities have equal access to educational opportunities.
4. Digital literacy: This category refers to the ability of individuals to effectively use and navigate digital technologies. This includes skills such as using computers, mobile devices, and the internet, as well as understanding issues related to digital privacy and security. Digital literacy is becoming increasingly important in many areas of life, including education, work, and personal communication.
5. Support services: This category generally refers to the various programs and resources that were available to support participants.

4.1 Introduction to the use of computers

In making sense out of the data, we delve into the initial experiences, challenges, and the urge to explore among participants in this study as it pertains to the use of computers in Ghana and Rwanda. This sets the stage to help us understand the factors and strategies that contribute to achieving technological empowerment through digital literacy and accessible education in these two countries.

Considering the foundation laid in the previous chapter, this category helps us to navigate each participant's experience including the challenges they had to navigate in facing their fears. Within this category, there emerged some key themes. These themes provide a comprehensive picture of each participant's experiences with the computer in their various countries.

The findings from the study revealed that many youths in Ghana and Rwanda, despite the limited infrastructure in terms of computers, internet services, internet speed, and high rate of downtime, received some form of introduction to the use of computers. The upcoming sections will present us with the lived experience of participants in each category.

4.1 a. Initial experience

The participants agreed that the differences in their experiences were because of the endowment of the schools they attended. Whereas most of the participants attended public schools, some of these schools were more equipped than others even within the same city partly due to the benevolence of the government, parent and teachers' associations, or some external support. The initial excitement or fear experienced by the participants can be understood through Piaget's concepts of assimilation and accommodation.

For instance, Participant 1 from Rwanda assimilated the new experience of using a computer into their existing cognitive framework, resulting in excitement. On the other hand, Participant 2 had to accommodate new information about YouTube, adjusting their understanding of what computers can do, which was initially challenging.

> *Participant 1 (Rwanda):*
>
> *The first time I interacted with a computer was when I was in my senior one of secondary school. It was included in our course. I liked the computer from that experience. I was extremely excited about the experience.*
>
> *Participant 2 (Rwanda):*
>
> *I was in senior two in secondary school when I had an encounter with the computer. I have to say it was a challenge. I could not even touch the mouse. I will just go near the computer, and I will be trembling. I would see some students going on YouTube. I asked him "Hey, what are you doing it? You have some DVD there. No, no, no, I am on YouTube." It was really challenging.*

The participants' initial encounters with computers often involved guidance from teachers or more knowledgeable peers, illustrating Vygotsky's Zone of Proximal Development (ZPD). For example, Participant 4 from Ghana practiced with a teacher's laptop, receiving the necessary support to bridge the gap between their current abilities and the new skills they were acquiring. This scaffolding is crucial for effective learning, especially in environments with limited resources. Furthermore, Piaget believed that learning is an active process of discovery. The participants' experiences, such as Participant 3 from Ghana experimenting with a cousin's computer, reflect this idea. Hands-on practice in computer labs or cybercafés allows students to construct their understanding and knowledge rather than passively receiving information.

> *Participant 3 (Ghana):*
>
> *My first encounter with a computer was in 2006. It was my cousin's computer and was a computer freak. I touched it to feel what it was like except I had no idea how to use it and I was scared I could damage it. Prior to that, I had taken a lesson in school about how to create a Yahoo mail but did not practice. I did not know there was something like the internet. It was when we had a chance to practice in the computer lab that I got to know about the internet.*
>
> *Participant 4 (Ghana):*
>
> *Though we took ICT lessons in junior secondary school, which was how I got to know about computers, we did not have any in my school to practice with. I remember the first time I saw a computer was when one of our teachers brought their laptop to school to help us practice what we had learned in ICT.*

Vygotsky's theory on social interaction and collaborative learning emphasizes the importance of social interactions in learning and this is evident in the participants' experiences with computers. For instance, Participant 2 from Rwanda learned about YouTube from a peer, highlighting the role

of social learning. Similarly, the availability of internet cafes as communal spaces for learning aligns with Vygotsky's idea that cognitive development is facilitated through social interactions. The process of equilibration as proposed by Piaget, where learners balance assimilation and accommodation to achieve cognitive stability, is evident as participants gradually become more comfortable and proficient with computers. For example, the transition from not knowing about the internet to practicing in computer labs represents a shift toward cognitive equilibrium.

Thus, the research findings further revealed that besides schools, the internet café, sometimes also known as a cybercafé, is where the participants were introduced to computers outside of the home. These cafés were popular among students, adults and person who did not have their own computers or internet connection. They provided essential services such as training, printing, and connection with friends.

4.1 b. Challenges

Vygotsky emphasized the importance of social interaction in learning. The practice of working in groups, as mentioned by Participant 8, aligns with this principle. However, the effectiveness of this interaction can be limited if not all students get a chance to actively engage with the computer. Piaget believed in the importance of active learning where students interact with their environment to construct knowledge. The passive role described by Participant 8, where some students only watch, is not conducive to effective learning.

> *Participant 8 (Rwanda):*
>
> *My school had a few numbers of computers. We had about five computers in the computer lab. There were about forty students, and we had to work in groups. There was one person whose job was to touch the mouse and another to use the keyboard while others watched.*

Consequently, Vygotsky's concept of ZPD suggests that students learn best with guidance and support that help them perform tasks they cannot do independently. Participant 9's experience of feeling afraid to use the computer highlights a need for scaffolding. According to Piaget, learners build knowledge through experiences and overcoming cognitive conflicts. Participant 9's fear of using the computer indicates a need for confidence-building experiences.

> *Participant 9 (Rwanda):*
>
> *I was in secondary school, and we had a few computers. I had a big challenge. I cannot even touch a mouse. I was just going near the computer. I was trembling. Yeah, I was worried about doing anything. I was afraid I could spoil it.*

Digital technologies are modern cultural tools that students need to master. The disparity in access to computers, as noted by Participant 10, limits students' opportunities to become familiar with these tools. Piaget's theory of cognitive development suggests that students at different stages have

different capacities for understanding and using technology. For example, students in the concrete operational stage (typically ages 7-11) benefit from hands-on, concrete experiences.

> *Participant 10 (Ghana)*
>
> *The only time we got to have some private time using the computer in junior high school was when we closed from school. In my school, you could go to the lab during your free period or after school to use the computer lab. Sometimes, even during those periods, the lab could be crowded as we only had less than 40 computers to serve over a thousand students.*

The findings revealed that although schools provided a level playing field for everyone to receive ICT training and often practice for short durations in the computer lab, not every student got the opportunity to spend a good amount of time interacting with a computer to get familiar.

4.1 c. Urge to explore.

The experiences of the participants from Ghana and Rwanda can be effectively understood through the lenses of Vygotsky's and Piaget's theories. Vygotsky's emphasis on social interaction, cultural tools, and the ZPD highlights the importance of collaborative learning environments and supportive tools in developing digital literacy. Piaget's focus on stages of cognitive development and constructivist learning underscores the role of active engagement and abstract thinking in mastering digital skills.

> *Participant 5 (Ghana):*
>
> *Oh, this was in Kumasi, we had moved from Bolga now. I was going to high school in Sunyani in the Bono Ahafo region. At the time we lived in Kumasi, my sister and I used to go to the internet cafe I would open the back of my nurse's dictionary and find the writers and their email addresses, and the schools were part of, then I will write to them and tell them I want to become a doctor. So, if they had any scholarship opportunities. I quite remember checking back to see if they have replied.*

This participant's interaction with the Internet café and the act of writing to schools and scholarship programs illustrate Vygotsky's principle of learning through social interaction. By reaching out to others, this participant engaged in a meaningful social practice that extended their learning beyond the classroom. Also, writing emails to schools and scholarship programs involves abstract thinking, foresight, and logical planning—key characteristics of the formal operational stage which forms part of Piaget's stages of cognitive development.

Collaborating with friends to practice what they learned in school and pooling resources to access the internet café highlights the importance of peer learning and social collaboration in cognitive development. More so, the collaborative practice of creating emails and navigating the internet suggests logical thinking and an understanding of abstract concepts like email communication.

Participant 6 (Ghana):

My friends and I would go to the café to practice what we were taught in school. A lot of times, we would run out of the minutes we bought before we could even create an email. We usually contributed to buy 1 hour and would take turns. Sometimes two or three of us.

Learning to use digital tools independently and engaging with social media represents the construction of digital literacy through personal exploration and interaction. Thus, learning to use Facebook and Google independently represents the participant's movement through their ZPD, transitioning from needing help to becoming self-sufficient in using digital tools.

Participant 7 (Rwanda):

I remember our school was near to one of the centres where they were providing some services related to the Internet where you can go and just buy some package and then you go for 10 minutes to do what you want. Internet cafe yes internet cafe. So, the time was somehow cheap and when my parents gave me some money, I kept some of it to go to the internet cafe and try to enjoy browsing Facebook because I did not know any other thing. When it comes to experience mostly, I became also comfortable with just the way I can be able to Google or to search something without any help.

The Internet cafés served as cultural tools that mediate the participants' access to information and digital literacy. These tools provided a bridge between their educational experiences and the broader digital world, allowing them to practice and develop their skills in a practical context. By integrating insights from Vygotsky and Piaget's models, we can better understand the participants' initial experiences, challenges, and the strategies that facilitate technological empowerment through digital literacy in Ghana and Rwanda.

Hence by fostering collaborative learning environments, providing appropriate scaffolding, ensuring active engagement, and gradually increasing exposure to technology, schools can better support students in developing digital literacy skills. This approach not only aligns with developmental theories but also promotes a more equitable and effective learning experience in the context of the Fourth Industrial Revolution.

4.2 ICT Curriculum

This category explores and examines the key factors and strategies related to the ICT Curriculum in this study. Thus, the category directly addresses the research question with insights from participants of the study. Understanding how ICT curricula are developed and implemented aids in assessing their effectiveness regarding digital literacy initiatives in these countries. Building upon the previous introduction category to the use of computers, this section will dive into the broader context of digital literacy programs by narrowing our focus to examine how participants interacted with the ICT curricula in their schools in Ghana and Rwanda.

The ICT textbooks and tools mentioned are cultural tools that mediate learning. However, their effectiveness depends on how well they are integrated into the learning process. The reliance on exams and limited practical application, as noted by Participant 10 (Ghana), suggests that these tools were not fully utilized to mediate practical skills development. Piaget's theory also emphasizes that children progress through stages of cognitive development. The participants, likely in the formal operational stage, should be capable of abstract thinking and problem-solving. However, the curriculum described appears to be more rote and less experiential, which might not align with Piaget's emphasis on active learning and exploration.

Participant 10 (Ghana):

We were taught how to create emails, how to create documents and draw shapes. Each lesson lasted about 40 minutes, and it took time to be able to do anything. We were given ICT textbooks. They were huge and besides studying them to practice in the labs, we had to write an exam on paper. We barely covered the syllabus.

Vygotsky's ZPD suggests that students learn best with tasks slightly above their current ability, supported by more knowledgeable others (teachers or peers). For Participant 2 (Rwanda), who was fearful of the computer, appropriate scaffolding and support from teachers could have helped bridge the gap between their current capabilities and potential proficiency. The lack of proper guidance mentioned indicates a missed opportunity to utilize the ZPD effectively. Piaget's concepts of assimilation and accommodation involve integrating new information with existing knowledge and adjusting understanding based on new experiences. The fear and disinterest in ICT described by Participant 2 (Rwanda) suggest that the learning environment did not adequately support these processes. Adequate scaffolding and practical experience are essential for students to assimilate and accommodate new technological knowledge.

Participant 2 (Rwanda):

Because I was fearful of the computer, especially the mouse, I had truly little interest in ICT. It was one of my fearful subjects. I would follow my classmates to attend the classes because I had no option. We did not learn much because we did not have what we needed or some proper guidance.

Piaget advocated for learning through active engagement with the environment. The limited practical experience described, such as rarely turning on computers or not having enough textbooks, indicates a lack of opportunities for students to actively construct their knowledge. For instance, Participant 4 (Ghana) had some hands-on experience with creating folders, but this was minimal and not consistently supported by resources or guidance.

Participant 4 (Ghana):

We were shown what system unit was by one of the teachers who offered to take on the class when they could, I do not know if that computer worked because we did not turn it on. A new teacher joined my school to teach pre-technical skills, and he offered to teach ICT. The pre-tech teacher realized we were about to sit for the Basic Education Certificate Examination and ICT was one of the

examinable subjects which we had not had the chance to practice. Hence, he offered and brought his laptop so when it is time for ICT, we use his laptop. Besides the challenge of not being able to go through the curriculum, we barely had enough textbooks to learn from. He allowed us to try to create folders, those are the things that were in the syllabus. To know how to create a folder, changing wallpaper, open a file and those things.

The limited guidance received by many of the participants of this research indicates the limitations around delivering ICT lessons in a way that made it easy for both young men and women to see their place in the bourgeoning cyberculture.

4.3 Access to technology and connectivity

Accessing technology and connectivity has become the foundation of modern life. More so considering the context of education and skills acquisition. This category of findings explores, in detail, the extent to which participants had access to technological resources and their ability to connect to the internet, which is crucial in facilitating their digital literacy and educational outcomes. Furthermore, we will explore how this category and themes address the research question of identifying key factors and strategies contributing to equitable technological empowerment. Understanding how access to technology and connectivity influences digital literacy and accessible education is critical in promoting equitable opportunities in Rwanda and Ghana.

In this category, we build on previous categories and themes that explored various aspects of technological empowerment, including introduction to the use of computers and ICT curriculum. Thus, we will focus on specific factors and strategies related to access to technology and connectivity. Two primary themes stand out within the broad category of access to technology and connectivity: the influence on career paths and the role of internet cafés. These primary themes illustrate how access to technology and connectivity can impact people's career choices, as well as how internet cafes serve to provide digital resources.

In the following section, we will dive into the experiences of participants in this study and examine the primary themes identified.

4.3 a. The influence on career paths

The impact of digital skills on career paths is a common theme in both Ghana and Rwanda. Proficiency in digital skills, including programming and online learning, is seen as positively influencing career trajectories. Digital skills and technologies themselves act as cultural tools that mediate cognitive development. Early exposure to these tools, as seen in the narratives of Participants 11 and 12 (Ghana), shaped their cognitive abilities and career aspirations.

Participant 11 (Ghana):

So, I will start and say those were the foundation of times right, the times that built us up because this space is very much evolving. I mean, there's a quote by Stuart Brand that says, when technology rolls over you if you're not part of the steam roller, you are part of the road, it means that you, you literally must intentionally build up skills, sharpen skills, polish them, and have relevant skills for the time that we are in…. That is what is positioning us now to be able to sharpen the skills we have, be it in communities, be it in programs. I have a background in computer science, and I have a masters in IT.

Equilibration, Piaget's process of balancing assimilation and accommodation to create stable understanding, is evident in these narratives. Participants assimilated new digital skills and accommodated their career goals based on their evolving understanding. For instance, Participant 12 assimilated their interest in ICT with their business background to accommodate a dual focus on computing and accounting.

Participant 12 (Ghana):

…it did influence my career path. Even though I did not think I could develop a tech career when I was growing up. It was just something I knew I was good at, like, nobody could beat me in ICT in class, like, you know, and so like it was something that I was following. But when I was finishing secondary school and I was applying for university, I saw computer science at Legon, and I applied, and I saw computing with accounting at University for Development Studies (UDS). I chose UDS because I did business, I like IT, and I would like to do both because in secondary school I was particularly good at accounting.

Vygotsky emphasized the importance of social interactions in cognitive development. Participant 3 (Rwanda) illustrates this by describing how engagement with peers at KLab fostered interest in a technology career. The collaborative environment provided opportunities for social learning, aligning with Vygotsky's view that knowledge is constructed through social interaction.

Participant 3 (Rwanda):

After completing secondary school, I taught for a year before going to the university…one afternoon, I learned about this company where you could get free lunch and meet young people to discuss some ideas. I began to research about how they can solve some of the country's problems by using technology. I joined KLab and I was given a computer and had to attend some trainings. That is when I became very interested in a career in technology, unlike the period before when I did not know what I could do with the computer because I was in the rural areas, teaching young people mathematics and so on. So, there were not any skills I was learning during that period.

Therefore, by applying Vygotsky's and Piaget's insights, we can understand that digital literacy and skills development are not just individual cognitive achievements but are deeply embedded in

social interactions and cultural contexts. The narratives from Ghana and Rwanda illustrate how early exposure to digital skills, supported by social environments and active engagement, can profoundly shape career paths, aligning with both Vygotsky's and Piaget's developmental theories.

4.3 b. The role of internet cafés

More so, to access these café's required money. Participants in Ghana and Rwanda often pooled their resources together to buy time at the café. This collective effort reflects Vygotsky's idea of learning as a social activity where peers support each other in achieving common goals. The findings of this study reveal that financial challenges in accessing the internet are mentioned in both Ghana and Rwanda, reflecting a shared theme of overcoming barriers to technology education. Participant 12 from Ghana helped others create email and Facebook accounts, demonstrating peer-assisted learning. This aligns with Vygotsky's concept of the Zone of Proximal Development (ZPD), where more knowledgeable individuals support others in learning new skills. Vygotsky stressed the importance of cultural tools and the social context of learning.

The two cultural and contextual influences identified include economic barriers and gender norms. Thus, financial challenges in accessing the internet are significant in both Ghana and Rwanda. The need to save lunch money or pool resources underscores the socio-economic constraints affecting technology education. These cultural and economic factors shape the participants' access to digital tools.

> *Participant 12 (Ghana):*
>
> *Sometimes, the visitors to our café could not afford to pay for an hour. A few of them would come together and pay for 30 minutes. So, when they come, then I help them create an email. Then they create a Facebook account. So yes, that is basically what we were doing.*
>
> *Participant 13 (Rwanda):*
>
> *For us to have access to the internet, we were supposed to buy some package using our money or our airtime. I remember our school was near one a centre where they were providing some services related to internet. I will go there just to buy some packages and then browse for 10 minutes to do what I want. The rates were cheap and when my parents gave me some money for school, I would save some and use it at the internet café and try to enjoy Facebook because I did not know any other thing.*
>
> *Participant 15 (Ghana):*
>
> *So, in terms of cost, it was not much. An hour will cost you something like fifty pesewas, which was five thousand cedis back then. The cost was not that much, so people could spend hours at the internet café, depending on what they want to do. Mostly when the students come there, it is either they are coming to look*

for information for their assignment or they have been given assignment, they have no computers to type out their work, so they come to the café to type.

Additionally, The experiences of Participants 2 and 4 highlight cultural norms around gender roles. Girls in these communities face social pressures and responsibilities that limit their access to internet cafés, reflecting Vygotsky's idea that learning is deeply embedded in cultural and social contexts.

Participant 2 (Rwanda):

The boys in our class would go to the internet café usually. Sometimes, when me and my friends walk by in our community, we barely see girls there. We must go home to help our mothers after school, so I never had the chance to. For me, I think it was only for boys. Maybe, that is why I was afraid to touch the mouse in school.

Participant 4 (Ghana):

Some of us wanted to go the internet café after school but we did not want to get into trouble. The boys would usually be the ones going. Nobody stopped us. It just was not easy for us because we did not want people to think we were doing something bad. Sometimes in class we heard the boys talk about what they did there.

Vygotsky's concept of social scaffolding complements Piaget's stages of cognitive development by highlighting the importance of social support in advancing cognitive skills. The peer assistance at internet cafés can be seen as scaffolding that helps participants move through Piaget's stages more effectively. Also, Vygotsky's emphasis on cultural tools and Piaget's focus on active learning converge in the participants' use of internet cafés. The internet serves as a cultural tool that mediates cognitive development, providing a platform for exploration and learning within the constraints of their socio-economic context.

4.4 Digital Literacy

Digital literacy involves basic computer skills, including proficiency in using software and navigating digital interfaces. This foundational knowledge is crucial for individuals to access and utilize the vast online resources, from educational materials to communication platforms. The category of digital literacy helps us understand the factors contributing to achieving equitable technological empowerment and accessible education. Thus, to address the disparities in access to technology and promote inclusive education, we must understand digital literacy.

Leveraging the groundwork laid in the previous section on access to technology and connectivity, we now focus on digital literacy's vital role. Developing digital literacy empowers people to unlock the transformative power of technology and enhance their personal and professional growth. Within the category of digital literacy, we will explore themes including early access to

digital learning, exposure to a wider range of advanced technologies, and the impact of government policies and initiatives on promoting digital literacy.

Consequently, digital literacy is a critical part of 21st-century skills and bridges the digital divide while promoting equal opportunities for technological empowerment and education. Knowing the key contributors and strategies that relate to digital literacy helps in addressing socio-economic inequalities and promotes inclusive development. Both countries recognize the importance of practical experience in improving digital skills. In the following sections, we will explore some of the insights from participants regarding the themes identified.

4.4 a. Early access to digital learning

The training programs at Alpha Net Cyber Café (Rwanda) and Khaippa-f Internet Café (Ghana) align with Vygotsky's ZPD by providing guidance and support to learners who have theoretical knowledge but lack practical experience. The step-by-step instruction helps bridge the gap between what learners can do independently and what they can achieve with assistance. More so, the personalized approach where learners specify their needs ("I want this, I want that") and receive targeted help exemplifies scaffolding within the ZPD. The young man from the secondary school is a prime example of a learner progressing through his ZPD with the help of the café staff.

> *Participant 14 (Rwanda):*
>
> *...Here at Alpha Net Cyber Café, we run training programs to support those who are not able to use the computer. During the holidays, parents and individuals come to enrol their children. These clients sometimes have the knowledge or theory but have not practiced. We show them how to type, create email and use the internet to do research.*
>
> *Participant 15 (Ghana):*
>
> *You will tell us what you want, and so we will take you step by step. Okay, I want this, I want that, and then we will do it for you...I quite remember there was a young guy who was then in senior secondary school, that's university practice secondary school. He started coming to the café, not knowing much. But bit by bit, he got to know his way out of the internet setting, how to browse, get information, how to send emails and through that he built his skills.*

The hands-on training approach described above aligns with Piaget's idea of constructivism, where learners actively construct knowledge through experience. Typing, creating emails, and using the internet are practical activities that enable learners to build and refine their understanding. Moreover, the incremental learning process described by Participant 15 is a constructivist approach where the learner actively engages with the material and builds knowledge through exploration and practice.

4.4 b. Exposure to a wider range of advanced technologies

Vygotsky emphasized the importance of social interaction in cognitive development. For Participant 4, learning programming in MATLAB and using LATEX for assignments in a structured academic environment provided opportunities for social learning. The interactions with instructors and peers likely facilitated the internalization of complex concepts. Participant 3's experiences in training sessions and collaborative projects, such as the IoT farm technology, also highlight the role of social interactions and collaborative efforts in enhancing their learning.

> *Participant 4 (Ghana):*
>
> *I got my personal computer in the second year second semester during my undergraduate studies. At that time, we had already started learning how to do programming in MATLAB and typing assignments with LATEX started that semester…But for me, I was only doing the things that they taught in school. So, if they use it to write a code, I come back I write a code, type an assignment, I type an assignment.*
>
> *Participant 3 (Rwanda):*
>
> *As a data analyst and a graduate of the University of Rwanda College of Science and Technology, I gained some experience in data analysis with Python Power BI. Before I had some training, in IoT and, the Internet of Things from Fab Lab and we have developed some of the technologies like as a farm technology that helps the farmers to know the status of their crops in real time and this is the project that is running in Eastern Province.*

Vygotsky's concept of ZPD can be seen in both participants' experiences. For Participant 4, tasks such as writing code and typing assignments were within their ZPD. The guidance provided in school helped them perform these tasks effectively. Participant 3's engagement with advanced technologies like IoT and data analysis tools, initially through structured training, represents the scaffolding necessary to progress through their ZPD. The practical application of these skills in real-world projects like farm technology exemplifies moving from assisted to independent task completion.

4.4 c. Impact of government policies

Vygotsky emphasized the importance of social interaction in learning. In Participant 1's experience in Rwanda, the provision of a laptop by the government and the availability of free Wi-Fi on campus created an environment conducive to collaborative learning. The participant utilized these resources to enhance their understanding of computers, likely engaging in peer interactions and online communities to facilitate learning. This aligns with Vygotsky's notion that learning is a socially mediated process.

> *Participant 1 (Rwanda)*

I remember before starting my studies in the university on government scholarship, one of my dreams just was to have a computer that was been provided by our government when you got that scholarship. At the time, the government made it a policy to provide each student entering the university on scholarship with a laptop. I spent like one year or ideally year one without having that personal computer, but I got it on the on the on the last day of completing my first year. I made sure that I used the free Wi-Fi on our campus to learn everything about the computer that I could.

Participant 17 (Ghana)

The government at a point introduced a policy where people who did not have and could not afford laptops were given laptops. It was exciting to hear but we did not know how one could get one. It felt like people close to the government were the only ones receiving these laptops.

Piaget's theory focuses on stages of cognitive development, with each stage characterized by different ways of thinking. For university students like Participants 1 and 17, who are likely in Piaget's formal operational stage, the ability to think abstractly and systematically is crucial. Access to technology such as laptops facilitates this stage by providing tools for research, problem-solving, and critical thinking.

4.5 Support Services

Vygotsky's ZPD concept suggests that learning occurs most effectively when individuals engage in activities with the guidance of more knowledgeable others. Community centres, libraries, and internet cafés, among many others, have continued to provide support services, significantly bridging the digital divide across social levers by addressing challenges, fostering skill development, and enhancing overall accessibility to technology. Piaget's theory emphasizes that learning is an active process of constructing knowledge based on prior experiences and interactions with the environment. Whether through targeted training sessions, mentorship programs, or inclusive initiatives, these services empower individuals to navigate the digital landscape, fostering a sense of confidence and proficiency.

The category of support services relates directly to the research question, which aims to uncover the factors and strategies that influence equitable technological empowerment. By investigating support services such as research assistance and training, and visa application support we gain a deeper understanding of the mechanisms that facilitate digital literacy and accessible education in Rwanda and Ghana.

Building on the previous findings above, this section shifts its focus towards specific support services that enable these outcomes. The results from Ghana and Rwanda reveal striking similarities and notable differences in digital service offerings, particularly in internet services and computer training. In both countries, businesses are crucial in providing diverse services, including internet and photography.

4.5 a. Research assistance and training

Internet cafes and labs serve as spaces where collaborative learning can take place. Participants engaged not only with technology but also with peers and mentors, fostering social interaction and shared learning experiences. This aligns with Vygotsky's emphasis on social interaction as a critical component of cognitive development. Participants actively explored and interacted with technology and information. For example, individuals went to the cafes not only to access the internet but also to learn practical skills like typing or using Microsoft Word and Excel. This hands-on approach allowed them to construct their understanding of digital tools and applications.

> *Participant 15 (Ghana):*
>
> *The main reason the internet café existed was to provide an internet service for students and the people within the community to use it for their research among other things. And so, in terms of research, especially with the graduate students and people outside the university community when they come and because of their busy schedule, they cannot sit or use the café, they just give you the information they are looking for to the attendant.*
>
> *Participant 18 (Rwanda):*
>
> *KLab is also known as the knowledge lab. And through KLab we have been able to implement several programs. We have a program for refugees where we train refugees in different camps in Rwanda with our partner ALIGHT Rwanda. KLab provides a unique, extensive program that helps equip and groom talented creative refugee programmers to provide them with the necessary tools needed to make them into 'A-level skill programmers and developers in Rwanda.*
>
> *Participant 16 (Rwanda):*
>
> *The internet café became our second line of business. Originally, we provided photography services, but the market changed, and we offered more services. These included training on how to use Microsoft Word and Excel. Duration of school vacations or after school closes, we would have students and other people come to learn how to type or look for information.*
>
> *Participant 12 (Ghana):*
>
> *At my dad's café, we had Mavis Beacon on our PCs. Some of the customers who came were used to learning how to type, so they came in bought time and just try to use a keyboard to type. Others also came to do some research and work on their assignments and papers.*

Through structured programs and mentoring (like at KLab), participants developed skills beyond their current capabilities, supported by knowledgeable instructors and peers. Participants actively engaged in learning through hands-on activities such as typing practice and software training, adapting their skills and knowledge based on their interactions with technology and others.

4.5 b. Visa support services

Vygotsky emphasized that learning occurs through social interaction and collaboration. Participants 15, 16, and 18 highlight how their businesses evolved based on responding to social needs. For instance, Participant 15 in Ghana recognized a community need for assistance with US visa lottery applications, which customers couldn't easily access at home. By providing this service, they not only addressed a practical need but also engaged in social interaction that potentially enhanced their service offerings based on community feedback and collaboration.

Piaget's theory emphasizes how individuals assimilate new information into existing cognitive frameworks (assimilation) and adjust these frameworks in response to new experiences (accommodation). Participants' experiences illustrate this process: as they encountered new demands (such as competitive markets or customer needs for visa assistance), they assimilated these challenges into their business models by expanding their service offerings. This process of accommodation involves adjusting their strategies and services to effectively meet new demands and expand their market reach.

> *Participant 15 (Ghana):*
>
> *...But then we realized that there was a need for other services too you know, to be incorporated, including helping customers with their US visa lottery application. Most customers could not access the DV lottery program from home and would come to us for assistance.*
>
> *Participant 16 (Rwanda):*
>
> *The market became extremely competitive. Many stalls opened across the street so we had to add some more service. We were the only ones helping people who wanted to apply for visas. We also provide services to people who want to access any government service online.*
>
> *Participant 18 (Rwanda):*
>
> *We have had some of the users of our space or students enrolled in our programs build solutions and one of the benefits they get with us is support including when they must travel to pitch at a competition for instance. We are able to help them get visas and a plane ticket.*

Piaget's stages of cognitive development suggest that individuals progress from sensorimotor to concrete operational thinking. In the context of these businesses, the entrepreneurs demonstrate concrete operational thinking by identifying practical needs (like visa assistance or online service access) and implementing solutions that cater to these needs. Their businesses evolve through practical, hands-on responses to market demands, reflecting cognitive development in action.

4.6 Conclusion

All eighteen participants agreed that their experiences with technology both in school and outside of school significantly shaped their worldview about the future use of technology in their daily lives. In this chapter, we examined the findings from this study, which aimed to uncover how we can foster equitable technological empowerment through digital literacy and accessible education in Ghana and Rwanda. Through our exploration and analysis, several key themes emerged, offering an opportunity to reflect on the participants' experiences.

Integrating Vygotsky's and Piaget's theories provided a robust framework for understanding and fostering both individual development and societal advancement in sub-Saharan Africa. By emphasizing social interaction, cultural mediation, developmental processes, and practical adaptation, these theories sheds light on the pathways towards equitable education, entrepreneurial success, and sustainable community empowerment in the region.

Firstly, the introduction to the use of computers served as a pivotal moment for many participants, sparking their curiosity and interest. We also examined the role of the ICT curriculum in the school systems in Ghana and Rwanda and its impact on evolving the participants' interests. Access to technology and connectivity proved instrumental in equipping individuals with the technical proficiencies and competencies necessary for meaningful engagement with digital technologies, thereby facilitating digital literacy. Sustained support over time enhances learning outcomes and contributes to the long-term empowerment of individuals.

In the following chapter, we will analyse the findings presented in this chapter in detail, providing a solid basis for further examination and contemplation. Chapter 5 will highlight the strengths, weaknesses, and opportunities for change in both Rwanda and Ghana. Crucially, we will extrapolate from these two case studies by leveraging insights from the AIMS network, as promised in the introduction, to provide key insights for the 4IR for Africa as a whole.

CHAPTER FIVE: DISCUSSION

Navigating Equitable Technological Empowerment in Ghana and Rwanda

The analysis of data on digital literacy and 4IR in Ghana and Rwanda sheds light on the interplay between national-level policies and the realities faced by individuals at the grassroots level. This discussion aims to unravel the successes and shortcomings of state policies in leveraging information and communication technology (ICT) to achieve equitable technological empowerment across sub-Saharan Africa through digital literacy in the context of the Fourth Industrial Revolution (4IR).

5.1 Introduction to ICT and the use of computers

The inclusion of Information and Communication Technology (ICT) into the educational frameworks and policies of both Ghana and Rwanda marks a notable advancement in their commitment to preparing students for the demands of the digital era. Ghana's ambitious Basic School Computerization policy and Rwanda's comprehensive ICT for Accelerated Development Policy showcase a deliberate effort to infuse technology into formal education, recognizing its transformative potential (Adarkwah, 2021; Mushimiyimana et al., 2022). Despite these commendable strides, an in-depth examination reveals intricate layers of challenges, particularly concerning the heterogeneous nature of ICT exposure among students, complexly linked to the disparities in school endowment.

The Basic School Computerization policy in Ghana, implemented in 2011, was envisioned as a transformative force, permeating computers, and e-learning tools throughout the educational system. Its objectives aimed to equip students with essential digital literacy skills, positioning them as adept navigators of the increasingly technology-driven world (Soma et al., 2021). Similarly, Rwanda's ICT for Accelerated Development Policy, initiated in 2003, embodies a multifaceted approach, designating a dedicated pillar to ICTs in education. This policy underscores Rwanda's commitment to fostering a culture of training and lifelong learning, aligning with the broader global narrative of preparing individuals for the challenges and opportunities presented by the digital age (Mugiraneza, 2021).

The research findings suggest that the introduction to the use of computers can be strongly associated with access to education. Thus, despite the challenges in the implementation of the various policies introduced by both the Ghanaian and Rwandan government, some form of ICT education was taking place in secondary schools. However, the study brings to light a nuanced reality characterized by disparities in the quality of ICT exposure among students. These disparities are intricately tied to the variations in school endowment, encompassing factors such as infrastructure, resources, and external support. The digital divide, manifested in unequal access to technology, implies that not all students experience the same level of immersion in ICT within the formal education system. Consequently, a critical examination of the impact of national policies on the ground is imperative to ensure that the envisioned benefits of technological integration reach all strata of the student population.

One notable manifestation of this digital divide, from the perspectives of Vygotsky and Piaget, is the reliance on internet cafés as supplementary learning spaces. Therefore, one could not rule out the importance of internet café's in ensuring persons who could afford could use some extra help in brushing up their skills. Despite the overarching goals of national policies to create uniform access and practice opportunities within formal educational settings, the prevalence of internet cafés as alternative learning environments and sometimes the nouveau technological version of playground for young people suggests a gap in the realization of these objectives. Students often turn to these cafés for essential services, such as training, printing, and connectivity, underscoring the significance of informal spaces in the broader digital education landscape (Adomako et al., 2022; Cullen et al., 2019; Mugiraneza, 2021). The emergence of these supplementary learning spaces prompts a revaluation of the effectiveness of national policies in providing comprehensive and equitable access to ICT resources.

The reliance on internet cafés not only highlights potential shortcomings in the reach of national policies but also raises concerns about the overall impact on the development of digital skills. Limited access and practice opportunities within formal education settings could hinder students' ability to fully comprehend and apply ICT concepts, potentially leaving them at a disadvantage in the digital age (Adomako et al., 2022). This realization necessitates a thorough examination of the efficacy of national policies, urging policymakers to address disparities in school endowment, explore innovative solutions, and refine implementation strategies to bridge the digital gap effectively. The efficacy of national policies becomes a focal point, urging policymakers to address the complicated web of disparities and limitations, ensuring that the promise of equitable and comprehensive digital education becomes a reality for all students. Only through a holistic and adaptive approach can the transformative potential of ICT in education be fully realized, preparing students to thrive in the evolving landscape of the Fourth Industrial Revolution.

5.2 ICT Curriculum and Skill Development

Since the year 2000, both Ghana and Rwanda have been introducing Information and Communication Technology (ICT) into schools. In 2011, Ghana introduced the Basic School Computerization policy targeted at introducing computers and eLearning into the entire educational system. Prior to this, the government also introduced ICT for Accelerated Development (ICT4AD) Policy in 2003 with a pillar dedicated to ICTs in education. Thus, the goal was to promote training and life-long learning (Al-Hassan & Natia, 2015). Rubagiza et al., 2011 posit that computer-based technologies can be powerful pedagogical tools – not just rich sources of information, but extensions of human capabilities and contexts for social interactions.

The exploration of ICT curriculum and skill development within the education policies of Ghana and Rwanda reveals the complex nature of the challenges and opportunities. Participants' narratives lay bare the inadequacies embedded in the existing ICT curriculum, as they recount experiences characterized by limited practice hours and a pervasive lack of confidence in utilizing digital tools effectively. This critical examination of the educational landscape brings to the forefront a gendered dimension, shedding light on how young girls grapple with the intimidating nature of internet cafés, signifying the pressing need for more inclusive and empowering educational approaches.

The shortcomings in the ICT curriculum, as articulated by participants, unveil a misalignment between policy intentions and on-the-ground realities (Agyei & Agyei, 2021; Karakara & Osabuohien, 2019). The limited practice hours underscore a potential gap in translating theoretical knowledge into practical skills, hindering students from developing the level of proficiency required in an increasingly technology-centric world. The pervasive lack of confidence further exacerbates these challenges, indicating a need for pedagogical strategies that foster a sense of competence and empowerment among students navigating the digital landscape.

Thus, the gendered dimension cannot be overlooked as it plays an essential role in ICT use both at school and internet cafés. In Ghana and Rwanda, it is evident that boys use computers at school for a broader range of activities than girls in pre-tertiary levels of education. In most cases, the nouveau technological version of the playground—the internet café—was not accessible to girls. The boys had more access and use of ICT tools available in these spaces more often than girls. The limitations faced by girls in accessing these facilities further entrenched the low levels of computer skills and, in some cases, affected their interest in using ICT tools. Additionally, girls' shyness contributed to their reluctance to frequent these spaces. Consequently, in both countries, it is evident that boys use more ICTs in learning than their female counterparts due to the time available to them to practice ICTs.

Furthermore, the gendered dimension introduced in the discussion adds another layer of complexity to the educational landscape. The findings emphasize how young girls perceive internet cafés as intimidating spaces. This perception hints at deeper societal norms and expectations that may contribute to a gendered digital divide, potentially limiting the participation of young girls in technology-related fields (Karakara & Osabuohien, 2019). The nuanced revelation underscores the imperative for national policies to move beyond a generic approach and address the specific challenges faced by different genders in the realm of digital education.

The core of the discussion revolves around the necessity for national policies to bridge the curriculum gaps and create an educational environment that fosters inclusivity and empowerment for all genders. This involves a multifaceted approach encompassing curriculum redesign, teacher training, and the creation of a supportive ecosystem that encourages all students to embrace technology with confidence. Policymakers must take into account the diverse learning needs and experiences of students, ensuring that the ICT curriculum aligns with the practical demands of the digital age.

Moreover, the call for inclusivity extends beyond the curriculum to the broader educational culture. Creating an environment where both genders feel empowered and supported in their pursuit of technology skills requires dismantling stereotypes, fostering mentorship programs, and actively encouraging girls to participate in ICT-related activities (Buabeng-Andoh, 2019; Soma et al., 2021). National policies should prioritize initiatives that promote diversity and equality in technology education, recognizing the potential of all students to contribute meaningfully to the digital landscape.

The exploration of ICT curriculum and skill development within the educational contexts of Ghana and Rwanda unveils a multifaceted challenge that demands a comprehensive and nuanced response from national policymakers. Some of these challenges share similar characteristics with the

literature examined in Chapter Two of this study and can be seen as a repetition of the nuances from previous policies including the change in language of instruction prior to Grade 4 in the case of Ghana and the switchover from French to English in the case of Rwanda. More so, the gendered dimension adds layers of complexity, emphasizing the need for targeted interventions to ensure that all genders feel empowered and supported in embracing technology. As the educational landscape continues to evolve in the digital age, national policies must adapt and innovate, fostering an inclusive and empowering environment that equips all students with the skills and confidence needed to thrive in the ever-changing world of technology.

5.3 Access to Technology

The theme of access to technology resonates profoundly within the educational landscapes of both Ghana and Rwanda, revealing a complex interplay of factors that significantly influence the digital literacy journey of individuals (Mugiraneza, 2021; Soma et al., 2021). This multifaceted exploration delves into the realms of physical accessibility, personal motivation, and the proactive pursuit of learning, emphasizing the critical need for national policies to not only acknowledge but actively address the challenges hindering broad and equitable access to technology. Physical accessibility emerges as a pivotal aspect of the access to technology narrative. While both countries recognize the role of internet cafés as instrumental in facilitating technology education, the nuanced reality of physical accessibility unfolds as a challenge.

The mere presence of these establishments does not guarantee uniform access, as factors such as geographic location, infrastructure, and resource distribution contribute to discrepancies in physical accessibility (Uwizeyimana, 2022). In Rwanda, nationwide access to 4G has significantly improved connectivity, providing a more level playing field for accessing digital resources. Similarly, in Ghana, the zero-rating of educational sites during the pandemic ensured that students could access critical learning materials without incurring data costs, thereby mitigating some barriers to digital literacy. These initiatives highlight the importance of national policies that assess and address the geographical spread of technology-related resources. Ensuring that both urban and rural areas have equitable access to the tools that foster digital literacy is essential for bridging the digital divide and promoting inclusive technological empowerment.

Considering the competitive nature of the world today, it has become clear that the ability to compete globally today requires a lot more than just brilliance. The need for technology skills has become more dire while access to technology is no longer a luxury. It has become clear that technology endowed students have a competitive edge over their non-technology endowed counterparts. Thus, the findings of this study revealed that both countries highlight the importance of informal learning environments, such as internet cafés, in facilitating technology education. In Ghana and Rwanda, the internet café was pivotal besides the classroom in acquiring the needed technology skills. Participants in both Ghana and Rwanda stressed the significance of personal motivation and being proactive – the insights given show that individuals took initiative, to explore technology independently, often driven by their interest and curiosity.

Personal motivation surfaces as another intricate layer in the access paradigm. Based on the findings in the previous chapter, this study further unveils insights into how individuals, driven by personal interests and curiosity, take proactive initiatives to explore technology independently.

This aspect underscores the importance of cultivating a culture that nurtures intrinsic motivation for technology-driven learning (Adegoke et al., 2023). National policies, in this context, should consider strategies to enhance the intrinsic motivation of learners, fostering a sense of curiosity that transcends the confines of formal education.

However, financial challenges loom large as a formidable barrier to access in both Ghana and Rwanda. The study identifies financial constraints as a shared theme, acknowledging that the ability to access the internet is often hindered by economic considerations. The high cost of internet access in both countries exacerbates this issue, making it difficult for many, especially those facing economic hardships, to participate in the digital revolution (Cullen et al., 2019; Kano & Toyama, 2020). This revelation unveils a stark reality where segments of the population find themselves on the fringes of technological advancements. To bridge this gap, national policies must confront the economic barriers by introducing innovative solutions that make technology more affordable and accessible to diverse socioeconomic groups.

Addressing financial challenges requires a multifaceted approach, potentially involving partnerships with the private sector, subsidies, or community initiatives (Attuquayefio, 2019; Kano & Toyama, 2020). In Ghana, universities have implemented strategies such as offering data SIMs with affordable plans targeted at tertiary students, significantly easing their access to online educational resources. In Rwanda, initiatives like those by IRED have played a crucial role in providing financial and technical support to underserved communities, ensuring broader access to technology. National policies, such as collaborating with internet service providers and telecommunication firms to zero-rate educational sites and make access to learning management systems free and accessible, as seen during the COVID-19 pandemic, could actively contribute to democratizing technology access. These measures help break down economic barriers, ensuring that digital literacy is not a privilege but a right for all citizens.

The overarching call is for national policies to foster a culture of self-driven exploration and curiosity. Recognizing that access is not solely about the physical availability of technology but also about creating an environment that encourages proactive learning, policymakers must align their strategies with the evolving dynamics of technology adoption. This entails promoting initiatives that inspire a love for learning and self-driven exploration, transcending the boundaries of formal education. The exploration of access to technology underscores the need for a comprehensive and dynamic approach within the realm of national policies. It demands a re-evaluation of the geographical distribution of technology resources, strategies to enhance intrinsic motivation, and innovative solutions to overcome financial barriers. As technology continues to shape the educational landscape, national policies must be agile, adaptive, and inclusive, ensuring that every individual, regardless of their geographic location or economic status, can partake in the transformative journey of digital literacy.

5.4 Digital Literacy Initiatives

Both Ghana and Rwanda continue to make strides in integrating ICT into their education systems. The landscape of digital literacy initiatives in these countries unfolds as a dynamic interplay between private enterprise and national policy, shaping the digital competencies of individuals across diverse demographics. This exploration delves into the role of businesses, particularly

internet cafés, in propelling digital literacy. It emphasizes the need for national policies to recognize and support these private initiatives while striking a delicate balance to ensure inclusivity across different age groups and socio-economic backgrounds (Buabeng-Andoh, 2019).

The heartbeat of digital literacy initiatives resonates with the active involvement of businesses, predominantly internet cafés, in both countries. These establishments serve as hubs where individuals can access essential digital skills training, from basic computer literacy to more specialized applications such as Microsoft Word, Excel, and PowerPoint. The business-centric approach, while instrumental in providing practical, hands-on learning experiences, introduces a distinctive dynamic to the digital education landscape, one that calls for a nuanced approach in national policymaking.

The discussion unfolds around the impact of this business-centric approach on diverse customer demographics. Internet cafés, as crucial players in the digital literacy ecosystem, attract a broad spectrum of individuals seeking to enhance their technological skills. In Ghana, clientele ranges from teachers to recent high school graduates, while Rwanda's cafés cater to teachers, students, and high school graduates. This diverse clientele underscores the importance of acknowledging the unique needs and preferences of different demographic groups, shaping policies that cater to the varied backgrounds and goals of the learners (Adegoke et al., 2023; Soma et al., 2021).

Crucially, the digital literacy initiatives spearheaded by businesses also reflect fluctuations in popularity based on seasons and student vacations. This dynamic nature suggests an adaptive response to the ebb and flow of demand, mirroring the agility of private enterprises in addressing the evolving needs of the digital education landscape (Adegoke et al., 2023). National policies, therefore, need to embrace a flexible framework that accommodates the dynamic nature of digital literacy initiatives, ensuring that interventions remain relevant and responsive to the shifting patterns of demand.

While recognizing and supporting private initiatives are imperative, the crux lies in striking a balance that fosters inclusivity. The digital divide is not only geographical but also socio-economic, and national policies should actively seek ways to bridge these gaps. Initiatives that cater to the needs of various age groups and socio-economic backgrounds should be prioritized, ensuring that digital literacy is not a privilege confined to a specific demographic but a right accessible to all (Kano & Toyama, 2020).

Acknowledging the impact of businesses on digital literacy, national policies should foster partnerships between public and private sectors. This collaborative approach can harness the strengths of both spheres, leveraging the agility of private enterprises and the strategic vision of government policies (Abedi, 2023; Uwizeyimana, 2022). Support mechanisms, such as incentives or subsidies for businesses engaged in digital literacy initiatives, can be integrated into national strategies, fostering a symbiotic relationship that advances the shared goal of creating a digitally literate population.

The narrative of digital literacy initiatives unfolds as a dynamic partnership between private businesses and national policies. The interplay is characterized by the agility of businesses in meeting diverse learning needs and the responsibility of national policies to ensure inclusivity.

Striking this delicate balance requires a nuanced understanding of demographic dynamics, flexible frameworks that adapt to evolving demands, and collaborative efforts that leverage the strengths of both private and public sectors. In the ever-evolving landscape of digital education, national policies must stand as pillars of support, guiding the trajectory of digital literacy initiatives towards a more inclusive and empowered.

5.5 Support Services and Inclusivity

The realm of support services in the digital education landscape emerges as a critical bridge in overcoming the digital divide, facilitating inclusivity, and ensuring that individuals of diverse backgrounds and abilities can actively participate in the digital transformation journey. This exploration navigates through the instrumental role of support services, showcasing the Rwandan context with KLab's inclusive efforts as a beacon for fostering diversity and inclusivity. The imperative for national policies lies in not only recognizing but replicating and scaling up such inclusive programs to create a digital landscape that leaves no one behind (Karakara & Osabuohien, 2019).

Support services, often encapsulated in computer training programs and mentorship initiatives, play a pivotal role in making technology education accessible to a broader demographic. The study underscores their significance in acting as a catalyst for bridging the digital divide, acknowledging that access to technology is not only about physical availability but also about providing the necessary tools, guidance, and mentorship to navigate the digital landscape effectively.

The Rwandan context, highlighted by KLab's efforts, stands out as a compelling model for inclusivity in support services. KLab's commitment to supporting individuals with varying skill levels, including kids and refugees, through training programs for coding and digital literacy, reflects a proactive approach to addressing the diverse needs of the community. This inclusive ethos ensures that individuals from diverse backgrounds and abilities are not only included in the digital conversation but are also empowered with the skills necessary to thrive in the digital age.

In the case of Ghana, support services provided by internet cafés have played a pivotal role in advancing digital literacy and technological empowerment. These establishments offer programs throughout the year targeting underserved populations, providing essential training and resources, especially during the long vacation holidays. Many of these businesses operate a split model, offering typing lessons and introductory computing courses at designated hours while functioning as full-time internet cafés. This approach ensures continuous access to both practical skills training and internet resources, significantly contributing to the digital competencies of diverse demographic groups.

The imperative for national policies is to recognize the significance of inclusive support services and to channel efforts into replicating and scaling up such initiatives (Adomako et al., 2022; Karakara & Osabuohien, 2019). KLab's model provides a blueprint for creating an environment where technology education is not a privilege limited to a select few but a right accessible to all. By embracing and expanding inclusive support programs, policymakers can actively contribute to levelling the playing field, dismantling barriers that hinder individuals from diverse backgrounds and abilities from fully participating in the digital transformation.

Replicating such initiatives involves a strategic approach to ensure that support services are tailored to the unique needs of different demographic groups. This includes considerations for age, educational background, and socio-economic status (Adegoke et al., 2023; Mushimiyimana et al., 2022). National policies should incorporate flexibility in their frameworks, allowing for the adaptation of support services to the specific requirements of the communities they serve.

Scaling up inclusive programs requires a commitment to resource allocation and strategic partnerships (Mushimiyimana et al., 2022). National policies should incentivize the establishment and expansion of initiatives like KLab, fostering collaborations between public and private sectors. This approach not only ensures the sustainability of inclusive support services but also enriches the overall digital education ecosystem with diverse perspectives and experiences.

Support services stand as a linchpin in ensuring inclusivity in the digital education landscape. The Rwandan example with KLab showcases the transformative impact of inclusive support programs, setting the stage for national policies to play a pivotal role in replicating and scaling up such initiatives. By prioritizing inclusivity in support services, policymakers can actively contribute to creating a digital landscape that reflects the diversity of its users, breaking down barriers and fostering an environment where everyone can thrive in the digital transformation journey.

5.6 Conclusion

At the heart of this discussion is the goal of using Information and Communication Technology (ICT) to improve digital literacy, which is crucial for the Fourth Industrial Revolution (4IR) in sub-Saharan Africa (Dosso et al., 2021). This culminating discussion examines how national policies play a key role in this effort, evaluating their success in meeting the overall objective. To achieve technological empowerment and digital skills, successes need to be highlighted and repeated, while failures should prompt strategic changes. The goal is to ensure everyone benefits from technological advancements, preparing the region to face the challenges and seize the opportunities of the 4IR (Fox, 2013; Metu et al., 2020).

As sub-Saharan Africa positions itself within the context of the 4IR, mastering digital skills is essential for individuals to navigate the global digital landscape, access information, and participate in international discussions (Doorsamy et al., 2021). National policies must therefore ensure that ICT and digital literacy are seamlessly integrated, preparing the population for the transformative journey of the 4IR. The scrutiny of national policies involves looking closely at successful initiatives. Identifying and promoting success stories is essential to find best practices that can be applied in different contexts. These successes might include initiatives that effectively integrate technology into educational curricula, provide teacher training programs for ICT proficiency, and create supportive environments that encourage students to embrace digital skills (Dosso et al., 2021; Nwosu et al., 2023).

On the other hand, it's important to acknowledge the failures of current national policies. Failures offer important learning opportunities and require a re-evaluation of strategies to improve their effectiveness. Issues might arise from infrastructure limitations, inadequate resource allocation, or implementation challenges. Addressing these failures requires a flexible and responsive approach.

Policymakers need to continuously seek feedback from educators, students, and stakeholders to refine strategies and make technological empowerment accessible to all.

Preparing the region for the 4IR depends on the fair distribution of these benefits. National policies play a crucial role in removing barriers that could worsen existing disparities. This means ensuring both rural and urban areas have access to strong ICT infrastructure, that teachers are equipped with the necessary skills to integrate technology into education, and that students from all socioeconomic backgrounds have equal opportunities to benefit from the digital age (Kano & Toyama, 2020; Mugiraneza, 2021).

In conclusion, national policies significantly impact sub-Saharan Africa's path in the 4IR. Aligning ICT with digital literacy is key to preparing individuals for the digital age's complexities. The successes and failures of current policies provide valuable insights, guiding policymakers toward better strategies that foster an inclusive and empowered population. As the region stands on the brink of the 4IR, examining national policies is not just necessary but is a driving force for a transformative journey that enables everyone to contribute meaningfully to the digital era's challenges and opportunities.

CHAPTER SIX: PRIORITIES FOR IMPLEMENTATION – A PRAXIS MODEL

6.1 Practical Implications

The findings from the interviews in Ghana and Rwanda offer practical implications that can guide practitioners in making better decisions and plans related to digital literacy initiatives, education policies, technology access, and community development. Here are how these findings can inform their actions:

1. **Equitable Access to Technology and Digital Divide:**
    - **Practical Implication:** Practitioners, such as educators, policymakers, and NGOs, can prioritize initiatives that ensure equitable access to technology, particularly in public schools and underserved communities. This could involve providing computer labs, mobile computer stations, or partnerships with internet cafés to facilitate access to computers and the internet. In doing so, disparities in school endowments will be addressed.
    - **Benefit:** By addressing the digital divide at its root, practitioners can create a more level playing field for individuals to acquire essential digital skills, thus reducing disparities in digital literacy, and fostering equal opportunities for education and employment.
2. **Importance of Education in Developing Digital Literacy:**
    - **Practical Implication:** Educational institutions should integrate comprehensive digital literacy education into curricula, focusing on practical hands-on training alongside theoretical knowledge. Practical workshops, coding clubs, and computer labs can be introduced to facilitate experiential learning.
    - **Benefit:** This approach ensures that students graduate with not only theoretical knowledge but also practical digital skills, preparing them for the demands of the digital workforce and empowering them to navigate the digital world effectively.
3. **Curiosity, Motivation, and Lifelong Learning:**
    - **Practical Implication:** Educators and trainers should design digital literacy programs that leverage individuals' curiosity and motivation. Incorporating interactive and engaging activities can sustain participants' interest and encourage them to explore technology further.
    - **Benefit:** This approach fosters a positive learning experience, increasing the likelihood of individuals embracing lifelong learning and keeping up with technological advancements throughout their lives.
4. **Tech Hubs and Community Development:**
    - **Practical Implication:** Establishing and supporting innovation technology hubs, like KLab in Rwanda, can provide a platform for aspiring tech entrepreneurs to access mentorship, training, and resources. Practitioners can facilitate partnerships between tech hubs and community organizations to maximize impact.
    - **Benefit:** Such initiatives can nurture local talent, stimulate entrepreneurship, and contribute to economic growth. Practitioners can facilitate networking events, workshops, and hackathons to encourage collaboration and innovation within the community.

5. **Adapting Education for Technological Evolution:**
    - **Practical Implication:** Educational institutions need to adapt curricula to reflect technological advancements. This includes introducing emerging technologies, coding languages, and digital problem-solving skills.
    - **Benefit:** Graduates will be better prepared to meet the evolving demands of the job market, fostering a skilled workforce that can drive innovation and contribute to economic growth.
6. **Addressing Societal Perceptions:**
    - **Practical Implication:** Advocacy campaigns and awareness programs can challenge societal perceptions that hinder the pursuit of technology-related careers, particularly for women. Encouraging parents, teachers, and peers to support technology interests can break down stereotypes and encourage more inclusive participation.
    - **Benefit:** This approach can diversify the technology workforce and ensure that no one is discouraged from pursuing a tech-related career due to societal biases.

Incorporating these practical implications into policies, educational programs, community initiatives, and workforce development strategies can lead to a more digitally literate society, equitable technology access, and enhanced opportunities for personal and economic growth.

6.2 Recommended Intervention: Equitable Digital Literacy Community Centres

The challenge of equitable access to digital literacy is significant, especially in underserved communities. While various initiatives are being implemented, such as providing computer labs in schools and offering digital skills workshops, a comprehensive and sustained solution is needed. More so, it is also recommended that continual and comprehensive training be provided in coding languages and applications, iterative problem-solving techniques, constructing digital narratives, and the ability to collaborate effectively.

In order to take these change initiatives further, a praxis model[1] has been developed, based on the outcomes of the research carried out in Ghana and Rwanda; the concept of Equitable Digital Literacy Community Centres (EDLCCs) that go beyond traditional computer labs, offering a holistic approach to digital literacy while addressing the gaps in existing efforts. Innovative financial approaches will have to be leveraged to fund and facilitate the smooth running of these centres. Several funding models can be considered and applied given specific context. In most cases, community investments will be required to ensure ownership and sustainability.

Key Features of EDLCCs:

1. **Multi-Purpose Learning Spaces:** EDLCCs will serve as multifunctional community spaces equipped with computers, internet access, and interactive learning resources. They will offer a comfortable and inviting environment for individuals of all ages to explore

[1] Developing a praxis model that demonstrates how research findings can be implemented is an integral part of the UCT Graduate School of Business Masters programme in Inclusive Innovation and is a recommended component of master's dissertations.

technology. The space will be designed for easy reconfiguration and arrangement to allow for easy adaptation to suite specific needs at any given time including a variety of learning activities, lectures, demonstrations, and collaborative group activities. Accordingly, the space will be equipped with a range of modern and innovative technologies including computers, high-speed internet, interactive whiteboards, virtual reality equipment among others that are integrated seamlessly into the learning environment and permits transitions between analogue and digital modes.

The EDLCCs will incorporate collaborative zones in the space to encourage collaboration. These collaborative zones will include dedicated spaces for individual learning, group discussions, breakout rooms, pods for meetings, dinning spaces, a communal area, and project-based learning spaces, among others. More so, accessibility will be a main priority in the design and building of the space to cater for the diverse needs of all users including those with physical and cognitive differences. Consequently, the space will be retrofitted with adjustable workstations, varied seating options and assistive technologies to facilitate smooth learning and instruction as well as for easy use.

In addition to the above, the space will be built to accommodate multisensory elements that engage multiple senses including appropriate lighting, ventilation, acoustics, and visual displays which enhance the learning experience. Thus, by futureproofing these spaces, we can provide the necessary support to our young people and prepare them for the forthcoming digital revolutions.

2. **Comprehensive Digital Literacy Programs:** EDLCCs will offer diverse digital literacy programs, including basic and advanced computer skills, coding workshops, artificial intelligence and machine learning training, cybersecurity training, and digital communication. These programs will cater to beginners as well as those seeking more advanced skills. The future proof EDLCCs will focus on developing foundational digital skills which includes training on safe and responsible use of technology which empowers the youth to have an appropriate digital etiquette.

   Also, the youth will be equipped with instruction on basic computing operations which includes file management and common software applications to effectively search, evaluate and utilize information and digital resources online. Thereby, building their critical thinking skills to be able to make assessments on bias of digital content, reliability, and credibility. An added layer of training will include computational thinking for learners who are prepared to be introduced to concepts in programming, algorithmic thinking and logical problem solving.

   In the wake of social media and the metaverse and considering that we are a few years shy from a quantum revolution, it is prudent to ensure that digital literacy programs include instruction on the use of digital tools to create and edit multimedia content for multiple platforms and allowing for the youth to tap into their creative potential and engage in self-expression through storytelling and media production.

3. **Personalized Learning:** Another key feature of EDLCC is the availability of personalized learning pathways. The centres will offer flexible and customizable learning tracks for students with diverse interests, skills level and learning preferences. To complement this, the EDLCCs will have skilled mentors who guide learners based on their interests and goals. This personalized approach will help participants progress at their own pace and explore areas of technology that align with their passions. By incorporating self-paced modules, interactive tutorials, and personalized feedback mechanisms in the development of training programs delivered at the centres will enable a life-long learning culture and opportunities.

   Personalized learning as an educational approach allows for an improved understanding of complex concepts vis-à-vis an improved learner experience. With the advent and democratization of data analytics and innovative tools that can improve learners experience, EDLCCs will leverage such innovations to create a dynamic environment that adjust curriculum, learning materials and instructional resources to each student's performance based on their progress and learning styles. Thereby, empowering students to play an active role in their own learning journey and equipping them to decide their learning goals, what types of content they are interested in and the pace at which they learn.

   This data-driven approach will also enable educators and program designers to continuously monitor the progress of students and identify areas where they could provide targeted support and allow for student self-reflection while owning the learning process. Additionally, the value in personalized learning as part of the EDLCCs is that the demands of the modern workforce which includes critical thinking, adaptability, flexibility, and self-directed learning will be met while preparing students with the tools to succeed in an ever-changing and complex world continuously been driven by technology.

4. **Community Engagement:** To make educational and training programs inclusive and effective, community engagement must be an integral part of these programs. Thus, EDLCCs will collaborate with local schools, community organizations, and non-governmental organizations to provide real-world learning experiences for learners. The EDLCCs will be established within communities and provide a platform for partnerships and collaboration. Mobile EDLCC units can also be deployed to reach remote areas with limited infrastructure.

   These collaborations with the private sector with a presence at local, regional, and national levels, community organizations and social impact organizations will be leveraged to provide trainee opportunities including internships, mentorship, job shadowing, and access to industry-relevant tools and technologies that promote real world applications of the knowledge, and skills acquired by these students. Furthermore, students will get the opportunity to organize and participate in community-based events that raise awareness and foster a sense of pride in their communities while encouraging both community and family participation in their education.

   Consequently, EDLCCs will feature a representation of community leadership and participation in the day to day running of the centres. Involving community members

including underrepresented groups in both decision-making processes especially around policies, curriculum and resource mobilisation and allocation is helpful in ensuring the educational system is responsive to the diverse needs and perspectives existing in these communities.

5. **Career Development and Entrepreneurship Support:** Another noteworthy feature of the EDLCCs is the inclusion of a carefully tailored career development and entrepreneurship support structure. Thus, the EDLCC as a platform could complement existing educational systems by providing the much-desired tailored career counselling, assessments, and exploration opportunities to assist students in identifying their interests and what skills they need to develop to further explore these interests and leverage it to build a career path. It is important that we expose students to diverse options of occupations, industries, and emerging job trends.

   Furthermore, providing students with work-integrated learning opportunities within EDLCCs will enable them to build the skills industry require of them by applying the skills they have acquired to real-world problems. Hence, the EDLCCs will offer workshops on job readiness, resume building, and interview skills. These programs will be developed with the support of both local businesses and organizations within the catchment area allowing them to relate their experiences to that of the broader community and empowering them to identify the challenges within their communities they would like to address.

   Additionally, EDLCCs will facilitate entrepreneurship programs. These programs will offer workshops that introduce students to the principles of entrepreneurship and modules will include business planning, design thinking, financing, marketing, data, and decision making. The centre will also connect participants of such programs with resources to turn their innovations into viable businesses.

6. **Inclusivity and Accessibility:** This feature will be mainstreamed into the principles of the EDLCCs to ensure equitable learning opportunities for all and sundry. EDLCCs will prioritize inclusivity by ensuring accessibility features for individuals with disabilities. Workshops on digital ethics, online safety, and responsible technology use will be conducted frequently to empower users as part of the holistic support they will receive from the centres.

   The centres will also be learning spaces are barrier-free, multilingual, and multicultural with regular talks from guest speakers, authors, and mentors from underrepresented groups. For instance, linguist or custodians of oral tradition will be given resident fellowship opportunities at these centres to nurture interest in deepening the knowledge of the users of the space on the history and implications of history on the growth and progress of the communities. This will restore some sense of pride and allow for the younger generation to learn from the mistakes of their ancestors while using the lessons to design a better experience for members of their communities.

   Considering the needs of marginalized groups and ensuring inclusive access to facilities and programs within EDLCCs will be the premise on which the ethos of these centres will

be built. Embracing this feature is critical to creating a learning environment that respects and celebrates diversity while eliminating barriers to active participation and empowers students, communities, and organizations to thrive and reach their full potential. The kind of symbiotic relationship needed in the world today.

Distinctive Factors of the Proposed Intervention

While other initiatives focus on single aspects like computer labs or coding workshops, EDLCCs provide a comprehensive approach. The multi-purpose nature of EDLCCs ensures that individuals can access resources, training, and mentorship under one roof, making digital literacy a holistic experience. The personalized learning approach, community engagement, and focus on career development set EDLCCs apart from existing efforts.

6.3 Conclusion

The praxis model of Equitable Digital Literacy Community Centres (EDLCCs) presented in this chapter directly addresses the critical issues highlighted by our research findings in Ghana and Rwanda. The interviewees consistently pointed out a lack of effective learning environments, underscoring the need for more comprehensive and supportive digital literacy infrastructure. The proposed EDLCCs would have significantly better prepared them for the demands of the digital age by providing access to advanced technological resources, personalized learning pathways, and community-driven support. The findings underscore the vital contribution cybercafés have made over the years, providing crucial access to technology for many who would otherwise be left behind. However, as technology evolves, so must our approach to digital literacy. EDLCCs represent a logical evolution from the opportunities that cybercafés offered earlier generations. These centres will build on the foundation laid by cybercafés, offering a more structured, inclusive, and forward-thinking approach to digital literacy.

In summary, the EDLCC model stands as a testament to the need for innovative, community-centric solutions in bridging the digital divide. By integrating practical implications from this study, the aim is to create a future where every individual can thrive in a digitally connected world. This model not only addresses current gaps but also paves the way for sustainable community development and empowerment through technology. The next chapter summarizes the entire study and presents a conclusion to the study.

CHAPTER SEVEN: SUMMARY AND CONCLUSION

Digital skills are crucial for working, communicating, and engaging in online activities, reflecting the theories of Vygotsky (1978) and Piaget (1952). Vygotsky's emphasis on social interaction and the zone of proximal development highlights that digital literacy must be nurtured through guided learning and collaboration. Piaget's focus on cognitive development underscores the need for digital skills to evolve with learners as they progress through different stages of cognitive maturity.

As students move towards university education and pursue their career paths, they will require strong digital skills, especially in navigating the Fourth Industrial Revolution and beyond. The ability to adapt to a constantly changing online environment is essential for success in both higher education and the workforce. This reinforces the need for educational approaches that integrate digital literacy from early stages and continue to build these skills throughout development. The significance of digital literacy is well-supported by research from Bergson-Shilcock (2020), and Cummins et al. (2019). The kind of learning environments essential for enabling such learning and skills development has been captured in the concept of the Equitable Digital Literacy Community Centre, set out in the previous chapter.

7.1 Summary of Findings

This study by integrating Vygotsky's (1978) and Piaget's (1952) theories provided a robust framework to address the question, "What are the key factors and strategies that will contribute to achieving equitable technological empowerment across sub-Saharan Africa through digital literacy, and in the context of the Fourth Industrial Revolution?" Insights from Ghana and Rwanda revealed several critical factors and strategies for promoting digital inclusion and empowerment.

1. **Limited Access:** A recurring issue across both countries is limited access to computers, particularly in public schools. This underscores the necessity of ensuring equitable access to technology within educational settings to bridge the digital divide.

2. **Importance of Education:** Education emerged as a fundamental factor in developing digital skills. While computer labs in schools were beneficial, disparities between private and government schools were evident. Integrating digital literacy into the curriculum is essential to equip all students with necessary skills.

3. **Challenges and Support:** Initial difficulties in using computers and the internet were common. However, with ongoing practice and support from educators, peers, and online resources, participants were able to overcome these challenges. Adequate training and resources are vital for effective digital literacy development.

4. **Curiosity and Excitement:** Participants demonstrated a high level of curiosity and enthusiasm when exploring digital technologies. This eagerness to learn played a significant role in their digital skill development. Encouraging curiosity is crucial for motivating individuals to enhance their digital capabilities.

5. **Access and Affordability:** Both countries faced challenges related to access and affordability of computers and internet services. Issues such as geographic location and limited internet cafés were noted. Initiatives aimed at making technology and internet access more affordable and widespread are essential.

6. **Changing Landscape:** The rise of personal devices like laptops and smartphones is altering the technology landscape, reducing reliance on internet cafés. This shift highlights the need for continuous adaptation and learning to keep pace with technological advancements.

7. **Tech Entrepreneurship and Community Development:** There is a growing focus on tech entrepreneurship and community development. Innovation hubs and related programs are fostering opportunities for tech entrepreneurs, contributing to job creation and societal progress.

These findings emphasize the need for equitable technology access, the pivotal role of education in digital literacy, the importance of continuous learning, and the value of supportive environments. These insights can guide the development of policies and initiatives aimed at advancing digital inclusion and empowering individuals in the digital age.

7.2 Limitations of the study

This research provides insight into young people's experiences with technology as a tool in preparing them for the future of work and the fourth industrial revolution. However, there were a few limitations in the process of conducting the study. These limitations include:

- **Unexpected life events:** The researcher encountered several unexpected life events during the research period. The family and work-related challenges including relocating abroad to provide care for a close family relation, employment retrenchment and the birth of their child. These unanticipated circumstances posed several challenges for the researcher to been able to complete the study with the intended number of participants and countries as a few missing data points from the country excluded from this study would have skewed the representativeness of the final dataset.
- **Reliance on self-reported data from participants:** The study was anchored on surveys and interviews as a means of information gathering on participants experiences and perceptions. Although this approach provides valuable insights into their lived experiences, self-reported data can be subject to potential biases including social desirability or recall bias which then influences the accuracy of the responses. More so, the study which was conducted in countries within specific geographical regions in sub-Sahara Africa, that is, East and West Africa could potentially limit the generalizability of the findings to other cultural and socio-economic contexts due to differences in educational systems, availability of infrastructure, social norms. These could impact the researcher's ability to transfer the results to other settings.
- **Nature of study:** The study was designed to capture the experiences of participants across sections of society. Thus, the cross-sectional nature of the study design provides a snapshot of participants experiences at a given time instead of a longitudinal perspective. Tracking

participants experiences over an extended period could provide more comprehensive insights into the dynamic nature of this study.

Conclusively, future research could make provisions for robust contingency plans and support systems that help address the impact of unexpected life events as well as incorporating a mix of data collection methods that help to corroborate self-reported information. Also, expanding the geographical scope of the study in future could also enhance how broad the application of the finding of this study is.

7.3 Conclusion

This study, which explored experiences with digital technology in Ghana and Rwanda, has provided valuable insights into achieving equitable technological empowerment. The findings highlight the need to address existing inequalities and involve those most affected in creating solutions. Key insights include the importance of accessible digital education. Issues like limited access to computers in public schools and the excitement sparked by initial encounters with technology point to the need for widespread digital education. To close the digital divide, educational curriculums should focus on both basic and advanced digital skills while ensuring inclusivity and participatory learning.

Recommendations include establishing Equitable Digital Literacy Community Centres. These centres would offer personalized mentorship and comprehensive programs, aligning with current initiatives to foster inclusive tech empowerment. Essential skills should include basic computer use, effective internet searching, hyperlink use, email communication, identifying misinformation, and productivity tools. In today's digital age, digital literacy is crucial. It guides our way through technological advancements. With these insights and recommendations, our goal is to empower communities, bridge digital divides, and unlock everyone's potential. This study is not just an academic exercise but a step towards a more equitable digital future, helping African countries compete on equal footing with wealthier nations where digital and language skills are more common.

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APPENDICES

Appendix A: Participant Invitation Email and Consent Form

Dear Participant,

Thank you for accepting to assist me in this study. I am working towards completing an MPhil in Inclusive Innovation (Research only) at the Graduate School of Business - University of Cape Town. While pursuing my MBA, I found it very intriguing that I had classmates from all over the world and the personalized MBA journey proved to be better than I expected. Hence, I sought to bring this insight to the Bertha Centre to conduct a study on how we can improve education in Africa and prepare young Africans for the future of work. **Please see my abstract attached**.

I am incredibly grateful to you for volunteering to give me 1-hour of your time. A WhatsApp group can be created for our communication as well. I would like to ask two things of you. First, could you please complete the survey below before the group discussion.
Research survey - Digital Inclusion

Secondly, I invite you to join me for a 1-hour group discussion on this topic **on the 18th of May 2022 from 7-8 pm**. You do not need to prepare. All you need is to come.

Thank you in advance for all your help.

Kind regards,

Sampson

MASTER OF PHILOSOPHY IN INCLUSIVE INNOVATION

INTERVIEW CONSENT FORM:

Participant name ……...

I volunteer to participate in a research project conducted by Sampson Kofi Adotey as partial fulfilment of the requirements for the MPhil Degree at the Graduate School of Business. I understand that the research is designed to gather information about "**Navigating Equitable Technological Empowerment: Insights from, Ghana, and Rwanda on Digital Literacy and Inclusive Education**" and that I will be one of approximately 30 people being interviewed for this research.

Background and purpose of the research

The research will delve into the intricate fabric of individuals' experiences with technology, specifically computers, the internet, and digital literacy, across, Ghana, and Rwanda. Its overarching purpose would be to shed light on the path towards equitable technological empowerment. Through a comprehensive study, the research will uncover insights that emphasize the need for accessible digital education.

Ethics approval

Ethical consent for the study has been approved by the *UCT Commerce Faculty Ethics in Research Committee*.

Participation and confidentiality

I understand that my participation in this research is voluntary, that I will not be compensated and that I may withdraw at any time.

The interview will take approximately 45 - 60 minutes to complete and will be audio recorded. I understand that I will not be identified by name in any reports using information obtained from this interview and that my confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.

Consent

I consent to participate in this interview, based on the terms outlined above and subject to the following additional condition of my own (if any).

----------	**----------**
Signed by interviewee	**Date**
……..	**…….**
Signed by Student	**Date**

Appendix B: Interview Guide

STUDY TITLE: NAVIGATING EQUITABLE TECHNOLOGICAL EMPOWERMENT: INSIGHTS FROM, GHANA, AND RWANDA ON DIGITAL LITERACY AND INCLUSIVE EDUCATION

Biographical Information About Interviewee

Male/Female or Binary

Tertiary Institution or Organization

Year/Job Title or Profession

- **Qualitative interview introduction**

Length: 45-60 minutes

Primary goal: To engage in a dialogue that mirrors your perspective, creating an environment akin to a conversation.

- **Consent Confirmation**

Are you interested in taking part in this interview?

The participants provided their signed consent before the interview commenced.

- **Background Information**

Invite interviewees to briefly introduce themselves. Then proceed with the following questions.

1. When was the first time you ever interacted with a computer or digital technology?
2. What was the experience like?
3. Did you have any prior knowledge of accessing the computer?
4. In your reflections, can you identify any cultural barriers within the target language communities?
5. What support did you receive or provide to peers interested in learning about technology or improving their digital skills?

Appendix C: Business Plan

To operationalize this intervention, a sustainable business model will be developed. A business model is a strategy or plan that illustrates how we intend to make money and provide value to our customers – in this case, users. Several tools exist to build a business model. However, we will use trhe business model canvas tool available online to map out how the EDLCCs will make money while providing value. Some of the building blocks within the model include key partnerships, value propositions, key activities and resources, revenue streams, cost structure, customer segments and relationships as well as the channels.

<table>
<tr><td colspan="2">Business Model Canvas</td><td>Designed for:
EDLCC</td><td>Designed by:
Sampson Kofi A</td><td>Date:
May 2024</td><td>Version:
1.0</td></tr>
<tr><td>Key Partners

Government of Ghana
Government of Rwanda
Multi-lateral organizations
Philanthropies
Communities and Local Government
Education Departments/Ministries
Non-formal education partners
Technology companies
Telecommunication networks</td><td>Key Activities

Rent/Build Learning Centres
Engage communities, partner, and tech ecosystem.
Hire Coaches, Admin Team and recruit Advisory Board
Obtain Funding
Implement marketing and recruitment drive etc.

Key Resources

Available land in a pilot community
Student program content</td><td>Value Proposition

Digital Literacy training programs
Ideation and Innovation Competitions
Student Exchange Programs
Access to coaching and mentoring
Live projects and business support services</td><td>Customer Relatio

Academic Institutions
Community groups
Youth Groups
Foundations and Non-profits focused on education

Channels

Social Media
Partner Referrals
Academic Partner
Advertising
Community Platforms
Word of Mouth</td><td colspan="2">Customer Segments

Students
Academic Institutions
Local Government
Private sector and other stakeholders
Entrepreneurs
Small and Medium scale enterprises
National Government</td></tr>
</table>

	Legal and business framework Website domain name Debt Capital		School notice boards	

Cost Structure	**Revenue Streams**
$150,000 Setting up budget for two pilot centres in Rwanda and Ghana Other costs yet to be determined	Competitions Grants from Public and Private organizations Events and Rentals, etc.

Consequently, the steps outlined below will follow the development of the business model canvas. Thus, the business plan for setting up and running an EDLCC will include considerations of the following:

1. **Funding:** To set the EDLCCs up, we will seek investments including grant funding from private investors and government, corporate sponsorships, philanthropic organizations, and crowdfunding campaigns. Other sources of funding will include community investments which could be in the form of labour in the construction of the centre from community as well as other in-kind support from local businesses including discounts for materials etc.
2. **Location:** We will identify strategic locations in underserved communities with proximity to clusters of schools or community centres with a high activity rate. The EDLCCs should be easy to locate and affordable to visit thereby eliminating any barriers of entry. We will leverage partnerships with local schools, libraries, or community centres to minimize infrastructure costs.
3. **Key Resources:** To accomplish the key features in the design, build and set up of the EDLCCs, we will invest resources in the procurement of net-zero and green tools and technology while leveraging existing resources within the community to construct and finish the building. The buildings will be made from earth while leveraging the sun using solar energy to power computers, and technologies within the centre. We will also prioritize ergonomic furniture, and accessibility tools. The design of the space must be conducive to learning and collaboration.
4. **Training and Mentorship:** In implementing programs at the centre, we will recruit experienced mentors who are enthusiastic about technology and community development. These mentors could be within the community or be willing to connect via media platforms such as webinars etc. The year-round mentors will be train in personalized mentoring techniques and digital literacy curriculum delivery. These roles will be purely voluntary and seen as community service.

5. **Program Development:** Key to the success of the EDLCCs is our programming. We will develop a range of digital literacy programs catering to different skill levels. Programs will include after school activities and seasonal camps to be held in collaboration with local educators and industry experts and design the equip participants with the skills and knowledge as well as character in addressing the everyday challenges they face.
6. **Community Engagement:** Consequently, we will forge partnerships with local schools, NGOs, and community leaders to identify target participants. Considering the EDLCCs will be community centred, we will organize awareness campaigns and orientation sessions to attract learners. Community investments will be prioritised and encouraged to encourage community ownership and ensure that the resources invested yield benefits for the community and its people.
7. **Sustainability:** In other to remain a viable business and ensure sustainability beyond grant funding, we will generate revenue through subscription-based access plans for individuals whose household income is above a specific threshold, corporate training partnerships, and community events hosted at the centre. Offer tiered memberships for various levels of engagement. Another way to reduce cost of running the centres will be the returns on investment in climate neutral technologies including power generation equipment functioning on solar, the earth used in the construction of the centre as well as the various initiatives targeted at minimizing direct cost and setting limits to indirect cost.
8. **Monitoring and Evaluation:** To ensure we are on track to achieving our goals and objectives, we will implement a robust monitoring system to assess participants' progress and gather feedback. Continuous improvement based on feedback is essential for the success of EDLCCs. It will also further allow us to report on our impact and enable us to keep an eye out for opportunities for investments in scaling our impact.

Appendix D: Implementation Plan for Equitable Digital Literacy Community Centres

1. Introduction

The Equitable Digital Literacy Community Centres (EDLCC) aim to bridge the digital divide by providing underserved communities in Ghana and Rwanda with access to technology, digital literacy education, and ongoing support. This plan outlines the steps necessary to establish and maintain these centres effectively. These two centres will be the pilot for this proposed intervention to test the validity of my recommendations.

2. Objectives

- **Improve Digital Literacy**: A key objective of the EDLCC is to provide education and training to increase digital skills among community members.
- **Enhance Access to Technology**: Additionally, our goal is to ensure that underserved communities have access to computers, the internet, and other digital tools to build capacity and become competitive.
- **Promote Social Inclusion**: More so, the EDLCCs will also enable participation in the digital economy and society.
- **Support Lifelong Learning**: The EDLCCs will consequently serve as a platform for fostering an environment of continuous education and skill development.

3. Target Audience

Whereas the EDLCCs will be open to all, we believe that our priority customers will include the following groups:

- Low-income individuals and families
- Unemployed and underemployed adults
- Students in underserved schools
- Marginalized and minority groups.

4. Key Components

1. **Partnerships and Collaborations**
    - Partner with philanthropies, national governments, local governments, non-profits, educational institutions, and tech companies.
    - Develop sponsorships strategy including materials for financial and material support.

- Collaborate with local community leaders to promote the centres.

2. **Program Design**
   - Develop a curriculum that covers basic to advanced digital skills including AI, Quantum Mechanics, Digital Marketing, Project Management etc.
   - Include specialized programs for different age groups and needs.
   - Incorporate both instructor-led and self-paced learning options.
3. **Staffing and Training**
   - Hire qualified instructors and support staff to run these centres.
   - Provide ongoing training for staff to stay updated with technological advancements.
   - Engage volunteers from the community and partnering organizations.
4. **Outreach and Engagement**
   - Conduct community awareness campaigns to promote the centres.
   - Use social media, local media, and community events for outreach.
   - Establish feedback mechanisms to understand community needs and improve services.
5. **Monitoring and Evaluation**
   - Develop impact measurement guidelines and protocols for assessing the impact of the centres (e.g., number of participants, improvement in digital skills, employment outcomes).
   - Regularly review and assess the programs to ensure they are meeting the requirements for upskilling students.
   - Adjust programs based on feedback and evaluation results.

5. Implementation Steps

In other to realize this vision of the EDLCCs, the following steps will be taken to ensure a smooth take off and implementation. Each phase will be mapped out including associated costs and nuances around the context of the communities.

Phase 1: Planning and Preparation

- Conduct a needs assessment in targeted communities.
- Secure funding and resources.
- Identify and rent/purchase space in suitable locations.

Phase 2: Setup and Staffing

- Purchase and install necessary infrastructure (computers, internet, etc.).
- Recruit staff and conduct on-boarding sessions.
- Develop, pilot, and finalize the curriculum.

Phase 3: Launch and Initial Outreach

- Launch the centres with an inauguration ceremony with different stakeholders in attendance.
- Initiate community outreach and awareness campaigns to recruit first batch of students.
- Begin training the first batch of students enrolled in the digital literacy programs.

Phase 4: Operation and Scaling

- Monitor daily operations and ensure smooth functioning.
- Collect and analyse feedback from participants.
- Plan for scaling up based on initial success and community demand.

6. Budget Requirements

- **Infrastructure**: Computers, internet setup, furniture, and utilities.
- **Staffing**: Salaries for instructors and support staff.
- **Training**: Professional development for staff.
- **Program Development**: Curriculum design and materials.
- **Outreach**: Marketing and promotional activities.
- **Operational Costs**: Maintenance, utilities, and miscellaneous expenses.

7. Sustainability Plan

- Develop a fundraising strategy including grants, donations, and sponsorships.
- Introduce membership or small participation fees for long-term sustainability.
- Regularly review and adapt business models to ensure financial viability.

8. **Risk Management**

- Identify potential risks (e.g., funding shortfalls, low community engagement).
- Develop mitigation strategies (e.g., diversified funding sources, robust outreach plans).
- Continuously monitor risks and adjust strategies, as necessary.

Appendix E: Selected Interview Transcripts

Transcript of Interview with Focus Group - Ghana

Interviewer: Okay, so this is a focus group discussion for Ghana. The second part. And I am confident that we might have someone else join us. But in the meantime, we are just going to start the conversation. So, this goes to any of you, when was the first time you ever saw touched, hacked, or interacted with a computer?

Person 1; Okay, I can start so this is Probably, the 2000s, early 2000s pretty much early with our ninety-five ermm, Windows 95, running a monitor computer sitting in the living room with our windows 95 on there. And we were born in 95 so you are thinking about it and I'm thinking okay, so once a time there was something like this also been developed or created, and we only had the opportunity to touch it after we had had good grades in school, because my dad allowed us to play pinball, and also to just learn typing with it, Mavis Beacon. So, this was the very early 2000s, probably maybe 2004, three Yeh around those times. And it was in a room. So, it was just, it is just worn. And we had four children around there. So, we should take turns to operate it. And my big brother would probably play solitaire. The two of us, my twin sister and I would play pinball and do Mavis Beacon, and my older sister, she used to really like Encarta Kids. And she goes there to explore. I mean, she usually used to do geography and English literature. And she actually went to learn general arts in school, and she did some of those, and it is exciting. So those were the times that we began exploring. It moved from there to creating email addresses, and probably maybe subsequent questions would ask me other, other things, how, how it progressed. But that is how it started for us.

Interview; yes, that's very interesting P1.

Person 2; Hi. So erm, I literally, saw a laptop or felt a laptop before I used a desktop computer. So, I cannot remember but somewhere in 2003, or 2004 our dad brought a laptop in the house. I am sure a friend has sent the laptop to him from the states. So, he bought the laptop, and we open the laptop. I had an idea about what a computer is, and a laptop is, and I knew I open the laptop. I mean, there were a lot of funny things I saw on the laptop. I mean, that was my first time, so I was trying to find a way around it. But a miracle happened when in 2005 our mom bought us a desktop computer the white, you know, elephant computer I mean, those big things, white mouse, white keyboard, and yes, so that was where the journey started. And after that, we had a computer sitting in the room every day, it is when it's connected to the internet. We did not have the internet, it was just, we had Mavis Beacon we had Encarta and then we had what, these funny games on Windows XP. Yes, so it was sitting, we are just literally typing every day. So, and you do not use the computer during school hours. So school is no one is allowed to touch the PC sitting in the room,

and weekends, and then vacation. So, on vacation we have to type every morning before we have breakfast. So that is where, you know, that's what I can clearly remember. Yes.

Interviewer; Yes. So, who made you type? What was the, what was the reason behind typing? Was it like, a requirement to actually, I do not know, like, why would you type?

Person 2; Okay, so the truth of the matter ermm, is we had a family friend staying in a house who had persuaded my mum to buy a computer, we were all boys in the house at that time. So he was in a university, he was in Tech reading architecture. So, he had a computer at that time because of his AutoCAD etc., etc. So, he was using a computer. So, he asked our mom to get us a computer and then he forced us to type actually. And he was the boss of the house. So, what he tells our mom is we do. Our mom cannot type, I mean, our mom is not a computer person. But he will tell us if you do not type to this speed limit, you're not taking your breakfast etc. But with time for the first three days, it was nothing fun because you are typing you do not know where to press A and D and S and etc. After two weeks, I think it became a passion, and everyone Love it. Erm, two of my siblings did not like it because they feel why should they type whilst maybe they can play Mario or play GTA and you're asking them to type by force, by force. So yes.

Interviewer; Yes, that's interesting. I am curious, like, so how long did that typing exercise happen, like for how long? Well, how!

Person 2; For how long? So, I clearly remember, when the computer came during that vacation, you know the computer was bought during vacation. And those times there was a long, like, lengthy, vacation, you do not have these two weeks and one week so, vacation can be a month and two weeks. It was a long vacation. And the experience was, I mean, it was exciting to wake up every morning, and then sit behind a PC and then type with all those Mavis Beacon funny sounds, and you are playing the games etc. So, it lasted for a month. And then yes, but since that time, I've not typed or used minutes, because again, so yeah, that was the time I learned how to type and, you know, you couldn't do anything with a PC just to type and play a game what, what Mario? GT…was it GTA? No that was after windows seven, but I know you couldn't do anything but to type and use the paint application, paint.

Person 1; Yes. So let me just pick it up from what confidence is saying. For our experience, l I told you, we used to do games and use a computer as a reward for doing like, a good job in school, and for studying hard and doing everything, right. And we used to just have different interests based on who was using the Pc. But I mean, we went to many computer classes too and computer training in schools. So, we had one. I mean, I remember, I will probably be ill. But because you had assignments to complete at a computer… ermm this is Bolgatanga And well, and Bolgatanga you know is at the northern part of Ghana is a place that probably people will feel so much under development in the, in those regions but we had the opportunity to have institutions. I think this one started with Afrikids, there are Afrikids and there is another institution that organized one around more in Bolgatanga. So, we should go there, have vacation classes, and there were people who really used to type so fast, and it was a competition. So, when we had competitions like that, even if you are not well, you want to go because it's exciting, and we had vindicated afterwards. So, we had typing lessons there. We also used, I think, PowerPoint, but it was really much around typing. And the last thing, I think the last model we took in that class was how to use Disk kits, that is how to store information, and everybody had bought one. So, your parents will buy one for you and then you write your name on it and then you move around with it. So, this was during, this was from primary, primary school for the typing of lesson. Then after primary after, JHS, you

know, people usually go, in Bolgatanga actually it is a norm, you either travel to your relation somewhere in the country, or probably volunteer, or even work in a school in a nursery school teaching people. So, I think my sister and I did not really have the idea of teaching. So, my dad took us back to Typing school, this was not the usual place we went to but a different place. And that one also our last module was a typing competition. And my twin sister won. And I mean, we have got a little certificate. So, we have quite a number of certificates, from type from computer schools, for typing, for data storing using disk kits, and a couple of other things around just searching generally. And then the other parts of social media came later on when we were having the bad around internet connectivity and having small MiFi devices at home. So that is how we transitioned from the games to typing because we went to school for it.

Interviewer; Fantastic. So, at this point, were you taking ICT lessons from school or yours was like, solely, you know, you had I think from what you are saying you have your first encounter in the home, but how did that help you in school? Because I want to understand that you were taking ICT in school.

Person 1; All right, so from my, from when we got our PC, we were taking IT classes or actually at that time ICT it was ICT classes in school. But those are very theoretical. We did not have a computer lab at the time, but I think a few years after we had a lab and we used to take turns to go to the lab, but most of us didn't like the ICT teacher because he was really wicked. He had a daughter in our school, he would beat us, and we will go beat his daughter. I mean he did not care; he would beat us. He knows that we will go and beat his daughter, but he will still beat us. And that is because he wanted us to really get things right. Somebody asked us to; he will shut down the PC and put it on and somebody forgot to plug it into the main power source. And he is still struggling with the thing to put it on. Right. So, he wanted us to be very much postural to understand the whole thing, or the whole concept about powering the machine, understand what is going on with the machine, and then going on to collaborate with it. So, the whole idea was having us understand, we thought was too cumbersome. Because we just wanted to get on and see what is happening with our games and the things we're excited about. We had to learn all these things as though we were technicians. And he wanted us to. So, we, for us, for me, that is my family and me, our first lessons with the computer and having to type started from home with my dad. We did not even know but we were just winging it, especially. So, we explore it together. And then we went to school. That was pretty much from I think, JHS one, it was when we got the chance to go into the computer lab to take turns to us PCs in there.

Interviewer: I see. So, at what point did you encounter the internet? And where would you go to access the internet?

Person 1; Right. So first, I mean, my friends would come to school and talk about high five to like, they make friends on high five, they are excited about high five. And I am wondering what exactly it was. But before I was, I was interested in, like, my dad used to call me a doctor because I liked science. And then he got us a small nurses dictionary. But this was, the nurse's dictionary will come into play sometime in senior high school, and I will tell you about it. But when we are leaving, we're leaving junior high school, my dad used to say that he's had friends who had the opportunity, after O- level to study abroad. And he feels like we can also make friends online, who can help us to, err who can help us to maybe get a chance to do scholarships and also travel abroad. So, you make sure that all of us had email addresses. And then we could connect and send emails to people randomly, we just look for the high school teachers in schools were excited about in the

US, or in different countries who write them, right? But where we started from was, first off, we did not have the device our home. So, we used to go to cafes around our house. And this was in a school, the school was, so we walked from our home, we will pay some money for us to be able to enter our email address and enter into a mailbox. And those times also empty. I mean, I wish I had those times because my mailbox was looking so like a lot of work right now. So, we go into our mailbox, and we see nothing. And then we move to high five and Facebook, Facebook, we used to be so excited even if somebody like commented on our post or we had a new friend I actually, I actually kept more like count of what is happening with my friends. Now I cannot, I don't even want to see what's happening but really, we were counting, if we get a new follower, we are excited. We are excited somebody had joined and everything that was what we used to do. So first we are using the internet, and my school also connected our lab where we were able to use Encarta because on Encarta, we also needed some error, for you to get onto the Internet to be able to access it. So, it was those places, Minadensin, which is another school l and my school later on joining that we are supposed to using the internet creating my email addresses and then using Encarta, visited your friends on high five also say hi to friends on high five and Facebook.

Interviewer: Thank you P2 I am just going to pause the recording here so I can do like an intro of P3 and then P1 you can come in

Person 2; Okay. So, as I said earlier, there was no internet in the house and you know, I was staying in Kumasi and then I was schooling in central parts of Kumasi. So, my school was in Bantama, armed forces, so I will pass through Adum where all the big internet café shops are and where all the big businesses in Kumasi are. So, internet cafe in every two hundred meters radius you're likely to find an internet cafe. So, where I joined my bus there was an internet cafe there. The internet cafe too was based on class so for example if you have money, you know which internet cafe you want to use and then if you're student there were specific internet cafes for you, em the idea of internet no one introduced me to me the internet, but I remember one Friday. I had closed from school. That was in JHS one, so we were having ICT lessons, they have mentioned the internet. So out of curiosity, I went to the café, I said, I want to use the internet, they ask you how many minutes you want to use, so if you are using taking minutes or hour. So, you will pay and then you sit behind a PC login. The first time I sat behind the PC, I only remember I logged in and I could not do anything. So, I could not do anything. I saw the page there and then there was nothing to do. So, it goes on and on where every week, I have to save money to use the internet. I do not remember how much I was paying. But I know it was something good for my lunch. So as to save money for that. Because a lot of times I will ask my mom to give me money for the internet. And then she will not give you. So yes, there were times you enter a café and then the café is full, so you have to move to the next Cafe, and then sit there. It is not so much of any high-speed internet. But I just have to sit there. What was I doing? I did not create an email the first day because I need it, I had heard about pen pal. So, I was just looking for pen pal sites. They said, people can connect you abroad and you can learn from them, they can send you books, you can learn from them. And so, I was looking for pen pal's sites. So, a lot of times, I was registering for Pen pal site. So that was when I had to create an email because I was going to do this whole pen pal thing. And then the idea of phase two came in, where I had to register for Facebook. Emm, I had liked the idea about ICT too during the three years. So, the passion for ICT and internet whole thing was in the JHS, you know, area. So, when I have to study hard that I top my ICT class, you know, I do not know, but most people in Kumasi at that time too, for a few people who are in our school. I mean, they were students coming from the barracks, so they are military guys and then

they their parents either police, so they have these PCs because their parents have been to Lebanon, they brought them PCs, they are considered rich and etc. So, the competition was there, people want to come and tell us what they are doing on the internet, what you've downloaded, what website you visited and what they've printed. So, the first time I was in a cafe, I had copied something from Google. I remember it was animal something in agriculture, where I had printed it, I went to the class and I was a champion and so those memories, were they in essence Yeah, but I think it would be so much longer time. And if move ahead, I mean, things have changed really quick. It is I mean some 10 - 15 years ago and then we are here you can do video conferencing. We can connect everything; you send message and then if you're using 3g and then even if it's on WhatsApp and it's not even ticking annoyed but those days you click on a page it will take four minutes to load and then you are quiet looking at it, so I mean that was it. Internet cafes were there in Adum and the entry I remember Adum and Dr. Mensa yes somewhere closer to that place. So yes

Interviewer: Do you remember the name of the internet café that you went to?

Person 2; Unfortunately, I am trying hard to remember but I can take you to the place now in Adum and then in … I can take you, but I can't remember the…

Interviewer: Are they still operating?

Person 2; You know, I wouldn't check because I don't need their services. So maybe they've changed something but I'm not sure maybe you know what, it got to a time when they stopped operating as internet cafes solely and then they were doing and printing, graphic designs and etc. So, there was a transformation within that space so I'm sure they'll see maintain the shop because it was at a very good area. But hey, I don't know. I have to go and check the next time I go to Kumasi.

Interviewer: All right, thank you. P2!

…

Transcript of Interview with Internet Café Owner – Rwanda

Interviewer 00:00

Okay, so let's start. When was the first time you use the computer? And what was that experience? Like?

Unknown Speaker 00:10

My first time that I use the computer if I remember well was in 2006 or seven. And it's not that I just went to use it just for any other purpose. It was only just to play games because I knew that computers, what you can do with it is only playing games because still, I was I was young. I didn't have information, or I didn't have enough information about computers. Yeah,

Interviewer 00:44

yeah. Okay. So, at what point did you know that there was more you could do with computers?

Unknown Speaker 00:52

Yeah, after attending secondary school for sure, now I started to know that a computer is something big or it's something huge that you can use on different things. So, it's where you got to know that it also has very many things in it. And it's where it started now using it for different purposes not only playing games, now, using it but having a purpose of using it.

Interviewer 01:24

Okay, so between Primary five and senior three yeah what changed is it that you took like what caused the change because you I mean you Do you have a personal computer so how did you discover that you could do things with it.

Unknown Speaker 01:46

Yes sure of course after joining secondary school – again scenario one was my school was having computer lab it was having a computer lab, but we were only having one. Was it for I think it's three hours a week where we could go to use computers or to learn how to use a computer, but it was just switching it on and then you switch it off. You open Microsoft Word you type like just a sentence you save it. So, from there I started now, realizing that you can do many things with computers then just started improving like that like that. Then it's where I even started loving this computer thing. And I just started now, having that you got to know more about computers, and I could even go and use the classes timetable there. As for me too to access computer.

Interviewer 02:50

yeah

Unknown Speaker 02:50

that is how I got like within that period just to know that I can do more with computer it's just came from Those that timetable which was in my school from SR one to SR three

Interviewer 03:07

Okay so you did Yeah How do the How did obtaining those skills transform your life. And how did that also influence you to do what you are doing today?

Unknown Speaker 03:22

Yes, because now I can say that it's even the one that has pushed me to love it and like liking how computer works, or how to really make things to be done easily compared to the normal work that we do manually. So I started loving it and it pushed me Do we even study computer science In my bachelor now I can say that now though, though I didn't maybe study computer science in my master's degree, but still now in my working place, I use the skills that I have even acquired from those, those years from SR one Snia to, though it wasn't It's like more professional, but that was the foundation. So now I can say that when you just get to know something when you are young and then you like it, you work hard and you just be passionate about that thing that you are using or that you are liking more it can push you and you can even reach where your dream where you have even dreamed before. Like we all have dreams. So, my dream was to know computer very well to use it and help people even on how to use it or you can even solve real life problems using computer and that's what we even did in my master's degree because we learned Python there, we

learnt are those programming languages and they solve real life problems. So that has really influenced me.

Interviewer 05:13

So, you were a regular customer at the internet café. yes? What would you say that you learned how to best interact with the computer or the Internet?

Unknown Speaker 05:26

yes

Unknown Speaker 05:28

I remember the first time I started now i could not even sleep I remember the first time I created an account on Facebook thus when Facebook look like him Don't remember the year but was it in two 2010 2010 or 11 I just created an account on Facebook Hello I started chat hang with friends the fan don't know like They just say hi Where are you from you Do I just get some Right I'm talking to someone from UK How is it was In this I started like asking you myself very many questions How can this be possible So this is what computer that See with internet so I He said Now we This tool My name is Now try to get what is behind that Facebook. Like, I wanted to know, how can I just type something? You send it within a second, it goes to someone who is in the UK. He replies, you get back the message. So, I just wanted to know now, what is behind it? Why do I take some synth while I am here, and someone is not on the site. So, it is why I started now saying let me explore more on this on this device.

Interviewer 06:50

Yes. So, you were telling me.

Unknown Speaker 06:56

Yes. On how I like my first time to just realize that computer is really something big and something that can be helpful in in very many things. So, I was telling a story when I created my account on Facebook. I just felt Yeah. I just said this is not something that I can just see. And then Just let it go and then I move so I said have to know what is behind or something that that has made this Facebook to work like that and that's why I even started I'm liking this programming languages because they're the ones that that Make these software's or these platforms that we use yeah, He does or doesn't short story.